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Aquila Trucks Centres

# TRAKKER EURO 4/5

## REPAIR MANUAL
## MECHANICAL
## ELECTRIC/ELECTRONIC

IVECO

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"This document provides data, characteristics, instructions and methodology to perform repair interventions on the vehicle and its components.

Anyhow, this document is addressed to qualified and specialised personnel. Iveco commercial and assistance network personnel as well as all Iveco authorised points of assistance are specifically qualified and equipped to perform the repair interventions that are indicated in this document.

Before performing any intervention, check to have available the document relating to the vehicle model on which the intervention is being performed and also make sure that all accident prevention devices, such as, as a rough guide, goggles, helmet, gloves, shoes, as well as work tooling, lifting and transport tooling, etc., are available and efficient, and further make sure that the vehicle is put such a way that an intervention can be made in safety conditions.

Making interventions strictly observing the indications given here, as well as using specific tooling indicated, assures a correct repair intervention, execution timing observance and operators' safety.

Each repair intervention must be finalised to the recovery of functionality, efficiency and safety conditions that are provided by Iveco.
Each intervention, on the vehicle, that is finalised to a modification, alteration or else, which is not authorised by Iveco, involves the exclusion of any responsibility for Iveco, and, in particular, where the vehicle is covered by a guarantee, each such intervention involves an immediate lapse of the guarantee.

Responsibility for Iveco in repair intervention execution is excluded.

Iveco is available to provide all clarifications necessary to make interventions, as well as to provide indications in cases and situations not included in this document.

In the case of a difference between what contained here and what actually found on the vehicle, please contact Iveco network before making any intervention."

Copy, even partial, of text and drawings is forbidden.

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IVECO S.p.A.
Customer Service
Lungo Stura Lazio, 15
10156 Torino (TO) - Italy

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## PRELIMINARY REMARKS

Manuals for repairs are split into Sections, each one of which is marked by a numeral; the contents of these sections are indicated in the general table of contents.
Each section is generally dedicated to a main Unit (e.g.: engine, gearbox, electric system, etc.).
Sections with mechanical contents include technical data, tightening torque collections, tool lists, connections – disconnections of units to/from the vehicle, overhauls at the bench and relating troubleshooting.
On the electric/electronic system section there are the descriptions of the electric network and vehicle electronic systems, electric schemes, components electric characteristics, components codes and troubleshooting relating to the central units specific of the electric system.
The manual uses proper symbols in its descriptions; the purpose of these symbols is to classify contained information. In particular, there have been defined a set of symbols to classify warnings and a set for assistance operations.

## SYMBOLS - WARNINGS



Danger for persons
Missing or incomplete observance of these prescriptions can cause serious danger for persons' safety.



Danger of serious damage for the vehicle
Partial or complete non observance of these prescriptions can cause serious damages to the vehicle and sometimes guarantee lapse too.



General danger
It includes the dangers of above described signals.



Environment protection
It indicates correct behaviour in order that vehicle use is environmentally friendly as much as possible.

**NOTE** It indicates an additional explanation for a piece of information.

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## SYMBOLS - ASSISTANCE OPERATIONS

| | |
|---|---|
|  | Removal<br>Disconnection |
|  | Refitting<br>Connection |
|  | Removal<br>Disassembly |
|  | Fitting in place<br>Assembly |
|  | Tighten to torque |
|  | Tighten to torque + angle value |
|  | Press or caulk |
|  | Regulation<br>Adjustment |
|  | Visual inspection<br>Fitting position check |
|  | Measurement<br>Value to find<br>Check |
|  | Equipment |
|  | Surface for machining<br>Machine finish |
|  | Interference<br>Strained assembly |
|  | Thickness<br>Clearance |
|  | Lubrication<br>Damp<br>Grease |
|  | Sealant<br>Adhesive |
|  | Air bleeding |
|  | Replacement<br>Original spare parts |

| | |
|---|---|
|  | Intake |
|  | Exhaust |
|  | Operation |
|  | Compression ratio |
|  | Tolerance<br>Weight difference |
|  | Rolling torque |
|  | Rotation |
|  | Angle<br>Angular value |
|  | Preload |
|  | Number of revolutions |
|  | Temperature |
|  | Pressure |
|  | Oversized<br>Higher than....<br>Maximum, peak |
|  | Undersized<br>Less than....<br>Minimum |
|  | Selection<br>Classes<br>Oversizing |
|  | Temperature < 0 °C<br>Cold<br>Winter |
|  | Temperature > 0 °C<br>Hot<br>Summer |

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## PRODUCT CODE

Each title or subtitle concerning operations being performed is preceded by a six-figure number named PRODUCT CODE. This number represents the PRODUCT CODE referred to by the repair operation contained in both REPAIR TIMES and TROUBLE CODE document.
As a quick reference there are shown below the guide lines to read this code (see Repair Timing, too).

Product Code:




The first and second figures identify the PRODUCT within motor vehicle.

Example :

| | | | |
|---|---|---|---|
| Product | 50 | = | Vehicle chassis; |
| Product | 52 | = | Axles; |
| Product | 53 | = | Transmission; |
| Product | 76 | = | Electric ssystem. |

Unit Code:




The third and fourth figures identify the UNIT within the PRODUCT.

Example :

| | | | |
|---|---|---|---|
| Product | 50 | = | Vehicle chassis; |
| Unit | 01 | = | Chassis; |
| Unit | 02 | = | Bumpers; |
| Unit | 03 | = | Alternator. |

Sub-assembly Code:




The fifth and sixth figures exactly identify the SUB-ASSEMBLY and Component of a Unit within a PRODUCT.

Example :

| | | | |
|---|---|---|---|
| Product | 50 | = | Vehicle chassis; |
| Unit | 01 | = | Chassis; |
| Sub-assembly | 40 | = | Chassis cross members; |
| Sub-assembly | 13 | = | Rotor. |

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## GENERAL WARNINGS



Warnings shown cannot be representative of all danger situations possibly occurring. Therefore, it is suggested to contact immediate superiors where a danger situation occurs which is not described.

Use both specific and general-purpose toolings according to the prescriptions contained in respective use and maintenance handbooks. Check use state and suitability of tools not subjected to regular check.

The manual handling of loads must be assessed in advance because it also depends, besides weight, on its size and on the path.

Handling by mechanical means must be with hoisters proper as for weight as well as for shape and volume. Hoisters, ropes and hooks used must contain clear indications on maximum carrying capacity acceptable. The use of said means is compulsorily permitted to authorised personnel only. Stay duly clear of the load, and, anyhow, never under it.

In disassembling operations, always observe provided prescriptions; prevent mechanical parts being taken out from accidentally striking workshop personnel.

Workshop jobs performed in pairs must always be performed in maximum safety; avoid operations which could be dangerous for the co-operator because of lack of visibility or of his/her not correct position.

Keep personnel not authorised to operations clear of working area.

Learn operation and safety knowledge necessary relating to the vehicle prior to each intervention on it. Scrupulously observe all safety warnings on the vehicle. Apply suitable signals for the vehicles being repaired. Once the repair intervention has been completed, before starting up the vehicle, perform all checks indicated on paragraph "Controls care of user" of Use and Maintenance handbook.

In lack of visibility in operating from the vehicle, charge a person on the ground with assistance. Do not leave unmanned a vehicle in motion during repair interventions.

Keep the vehicle stationary by proper chocks.

In the case of an intervention on a vehicle lifted from the ground, check the vehicle to be quite steady on special support stands and, in the case of lifting by means of a lift, check manual/automatic safeties to be activated.

When it is necessary to perform an intervention on methane-fed vehicles, observe the indications contained inside the document, as well as all specific safety regulations provided.

Only remove radiator cap when the engine is cold by cautiously unscrewing it in order to let system residual pressure out.

Inflammable fuel and all inflammable fluids and liquids must be handled with care, according to what contained on harmful materials 12-point cards. Refuelling must be performed outdoors with the engine off, avoiding lit cigarettes, free flames or sparks in order to prevent sudden fires/bursts. Adequately store inflammable, corrosive and polluting fluids and liquids according to what provided by regulations in force. Compulsorily avoid to use food containers to store harmful liquids. Avoid to drill or bore pressurised containers, and throw cloths impregnated with inflammable substances into suitable containers.

Worn out, damaged or consumable parts must be replaced by Iveco original spares.

During workshop activity, always keep the work place clean; timely clear or clean floors from accidental liquid or oil spots. Electric sockets and electric equipment necessary to perform repair interventions must meet safety rules.

For every intervention on vehicle hydraulic, pneumatic, conditioning and AIR - BAG systems, scrupulously observe indications specified in relating manual sections.

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## GENERAL WARNINGS



Put on, where required by the intervention, garments and protections provided in accident prevention rules; contact with moving parts can cause serious injuries. Use suitable, preferably tight-fitted garments, and avoid to use jewels, scarves, etc.

Do not leave the engine in motion at workshop locations not provided with a pipe to scavenge exhaust gas outside.

Avoid to breathe fumes coming from heating or from paint welding because they can cause damages to health; operate outdoors or in suitably ventilated areas. Put on proper inspirator if paint powder is present.

Avoid contact with hot water or steam coming from the engine, radiator and pipings because they could cause serious burns. Avoid direct contact with liquids and fluids present in vehicle systems; where an accidental contact has occurred, refer to 12-point cards for provisions to make.



Clean units or assemblies detached from the vehicle and carefully check their integrity before overhaul. Tidy up detached or disassembled parts with their securing elements (screws, nuts, etc.) into special containers.

Check for the integrity of the parts which prevent screws from being unscrewed: broken washers, dowels, clips, etc. Self-locking nuts with an insert made of nylon must always be replaced.

Avoid contact of rubber parts with diesel oil, petrol or other not compatible substances.

Before washing under pressure mechanical parts, protect electric connectors, and central units, if present.

Tightening screws and nuts must always be according to prescriptions; IVECO commercial and assistance network is available to give all clarifications necessary to perform repair interventions not provided in this document.

Before welding:

- Disconnect all electronic central units, take power cable off battery positive terminal (connect it to chassis bonding) and detach connectors.
- Remove paint by using proper solvents or paint removers and clean relevant surfices with soap and water.
- Await about 15 minutes before welding.
- Equip with suitable fire resistant protections to protect hoses or other components where fluids or other materials flow which may catch fire easily on welding.

Should the vehicle be subjected to temperatures exceeding 80°C (dryer ovens), disassemble drive electronic central units.



The disposal of all liquids and fluids must be performed with full observance of specific rules in force.

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## GENERAL WARNINGS ON THE ELECTRIC SYSTEM



If an intervention has to be made on the electric/electronic system, disconnect batteries from the system; in this case, always disconnect, as a first one, the chassis bonding cable from batteries negative terminal.

Before connecting the batteries to the system, make sure that the system is well isolated.

Disconnect the external recharging apparatus from the public utility network before taking apparatus pins off battery terminals.

Do not cause sparks to be generated in checking if the circuit is energised.

Do not use a test lamp in checking circuit continuity, but only use proper control apparatuses.

Make sure that the electronic devices wiring harnesses (length, lead type, location, strapping, connection to screening braiding, bonding, etc.) comply with IVECO system and are carefully recovered after repair or maintenance interventions.

Measurements in drive electronic central units, plugged connections and electric connections to components can only be made on proper testing lines with special plugs and plug bushes. Never use improper means like wires, screwdrivers, clips and the like in order to avoid the danger of causing a short circuit, as well as of damaging plugged connections, which would later cause contact problems.

Before replacing an electronic control unit, verify the wiring. If necessary, contact the local T.H.D. (Technical Help Desk) for an authorization or a recommendation on the possible interventions before replacing.



To start up the engine, do not use fast chargers. Start up must only be performed with either separate batteries or special truck.

A wrong polarisation of supply voltage in drive electronic central units (for instance, a wrong polarisation of batteries) can cause them to be destroyed.

Disconnect the batteries from the system during their recharging with an external apparatus.

On connecting, only screw up connector (temperature sensors, pressure sensors etc.) nuts at prescribed tightening torque.

Before disconnecting the junction connector from an electronic central unit, isolate the system.

Do not directly supply electronic central units servo components at nominal vehicle voltage.

Cables must be arranged such as to result to be parallel to reference plane, i.e. as close as possible to chassis/body structure.

Once the intervention on the electric system has been completed, recover connectors and wiring harnesses according to original arrangement.

Key memorisation procedures are influenced by electromagnetic jamming (mobile phones, etc.). Therefore, during key memorisation:

1 Pay attention that jamming sources are not present in the cab or near the keys.
2. Keys not insered in the panel must be at least 1 meter away.

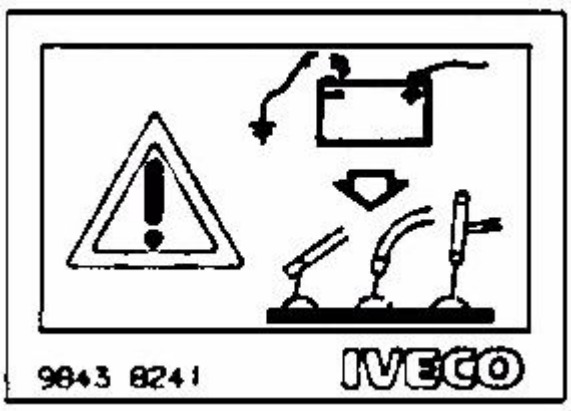
**NOTE** Connectors present must be seen from cable side. Connectors views contained in the manual are representative of cable side.

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In order to prevent damage or short-circuiting of the on-board electronic control units, the following operations must be always carried out before starting any welding operation on the chassis.

- If electric welding has to be done on the vehicle,




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isolate the electric system as follows:

a) disconnect the power lead from the battery positive terminal and connect it to the chassis earth;

b) disconnect the power lead from the battery negative terminal;

c) disconnect the electronic control unit connectors, taking care to avoid touching the control unit connector pins.

- Moreover:

a) should it be necessary to carry out welding operations close to the control unit, remove it from its location.

b) whenever possible, earth the welding machine directly to the piece that has to be welded.

In the case of vehicles equipped with a DTCO digital tachograph, do not disconnect the battery leads and then connect them by jumpers to reset the electronic systems.

This operation should be avoided, as it could cause permanent damage to the DTCO tachograph CARD or other on-board electronic systems.

To reset the electronic system without running risks, disconnect the vehicle battery and wait for 10 minutes.

It is strictly forbidden to carry out any modifications or connections to the electronic control unit wiring; in particular, the line interconnecting data between the control units (CAN line) must be considered as untouchable.

Diagnostic and maintenance operations can only be carried out by authorised personnel with IVECO approved equipment.

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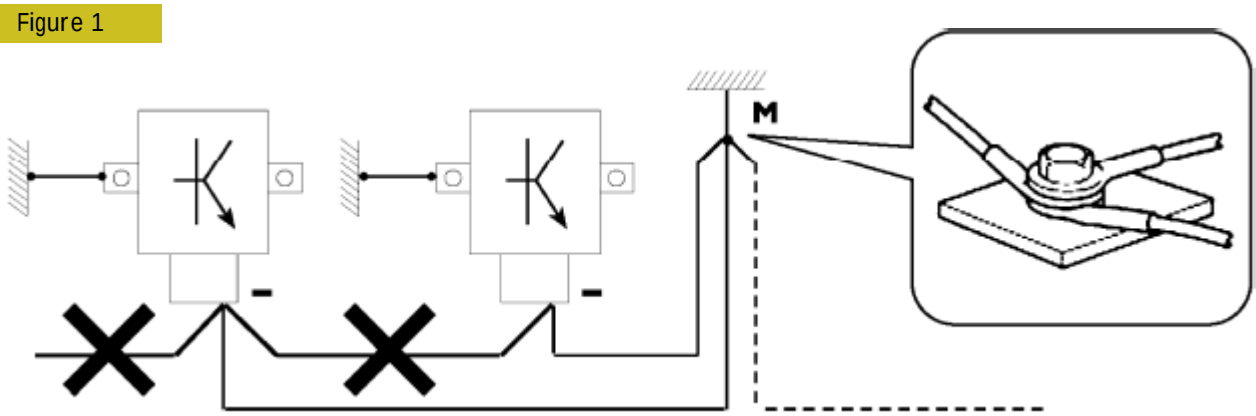
## Bonding and screening

Negative leads connected to a system bonded point must be both as short and possible and "star"-connected to each other, trying then to have their centering tidily and properly made (Figure 1, re. M).

Further, following warnings are to be compulsorily observed for electronic components:

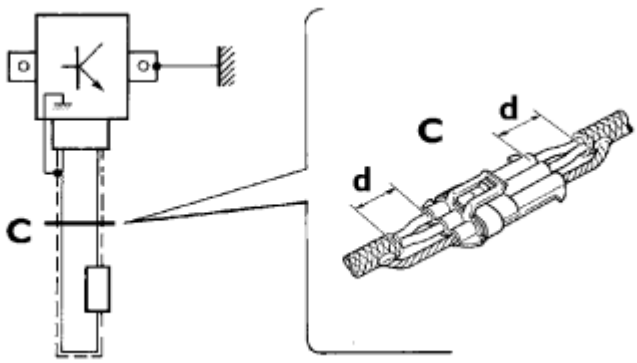
- Electronic central units must be connected to system bonding when they are provided with a metallic shell.
- Electronic central units negative cables must be connected both to a system bonding point such as the dashboard opening bonding (avoiding "serial" or "chain" connections), and to battery negative terminal.
- Analog bonding (sensors), although not connected to battery negative system/terminal bonding, must have optimal isolation. Consequently, particularly considered must be parasitic resistances in lugs: oxidising, clinching defects, etc.
- Screened circuits braiding must only electrically contact the end towards the central unit entered by the signal (Figure 2).
- If junction connectors are present, unscreened section d, near them, must be as short as possible (Figure 2).
- Cables must be arranged such as to result to be parallel to reference plane, i.e. as close as possible to chassis/body structure.

Figure 1




1. NEGATIVE CABLES "STAR" CONNECTION TO SYSTEM BONDING M

Figure 2




88039

2. SCREENING THROUGH METALLIC BRAIDING OF A CABLE TO AN ELECTRONIC COMPONENT – C. CONNECTOR
d. DISTANCE ! 0

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## OPTIONAL ELECTRICAL AND MECHANICAL PARTS INSTALLATIONS

Accessories mounting, additions and modifications on the vehicle are to be performed complying with IVECO mounting instructions (specific document "Instructions for transformation and preparation" is available at Assistance Network workshops).
It is reminded that, especially about the electric system, several electric sockets are provided for as series (or optional) sockets in order to simplify and normalise the electrical intervention that is care of preparation personnel.
For any exception to mounting instructions, IVECO's authorisation is necessary.
Lack of observance of above described prescriptions involves guarantee lapse.



It is absolutely forbidden to make modifications or connections to electric central units wiring harnesses; in particular, the data interconnection line between central units (CAN line) is to be considered inviolable.

## CONVERSIONS BETWEEN THE MAIN UNITS OF MEASUREMENT OF THE INTERNATIONAL SYSTEM AND MOST USED DERIVED QUANTITIES

Power

| | | |
|---|---|---|
| 1 kW | = | 1.36 metric HP |
| 1 kW | = | 1.34 HP |
| 1 metric HP | = | 0.736 kW |
| 1 metric HP | = | 0.986 HP |
| 1 HP | = | 0.746 kW |
| 1 HP | = | 1.014 metric HP |

Torque

| | | |
|---|---|---|
| 1 Nm | = | 0.1019 kgm |
| 1 kgm | = | 9.81 Nm |

Revolutions per time unit

| | | |
|---|---|---|
| 1 rad/s | = | 1 rpm x 0.1046 |
| 1 rpm | = | 1 rad/s x 9.5602 |

Pressure

| | | |
|---|---|---|
| 1 bar | = | 1.02 $kg/cm^2$ |
| 1 $kg/cm^2$ | = | 0.981 bar |
| 1 bar | = | $10^5$ Pa |

Where accuracy is not particularly needed:

- Nm unit is for the sake of simplicity converted into kgm according to ratio 10:1

1 kgm = 10 Nm;

- bar unit is for the sake of simplicity converted into $kg/cm^2$ according to ratio 1:1

1 $kg/cm^2$ = 1 bar.

Temperature

| | | |
|---|---|---|
| 0° C | = | 32° F |
| 1° C | = | (1 x 1.8 + 32) ° F |

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## UPDATE DATA

| Section | Description | Page | Revision date |
|---|---|---|---|
| 1 | General | 3, 5, 10÷17, 19, 20 | June 2007 |
| 2 | Engine | 8, 22, 24, 52, 57, 73, 86, 89, 91, 97 128, 143, 144, 147, 168, 171, 174, 175, 180, 197, 203, 211, 214, 219, 222, 282 | June 2007 |
| 3 | Clutch | 2, 18, 19, 20, 21 | June 2007 |
| 4 | Gearboxes | 13,14, 16/1÷16/6, 18, 18/1÷18/2, 20, 20/1÷20/6, 22/1÷22/30, 23, 26÷46, 46/1÷46/32, 47÷54, 54/1÷54/4, 56/1÷56/32 | June 2007 |
| 6 | Transfer box TC 1800-TC 2200 | 6, 8, 10÷12, 15, 24 | June 2007 |
| 8 | Axles | 58, 59, 63, 66, 79, 80, 82÷86, 88, 90, 91, 92, 93, 96, 136, 162 | June 2007 |
| 13 | Pneumatic system - Brakes | 1, 21/1÷21/2, 81 | June 2007 |
| 15 | Programmed maintenance | 5÷33 | June 2007 |
| 16 | ElectricElectronic system | 2, 6÷10, 89, 121/1÷121/4, 134/1÷134/8, 139÷143, 154, 156÷161, 193, 198, 237, 258, 275, 284, 287 | June 2007 |
| | | | |

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# INDEX OF SECTIONS


| | Section |
|---|---|
| General | 1 |
| Engines | 2 |
| Clutch | 3 |
| Gearboxes | 4 |
| Power take-off | 5 |
| Transfer box TC 1800-TC 2200 | 6 |
| Propeller shafts | 7 |
| Axles | 8 |
| Front axles | 9 |
| Suspensions | 10 |
| Wheels and tyres | 11 |
| Steering | 12 |
| Pneumatic system - Brakes | 13 |
| Bodywork and Chassis frame | 14 |
| Programmed maintenance | 15 |
| Electric/electronic system | 16 |

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# Aquila Trucks Centres

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SECTION 1

# General


| | Page |
|---|---|
| VEHICLE IDENTIFICATION DATA | 3 |
| - Vehicle Identification Plate | 4 |
| - Production Identification Plate | 4 |
| COMMERCIAL CODING | 5 |
| P.I.C. NUMBER CODING | 6 |
| VEHICLE CONFIGURATION | 10 |
| COMPOSITION OF THE MODELS | 11 |
| FILLING FLUIDS | 18 |
| - International specifications of lubricants and fluids | 20 |

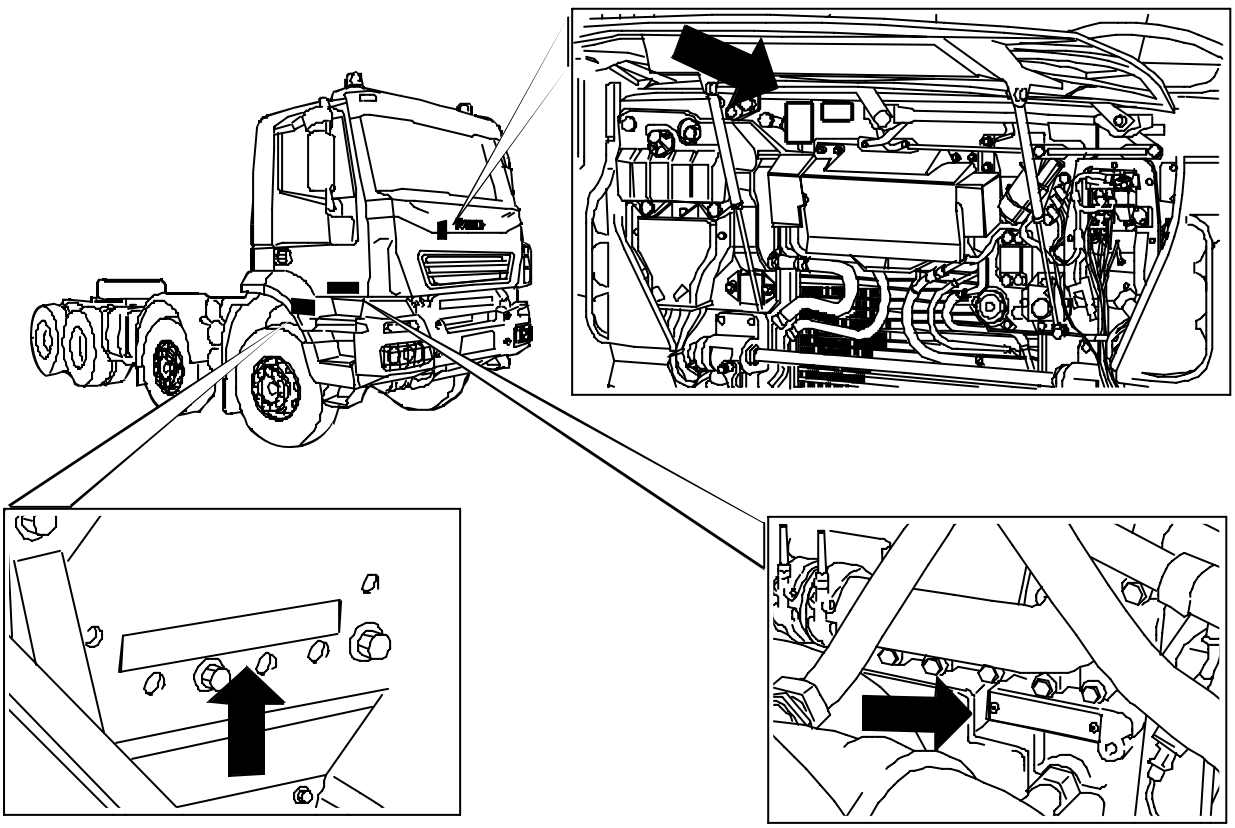
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## VEHICLE IDENTIFICATION DATA

The type and number of engine, type and number of chassis and manufacturer's plate comprise the vehicle identification data.

Figure 1



Manufacturer's plate

To identify the vehicle in accordance with the E.E.C. directive (under the front radiator cowling).

Chassis frame

Punching (front on right side member of chassis frame).

Engine

Plate on the left rear side of the crankcase

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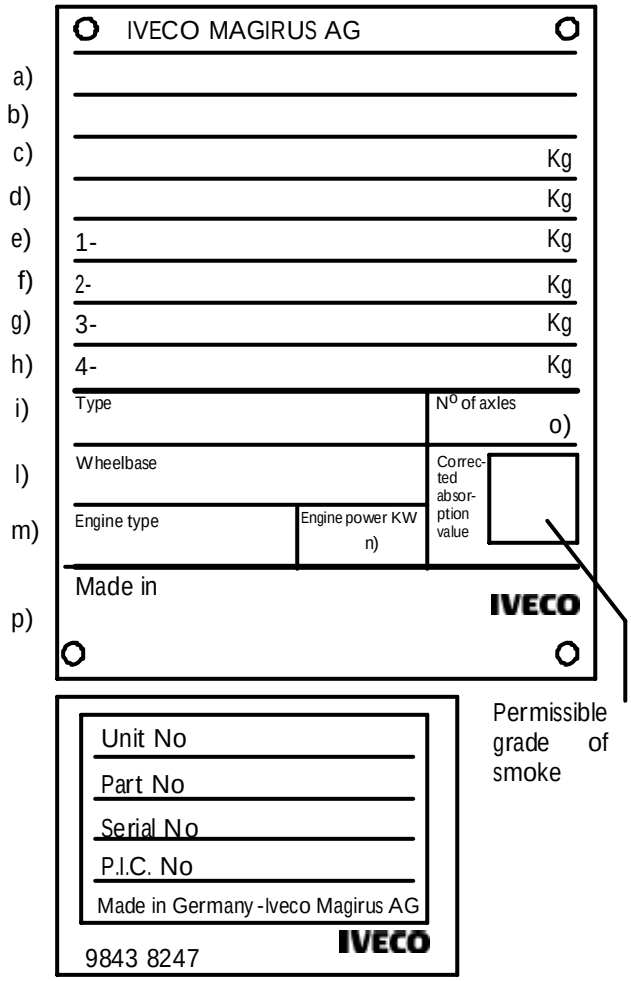
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## Vehicle Identification Plate

Figure 2

Plate legend

a) Type-approval number marking (if applicable).
b) Vehicle identification code number (V.I.N.).
c) Total tractor weight.
d) Total weight of tractor + trailer (if applicable).
e) Permissible weight limit on 1st axle.
f) Permissible weight limit on 2nd axle (if applicable).
g) Permissible weight limit on 3rd axle.
h) Permissible weight limit on 4th axle (if applicable).
i) Specific identification of type.
l) Wheelbase in mm.
m) Engine type.
n) Engine power.
o) No. of axles.
p) Place of manufacture.

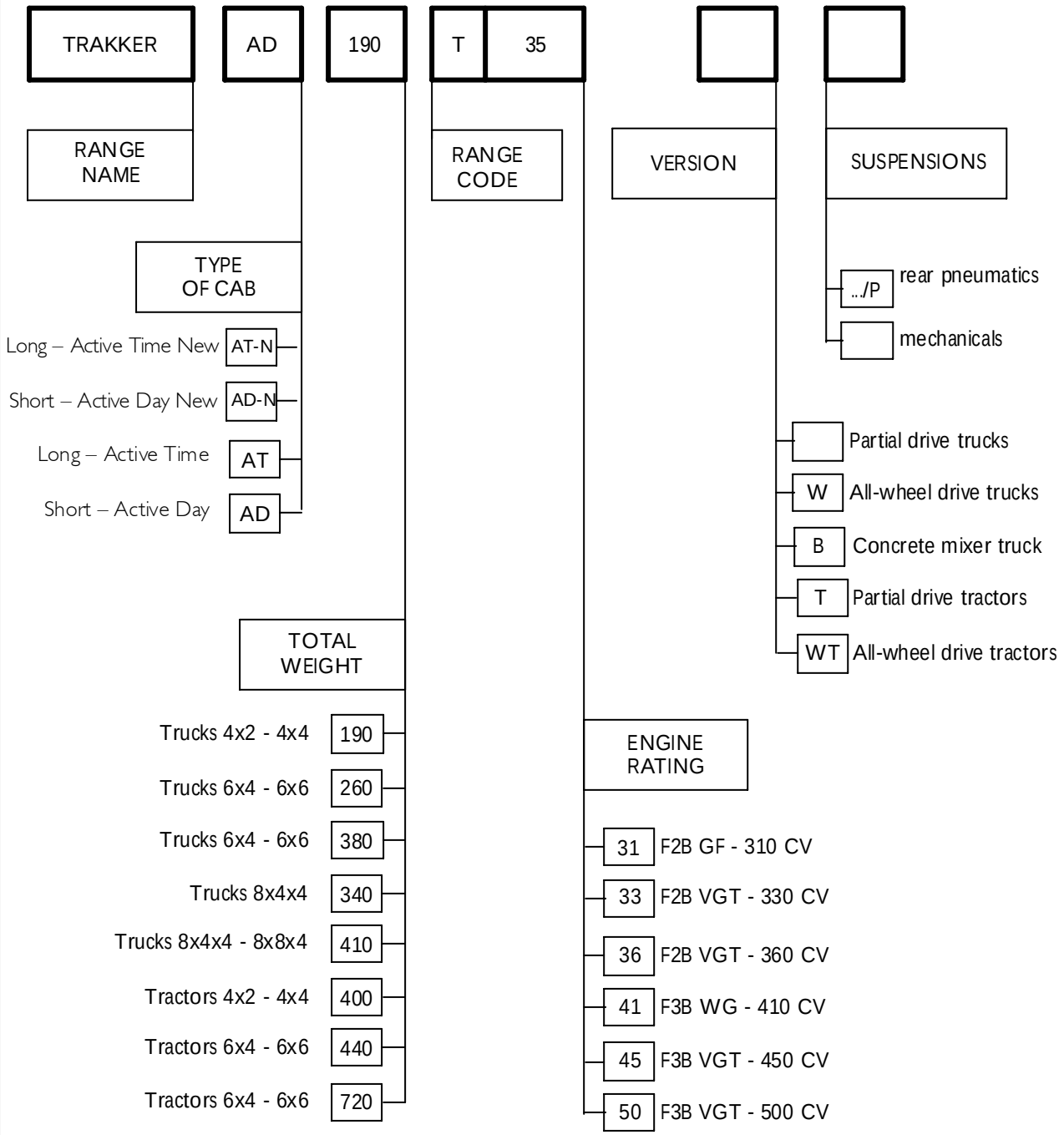



## Production Identification Plate

This plate shows the P.I.C. (production identification code number), which is needed when referring to the spare parts catalogue (electronic and/or Cd catalogue).
The P.I.C. is also given on the vehicle warranty card.
Note: When consulting the catalogues, use only the first 8 digits of the product identification code number.

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## COMMERCIAL CODING



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## P.I.C. NUMBER CODING

### HABITABILITY

| A | A | A | B | B | C | C | D |
|---|---|---|---|---|---|---|---|

- K ⇨ AD
- H ⇨ AT

### AXLE CONFIGURATION - TOTAL EARTH MASS

| A | A | A | B | B | C | C | D |
|---|---|---|---|---|---|---|---|

- L ⇨ Chassis cab 4x2 (18-20 ton)
- M ⇨ Tractor 4x2 (18-20 ton)
- N ⇨ Chassis cab 6x4 - 8 mm (26 ton)
- P ⇨ Chassis cab 6x4 - 10 mm (33 ton)
- Q ⇨ Tractor 6x4 - 8 mm (26 ton)
- R ⇨ Tractor 6x4 - 10 mm (33 ton)
- S ⇨ Chassis cab 8x4 - 8 mm (32 ton)
- T ⇨ Chassis cab 8x4 - 10 mm (32-40 ton)
- U ⇨ Chassis cab 4x4 (18-20 ton)
- V ⇨ Tractor 4x4 (18-20 ton)
- X ⇨ Chassis cab 6x6 - 8 mm (26 ton)
- Y ⇨ Chassis cab 6x6 - 10 mm (33 ton)
- Z ⇨ Tractor 6x6 - 10 mm (33 ton)
- W ⇨ Chassis cab 8x8 - 10 mm (32-40 ton)

### ENGINE

| A | A | A | B | B | C | C | D |
|---|---|---|---|---|---|---|---|

- A ⇨ 310
- B ⇨ 330
- C ⇨ 360
- D ⇨ 410
- E ⇨ 450
- F ⇨ 500
- G ⇨ 560

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## TYPE OF REAR AXLE – TYPE OF SUSPENSION

| A | A | A | B | B | C | | C | D |
|---|---|---|---|---|---|---|---|---|

- **A** ⇨ Mechanical - HR-P
- **B** ⇨ Pneumatic - HR-P
- **A** ⇨ Mechanical - HR-TL
- **B** ⇨ Mechanical - HR-TM
- **C** ⇨ Mechanical - HR-TP
- **D** ⇨ Mechanical - SR
- **E** ⇨ Pneumatic - HR-TP
- **F** ⇨ Pneumatic - SR

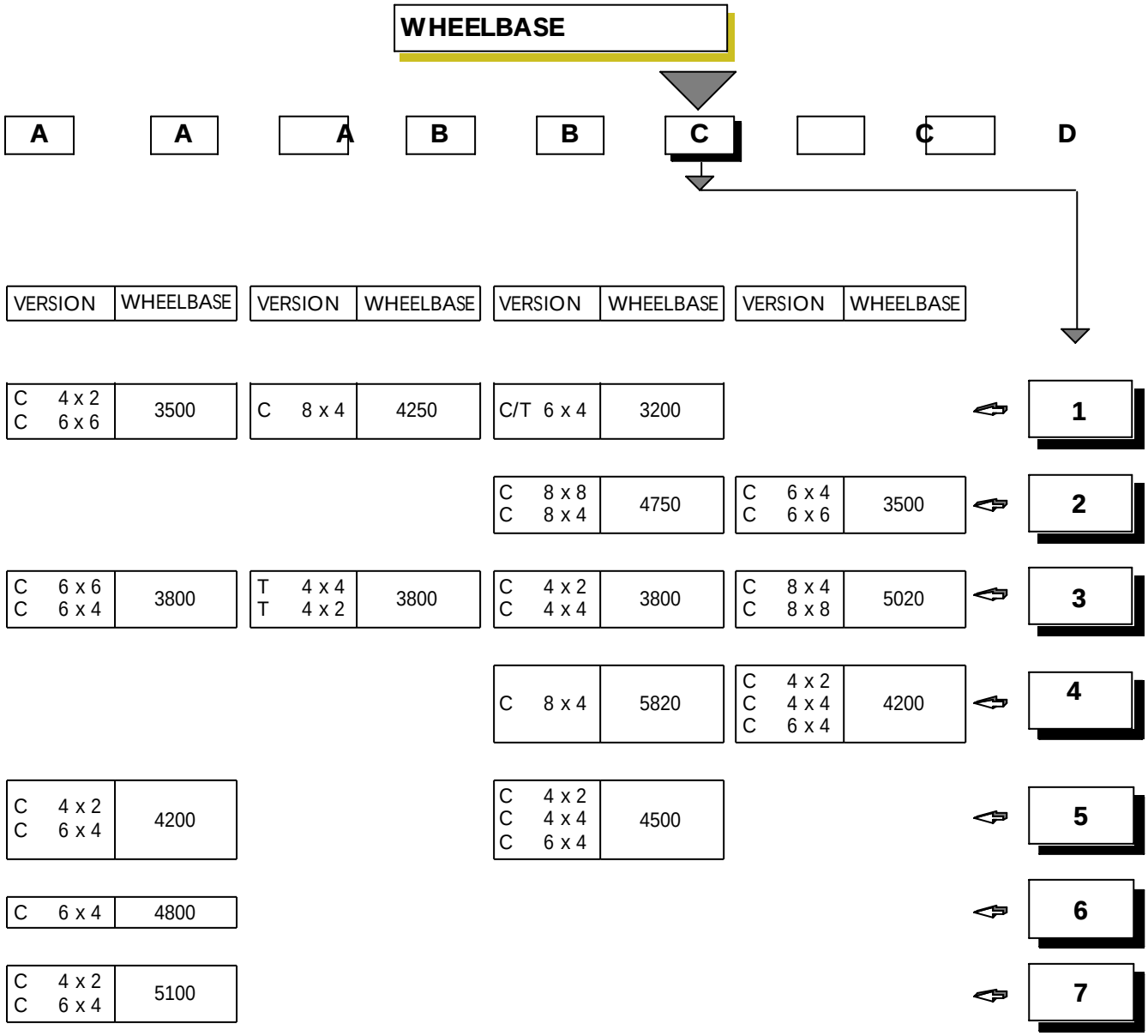
H.R. = Double reduction rear axle
S.R. = Simple reduction rear axle
T.L. = Light tandem rear axle
T.M. = Medium tandem rear axle
T.P. = Heavy tandem rear axle

## VERSION

| A | A | A | B | B | C | | C | D |
|---|---|---|---|---|---|---|---|---|

- **1** ⇨ Chassis cab
- **2** ⇨ Tractor
- **7** ⇨ Concrete mixer

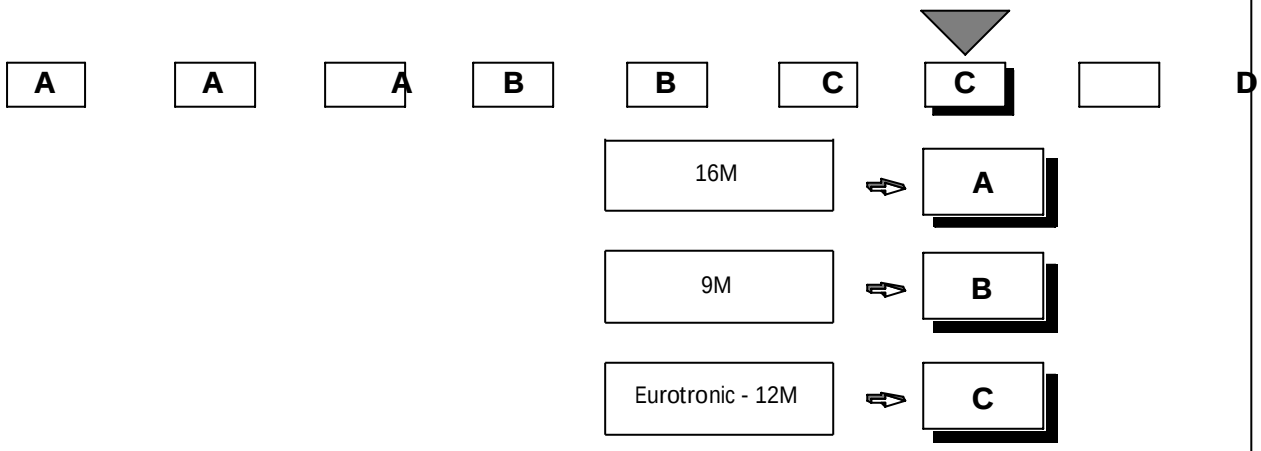
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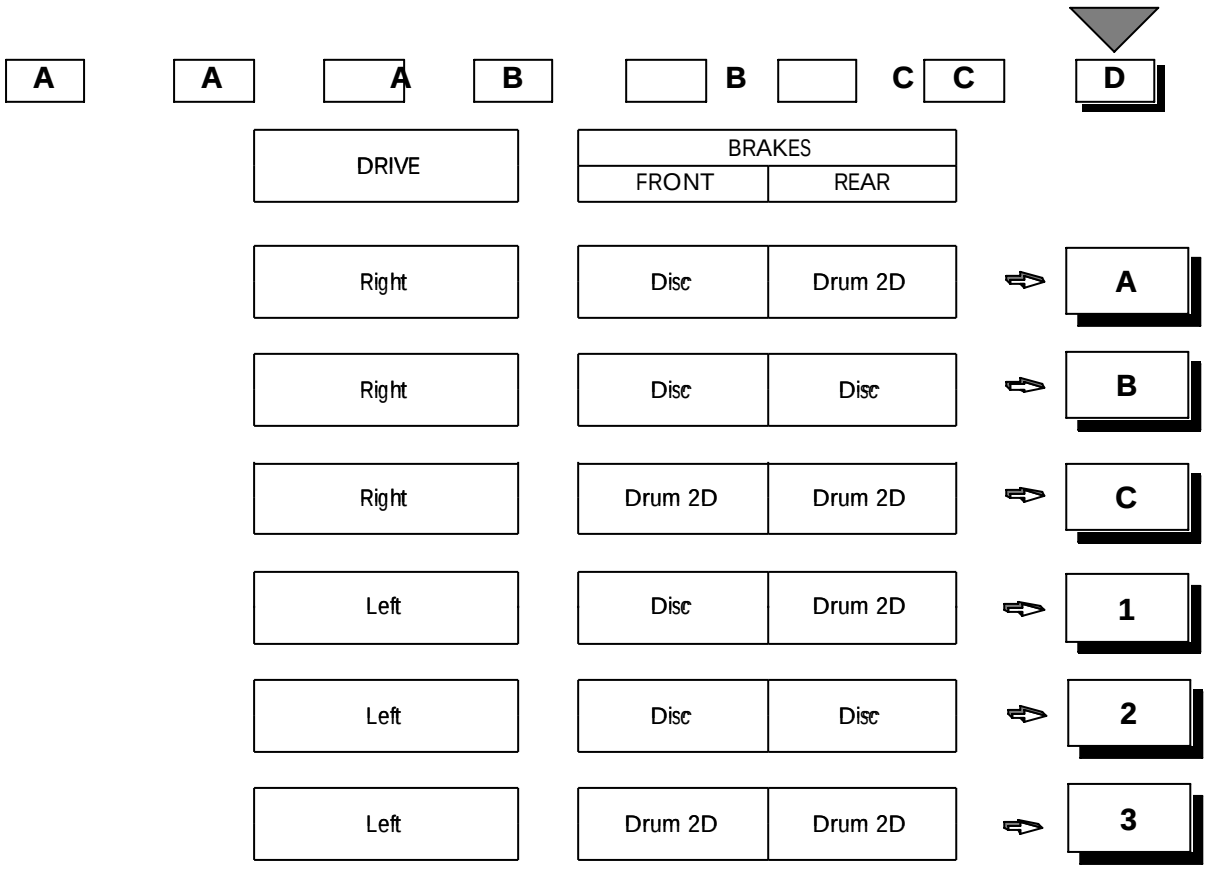

C = Chassis cabs
T = Tractors

Aquila Trucks Centres

## GEAR SHIFTS




## DRIVE – BRAKE COMBINATION



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## VEHICLE CONFIGURATION

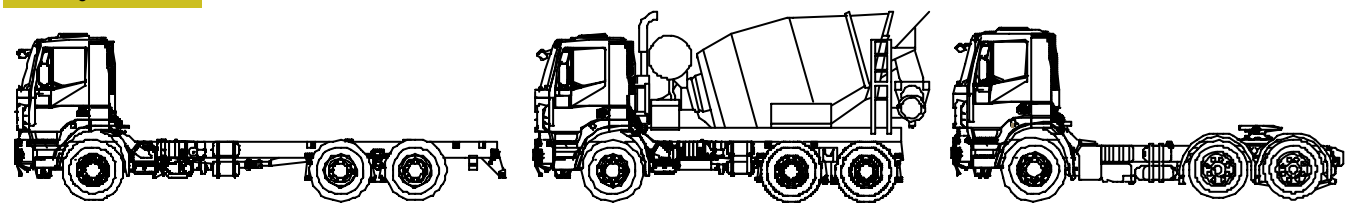
Figure 3




4x2 = Vehicles with two axles with rear driving axle.

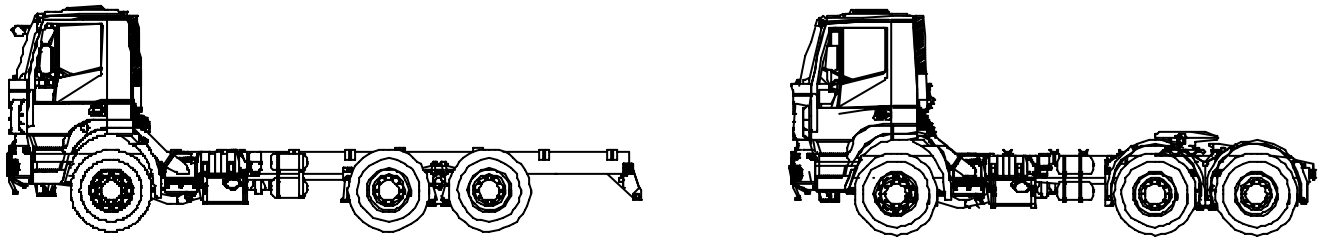
4x4 = Vehicles with two axles with front and rear driving axle.

Figure 4



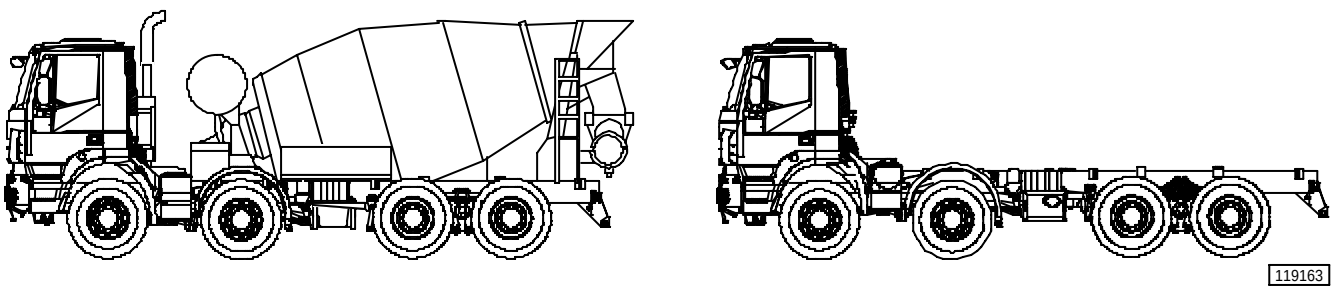

6x4 = Vehicles with three axles with two rear driving axles (in Tandem).

Figure 5




6x6 = Vehicles with three axles with front axle and two rear driving axles (in Tandem).

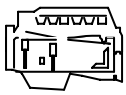
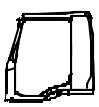
Figure 6




8x4x4 = Vehicles with four axles: first and second steering axles, third and fourth driving axles (in Tandem)
8x8x4 = Vehicles with four driving axles with first and second steering axles and two rear axles (in Tandem)

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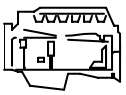
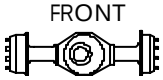
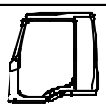
## COMPOSITION OF THE MODELS

| GROUPS/CABIN \ MODELS 4x2 | | | 190 T 31 | 190 T 33 | 190 T 36 | 190 T 41 | 190 T 45 | 400 T 36 T | 400 T 41 T | 400 T 41 T/P | 400 T 45 T | 400 T 45 T/P | 400 T 50 T | 400 T 50 T/P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | F2BE3681C (310 CV) | | • | | | | | | | | | | | |
| | F2BE3681B (330 CV) | | | • | | | | | | | | | | |
| | F2BE3681A (360 CV) | | | | • | | | • | | | | | | |
| | F3BE3681D (410 CV) | | | | | • | | | • | • | | | | |
| | F3BE3681C (450 CV) | | | | | | • | | | | • | • | | |
| | F3BE3681B (500 CV) | | | | | | | | | | | | • | • |
|  | Pushing one-disc 17" | | • | • | | | | | | | | | | |
| | Pulling one-disc 17" | | | | • | • | • | • | • | • | • | • | • | • |
|  | 9S 1310 TO | | • | • | | | | | | | | | | |
| | 16S 1620 TD | | | • | • | | | • | | | | | | |
| | 16S 2220 TO | | | | | • | • | | • | • | • | • | | |
| | 16S 2520 TO | | | | | | | | | | | | • | • |
| | 12 AS 1930 TD | | | | | | | • | | | | | | |
| | 12 AS 2330 TO | | | | | | | | • | • | • | • | • | • |
|  | 5886/D : | | • | • | • | • | • | • | • | • | • | • | • | • |
|  | 451391/2D J | | • | • | • | • | • | • | • | • | • | • | • | • |
|  | ZF 8098 | | • | • | • | • | • | • | • | • | • | • | • | • |
|  | Front mechanic | | • | • | • | • | • | • | • | • | • | • | • | • |
| | Rear mechanic | | • | • | • | • | • | • | • | | • | | • | |
|  | Rear air | | | | | | | | | • | | • | | • |
|  | Cabin type | AT/AD | | • | • | • | • | • | • | • | • | • | • | • |
| | | AT-N/AD-N | • | • | • | • | • | • | • | • | • | • | • | • |

: With disc brakes
J With Duo Duplex drum brakes

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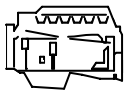
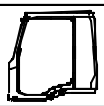
## COMPOSITION OF THE MODELS

| GROUPS/CABIN | MODELS 4x4 | 190 T 31 W | 190 T 31 W/P | 190 T 33 W | 190 T 33 W/P | 190 T 36 W | 190 T 36 W/P | 190 T 41 W | 190 T 45 W | 400 T 41 W/T | 400 T 45 W/T |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  | F2BE3681C (310 CV) | • | • | | | | | | | | |
| | F2BE3681B (330 CV) | | | • | • | | | | | | |
| | F2BE3681A (360 CV) | | | | | • | • | | | | |
| | F3BE3681D (410 CV) | | | | | | | • | | • | |
| | F3BE3681C (450 CV) | | | | | | | | • | | • |
|  | Pushing one-disc 17" | f | f | f | f | | | | | | |
| | Pulling one-disc 17" | | | • | • | • | • | • | • | • | • |
|  | 9S 1310 TO | • | • | • | • | | | | | | |
| | 16S 1620 TD | | | • | • | • | • | | | | |
| | 16S 2220 TO | | | | | | | • | • | • | • |
| | 12AS 1420 TD * | | | • | • | | | | | | |
| | 12AS 1930 TD | | | | | • | • | | | | |
| | 12AS 2330 TO | | | | | | | • | • | • | • |
|  | T C 1800 | • | • | • | • | • | • | | | | |
| | T C 2200 | | | | | | | • | • | • | • |
| FRONT  | 5985/2D J | • | • | • | • | • | • | • | • | • | • |
| REAR  | 451391/2D J | • | • | • | • | • | • | • | • | • | • |
|  | ZF 8098 | • | • | • | • | • | • | • | • | • | • |
|  | Front mechanic | • | • | • | • | • | • | • | • | • | • |
| | Rear mechanic | • | | • | | • | | • | • | • | • |
|  | Posteriori pneumatiche | | • | | • | | • | | | | |
|  | Cabin type AT/AD | • | • | • | • | • | • | • | • | • | • |
| | AT-N/AD-N | • | • | • | • | • | • | • | • | • | • |

J Drum brakes Duo Duplex
f Only for 9S1310TO gearboxes
* Available only without Intarder

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## COMPOSITION OF THE MODELS

| GROUPS/CABIN | MODELS 6x4 | 260 T 33 | 260 T 33 B | 260 T 33 B/P | 260 T 36 | 260 T 36 B | 260 T 36 B/P | 260 T 41 | 260 T 41/P | 260 T 45 | 260 T 45/P | 260 T 50 | 260 T 50/P | 380 T 36 | 380 T 36 B | 380 T 41 | 380 T 41 B | 380 T 41/P | 380 T 45 | 380 T 45 B | 380 T 45/P | 380 T 50 | 380 T 50/P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | F2BE3681B (330 CV) | • | • | • | | | | | | | | | | | | | | | | | | | |
| | F2BE3681A (360 CV) | | | | • | • | • | | | | | | | • | • | | | | | | | | |
| | F3BE3681D (410 CV) | | | | | | | • | • | | | | | | | • | • | • | | | | | |
| | F3BE3681C (450 CV) | | | | | | | | | • | • | | | | | | | | • | • | • | | |
| | F3BE3681B (500 CV) | | | | | | | | | | | • | • | | | | | | | | | • | • |
|  | Pushing one-disc 17" | ∇ | ∇ | ∇ | | | | | | | | | | | | | | | | | | | |
| | Pulling one-disc 17" | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
|  | 9S 1310 TO | • | • | • | | | | | | | | | | | | | | | | | | | |
| | 16S 1620 TD | • | | | • | • | • | | | | | | | • | • | | | | | | | | |
| | 16S 2220 TO | | | | | | | • | • | • | • | | | | | • | • | • | • | • | • | | |
| | 16S 2520 TO | | | | | | | | | | | • | • | | | | | | | | | • | • |
| | 12AS 1420 TD Y | • | • | • | | | | | | | | | | | | | | | | | | | |
| | 12AS 1930 TD | | | | • | • | • | | | | | | | • | • | | | | | | | | |
| | 12AS 2330 TO | | | | | | | • | • | • | • | • | • | | | • | • | • | • | • | • | • | • |
|  | 5886/D : | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| TANDEM  | INTERMEDIATE 452146/2D J | • | • | | • | • | | | | | | | | | | | | | | | | | |
| | REAR 452146/2D J | • | • | | • | • | | | | | | | | | | | | | | | | | |
| | INTERMEDIATE 453291/2D J | | | | | | | | • | | • | | • | • | • | • | • | • | • | • | • | • | • |
| | REAR 453291/2D J | | | | | | | | • | | • | | • | • | • | • | • | • | • | • | • | • | • |
| | INTERMEDIATE 452191/2D J | | | | | | | • | | • | | • | | | | | | | | | | | |
| | REAR 452191/2D J | | | | | | | • | | • | | • | | | | | | | | | | | |
| | INTERMEDIATE MT 23-155/2D J | | | | | | | | | | | | | | | | | | | | | | |
| | REAR MT 23-155/2D J | | | | | | | | | | | | | | | | | | | | | | |
| | INTERMEDIATE MT 23-155/D : | ◆ | • | • | ◆ | • | • | | | | | | | | | | | | | | | | |
| | REAR MT 23-155/D : | ◆ | • | • | ◆ | • | • | | | | | | | | | | | | | | | | |
|  | ZF 8098 | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
|  | Front mechanic | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| | Rear mechanic | • | • | | • | | • | • | | • | | • | | • | • | • | • | | • | • | | • | |
|  | Rear air | | | • | | • | | | • | | • | | • | | | | | • | | | • | | • |
|  | Cabin type AT/AD | • | h | h | • | h | h | • | • | • | • | • | • | • | h | • | h | • | • | h | • | • | • |
| | Cabin type AT-N/AD-N | • | h | h | • | h | h | • | • | • | • | • | • | • | h | • | h | • | • | h | • | • | • |

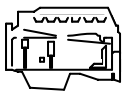
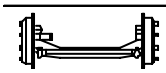
: With disc brakes
J With Duo Duplex drum brakes
◆ Only on vehicles with right-hand steering
∇ Only for 9S 1310 TO gearboxes
Y Available only without Intarder
j Cabin type AD or AD-N

*(continue)*

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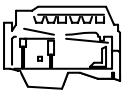
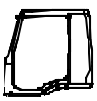
## COMPOSITION OF THE MODELS

| GROUPS/CABIN | | MODELS 6x4 | 440 T 41 T | 440 T 41 T/P | 440 T 45 T | 440 T 45 T/P | 440 T 50 T | 440 T 50 T/P | 720 T 41 T | 720 T 41 T/P | 720 T 45 T | 720 T 45 T/P | 720 T 50 T | 720 T 50 T/P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | F3BE3681D (410 CV) | | • | • | | | | | • | • | | | | |
| | F3BE3681C (450 CV) | | | | • | • | | | | | • | • | | |
| | F3BE3681B (500 CV) | | | | | | • | • | | | | | • | • |
|  | Pulling one-disc 17" | | • | • | • | • | • | • | • | • | • | • | • | • |
|  | 16S 2220 TO | | • | • | • | • | | | • | • | • | • | | |
| | 16S 2520 TO | | | | | | • | • | | | | | • | • |
| | 12AS 2330 TO | | • | • | • | • | • | • | • | • | • | • | • | • |
| | 12AS 2530 TO | | | | | | | | | | | | | |
|  | 5886/D : | | • | • | • | • | • | • | • | • | • | • | • | • |
| TANDEM  | INTERMEDIATE 452191/2D J | | • | | • | | • | | | | | | | |
| | REAR 452191/2D J | | • | | • | | • | | | | | | | |
| | INTERMEDIATE 453291/2D J | | | • | | • | | • | • | • | • | • | • | • |
| | REAR 453291/2D J | | | • | | • | | • | • | • | • | • | • | • |
|  | ZF 8098 | | • | • | • | • | • | • | • | • | • | • | • | • |
|  | Front mechanic | | • | • | • | • | • | • | • | • | • | • | • | • |
| | Rear mechanic | | • | | • | | • | | • | | • | | • | |
|  | Rear air | | | • | | • | | • | | • | | • | | • |
|  | Cabin type | AT/AD | • | • | • | • | • | • | • | • | • | • | • | • |
| | | AT-N/AD-N | • | • | • | • | • | • | • | • | • | • | • | • |

: With disc brakes
J With Duo Duplex drum brakes

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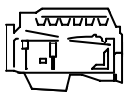
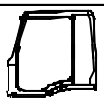
## COMPOSITION OF THE MODELS

| GROUPS/CABIN | | MODELS 6x6 | 260 T 36 WW | 260 T 41 WW | 260 T 45 WW | 380 T 36 WW | 380 T 41 WW | 380 T 45 WW | 720 T 41 WT | 720 T 45 WT |
|---|---|---|---|---|---|---|---|---|---|---|
|  | F2BE3681A (360 CV) | | • | | | • | | | | |
| | F3BE3681D (410 CV) | | | • | | | • | | • | |
| | F3BE3681C (450 CV) | | | | • | | | • | | • |
|  | Pulling one-disc 17" | | • | • | • | • | • | • | • | • |
|  | 16S 1620 TD | | • | | | • | | | | |
| | 16S 2220 TO | | | • | • | | • | • | • | • |
| | 12AS 1930 TD | | • | | | • | | | | |
| | 12 AS 2330 TO | | | • | • | | • | • | • | • |
|  | T C 1800 | | • | | | • | | | | |
| | T C 2200 | | | • | • | | • | • | • | • |
| FRONT  | 5985/2D J | | • | • | • | • | • | • | • | • |
| TANDEM  | INTERMEDIATE 452191/2D J | | • | • | • | | | | | |
| | REAR 452191/2D J | | • | • | • | | | | | |
| | INTERMEDIATE 453291/2D J | | | | | • | • | • | • | • |
| | REAR 453291/2D J | | | | | • | • | • | • | • |
|  | ZF 8098 | | • | • | • | • | • | • | • | • |
|  | Front mechanic | | • | • | • | • | • | • | • | • |
| | Rear mechanic | | • | • | • | • | • | • | • | • |
|  | Cabin type | AT/AD | • | • | • | • | • | • | • | • |
| | | AT-N/AD-N | • | • | • | • | • | • | • | • |

J With Duo Duplex drum brakes

Aquila Trucks Centres

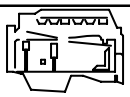
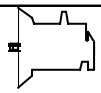
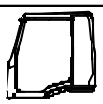
## COMPOSITION OF THE MODELS

| GROUPS/CABIN \ MODELS 8x4 | | 340 T 36 | 340 T 36/P | 340 T 36 B | 340 T 36 B/P | 340 T 41 | 340 T 41/P | 340 T 41 B | 340 T 41 B/P | 340 T 45 | 340 T 45 B | 340 T 45/P | 410 T 36 | 410 T 41 | 410 T 41 B | 410 T 41/P | 410 T 45 | 410 T 45 B | 410 T 45/P | 410 T 50 | 410 T 50/P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | F2BE3681A (360 CV) | • | • | • | • | | | | | | | | • | | | | | | | | |
| | F3BE3681D (410 CV) | | | | | • | • | • | • | | | | | • | • | • | | | | | |
| | F3BE3681C (450 CV) | | | | | | | | | • | • | • | | | | | • | • | • | | |
| | F3BE3681B (500 CV) | | | | | | | | | | | | | | | | | | | • | • |
|  | Pulling one-disc 17" | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
|  | 16S 1620 TD | • | • | • | • | | | | | | | | • | | | | | | | | |
| | 16S 2220 TO | | | | | • | • | • | • | • | • | • | | • | • | • | • | • | • | | |
| | 16S 2520 TO | | | | | | | | | | | | | | | | | | | • | • |
| | 12 AS 1930 TD | • | • | • | • | | | | | | | | • | | | | | | | | |
| | 12 AS 2330 TO | | | | | • | • | • | • | • | • | • | | • | • | • | • | • | • | • | • |
|  | 1° 5886/D : | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| | 2° 5886/D : | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| REAR  | INTERMEDIATE 452146/2D J | • | | • | | | | | | | | | | | | | | | | | |
| | REAR 452146/2D J | • | | • | | | | | | | | | | | | | | | | | |
| | INTERMEDIATE 453291/2D J | | | | | | • | | | | | • | • | • | • | • | • | • | • | • | • |
| | REAR 453291/2D J | | | | | | • | | | | | • | • | • | • | • | • | • | • | • | • |
| | INTERMEDIATE 452191/2D J | | | | | • | | • | | • | • | | | | | | | | | | |
| | REAR 452191/2D J | | | | | • | | • | | • | • | | | | | | | | | | |
| | INTERMEDIATE MT 23 - 155/2D J | | | | | | | | | | | | | | | | | | | | |
| | REAR MT 23 - 155/2D J | | | | | | | | | | | | | | | | | | | | |
| | INTERMEDIATE MT 23 - 155/D : | ◆ | ◆ | | • | ◆ | ◆ | | • | ◆ | | ◆ | | | | | | | | | |
| | REAR MT 23 - 155/D : | ◆ | ◆ | | • | ◆ | ◆ | | • | ◆ | | ◆ | | | | | | | | | |
|  | ZF 8099 | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
|  | Front mechanic | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| | Rear mechanic | • | | • | | • | | • | | • | • | | • | • | • | | • | • | | • | |
|  | Posteriori pneumatiche | | • | | • | | • | | • | | | • | | | | • | | | • | | • |
|  | Cabin type AT/AD | • | • | h | • | h | • | h | h | • | h | • | • | • | h | • | • | h | • | • | • |
| | AT-N/AD-N | • | • | h | • | h | • | h | h | • | h | • | • | • | h | • | • | h | • | • | • |

: With disc brakes
J With Duo Duplex drum brakes
◆ Only on vehicles with right-hand steering

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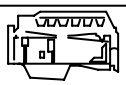
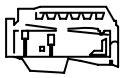
## COMPOSITION OF THE MODELS

| GROUPS/CABIN | | | MODELS 8x8 410 T 45W |
|---|---|---|---|
|  | F3BE3681C (450 CV) | | • |
|  | Pulling one-disc 17" | | • |
|  | 16S 2220 TO | | • |
| | 12 AS 2330 TO | | • |
|  | TC 2200 | | • |
| REAR  | FRONT 5985/2D J | | • |
| | INTERMEDIATE 5985/2D J | | • |
| | INTERMEDIATE 453291/2D J | | • |
| | REAR 453291/2D J | | • |
|  | ZF 8099 | | • |
|  | Front mechanic | | • |
| | Rear mechanic | | • |
|  | Cabin type | AD | • |
| | | AD-N | • |

J With Duo-Duplex drum brakes

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## FILLING FLUIDS

| LUBRICANTS RECOMMENDED BY IVECO | | PARTS TO BE FILLED UP | | Quantity Liters | Quantity Kg |
|---|---|---|---|---|---|
| Urania FE 5W30[1]<br>Urania LD7 |  | Engine F2B | | | |
| | | Total capacity 1st filling: | | 28 | 25.2 |
| | | Capacity: | | | |
| | | - engine sump min level | | 12.5 | 11.2 |
| | | - engine sump max level | | 23 | 21 |
| | | - circulating quantity not returning to sump | | 5 | 4.5 |
| | | - quantity contained in the cartridge filter (to add when replacing the cartridge filter) | | 2.5 | 2.3 |
| Urania FE 5W30[1]<br>Urania LD7 |  | Engine F3B | | | |
| | | Total capacity 1st filling | | 35 | 31.5 |
| | | Capacity: | | | |
| | | - engine sump at minimum level | | 20 | 18 |
| | | - engine sump at maximum level | | 28 | 25.2 |
| | | - quantity in circulation that does not return to sump | | 7 | 6.3 |
| | | - quantity contained in cartridge filters (to add when changing the cartridge filters) | | 3 | 2.7 |
| Tutela Truck FE - gear<br>Tutela ZC 90 |  | Gearbox | | | |
| | | ZF 9S 1310 TO* | | 8.5 | 7.6 |
| | | ZF 9S 1311 TO* | | 21 | 18.9 |
| | | ZF 16S 1620 TD* | | 11 | 9.9 |
| | | ZF 16S 1621 TD* | | 18.5 | 16.6 |
| | | ZF 16 S 2220 TO/2520 TO* | | 13 | 11.7 |
| | | ZF 16 S 2221 TO/2521 TO* | | 21.5 | 19.3 |
| | | ZF 12 AS 1420 TD* | | 11 | 9.9 |
| | | ZF 12 AS 1930 TD/2330 TO* | | 12 | 10.8 |
| | | ZF 12 AS 1931 TD/2331 TO* | | 21 | 18.9 |
| | | * Quantity 1st filling | | | |
| Tutela ZC 90<br>Tutela GI/A for arctic climate |  | Transfer box | TC 1800 (32180) | 6.5 | 5.5 |
| | | | TC 2200 (32220) | 6.5 | 5.5 |

(1) IVECO recommends using these oils for better fuel economy. IVECO supplies each new vehicle ready filled with this type of lubricant Also designed for cold climates (minimum temperature down to -30°).

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## FILLING FLUIDS

| LUBRICANTS RECOMMENDED BY IVECO | | PARTS TO BE FILLED UP | Quantity Liters | Quantity Kg |
|---|---|---|---|---|
| |  | Axle 5886/D (for each hub) | 0.35 | 0.32 |
| |  | Front axle 5985/2D | 5 | 4.5 |
| |  | Front axle wheels reduction unit 5985/2D | 0.75 | 0.68 |
|  Tutela W140/M-DA<br>Tutela W90/M-DA[1] |  | Rear axle 451391/2D | 16 | 14.5 |
| | | Axle in tandem 453291/2D:<br>- (intermediate + transm.)<br>- rear | 27<br>16 | 24.3<br>14.5 |
| | | Axle in tandem 452191/2D:<br>- (intermediate + transm.) | 27<br>16 | 24.3<br>14.5 |
| | | Axle in tandem 452146/2D:<br>- (intermediate + transm.)<br>- rear | 13<br>11.5 | 11.7<br>10.5 |
| | | Axle in tandem MT 23-155:<br>- (intermediate + transm.)<br>- rear | 20<br>18.5 | 18<br>16.6 |
|  Tutela GI/A |  | Power steering<br><br>* Excluding vehicles with steering rear axle<br>** For vehicles with steering rear axle only | 2.7*<br>13.5** | 2.4<br>12 |
|  Tutela TRUCK DOT SPECIAL |  | Clutch circuit<br>(excluding vehicles with Euro Tronic gearbox) | 0.5 | 0.45 |
|  Water+Paraflu[11] | | Cooling system<br>Engine F2B Total capacity *<br>Engine F2B with Intarder Total capacity *<br>Engine F3B Total capacity *<br>Engine F3B with Intarder Total capacity *<br>* = Protective anti-freeze<br>(concentration 50% freezing point –35°C) | <br>~34<br>~50<br>~44<br>~64 | <br>30.6<br>45<br>39.6<br>58 |
|  Tutela LHM |  | Cab tilting system<br><br>* = Protective anti-freeze<br>(concentration 50% freezing point –35°C) | 0.6 | 0.54 |

(1) Specific for cold climates

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| **International specifications of lubricants and fluids** | | FL Products |
|---|---|---|
| Engine oil<br>Meets the specifications:<br>**ACEA E4 with a totally synthetic base**<br>IVECO Standard 18-1804<br>ACEA E7 with a mineral base<br>IVECO Standard 18-1804 T2E7 | **SAE 5W 30**<br><br>SAE 15W 40 | **URANIA FE 5W30** (1)<br><br>Urania LD7 |
| Oil for total power takeoff (Multi-power)<br>Containing non-EP anti-wear additives<br>Complies with the following specification:<br>API GL5 with a mineral base<br>IVECO Standard 18-1807 | <br><br><br>SAE 80W90 | <br><br><br>Tutela ZC 90 |
| Oil for differential gear and wheel hubs<br>Meets the specifications:<br>API GL5 with a mineral base<br>API GL5 with a mineral base<br>IVECO Standard 18-1805 | <br>SAE 85W 140<br>SAE 80W 90 | <br>Tutela W140/M-DA (hot or mild climates)<br>Tutela W90/M-DA (cold climates) |
| Oil for mechanical gearboxes<br>Containing non-EP anti-wear additives<br>Meets the specifications:<br>**API GL4 with a totally synthetic base**<br>API GL3 with a mineral base<br>IVECO Standard 18-1807 | <br><br><br>**SAE 75W 80**<br>SAE 80W 90 | <br><br><br>**Tutela Truck FE-Gear** (1)<br>Tutela ZC 90 |
| Oil for hydrostatic transmission and power steering oil<br>A.T.F. DEXRON II D<br>A.T.F. DEXRON III | | <br>Tutela GI/A<br>Tutela A.T.F. 90 |
| Grease for general use<br>with base of lithium soap, consistency N.L.G.I. no. 2<br>IVECO Standard 18-1810 | | <br>Tutela MR 2 |
| Grease for bearings and wheel hubs<br>with base of lithium soap, consistency N.L.G.I. no. 3<br>IVECO Standard 18-1810 | | <br>Tutela MR 3 |
| Fluid for hydraulic brakes and clutch control<br>complies with standards: N.H.T.S.A. N. 116 ISO 4925 -Std. SAE J 1703<br>CUNA NC 956-01 - IVECO STANDARD 18 - 1820 | | <br>Tutela TRUCK DOT SPECIAL |
| Mineral oil for hydraulic circuits<br>complies with standards: IVECO STANDARD 18-1823 | | <br>Tutela LHM |
| Windshield washer liquid,<br>mixture of alcohols, water and surface tensioners<br>CUNA NC 956-11 | | <br>Tutela Professional SC 35 |
| Grease for centralised lubrication systems<br>with base of lithium soap (synthetic base), N.L.G.I. no. 2.<br>Operating temperatures: -30 °C to +140 °C | | <br>Tutela COMAR 2 |
| Mineral oil for hydraulic circuits<br>complies with standard: IVECO STANDARD 18-1830<br>to be used diluted with water at 50% | | <br>Paraflu[11] |

(1) IVECO recommends using this type of oils to obtain benefits in terms of "fuel economy". The new vehicle is already equipped by IVECO with this type of lubricants (also adequate for cold climate min. temperature up to -30°C).

These quantities are not determinant. The exact check to be done when checking levels.

Aquila Trucks Centres

SECTION 2

# Engines


| | | Page |
|---|---|---|
| - | F2B Engine | 3÷122 |
| - | F3B Engine | 123÷246 |
| - | Hydrocar pressure take-off on timing system (P.T.O. - Optional) | 247÷250 |
| - | Denox 2 system | 251÷258 |
| - | Diagnosis | 259÷292 |

Aquila Trucks Centres

Aquila Trucks Centres

## F2B Engine


| | Page |
|---|---|
| VIEWS OF THE ENGINE | 8 |
| MAIN DATA | 12 |
| ASSEMBLY CLEARANCE DATA | 15 |
| TIGHTENING TORQUES | 22 |
| TOOLS | 29 |
| ENGINE REMOVAL - REFITTING | 39 |
| - Removal | 39 |
| - Refitting | 40 |
| - Filling the cooling system | 41 |
| - Bleeding air from the fuel system | 42 |
| - Checks and tests | 42 |
| ELECTRO-MAGNETIC FAN DRIVE REPLACEMENT | 43 |
| - Removal | 43 |
| - Refitting | 44 |
| DISASSEMBLING THE ENGINE | 47 |
| REPAIR OPERATIONS | 54 |
| CYLINDER BLOCK | 54 |
| - Checks and measurements | 54 |
| CYLINDER LINERS | 55 |
| - Replacing cylinder liners | 56 |
| - Removal | 56 |
| - Fitting and checking protrusion | 56 |
| CRANKSHAFT | 57 |
| - Measuring main journals and crank pins | 58 |
| PRELIMINARY MEASUREMENT OF MAIN AND BIG END BEARING SHELL SELECTION DATA | 59 |
| - Replacing the valve drive gear and the oil pump drive gear | 66 |
| - Checking main journal installation clearance | 66 |
| - Checking crankshaft end float | 67 |
| PISTON-CONNECTING ROD ASSEMBLY | 68 |
| - Removal | 68 |
| - Measuring the diameter of the pistons | 69 |

https://truckmanualshub.com/

Aquila Trucks Centres


| | Page |
|---|---|
| - Conditions for correct gudgeon pin-piston coupling | 69 |
| - Piston rings | 70 |
| CONNECTING ROD | 71 |
| - Checking connecting rod squareness | 72 |
| - Fitting the connecting rod-piston assembly | 72 |
| - Fitting the piston rings | 72 |
| - Fitting the connecting rod-piston assembly into the cylinder liners | 73 |
| - Piston protrusion check | 73 |
| - Checking assembly clearance of big end pins | 74 |
| CYLINDER HEAD | 74 |
| - Dismounting the valves | 74 |
| - Checking the planarity of the head on the cylinder block | 74 |
| VALVE | 75 |
| - Removing dust and checking the valves | 75 |
| VALVE GUIDES | 75 |
| - Replacing of valve guides | 76 |
| - Replacing - Reaming the valve seats | 76 |
| REPLACING INJECTOR HOLDERS | 76 |
| - Removal | 76 |
| - Checking protrusion of injectors | 78 |
| TIMING GEAR | 79 |
| - Camshaft drive | 79 |
| - Intermediate gear pin | 79 |
| - Idler gear | 79 |
| - Twin idler gear | 79 |
| - Replacing the bushings | 79 |
| - Camshaft | 80 |
| - Checking cam lift and pin alignment | 80 |
| - Bushes | 81 |
| - Replacing camshaft bushes using beater 99360487 | 82 |
| - Removal | 82 |
| - Assembly | 82 |
| VALVE SPRINGS | 83 |
| - Fitting the valves and oil seal ring | 83 |
| ROCKER SHAFT | 84 |
| - Shaft | 84 |
| - Rocker | 84 |
| ASSEMBLING THE ENGINE | 85 |
| DIAGRAM SHOWING THE LOWER CRANKCASE FIXING SCREWS TIGHTENING ORDER | 87 |
| - Fitting the connecting rod-piston assembly into the cylinder liners | 88 |
| FLYWHEEL | 91 |
| - Fitting flywheel | 91 |
| - Fitting camshaft | 92 |
| - Fitting pump-injectors | 93 |
| - Fitting rocker-arm shaft assembly | 93 |
| - Camshaft timing | 94 |
| - Phonic wheel timing | 96 |
| - Intake and exhaust rocker clearance adjustment and pre-loading of rockers controlling pump injectors | 97 |
| ENGINE COMPLETION | 98 |
| LUBRICATION | 101 |
| - Oil pump | 103 |
| - Safety relief valve | 103 |
| - Oil overpressure valve | 104 |
| - Heat exchanger | 104 |
| - By-pass valve | 105 |
| - Thermostatic valve | 105 |
| - Engine oil filters | 105 |

Aquila Trucks Centres

Page


- Valve integrated in piston cooling nozzle ..... 106

COOLING ..... 107

- Description ..... 107
- Operation ..... 107
- Electromagnetic fan drive ..... 109
- Water pump ..... 109
- Thermostat ..... 110

TURBOCHARGER ..... 112

VGT TURBOCHARGER ..... 112

- Actuator ..... 113
- Solenoid valve for VGT control ..... 113

REPAIRING ACTIONS ..... 113

- Variable geometry movement control ..... 114
- Checking the actuator ..... 114
- Checking actuator travel ..... 115
- Cleaning turbine body ..... 115

FUEL SYSTEM ..... 118

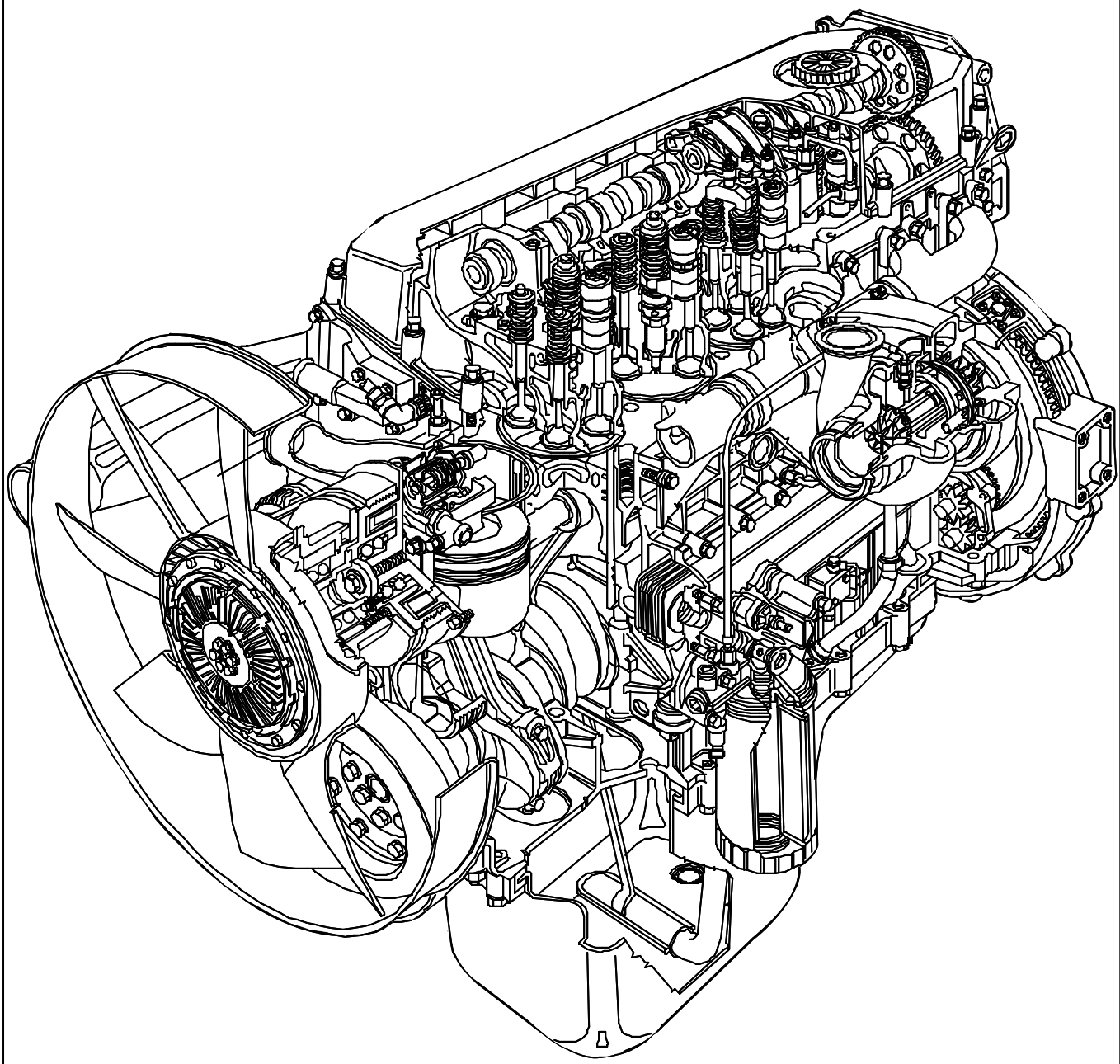
- Overpressure valve ..... 119
- Feed pump ..... 119
- Injector-pump ..... 120
- Replacing injectors-pump ..... 120
- Injector Phases ..... 121

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Figure 1

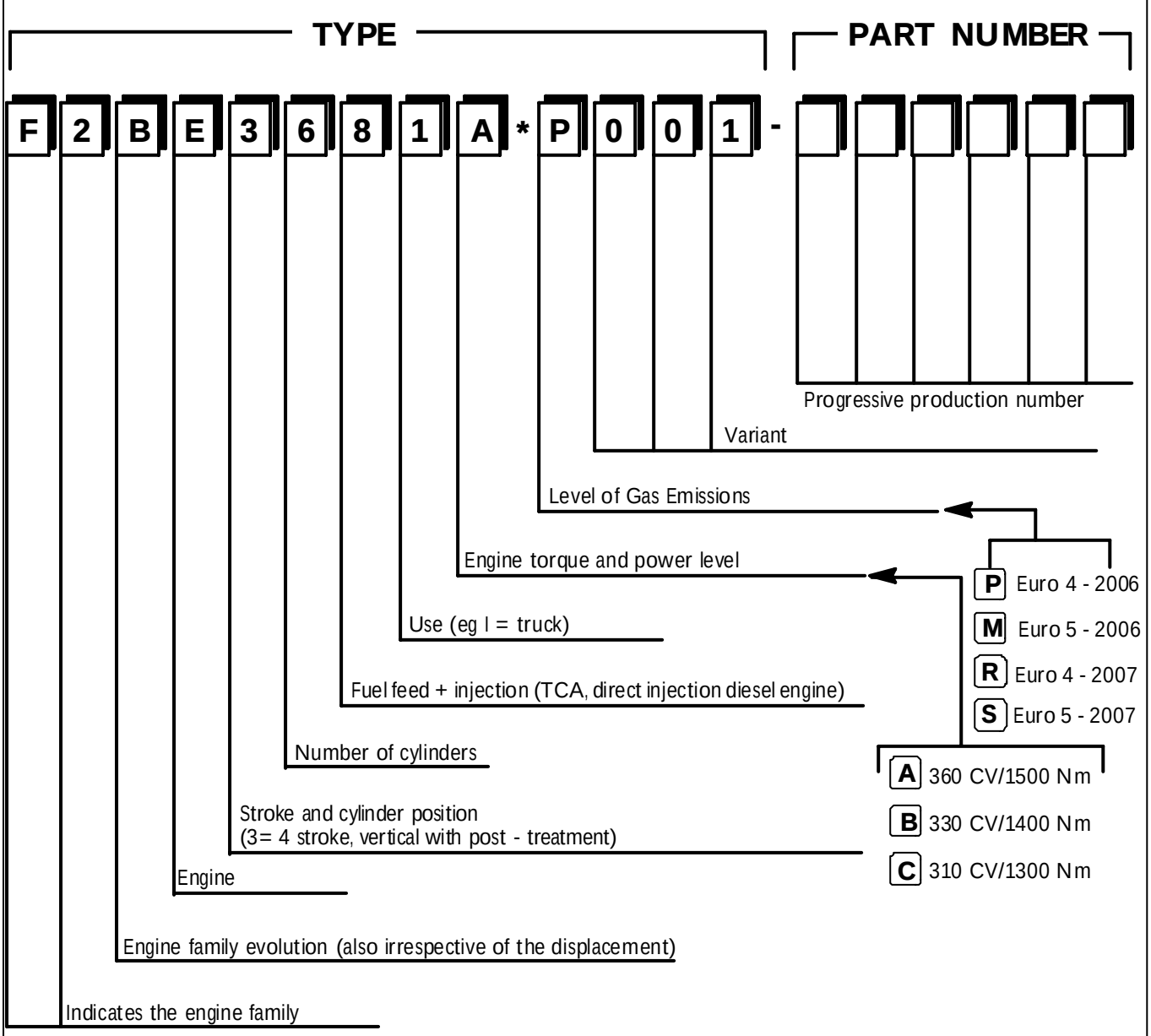



F2B ENGINE

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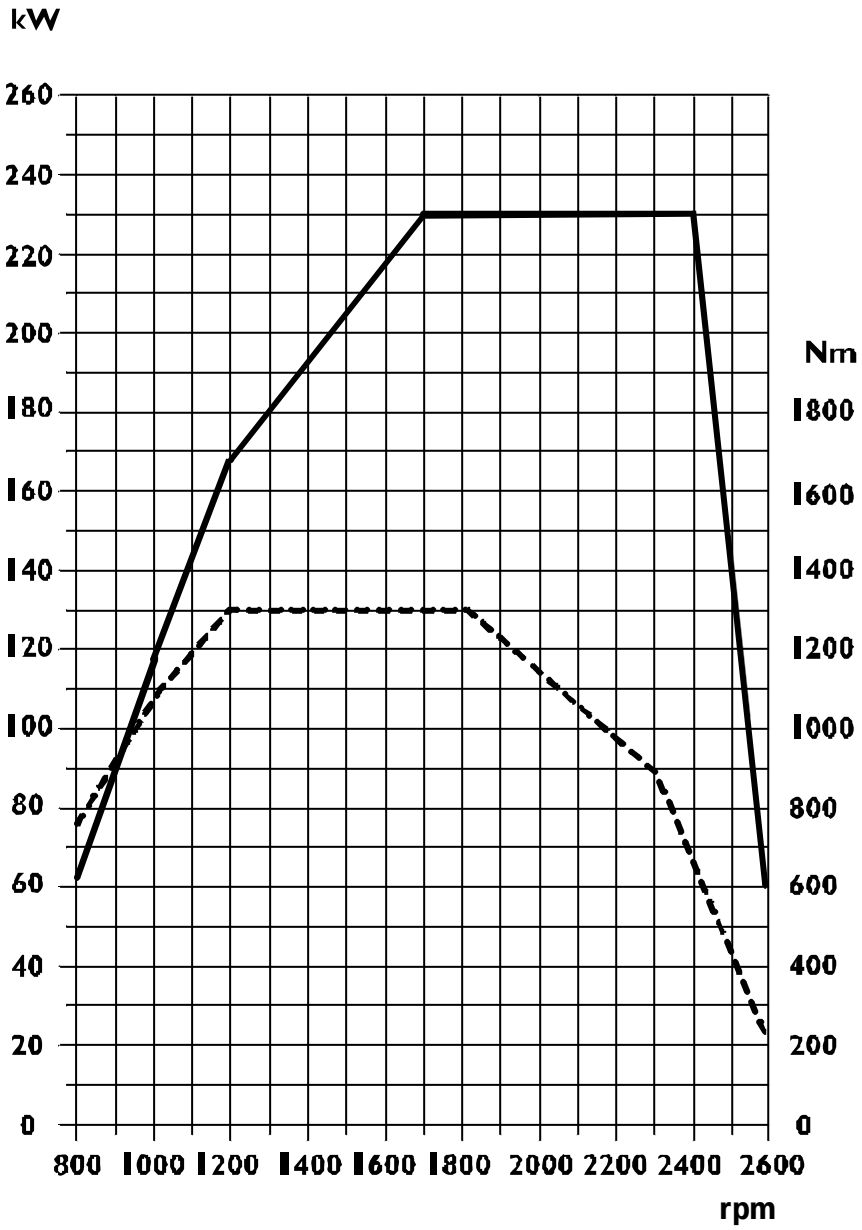
## VIEWS OF THE ENGINE

**ENGINE**



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Figure 2



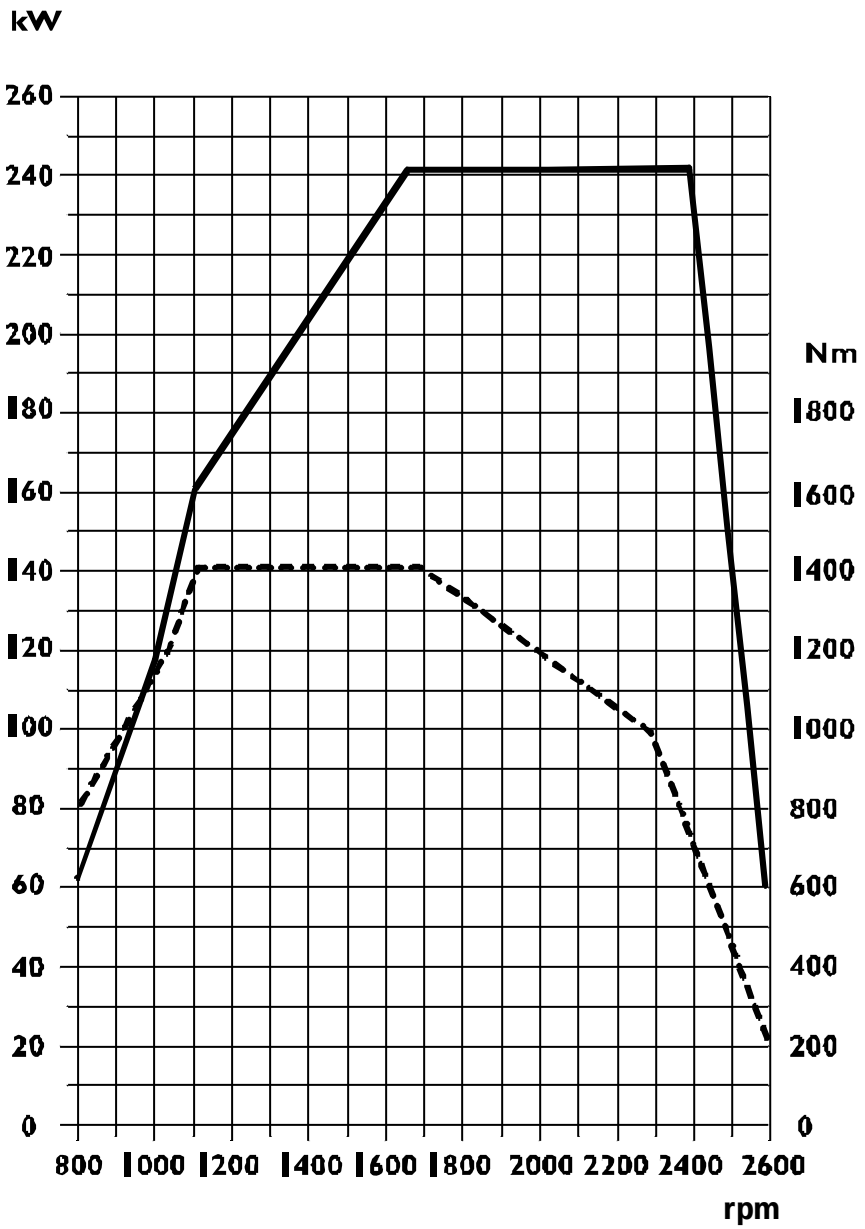

108514

F2BE3681C: POWER-TORQUE CURVES

| | | | |
|---|---|---|---|
| **Max OUTPUT** | **230 kW** | **310 HP** | **2400 rpm** |
| **Max TORQUE** | **1300 Nm** | **132 kgm** | **1200 to 1675 rpm** |

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Figure 3



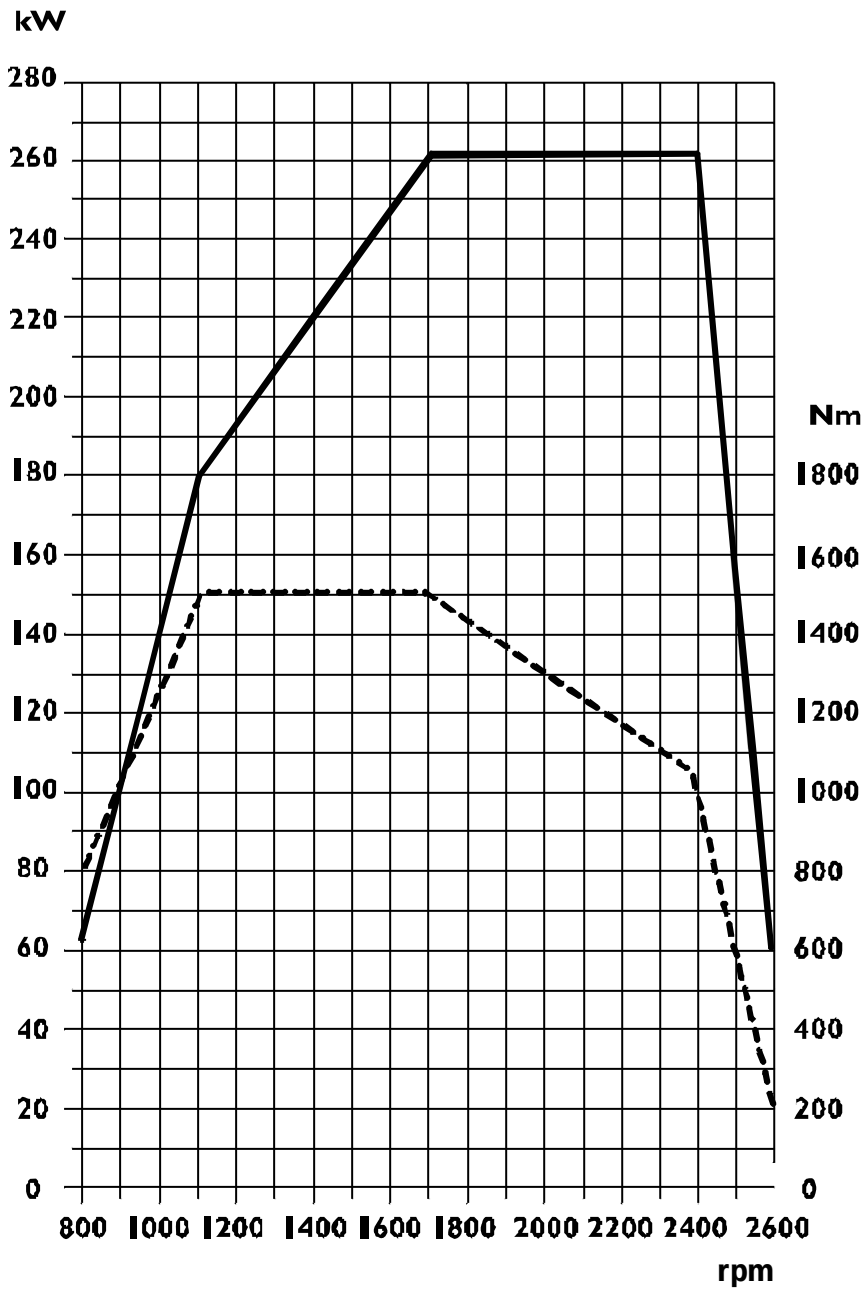

108515

F2BE3681B: POWER-TORQUE CURVES

| | | | |
|---|---|---|---|
| **Max OUTPUT** | **245 kW** | **330 HP** | **2400 rpm** |
| **Max TORQUE** | **1400 Nm** | **143 kgm** | **1080 to 1655 rpm** |

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Figure 4

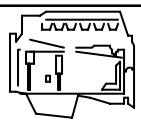
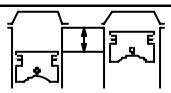
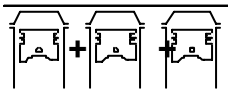
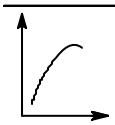
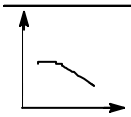



F2BE3681A: POWER-TORQUE CURVES

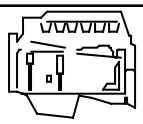
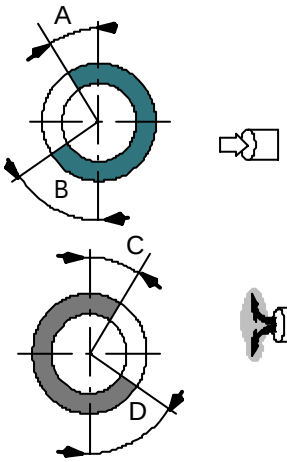
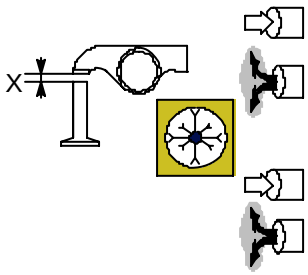
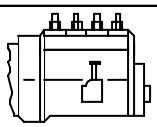
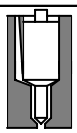
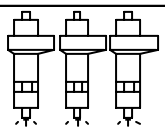
| | | | |
|---|---|---|---|
| **Max OUTPUT** | **265 kW** | **360 HP** | **2400 rpm** |
| **Max TORQUE** | **1500 Nm** | **153 kgm** | **1200 to 1685 rpm** |

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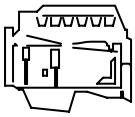
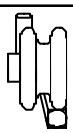
## MAIN DATA

| | | | | |
|---|---|---|---|---|
|  | Type | F2BE3681C | F2BE3681B | F2BE3681A |
|  | Cycle | 4-stroke Diesel engine | | |
| | Fuel feed | Tu rbocharged with aftercooler | | |
| | Injection | Direct | | |
|  | No of cylinders | 6 in line | | |
|  | Bore mm | 115 | | |
|  | Stroke mm | 125 | | |
|  | +.. = Total displacement $cm^3$ | 7790 | | |
|  | Compression ratio | 16 ± 0.8 | | |
|  | Max. output kW (HP) | 230 (310) | 245 (330) | 265 (360) |
|  | rpm | 2400 | 2400 | 2400 |
|  | Max. torque Nm (kgm) | 1300 (132) | 1400 (143) | 1500 (153) |
|  | rpm | 1200÷1675 | 1080÷1655 | 1200÷1685 |
|  | Engine idling speed no load rpm | 600 ± 50 | | |
|  | Maximum engine speed no load rpm | 2660 ± 50 | | |

Aquila Trucks Centres

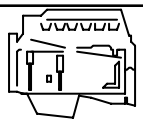
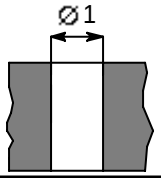
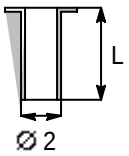
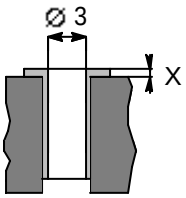
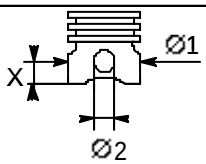
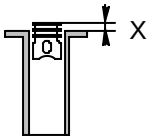
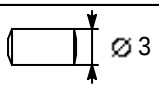
| | | |
|---|---|---|
|  | Type | F2B |
|   | VALVE TIMING<br>opens before T.D.C. A<br>closes after B.D.C. B<br>opens before B.D.C. D<br>closes after T.D.C. C | <br>17°<br>31°<br>48°<br>9° |
|   | For timing check<br>X mm<br>mm<br>Running<br>X mm<br>mm | <br>–<br>–<br><br>0.35 to 0.45<br>0.35 to 0.45 |
|  | FEED | Through fuel pump - Filters |
| | Injection<br>type Bosch | With electronically regulated injectors UIN2<br>pump injectors controlled by overhead camshaft |
|  | Nozzle type | – |
|  | Injection order | 1 - 4 - 2 - 6 - 3 - 5 |
|   | Injection pressure bar | 1600 |

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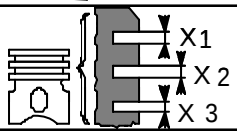
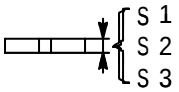
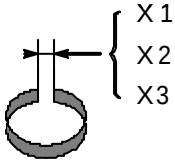
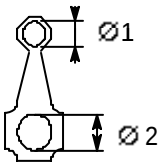
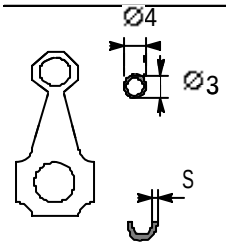
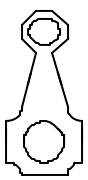
| | | | | |
|---|---|---|---|---|
|  | Type | F2BE3681C | F2BE3681B | F2BE3681A |
|  | SUPERCHARGING | | | |
| | Turbocharger type: | Fixed geometry HOLSET HX 40 | Variable geometry HOLSET HE 431 V | |
| | LUBRICATION | Forced by gear pump, overpressure valve, oil filter | | |
|   | Oil pressure, engine hot (100 °C ± 5 °C): | | | |
| | at idling speed bar | 1.5 | | |
| | at maximum speed bar | 5 | | |
| COOLING | | By centrifugal pump, thermostat, electro-magneting fan, radiator and heat exchanger | | |
| | Water pump control | By belt | | |
| | Thermostat: | N. 1 | | |
| | starts to open: | 85 °C | | |
| | fully open: | – | | |
| | OIL FILLING | | | |
| | Total capacity at 1st filling | | | |
| | liters | 28 | | |
| | kg | 25.2 | | |
| | Capacity: | | | |
| | - engine sump min level | | | |
| | liters | 12.5 | | |
| | kg | 11.2 | | |
| | - engine sump max level | | | |
| | liters | 23 | | |
|  Urania FE 5W30 Urania LD7 | kg | 21 | | |
| | - quantity in circulation that does not flow back to the engine sump | | | |
| | liters | | | |
| | kg | 5 | | |
| | - quantity contained in the cartridge filter (which has to be added to the cartridge filter refill) | 4.5 | | |
| | liters | 2.5 | | |
| | kg | 2.3 | | |

Aquila Trucks Centres

## ASSEMBLY CLEARANCE DATA

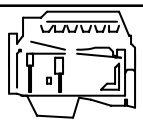
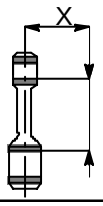
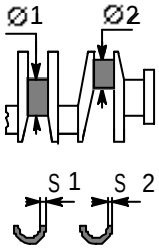
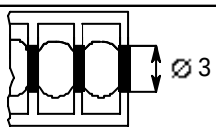
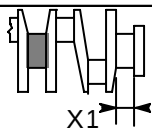
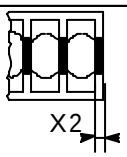
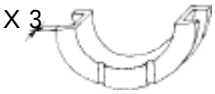
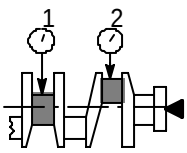
| | | |
|---|---|---|
|  | Type | F2B |
| CYLINDER BLOCK AND CRANK MECHANISM COMPONENTS | | mm |
|  | Cylinder liner bore<br>Ø 1 upper<br>Ø 1 lower | 130.200 to 130.225<br>128.510 to 128.535 |
|  | Cylinder liners:<br>outer diameter:<br>Ø 2 upper<br>Ø 2 lower<br>length L | 130.161 to 130.186<br>128.475 to 128.500 |
|  | Cylinder liner - crankcase bore<br>upper<br>lower | 0.014 to 0.064<br>0.010 to 0.060 |
|  | Outside diameter Ø 2 | – |
|  | Cylinder liner<br>A*<br>inside diameter Ø 3<br>B*<br>Protrusion X** | <br>115.000 to 115.012<br><br>115.010 to 115.022<br>0.035 to 0.065 |
| * Available dia. class<br>** Under a load of 6000 kg | | |
|  | Pistons:<br>measuring point X<br>outside diameter Ø 1 A•<br>outside diameter Ø 1 B••<br>outside diameter Ø 2 | <br>18<br>114.871 to 114.883<br>114.881 to 114.893<br>46 .010 to 46.018 |
| • Class A pistons supplied as spares.<br>•• Class B pistons are fitted in production only and are not supplied as spares. | | |
|  | Piston - cylinder liner | 0.117 to 0.141 |
|  | Piston diameter Ø 1 | – |
|  | Pistons protrusion X | 0.32 to 0.69 |
|  | Gudgeon pin Ø 3 | 45.994 to 46.000 |
|  | Gudgeon pin - pin housing | 0.010 to 0.024 |

# Aquila Trucks Centres

| | | F2B | |
|---|---|---|---|
| | Type | mm | |
| | | FEDERAL MOGUL J | MAHLE PISTON Y |
|  | Piston ring grooves X1* | 1.583 (rated) | 1.583 to 1.613 |
| | X 2 | 1.554 to 1.574 | 1.550 to 1.570 |
| | X3 | 4 .02 to 4.04 | |
| | *measured on Ø of 111 mm | | |
|  | Piston rings: | | |
| | Compression ring S1* | 1.429 to 2.463 | |
| | Scraper ring S2 | 1.47 to1.50 | |
| | Slotted oil scraper ring S3 | 3.970 to 3.990 | |
| D Measured at 2 mm from the Ø outside | | | |
|  | Piston rings - grooves 1 | 0 .247 to 0.311 | 0.111 to 0.175 |
| | 2 J | 0.054 to 0.104 | |
| | 2 Y | 0.050 to 0.100 | |
| | 3 | 0 .030 to 0.070 | |
|  | Piston rings | – | |
|  | Piston ring end gap in cylinder liners: | | |
| | X1 | 0.30 to 0.40 | |
| | X2 | 0.55 to 0.70 | |
| | X3 | 0.35 to 0.65 | |
|  | Small end bush housing Ø 1 | 49.975 to 50.000 | |
| | Big end bearing housing Ø 2 | Rated value | 77.000 to 77.030 |
| | Selection classes Ø 1 | | 77.000 to 77.010 |
| | 2 | | 77.011 to 77.020 |
| | 3 | | 77.021 to 77.030 |
|  | Small end bush diameter | | |
| | outside Ø4 | | 50 .055 to 50.080 |
| | inside Ø 3 | | 46.015 to 46.030 |
| | Big end bearing shell S | | |
| | Red | | 2.000 to 2.010 |
| | Green | | 2.011 to 2.020 |
| | Yellow | | 2.021 to 2.030 |
|  | Small end bush - housing | | 0.055 to 0.105 |
|  | Piston pin - bush | | 0.015 to 0.036 |
|  | Big end bearing shells | | 0.127 - 0.254 - 0.508 |
|  | Connecting rod weight | | |
| | Class A | | g. 2865 to 2895 |
| | B | | g . 28961 to 2925 |
| | C | | g. 2926 to 2955 |

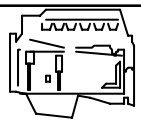
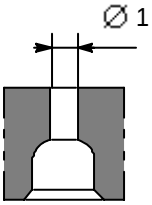
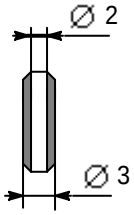
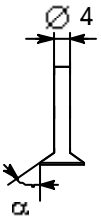
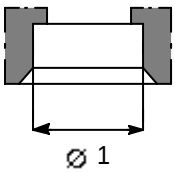
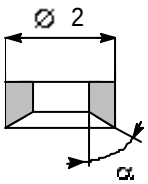
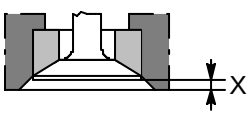
* Factory-assembled only, and not provided with a spare part

Aquila Trucks Centres

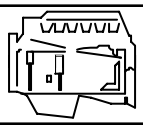
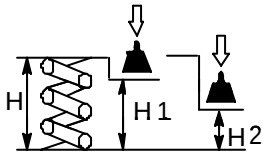
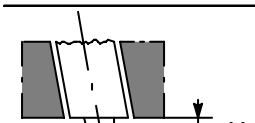
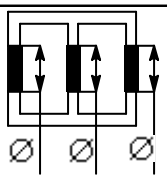
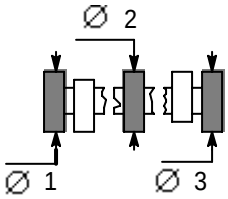
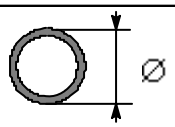
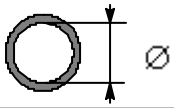
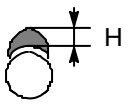
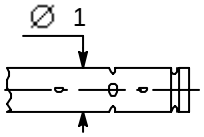
| | | | |
|---|---|---|---|
|  | Type | | F2B |
| | | | mm |
|  | Measuring point X | | 125 |
| | Max. connecting rod axis misalignment tolerance // | | 0.08 |
|  | Main journals Ø 1 | Rated value | 82.910 to 82.940 |
| | Selection class 1 | | 82.910 to 82.919 |
| | Selection class 2 | | 82.920 to 82.929 |
| | Selection class 3 | | 82.930 to 82.940 |
| | Crankpins Ø 2 | Rated value | 72.915 to 72.945 |
| | Selection class 1 | | 72.915 to 72.924 |
| | Selection class 2 | | 72.925 to 72.934 |
| | Selection class 3 | | 72.935 to 72.945 |
| | Main bearing shells S1 | | |
| | Red | | 3.000 to 3.010 |
| | Green | | 3.011 to 3.020 |
| | Yellow D | | 3.021 to 3.030 |
| | Big end bearing shells S2 | | |
| | Red | | 2.000 to 2.010 |
| | Green | | 2.011 to 2.020 |
| | Yellow D | | 2.021 to 2.030 |
|  | Main bearing housings Ø 3 | Rated value | 89.000 to 89.030 |
| | Selection class 1 | | 89.000 to 89.009 |
| | Selection class 2 | | 89.010 to 89.019 |
| | Selection class 3 | | 89.020 to 89.030 |
|  | Bearing shells - f main journals | | 0.040 ÷ 0.098 * - 0.040 ÷ 0.110 ** |
| | Bearing shells - f big ends | | 0.035 ÷ 0.093 * - 0.035 ÷ 0.083** |
|  | Main bearing shells | | 0.127 - 0.254 - 0.508 |
| | Big end bearing shells | | 0.127 - 0.254 - 0.508 |
|  | Main journal, thrust bearing X1 | | 39.96 to 40.00 |
|  | Main bearing housing, thrust bearing X2 | | 32.94 to 32.99 |
|  | Thrust washer halves X3 | | 3.38 to 3.43 |
|  | Crankshaft shoulder | | 0.11 to 0.30 |
|  | Parallel // 1 - 2 | | 0.010 |
| | Concentric ◎ 1 - 2 | | 0.040 |

D Only mounted in production and not provided with spares
f Spares provided: : * = standard spares - 0.127; ** = 0.254 - 0.508

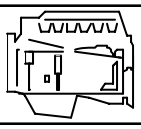
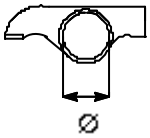
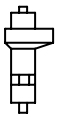
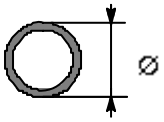
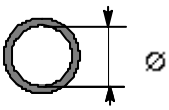
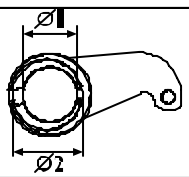
Aquila Trucks Centres

| | | |
|---|---|---|
|  | Type | F2B |
| **CYLINDER HEADS - VALVE TRAIN** | | mm |
|  | Valve guide housings in cylinder head Ø1 | 12.980 to 12.997 |
|  | Valve guide Ø2 Ø3 | 8.023 to 8.038<br>13.012 to 13.025 |
|  | Valve guides - housings in the cylinder head | 0.015 to 0.045 |
|  | Valve guide | 0.2 to 0.4 |
|  | Valves: Ø4 α<br>Ø4 α | 7.970 to 7.985<br>60° 30' ± 7' 30"<br>7.970 to 7.985<br>45° +15' -0° |
|  | Valve stem and its guide | 0.038 to 0.068 |
|  | Housing in head for valve seat Ø1<br>Ø1 | 41.985 to 42.020<br>40.985 to 41.020 |
|  | Outside diameter of valve seat; angle of valve seat in cylinder head: Ø2 α<br>Ø2 α | 42.060 to 42.075<br>60° - 30'<br>41.060 to 41.075<br>45° - 30' |
|  | Recessing of valve X | 0.5 to 0.8<br>1.6 to 1.9 |
|  | Between valve seat and head | 0.040 to 0.090 |

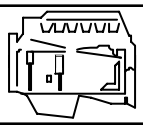
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| | | |
|---|---|---|
|  | Type | F2B |
| | | mm |
|  | Valve outside spring height:<br>free height H<br>under a load of:<br>540 ± 27N H1<br>966 ± 48N H2 | <br>66<br><br>49 .5<br>37 .5 |
|  | Injector protrusion X | 0.7 |
|  | Camshaft bush housing fitted in the cylinder head:<br>1 ⇒ 7 Ø | 80.000 to 80.030 |
|  | Camshaft journal diameter:<br>1 ⇒ 7 Ø | 75.924 to 75.940 |
|  | Camshaft bushing outer diameter: Ø | 80.090 to 80.115 |
|  | Camshaft bushing inner diameter: Ø1 ⇒ 6<br>Ø7 | 75.990 to 76.045<br>76.008 to 76.063 |
|  | Bushings and housings in engine block | 0.060 to 0.115 |
|  | Bushings and journals | 0.050 to 0.121 |
|  | Cam lift:<br>  | 8.07<br>7.63<br>8.828 |
|  | Rocker shaft Ø 1 | 37.984 to 38.000 |

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|  | Type | F2B |
|---|---|---|
| | | mm |
|  | Bushing housing in rocker arms<br>  <br>  <br>  | 41.000 to 41.016<br>53.000 to 53.019<br>42.000 to 42.016 |
|  | Bushing outer diameter for rocker arms:<br>  <br>  <br>  | 41.097 to 41.135<br>53.105 to 53.156<br>42.066 to 42.091 |
|  | Bushing inner diameter for rocker arms:<br>  <br>  <br>  | 38.025 to 38.041<br>50.025 to 50.041<br>38.015 to 38.071 |
|  | Between bushings and housings<br>  <br>  <br>  | 0.081 to 0.135<br>0.086 to 0.156<br>0.050 to 0.091 |
|  | Between rocker arms and shaft<br>  <br>  | 0.025 to 0.057<br>0.015 to 0.087 |
|  | Engine brake control lever<br>Eccentric pin outer diameter Ø2<br>Rocker arms shaft seat Ø1 | 49.984 ÷ 50.000<br>38.025 ÷ 38.041 |

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| | | | | |
|---|---|---|---|---|
|  | Type | F2BE3681C | F2BE3681B | F2BE3681A |
| | | mm | | |
|  | Rocker arms and engine brake control lever pin  | 0.025 to 0.068 | | |
|  | Rocker arm shaft and seat on engine brake control lever  | 0.025 to 0.057 | | |
| TURBOCHARGER | | | | |
| Type | | Fixed geometry HOLSET HX 40 | Variable geometry HOLSET HE 431 V | |
| End float | | 0.025 to 0.127 | 0.025 to 0.127 | |
| Radial play | | 0.330 to 0.508 | 0.254 to 0.356 | |

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## TIGHTENING TORQUES

| PART | | | TORQUE Nm | TORQUE kgm |
|---|---|---|---|---|
| Lower crankcase fastening screws to cylinder block (see Figure 5) ♦ | | | | |
| Outer screws | First stage : pre-tightening | M 10x1.25 | 25 | 2 .5 |
| Inner screws | Second stage : pre-tightening | M 16x2 | 140 | 14 |
| Inner screws | Third stage : angle closing | M 16x2 | 60 ° | |
| Inner screws | Fourth stage : angle closing | M 16x2 | 60 ° | |
| Outer screws | Fifth stage : angle closing | M 10x1.5 | 90 ° | |
| Pipe union for piston cooling nozzle | | M 12X1.5 | 35 ± 2 | 3.5 ± 0.2 |
| Intercooler fastening screws to cylinder block ♦ (see Figure 10) | | | | |
| pre-tightening | | | 11.5 ± 3.5 | 1.15 ± 0.35 |
| tightening | | | 19 ± 3 | 1.9 ± 0.3 |
| Plug | | | 125 ± 15 | 12.5 ± 1.5 |
| Spacer and oil sump fastening screws (see Figure 11) | | | 41.5 ± 3.5 | 4.1 ± 0.3 |
| Gearcase fastening screws to cylinder block: | | | | |
| | | M10x1.25 | 41.5 ± 3.5 | 4.1 ± 0.3 |
| | | M12x1.75 | 63 ± 7 | 6.3 ± 0.7 |
| | | M8x1.25 | 23.5 ± 1.5 | 2.3 ± 1.5 |
| Cylinder head fastening screw: (see Figure 6) ♦ | | | | |
| First stage | pre -tightening | | 50 | 5 |
| Second stage | pre -tightening | | 100 | 10 |
| Third stage | angle closing | | 90° | |
| Fourth stage | angle closing | | 75° | |
| Rocker arm shaft fastening screw ♦ | | | | |
| First stage | pre -tightening | | 40 | 4 |
| Second stage | pre -tightening | | 60° | |
| Locknut for rocker arm adjusting screw ♦ | | | 39 ± 5 | 3.9 ± 5 |
| Screws for injector fastening brackets ♦ | | | 36 ± 1.5 | 3.65 ± 0.2 |
| Shoulder plate fastening screws to head ♦ | | | 20 ± 2 | 2 ± 0.2 |
| Engine support bracket fastening screws to cylinder head | | | 74 ± 8 | 7.4 ± 0.8 |
| Gear fastening screws to camshaft: ♦ | | | | |
| First stage | pre -tightening | | 50 | 5 |
| Second stage | pre -tightening | | 50° | |
| Phonic wheel fastening screws to distribution gear | | | 8.5 ± 1.5 | 0.8 ± 0.1 |
| Exhaust pipe fastening screws • (see Figure 8) | | | | |
| pre-tightening | | | 30 ± 3 | 3 ± 03 |
| tightening | | | 60 ± 3 | 6 ± 0.3 |
| Engine brake actuator cylinder fastening screws | | | 19 ± 3 | 1.9 ± 0.3 |
| Connecting rod cap fastening screws: ♦ | | | | |
| First stage | pre -tightening | | 50 | 5 |
| Second stage | pre -tightening | | 40° | |
| Engine flywheel fastening screws: ♦ | | M16x1.5x58 | | |
| First stage | pre -tightening | | 100 | 10 |
| Second stage | pre -tightening | | 60° | |
| Engine flywheel spacer mount screws: ♦ | | M16x1.5x110: | | |
| First stage | pre -tightening | | 100 | 10 |
| Second stage | pre -tightening | | 120° | |
| Flywheel pulley fastening screws to crankshaft: ♦ | | | | |
| First stage | pre -tightening | | 70 | 7 |
| Second stage | pre -tightening | | 50° | |

♦ Lubricate with oil MOLYKOTE before assembly
• Lubricate with graphitized oil before assembly

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| PART | | TORQUE Nm | TORQUE kgm |
|---|---|---|---|
| Damper flywheel fastening screws: ♦ | | 115 ± 15 | 11.5 ± 1.5 |
| Idler gear pin fastening screws: ♦ | | | |
| First stage | pre -tightening | 30 | 3 |
| Second stage | angle closing | 90° | |
| Idle gear link rod fastening screw | | 24.5 ± 2.5 | 2.4 ± 0.2 |
| Oil pump fastening screw | | 24.5 ± 2.5 | 2.4 ± 0.2 |
| Oil pump suction rose fastening screw | | 24.5 ± 2.5 | 2.4 ± 0.2 |
| Front cover fastening screw to cylinder block ♦ | | 19 ± 3 | 1.9 ± 0.3 |
| Control unit fastening screw to cylinder block ♦ | | 19 ± 3 | 1.9 ± 0.3 |
| Supply pump fastening screw to gearcase ♦ | | 19 ± 3 | 1.9 ± 0.3 |
| Fuel filter support fastening screw to cylinder head ♦ | | 24.5 ± 2.5 | 2.4 ± 0.2 |
| Screw securing the engine support to the wheelcase ♦ | | | |
| First stage | pre -tightening | 100 | 10 |
| Second stage | angle closing | 60° | |
| Turbo-compressor fastening screws and nuts • (see Figure 10) | | | |
| pre-tightening | | 35 ± 5 | 3.5 ± 0.5 |
| tightening | | 46 ± 2 | 4.6 ± 0.2 |
| Water pump fastening screw to cylinder block | | 24.5 ± 2.5 | 2.4 ± 0.2 |
| Pulley fastening screw to hub | | 55 ± 5 | 5.5 ± 0.5 |
| Rocker arm cover fastening screws (see Figure 12) | | 8.5 ± 1.5 | 0.8 ± 0.1 |
| Thermostat box fastening screws to cylinder head | | 24.5 ± 2.5 | 2.4 ± 0.2 |
| Automatic tightener fastening screws to cylinder block | | 45 ± 5 | 4.5 ± 0.5 |
| Fixed tightener fastening screws to cylinder block | | 105 ± 5 | 10.5 ± 0.5 |
| Fan support fastening screws to cylinder block | | 24.5 ± 2.5 | 2.4 ± 0.2 |
| Starter fastening screws | | 44 ± 4 | 4 ± 0.4 |
| Air heater on cylinder head | | 50 ± 5 | 5 ± 0.5 |
| Air compressor fastening screw to cylinder head | | 74 ± 8 | 7.4 ± 0.8 |
| Air compressor control gear fastening nut | | 170 | 17 ± 1 |
| Hydraulic power steering pump gear fastening nut | | 46.5 ± 4.5 | 4.6 ± 0.4 |
| Air conditioner compressor fastening screw to support | | 24.5 ± 2.5 | 2.4 ± 2.5 |
| Air conditioner compressor support fastening screw to cylinder block | | 44 ± 4 | 4.4 ± 0.4 |
| Alternator support fastening screw to cylinder block | | 44 ± 4 | 4.4 ± 0.4 |
| Alternator bracket fastening screw to cylinder block | | 24.5 ± 2.5 | 2.4 ± 0.2 |
| Water pipe unions | | 35 | 3.5 |
| Water temperature sensor | | 32.5 ± 2.5 | 3.2 ± 0.2 |

♦ Lubricate with oil MOLYKOTE before assembly
• Lubricate with graphitized oil before assembly

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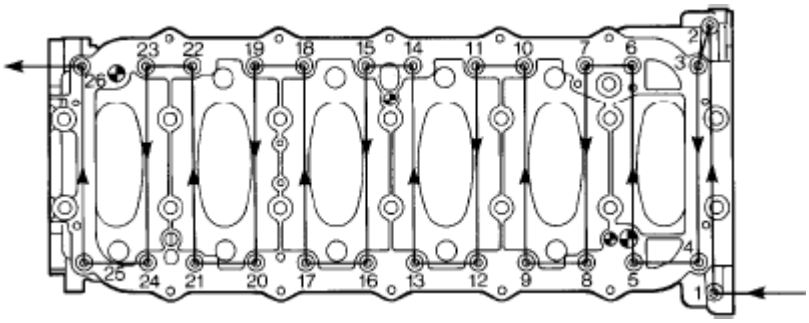
| PART | TORQUE | |
|---|---|---|
| | Nm | kgm |
| Engine brake solenoid valve fastening screws | 32.5 ± 2.5 | 3.2 ± 0.2 |
| Flywheel rev sensor fastening screw | 8 ± 2 | 0.8 ± 0.2 |
| Camshaft rev sensor fastening screw | 8 ± 2 | 0.8 ± 0.2 |
| P.D.E solenoid connector fastening screw | 1.62 ± 0.3 | 0.1 ± 0.3 |
| Overboost pressure sensor fastening screw | 8 ± 2 | 0.8 ± 0.2 |
| Absolute pressure sensor fastening screw | 22.5 ± 2.5 | 2.2 ± 0.2 |
| P.W.M. control valve fastening screw/nut | 8 ± 2 | 0.8 ± 0.2 |
| Fuel/coolant temperature sensor | 35 | 3.5 |
| Coolant temperature indicator | 23.5 ± 2.5 | 2.3 ± 0.2 |
| Filter clogging sensor | 10 | 1 |
| Oil temperature switch | 25 ± 1 | 2.5 ± 0.1 |
| Oil pressure sensor | 25 ± 1 | 2.5 ± 0.1 |
| Oil clogging sensor | 55 ± 5 | 5.5 ± 0.5 |
| Electric wire fastening screw | 8 ± 2 | 0.8 ± 0.2 |
| Heater fastening screw | 16 ± 1 | 1.6 ± 0.1 |
| Power unit | | |
| M14x70/80 screw securing front and rear elastic blocks to chassis | 192.5 ± 19.5 | 19.2 ± 1.9 |
| M16x130 screw securing front and rear elastic blocks to engine | 278 ± 28 | 27.8 ± 2.8 |
| M18x62 flanged HEX screw for front engine block | | |
| Pre-tightening 1st step | 120 | 12 |
| Angle closing 2nd step | 45° | |
| M14x60 socket cheese-head TC screw for front engine block | | |
| Pre-tightening 1st step | 60 | 6 |
| Angle closing 2nd step | 45° | |
| Flanged HEX screw for rear engine block | | |
| Pre-tightening 1st step | 100 | 10 |
| Angle closing 2nd step | 60° | |

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## LOWER CRANKCASE FIXING SCREWS TIGHTENING SEQUENCE

Figure 5

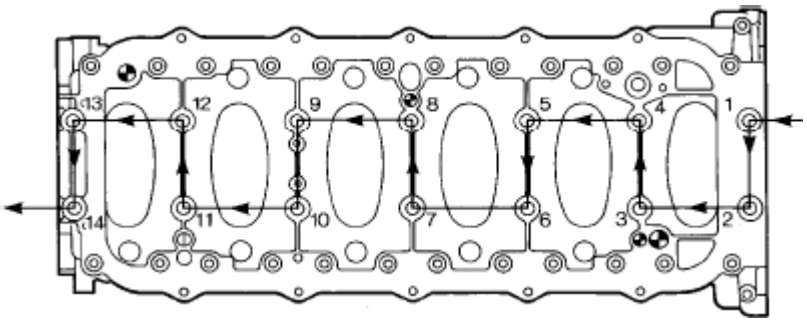
FRONT SIDE




44897

First phase:
preliminary tightening
of outer screws
(25 Nm)

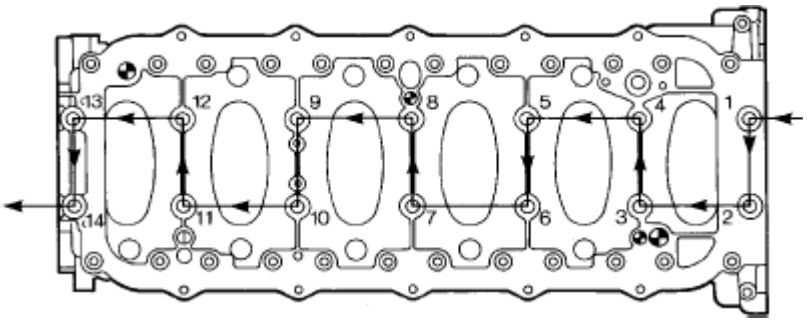
FRONT SIDE




44898

Second phase:
preliminary
tightening of
inner screws
(140 Nm)

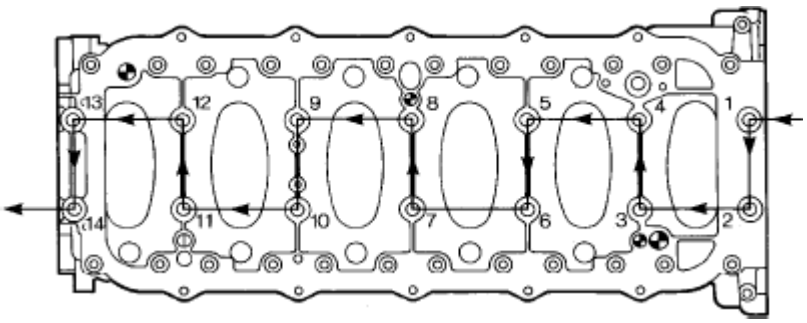
FRONT SIDE




44898

Third phase:
angle tightening
of inner screws
60º

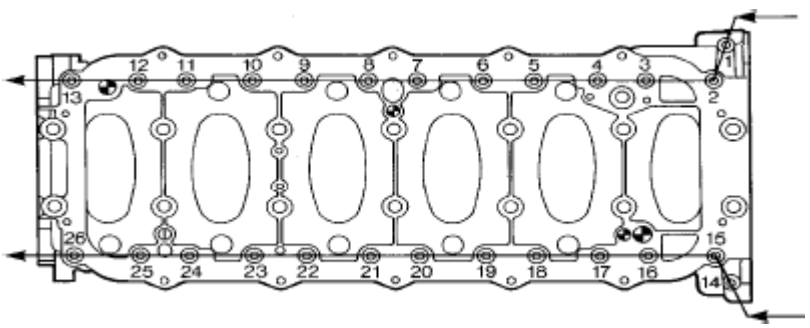
FRONT SIDE




44898

Front phase:
angle tightening
of inner screws
60º

FRONT SIDE




44899

Fifth phase:
angle tightening
of outer screws
90º

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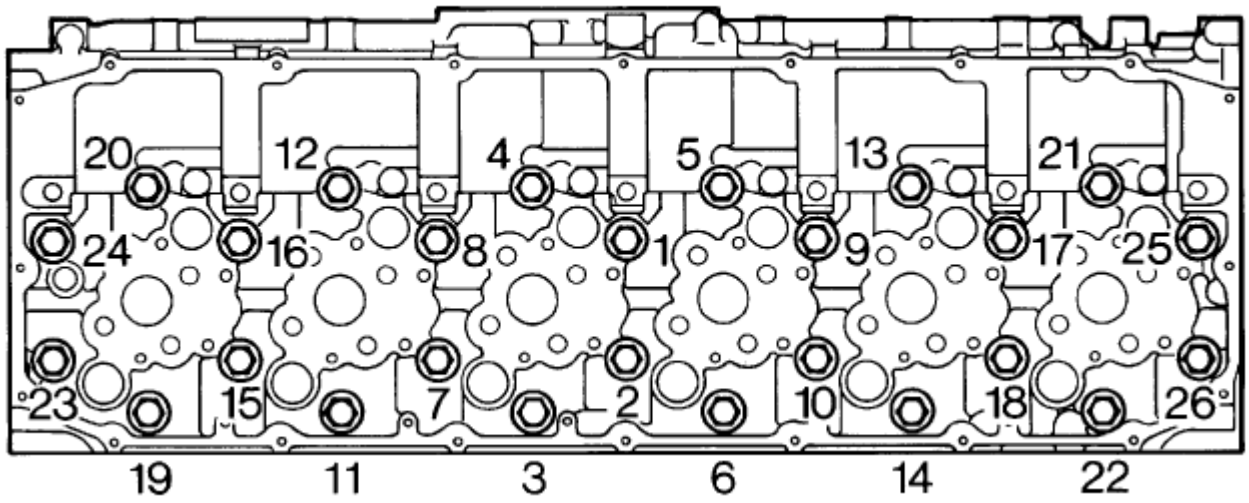



**DIAGRAM OF CYLINDER HEAD FIXING SCREWS TIGHTENING SEQUENCE**

Figure 7

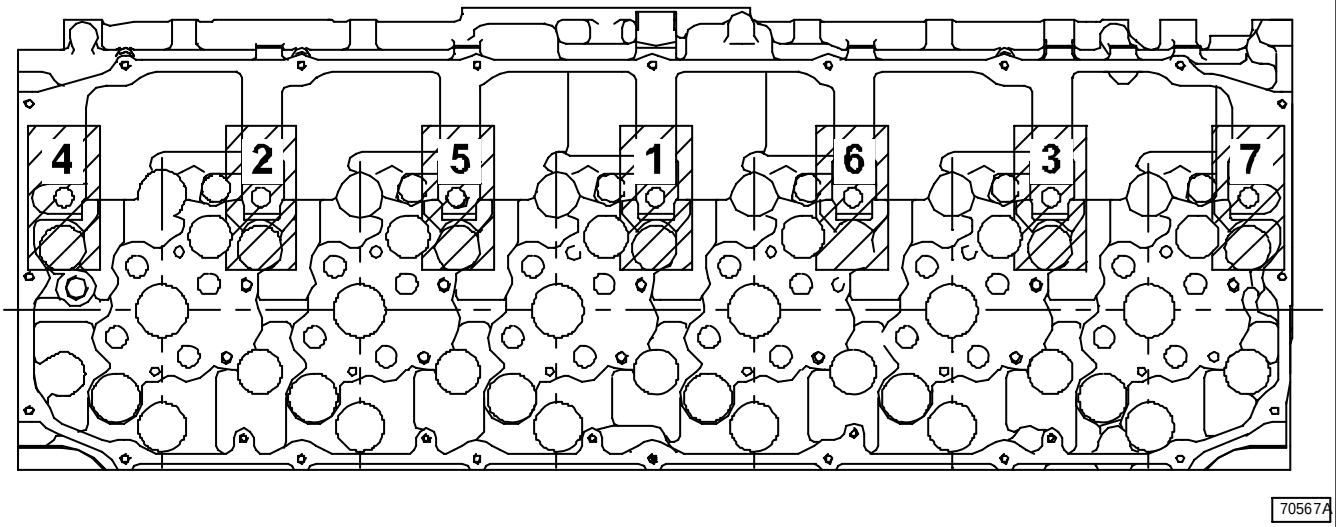



**DIAGRAM OF ROCKER SHAFT FIXING SCREWS TIGHTENING SEQUENCE**

Figure 8

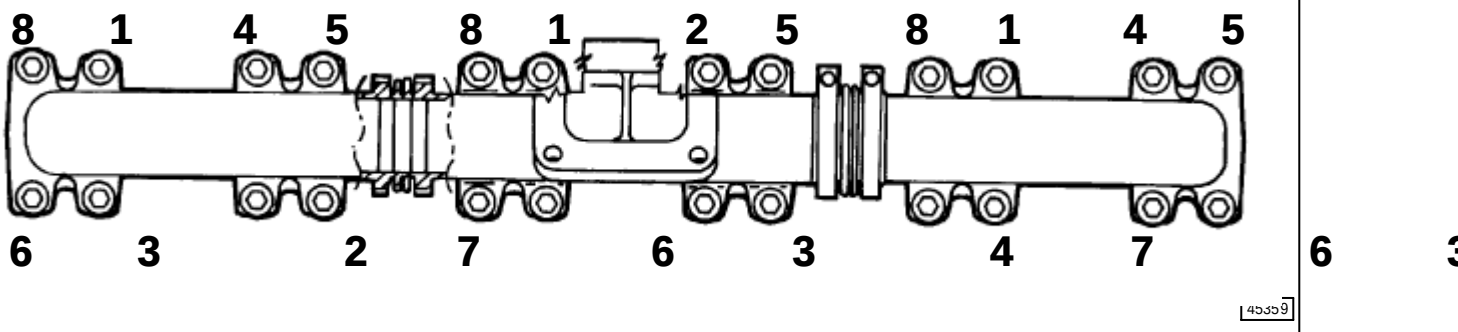



**DIAGRAM OF EXHAUST MANIFOLD FIXING SCREWS TIGHTENING SEQUENCE**

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Figure 9

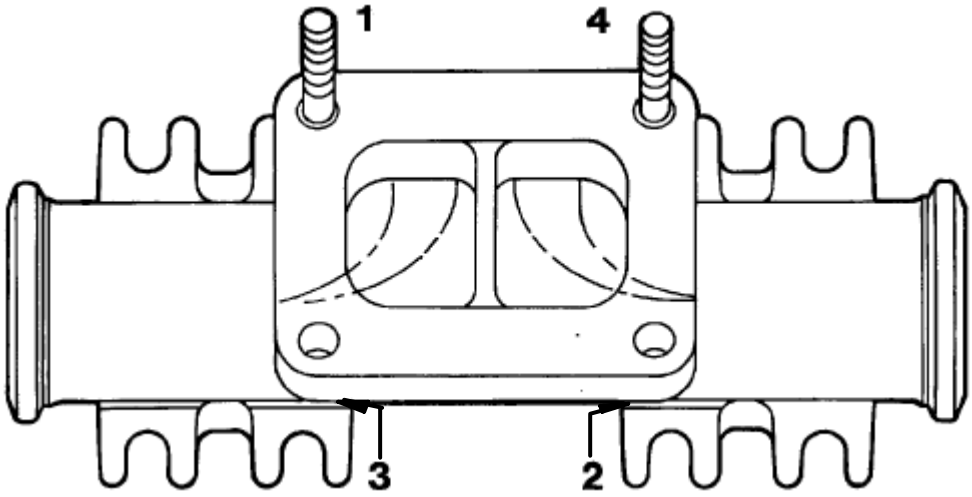



**DIAGRAM OF TURBOCHARGER FIXING SCREWS AND NUTS TIGHTENING SEQUENCE**

SEQUENCE: Preliminary tightening 4 - 3 - 1 - 2
Tightening 1 - 4 - 2 - 3

Figure 10

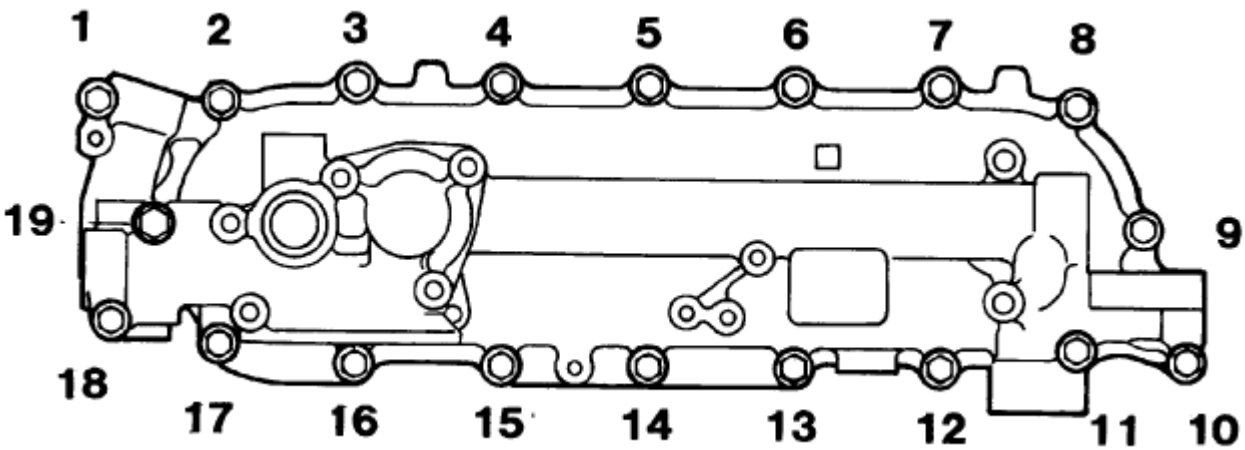



**DIAGRAM OF HEAT EXCHANGER FIXING SCREWS TIGHTENING SEQUENCE**

Figure 11

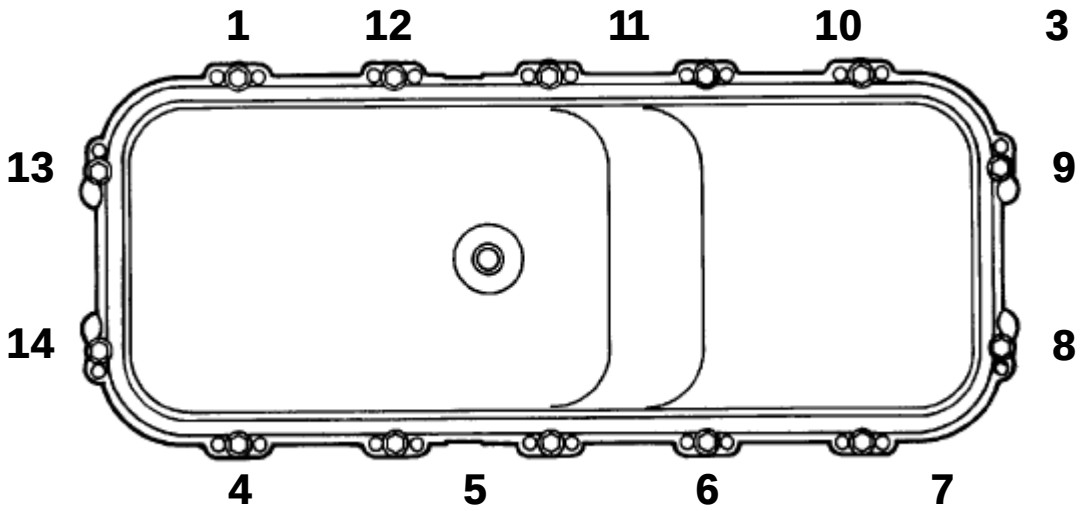



**DIAGRAM OF OIL SUMP FIXING SCREWS TIGHTENING SEQUENCE**

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Figure 12

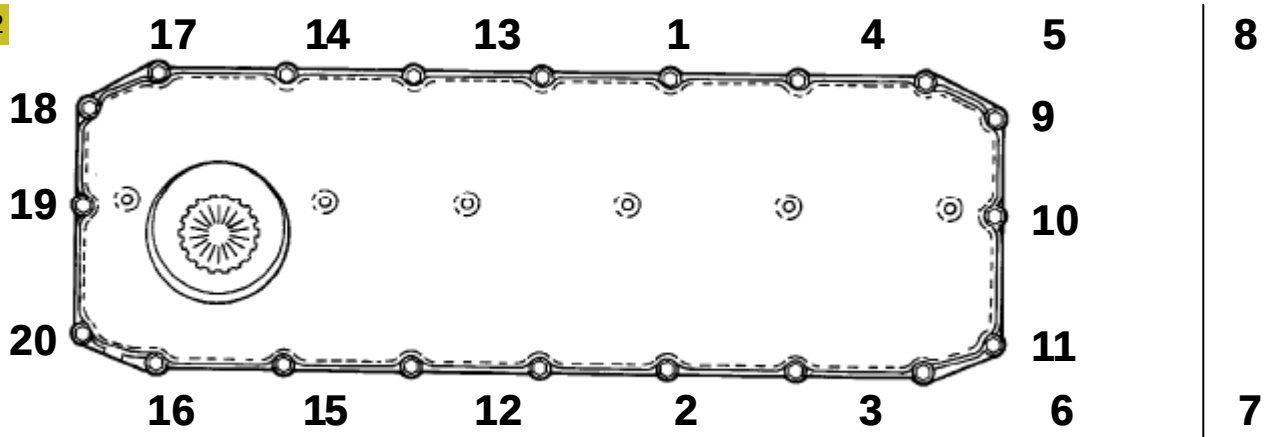
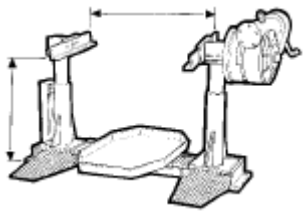
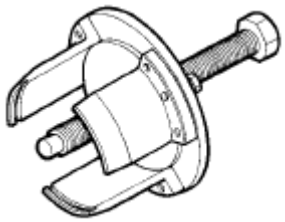
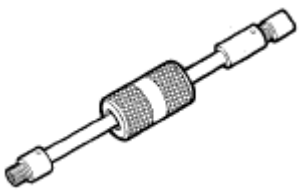
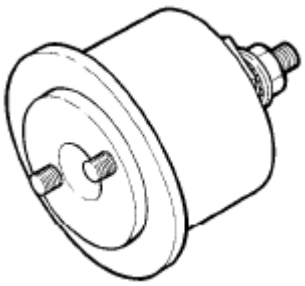



**DIAGRAM OF ROCKER COVER FIXING SCREWS TIGHTENING SEQUENCE**

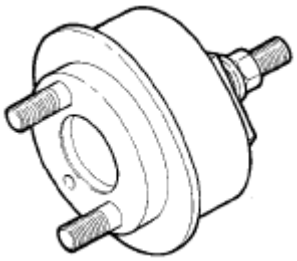
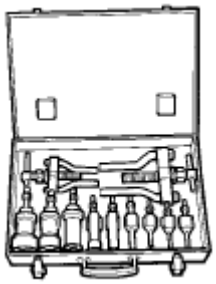
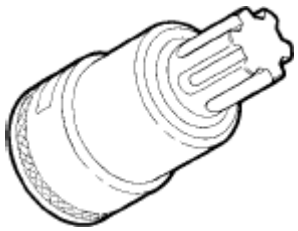
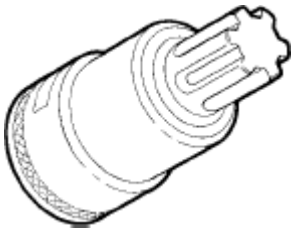
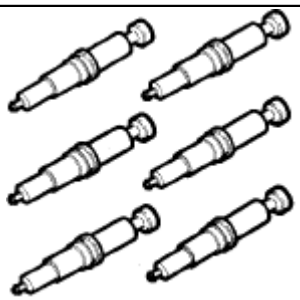
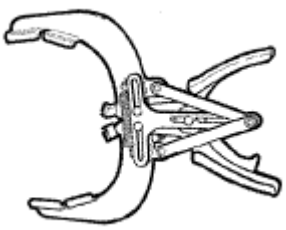
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## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99322230** |  | Rotary telescopic stand |
| **99340051** |  | Extractor for crankshaft front gasket |
| **99340052** |  | Extractor for crankshaft rear gasket |
| **99340205** |  | Puller with sliide-hammer |
| **99342149** |  | Extractor for injector-holder |
| **99346245** |  | Tool to install the crankshaft front gasket |

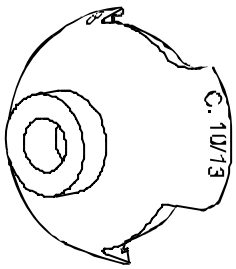
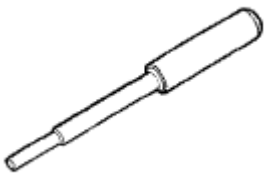
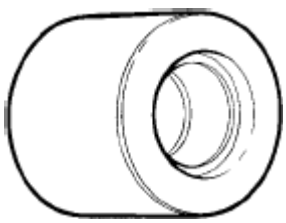
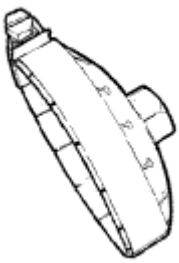
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## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99346246** |  | Tool to install the crankshaft rear gasket |
| **99348004** |  | Universal extractor for 5 to 70 mm internal components |
| **99350072** |  | Box wrench for transmission gear support fixing screws |
| **99350074** |  | Box wrench for block junction bolts to the lower crankcase |
| **99360177** |  | Injector housing plug |
| **99360184** |  | Tool for removing and refitting piston rings (105-160 mm) |

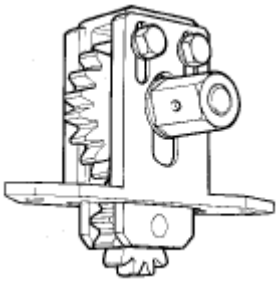
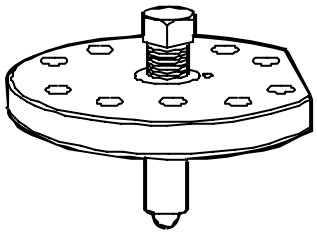
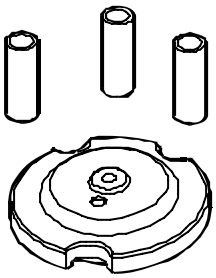
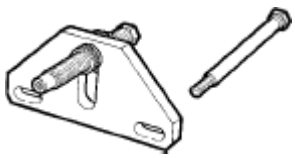
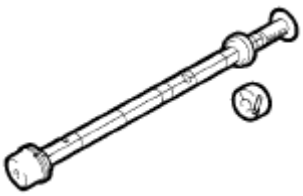
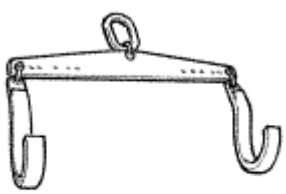
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## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99360192** |  | Elastic belt assembling tool |
| **99360264** |  | Tool to take down-fit engine valves |
| **99360288** |  | Tool to remove valve guide |
| **99360292** |  | Tool to install gasket on valve guide |
| **99360294** |  | Tool to drive valve guide<br>(use with 99360288) |
| **99360314** |  | Tool to remove cartridge filters |

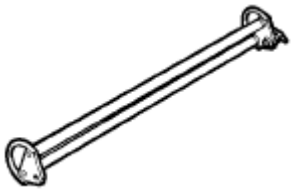
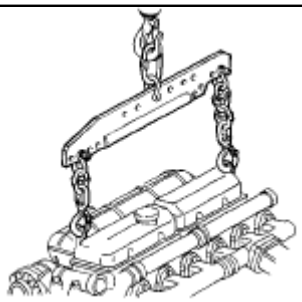
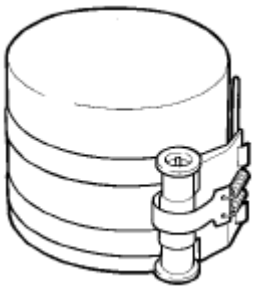
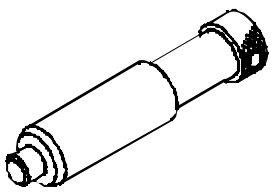
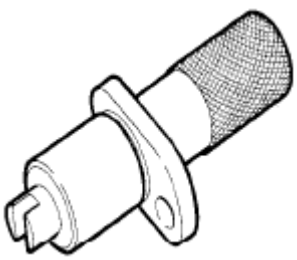
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Aquila Trucks Centres

## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99360321** |  | Tool to rotate engine flywheel |
| **99360334** |  | Tool for checking cylinder liners protrusion |
| **99360335** |  | Cylinder liners compression cap (to be used with 99360334) |
| **99360351** |  | Tool to stop engine flywheel |
| **99360487** |  | Tool to take down and fit camshaft bushes |
| **99360500** |  | Tool to lift crankshaft |

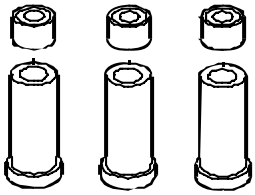
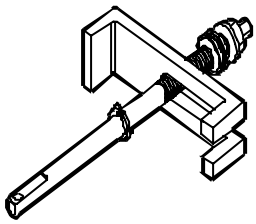
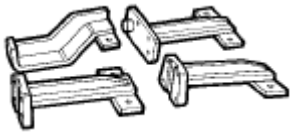
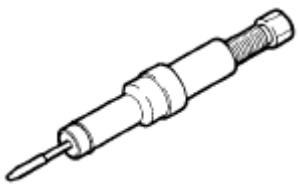
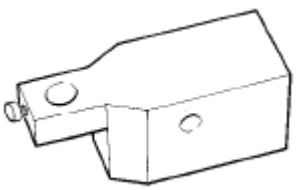
Aquila Trucks Centres

## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99360551** |  | Bracket to take down and fit engine flywheel |
| **99360558** |  | Tool to lift and transport rocker shaft |
| **99360585** |  | Tool for lifting and handling engine |
| **99360605** |  | Belt to insert piston in cylinder liner (60 - 125 mm) |
| **99360612** |  | Tool for positioning engine T.D.C. |
| **99360613** |  | Tool for timing of phonic wheel on timing gear |

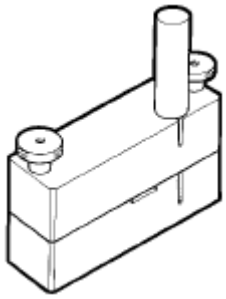
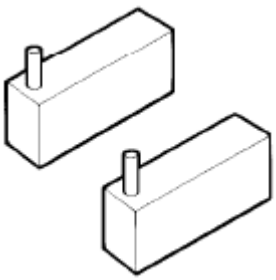
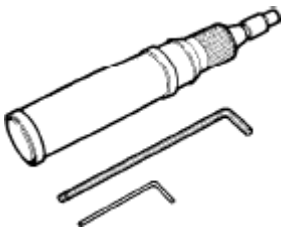
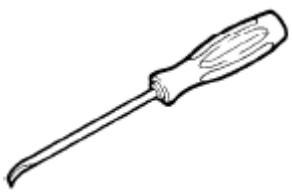
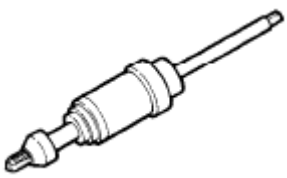
Aquila Trucks Centres

## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99360703** |  | Tool to stop cylinder liners |
| **99360706** |  | Tool to extract cylinder liners |
| **99360724** |  | Ring (115 mm) (use with 99360706) |
| **99361035** |  | Brackets fixing the engine to rotary stand 99322230 |
| **99365054** |  | Tool for injector holder heading |
| **99370415** |  | Tool to detect cylinder liner protrusion (use with 99395603) |

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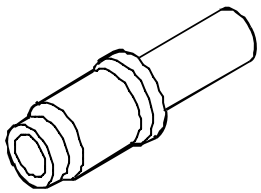
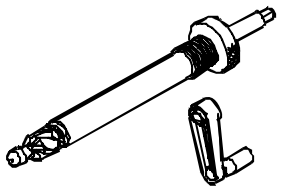
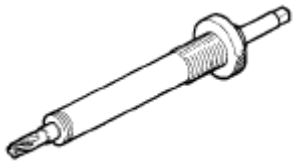
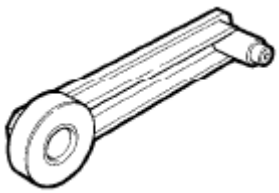
## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99378100** |  | Tool for printing engine identification plates (to be used with special punches) |
| **99378130** |  | Punches for printing engine identification plates (consisting of: 99378101 (A) - 99378102 (B) - 99378103 (C) - 99378104 (D) - 99378105 (E) - 99378106 (F) - 99378107 (G) - 99378108 (V)) |
| **99389834** |  | Torque screwdriver to calibrate screws for injector solenoid valve |
| **99390310** |  | Valve guide sleeker |
| **99390772** |  | Tool to remove residues from injector holder |
| **99390804** |  | Tool to thread injector holders to be extracted |

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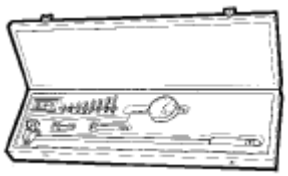

Aquila Trucks Centres

## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99394014** |  | Guide bush (to be used with 99394041 or 99394043) |
| **99394041** |  | Cutter to rectify injector holder housing (to be used with 99394014) |
| **99394043** |  | Reamer to rectify injector holder lower side (to be used with 99394014) |
| **99395215** |  | Gauge for centre distance check between camshaft and idle gear |
| **99395216** |  | Measuring pair for angular tightening with 1/2" and 3/4" square couplings |
| **99395603** |  | Dial gauge (0 - 5 mm) |

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## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99395687** |  | Reaming gauge (50-178 mm) |
| **99396033** |  | Centering ring of crankshaft front cap |

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## 540110 ENGINE REMOVAL - REFITTING

### Removal

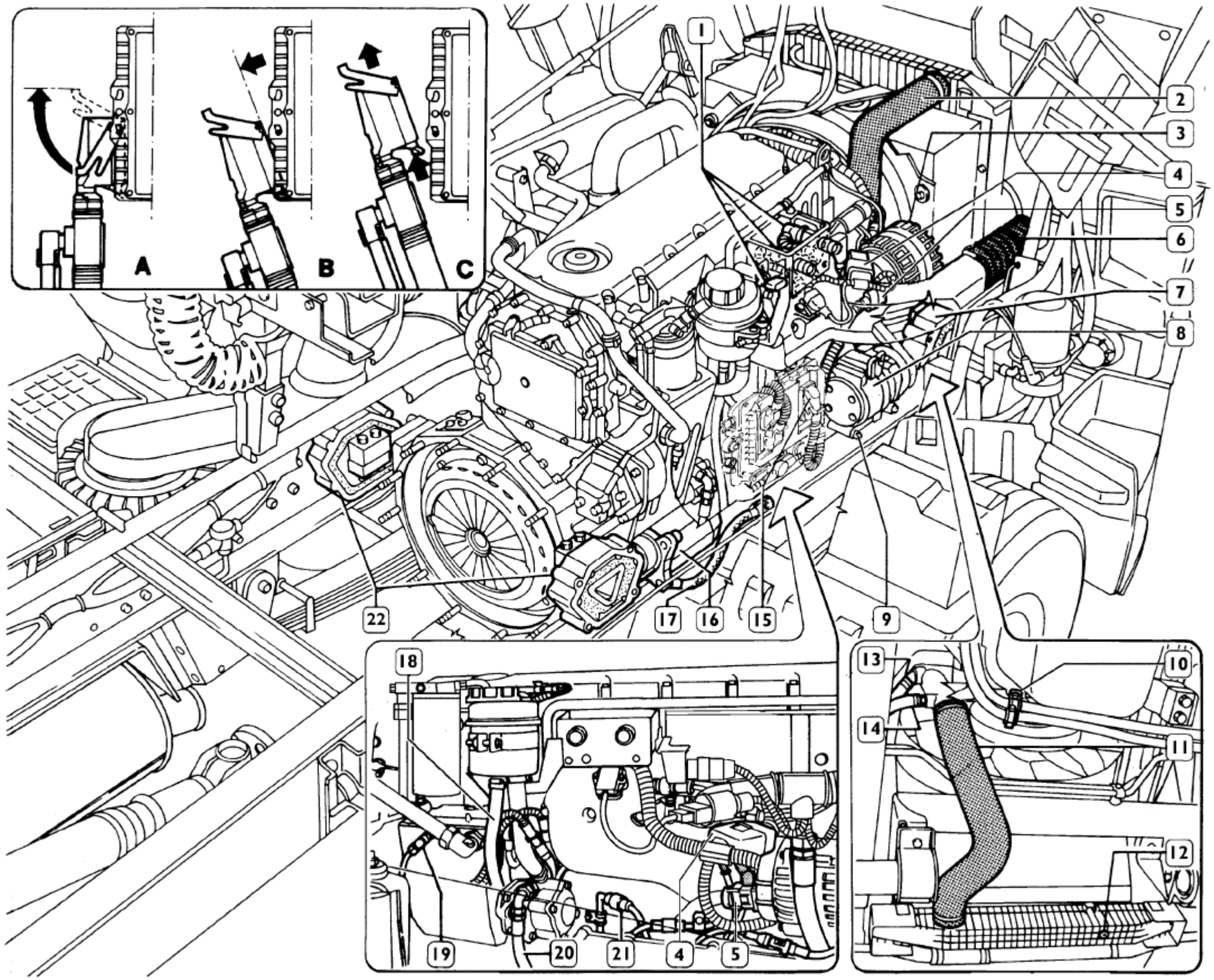
**NOTE** If washing the engine bay, adequately protect the electric/electronic components and their connections.

Deactivate the batteries by disconnecting the electric wires or opening the current main switch, lift the cowling and tilt cab.
Disconnect the transmission, as described in section 4.

Operations to be carried out in the lower side:

- drain the coolant in a proper container, by removing the radiator drain plug (12);
- remove the piping (11) between the radiator and the water pump;
- drain power steering oil in a proper container, by disconnecting delivery and return lines (20 and 18);
- disconnect pipings (13 and 14) from the water pump fitting;
- disconnect connector (15) from the electronic control unit as follows:
  **A**, lift the safety lever
  **B**, shift the connector by disconnecting it from the control
  unit
  **C**, lift the connector by releasing the pawl;
- Disconnect electric connections (1 - 4 - 5) from the engine, then release the cable from the straps used for fastening to the intake manifold;
- disconnect the electrical cables from the starter motor (16) and the ground cable (17);
- disconnect pipe (19) from air compressor;
- disconnect the sleeve (6) connecting aftercooler radiator-intake manifold;
- remove water pipe (2) between radiator and thermostat assembly;
- disconnect fuel delivery and return pipings (21);
- if present, remove the pipe support bracket (10) fastening screws to the engine block;
- rremove screws (9) (where available), then remove air-conditioning compressor (8) from its support;
- without disconnecting the compressor pipes and to prevent draining the climate control system, fasten the compressor to the vehicle so that it does not interfere with the engine removal.

Figure 13




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- disconnect water pipings (7 and 8) from thermostat unit (9) (see Detail A);
- if present, remove the pipe fastening screw (1) to the conveyor (3);
- if present, remove the screws and (12) detach the heat guard (11);
- remove the screws (4) and disconnect the pipe (3) from the support bracket (5);
- disconnect the air pipe (6); connection – drier compressor (A.P.U.);
- disconnect sleeve (2) connecting outlet piping (3) between the turbocharger and the aftercooler radiator;
- disconnect the sleeve (13) connecting air filter pipings and turbocharger manifold;
- disconnect exhaust piping (14);
- if the vehicle is fitted with mechanical transmission, remove the support (18) together with the engine gear control lever (19);
- only vehicles with short cab: remove sound-proof guard (16), bolts (15), and then take off cab suspension crossbar (17);

Use a lifting device and spinter bar 99360595 (hooked to the engine brackets) to stretch the chains. Loosen the screws fastening the engine brackets to elastic supports (10 – 7 and 22, Figure 252) on the chassis.

- Slowly raise the engine from its compartment by taking it backwards so that the fan is released from the air conveyor compartment (20) on the radiator.
- Operate the screws to remove the fan from the hub. Remove the engine completely without interfering with the remaining fixed parts on the chassis, in particular the wiring interfering with the rear right engine support.

## Refitting

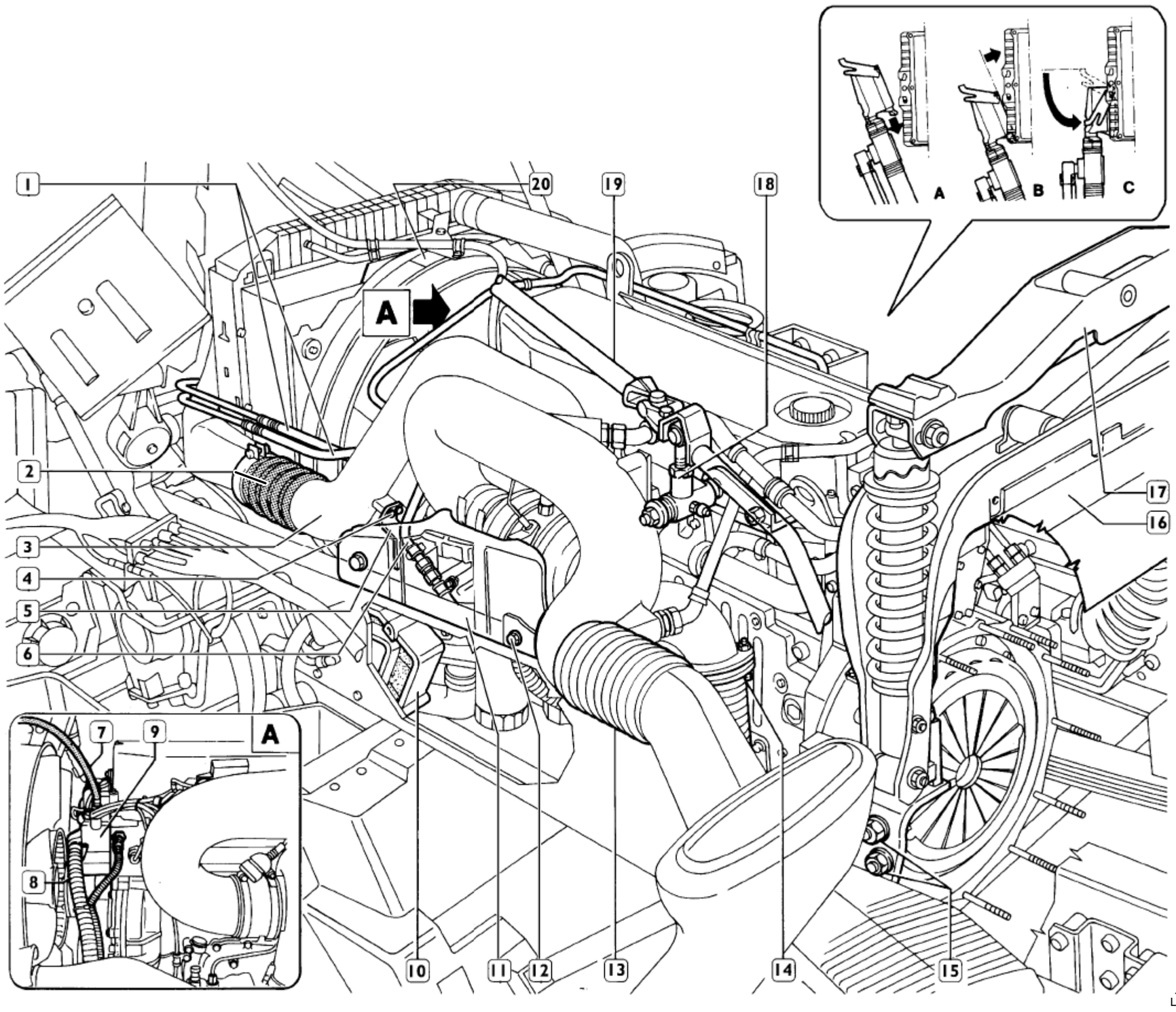
Reverse the order of detachment operations, taking great care when fitting the assembly into the engine compartment and following the advice below:

- check that the exhaust piping is not worn or about to deteriorate; replace, if necessary;
- tighten the screws and/or nuts to the prescribed torque;

**NOTE** Tighten the nuts fastening the electric cables to the starting motor terminals, by applying the torque values below:
- nut M10 x 1.5 (terminal 30): 17.6 ÷ 24.5 Nm (1.8-2.5 Kgm);
- nut M5 x 0,8 (terminal 50): 2.6 ÷ 4.6 Nm (0.27-0.47 Kgm);

- fill the cooling system with suitable coolant, then blow air off the cooling system as described in the relevant chapter;
- blow air off the fuel system as described in the relevant chapter (operation 542011);

Figure 14



Aquila Trucks Centres

## Filling the cooling system

### Preliminary operations

For vehicles equipped with just the standard cab heating system or manual air-conditioning:

- Fully open the coolant cock on the instrument panel.

For vehicles equipped with the automatic air-conditioning system:

- Set the temperature control in the cab on the HI position.

For vehicles equipped with an additional heater:

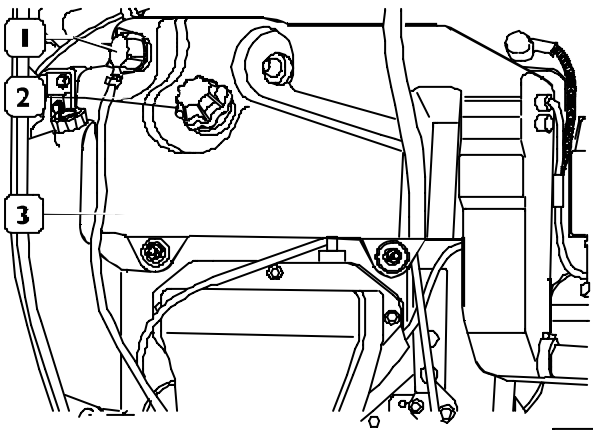
- The heater must not be turned on.

### Operations

Place a sheet of cardboard between the coolant radiator and the intercooler radiator in order to shorten the time it takes to reach the engine's working temperature (approx. 90°C).

### Filling the system

Figure 15




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**NOTE** GENERAL WARNINGS
Filling must be done with the engine cold.
The cap (1) must not be removed for any reasons whatsoever.
To prevent pockets of air forming in the system, the fluid has to be transferred slowly (approximate flow rate 8 litres/min).
For vehicles equipped with an additional heater: the percentage of glycols in the coolant must be no greater than 50%.

After conscientiously following the above warnings, proceed as follows:

- Remove the cap (2) from the expansion tub (3).
- Pour the coolant into the expansion tub (3) till it is quite full.

### Bleeding air from the system

**NOTE** For vehicles equipped with an additional heater:
- Turn on the heater.

- Start the engine and keep the speed just above idling for 5 min.

**NOTE** If the tub empties completely during these first few minutes, stop and engine and top it up at a slower rate than before.
Restart the engine.

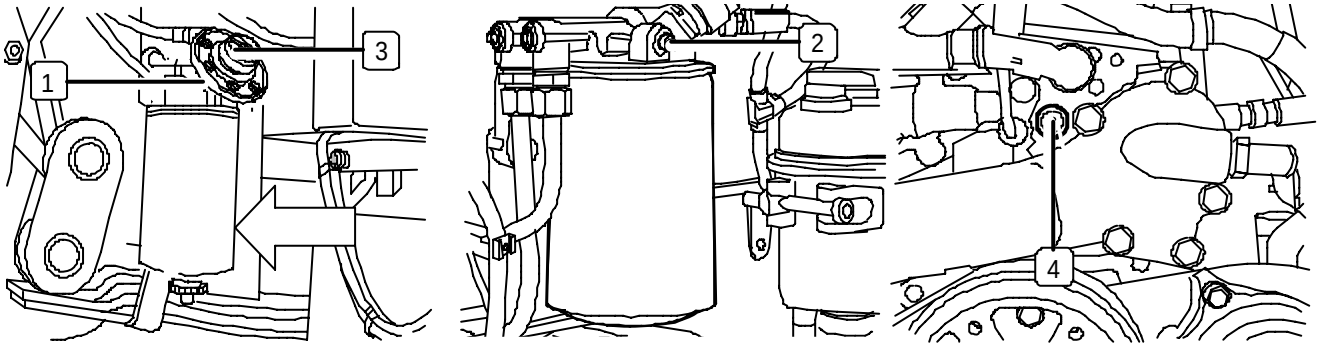
- After 5 min. running, top up the level of fluid in the expansion tub, if necessary.
- Close the expansion tub filler with the cap (2).
Take the engine up to top speed so that the coolant quickly reaches the temperature of full thermostat opening (approx. 90°C) and keep it in this state until all the air is bled out of the system.
This is checked by seeing there is no foam or air bubbles in the tub.
The longest time it takes to bleed the air from the system completely is approximately 15 minutes from the moment when the thermostat opens (opening starts 85°±2° C).

**NOTE** Do not take the filler cap off the expansion tub until the fluid in the system has cooled completely.
Any topping up must only be done with the engine cold.
This is to avoid:
1 - Operator burns.
2 - Damage to the engine since cooling system pressurization is only created with the fluid heating from the condition of the engine cold.

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## 542011 Bleeding air from the fuel system

Figure 16




**NOTE** Before bleeding the fuel system connect proper pipes to the bleeding screws located on prefilter support, filter and cylinder head front part, in order to recover fuel in suitable containers during this operation.
In particular, never allow that the fuel, coming out of the cylinder head draining screw, stains the control belts of the fan, the water pump, the alternator and the conditioner compressor, thus damaging them.

- Bleed screw (1) on the pre-filter mounting.
- Bleed screw (2) on the filter mounting.
- Bleed screw (4) on the front of the cylinder head.
- Work the pump (3) on the pre-filter mounting till fuel with no air bubbles in it comes out of the screw (1); close the screw.
- Repeat this step for screw (2).
- Repeat this step for screw (4).

### Checks and tests

Start the engine, leave it running at just a little faster than idling speed and wait for the temperature of the coolant to reach the level to open the thermostat. Then, check that:

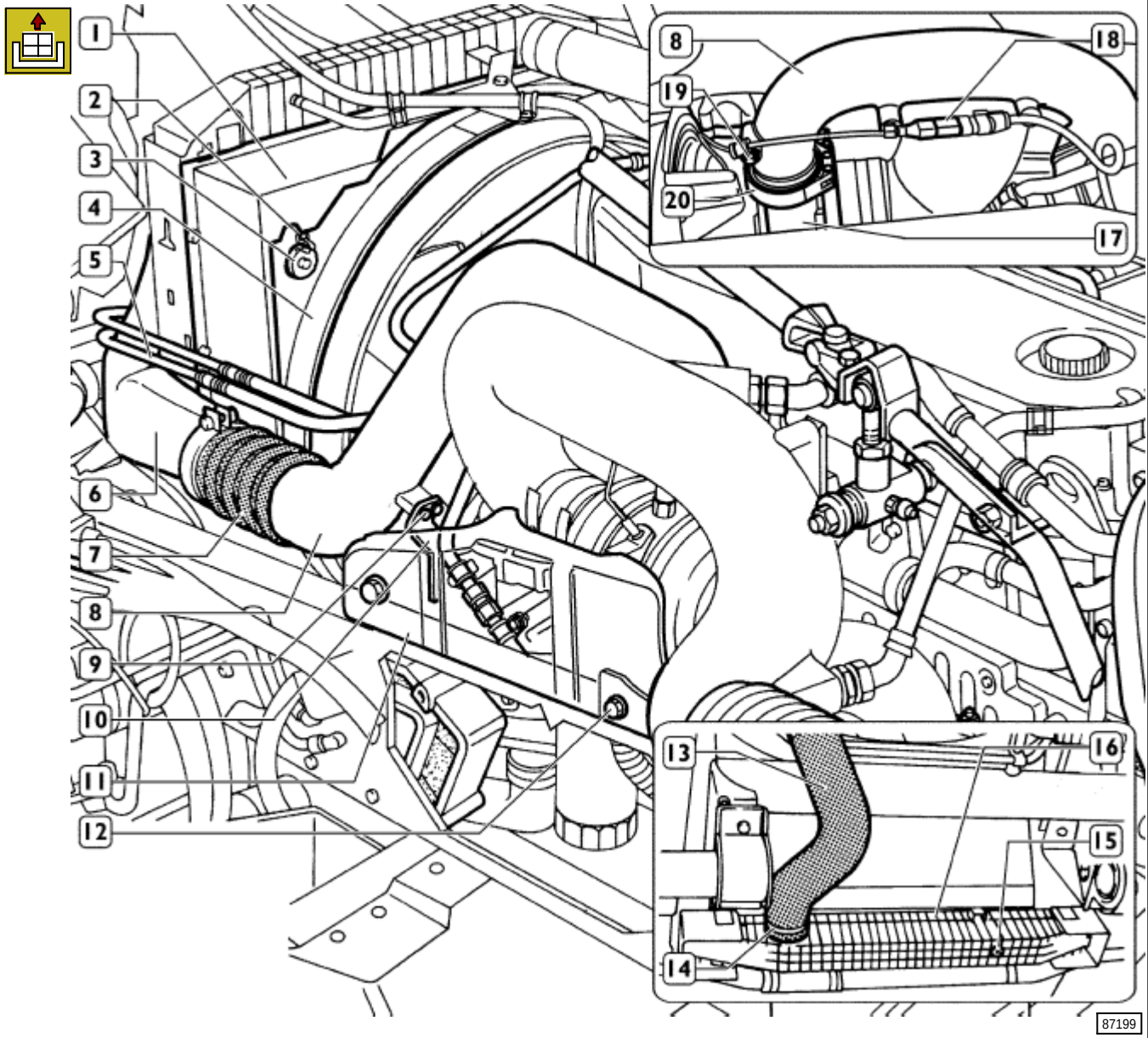
- No water leaks from the connecting sleeves of the pipes in the engine cooling and cab heating circuits, tightening the collars further if this is necessary.
- No oil leaks from between the cover and the cylinder head, between the oil sump and the crankcase, between the oil filter and its seat, between the heat exchanger and the crankcase, or between the various pipes in the lubrication circuit.
- No air leaks from the pipes connected to the pneumatic components involved in removal.
- The indicator lights on the instrument panel and the devices disconnected when removing the engine all work properly.

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## 543422 ELECTRO-MAGNETIC FAN DRIVE REPLACEMENT

### Removal

Figure 17




To cut off the batteries, remove the electric wires or open the main switch.

Remove the bumper fastening screws.
Move the bumper away from its respective supporting brackets, then place it, without subjecting the electric cables and the headlamp wiper pipe (if any) under tension, on a suitable stand so as to subsequently allow the cab to be tilted.

Lift the radiator grill, then tilt the cab.

Go under the vehicle and remove the plug (15) from the radiator (16) and drain the coolant fluid in the appropriate container.

Remove the clip (14) and disconnect the radiator (16) sleeve (13).

On the engine compartment left-hand side, remove the screws (12) and the heat guard (11). Take off the screws and disconnect the air conveyor (8) climate control pipes (5).

Slacken the sleeve fastening clamp (7) from the intercooler (6) radiator.

Remove the air conveyor (8) fastening screws (9) to the support bracket (10).

Remove the screw (19) and detach the electric wire (18) from the air conveyor (8).

Remove the clamp (20) and detach the air conveyor (8) together with the sleeve (7) from the turbocharger (17) and from the intercooler radiator (6).

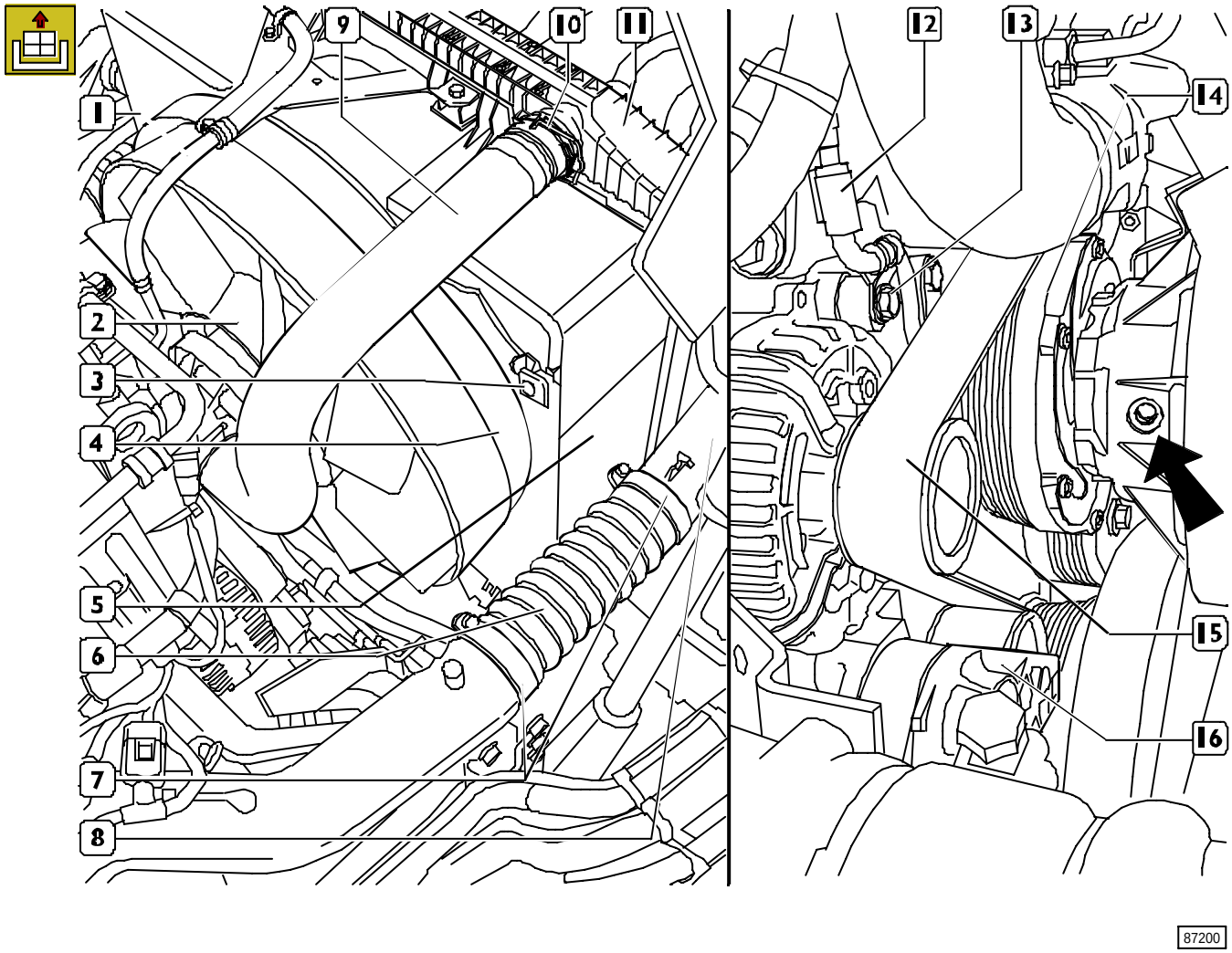
Drive in the suitable self-threading screw in the pin hole (3) taking care to partially take off and finally remove with a screwdriver the upper clip (2) fastening the fan air conveyor (4) to radiator guard (1).

Remove the lower clip in the same way.

Remove the two radiator support fastening screws to the chassis.

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Figure 18




On the right-hand side

Disconnect the pipe (1) from the thermostat.

Remove clip (10), then disconnect sleeve (9) from radiator (11).

Slacken the clamps (7) and remove the sleeve (6)

Remove the upper and lower clip (3) as described for the left-hand side.

Remove the radiator fastening screws to the chassis and move the radiator unit forwards.

Remove the fan (2) fastening screws to the electro-magnetic joint (14).

Remove the fan (2) together with the air conveyor (4).

Release, by acting on automatic stretcher (16), belt (15) tension, then remove the belt from the pulleys.

Disconnect the electric connection (12) of the electro-magnetic joint (14).

Remove the screws (13) and the electro-magnetic joint (14) from the engine.

## Refitting

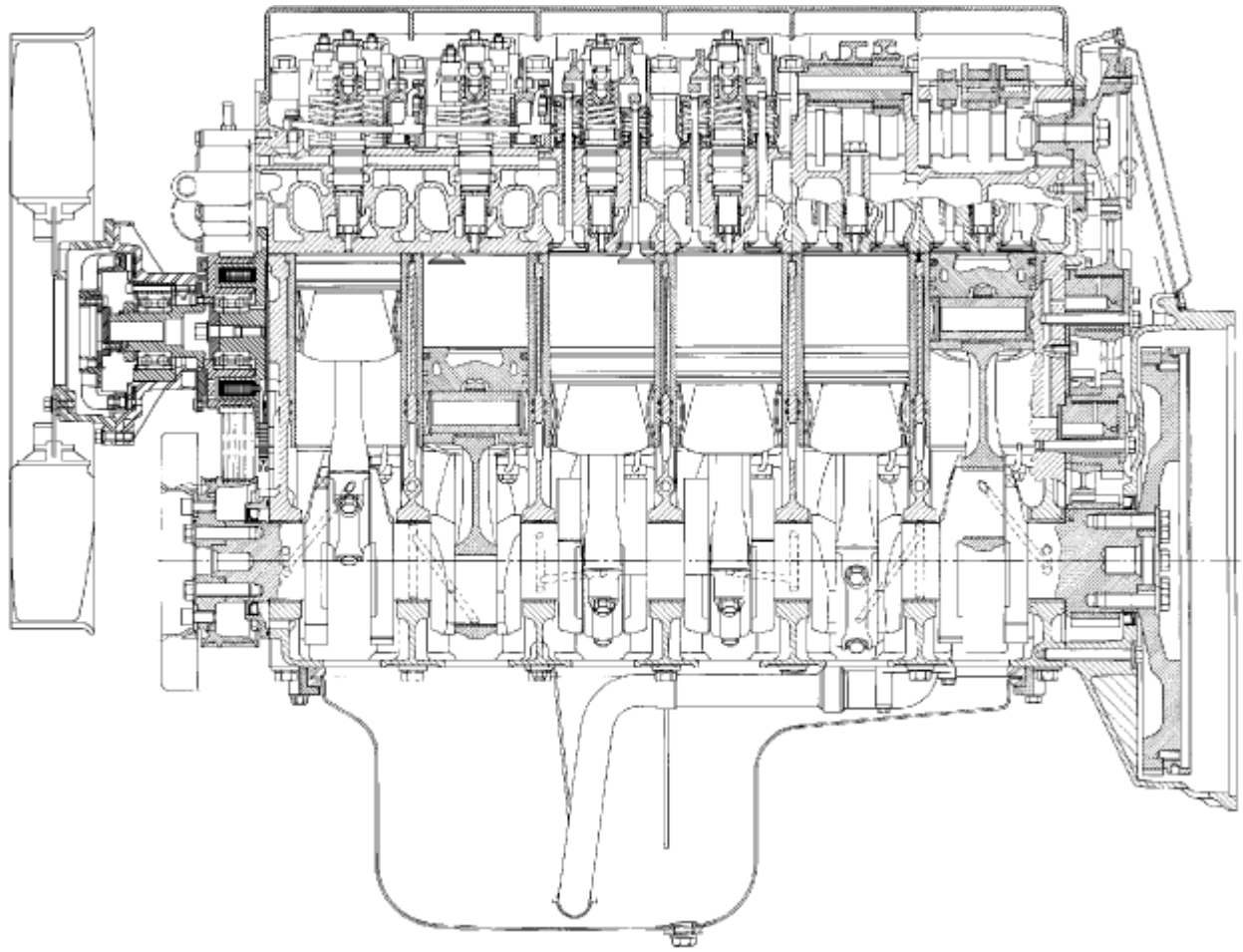
To refit the electro-magnetic fan drive, reverse the removal procedure and attain to the following rules:

- check the control belt (15) conditions; replace it if damaged or worn out;
- tighten the screws and/or nuts to the prescribed torque;
- fill the cooling system with the prescribed fluid, then blow air off the cooling system as described in the respective chapter;

**NOTE** The electro-magnetic joint is fitted with two threaded holes (→) at 180° one from the other. In the event of fault, lock the joint control driving in a M8x16 mm screw in these holes. In this way it is possible to take the vehicle to the closest dealership.

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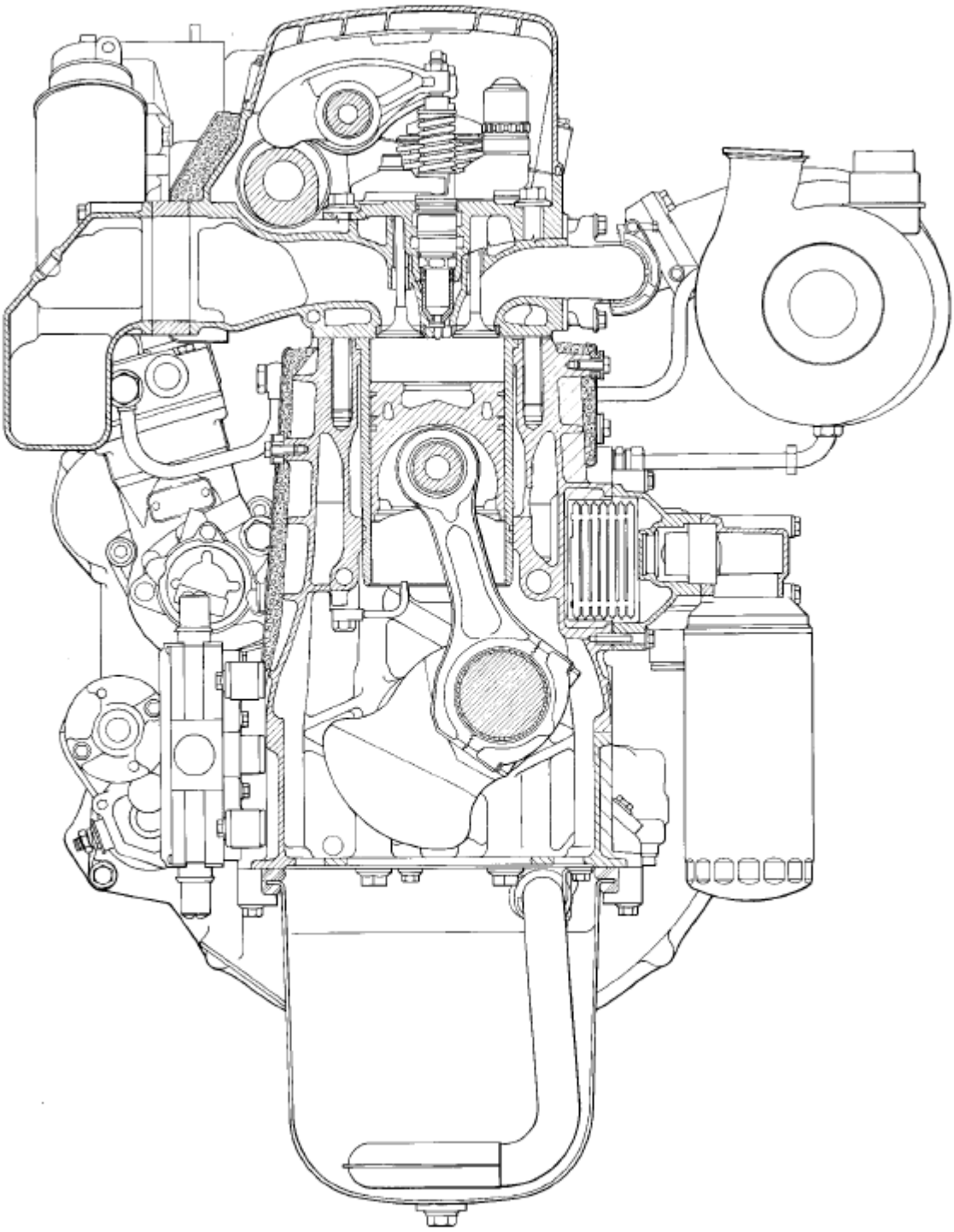
Figure 19




ENGINE - LONGITUDINAL SECTION

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Figure 20



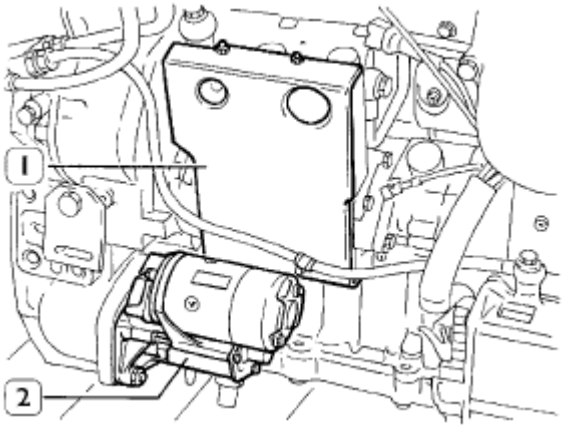
78841

ENGINE - CROSS SECTION

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## 540110 DISASSEMBLING THE ENGINE

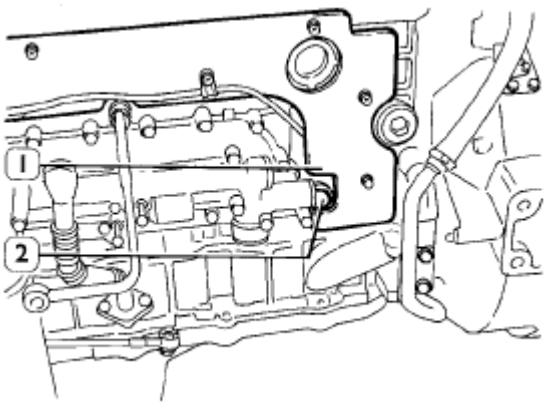
Figure 21




47562

Before dismantling the engine on the rotary stand 99322230, remove the following components:
- starter (2)
- turbocharger soundproofing shield (1)

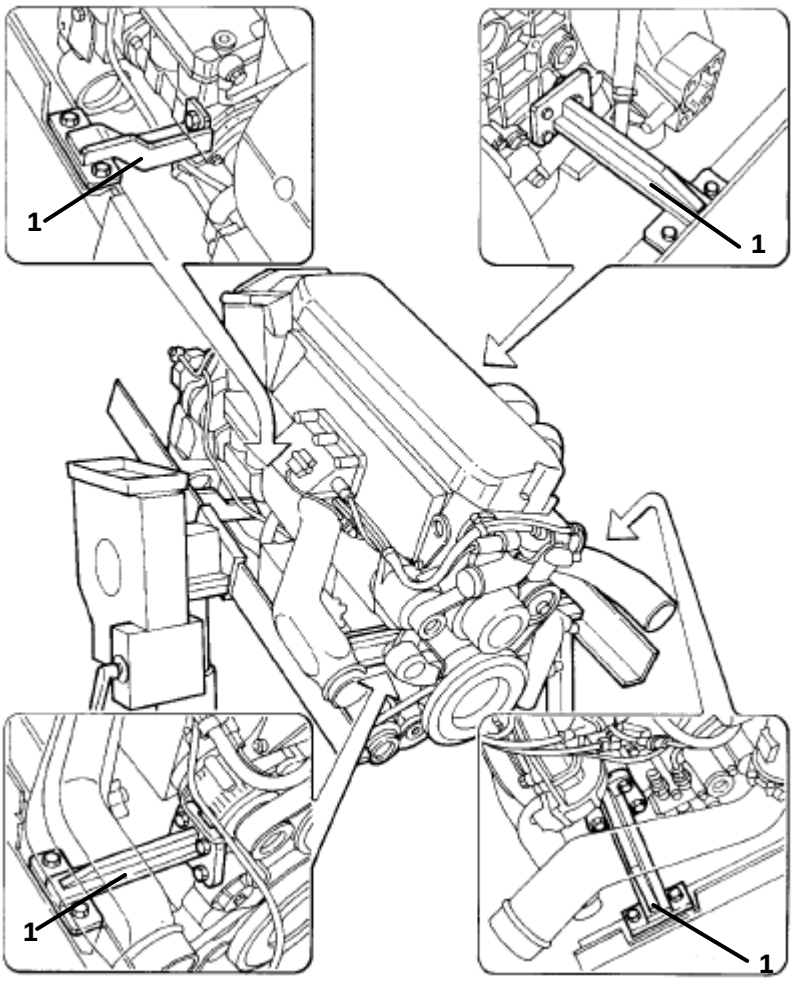
Figure 22




47563

Remove the soundproofing shield (1) and plug (2)

Figure 23

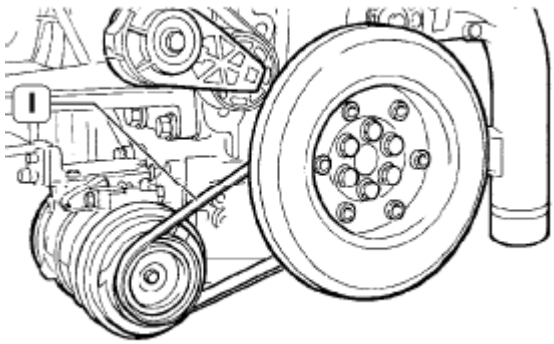



47601

Fix the engine to the rotary stand 99322230, by means of brackets 99361035 (1), remove the fan.

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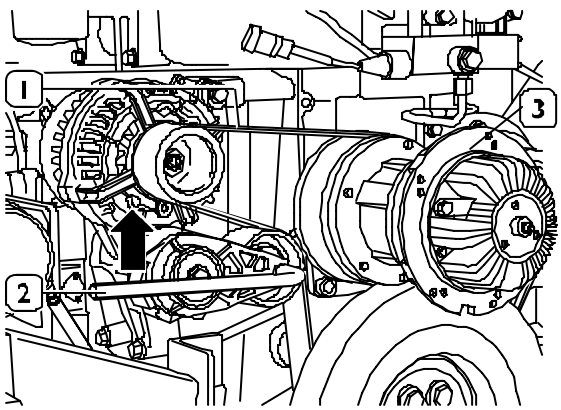
Figure 24




112330

Cut the belt (1), as it must not be used again.

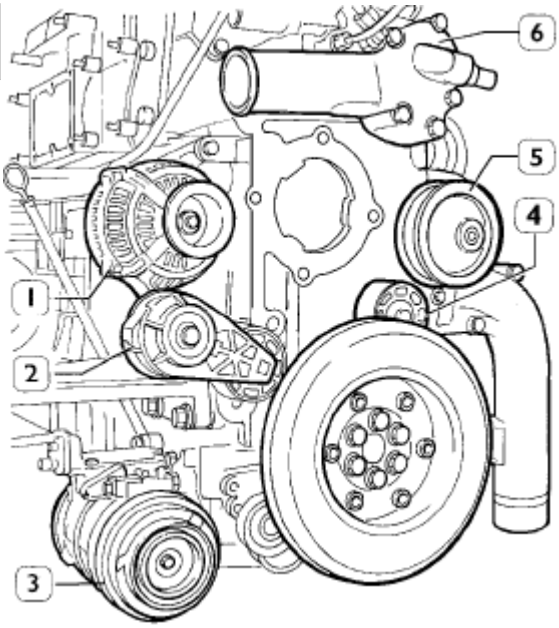
Figure 25




73579

Using an appropriate tool (2), operate in the direction of the arrow, and remove the belt (1) driving the water pump, alternator and fan.
Take out the screws and remove the electromagnetic coupling (3).

Figure 26




87202

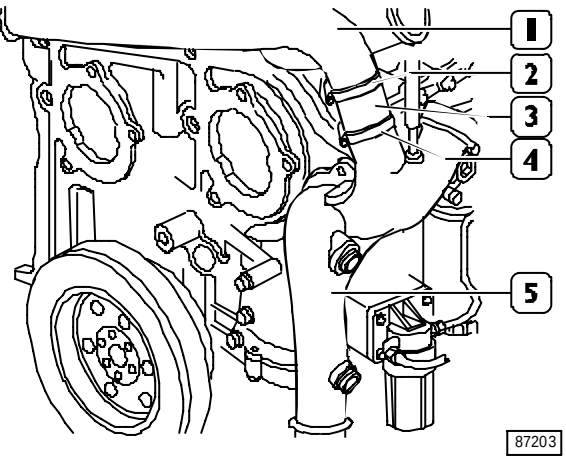
Remove the following components:

- alternator (1);
- belt tightener support (2);
- if present, air conditioner compressor (3);
- water pump (5) and pipe;
- fixed backstand (4).

Only models equipped without Intarder

- thermostat unit (6).

Figure 27

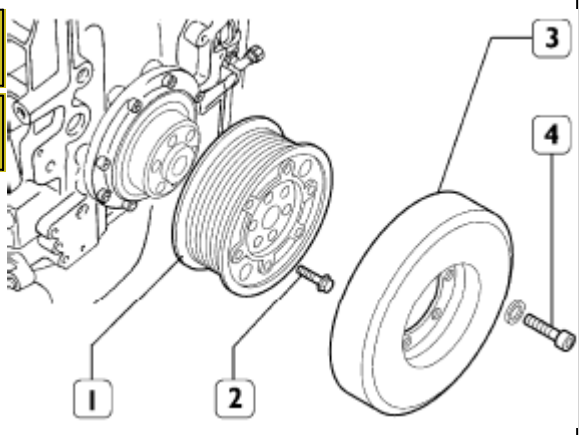



87203

Only models equipped with Intarder
Loosen straps (2 and 4), then remove pipe (1) from the cylinder head and pipe (3).
Remove the fastening screws, then take off thermostat unit (5).

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Figure 28



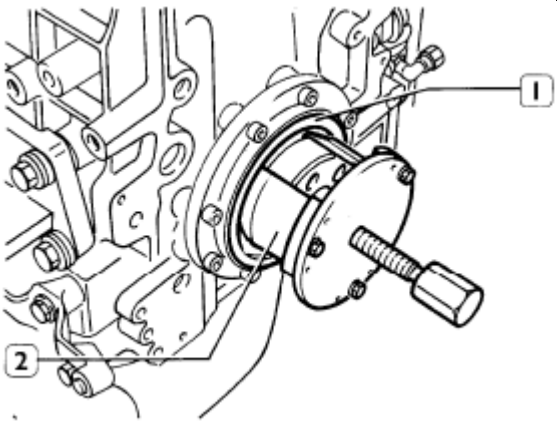

87204

Block the flywheel rotation with tool 99360351.

Remove screws (4), then disassemble damper (3).

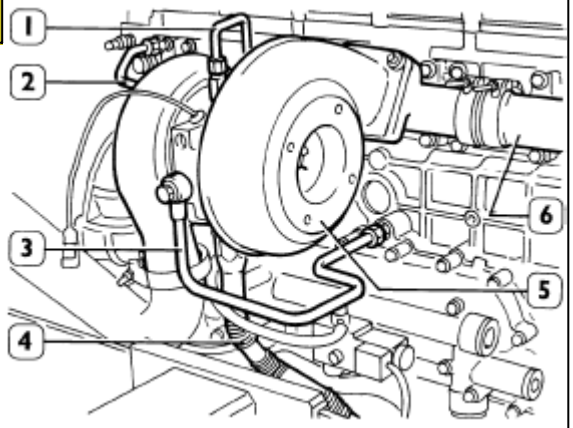
Remove the screws (2) and the pulley (1).

Figure 29




Install extractor 99340051 (2) and remove the seal gaskets (1). Unscrew the screws and remove the cover. Disconnect all electric connections and sensors.

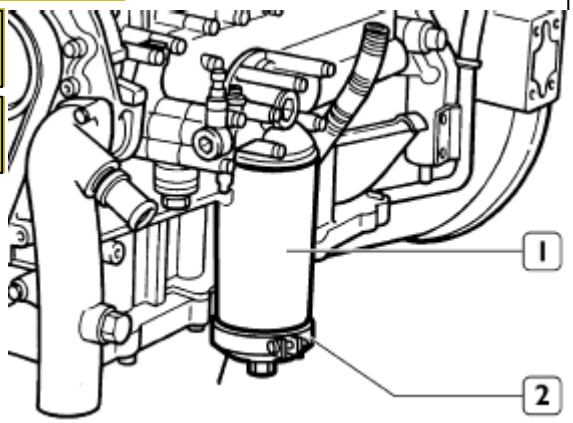
Figure 30




47566

Remove the following components: oil supply lines (1); water cooling supply lines (3); water discharge lines (2); oil return lines (4); turbocharger (5); exhaust manifold (6).

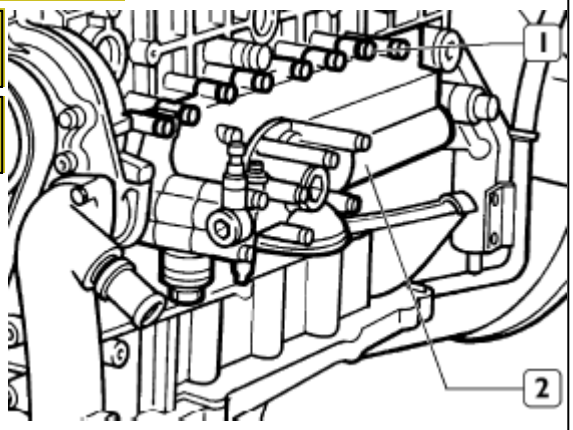
Figure 31




87205

Unscrew the oil filter (1) by tool 99360314 (2).

Figure 32

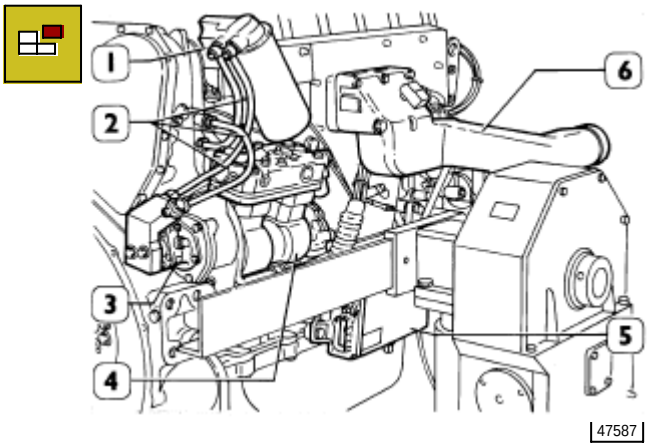



87206

Unscrew the screws (1) and remove the entire heat exchanger (2).

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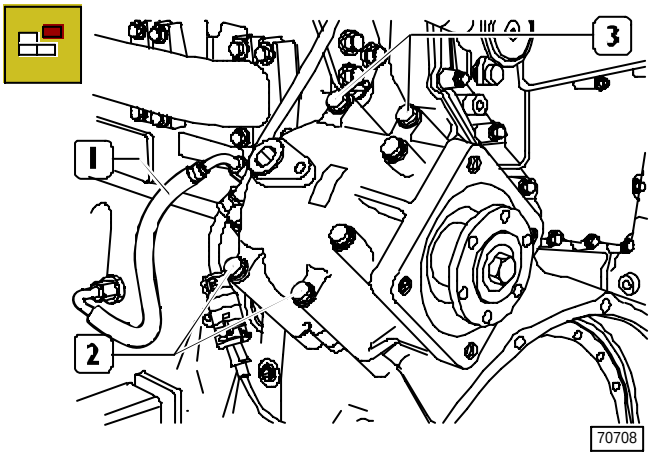
Figure 33




47587

Remove the following components: inlet manifold (6); support for fuel filter (1); fuel lines (2); fuel pump (3);compressor (4); control unit (5).

Figure 34

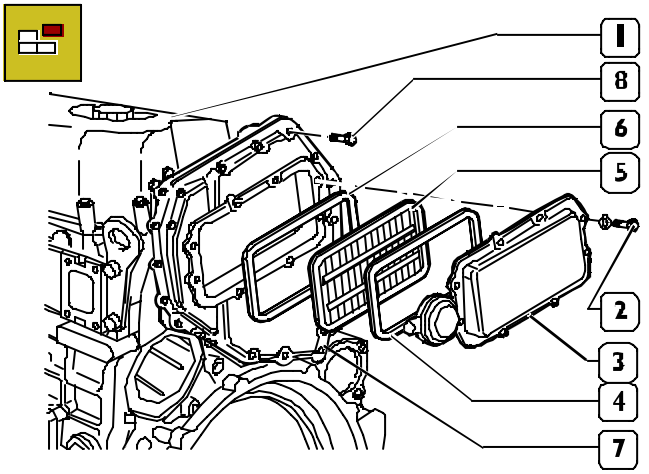



70708

To remove the P.T.O. (if applicable):

- Disconnect the oil pipe (1).
- Unscrew the 4 screws (2) and (3).

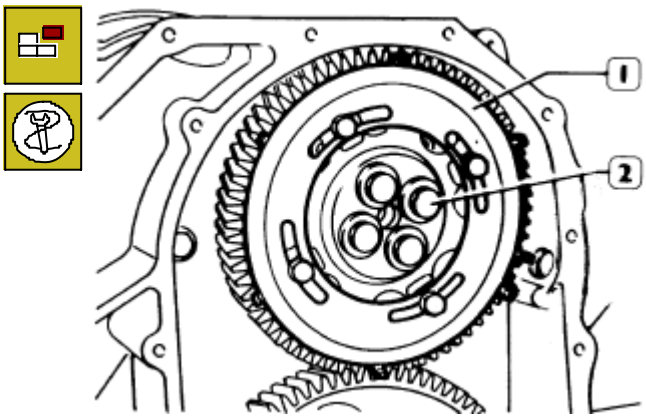
Figure 35




84377

Remove the rocker arm cover (1), take off the screws (2) and remove: the cover (3), the filter (5) and the gaskets (4 and 6). Take off the screws (8) and remove the blow-by case (7).

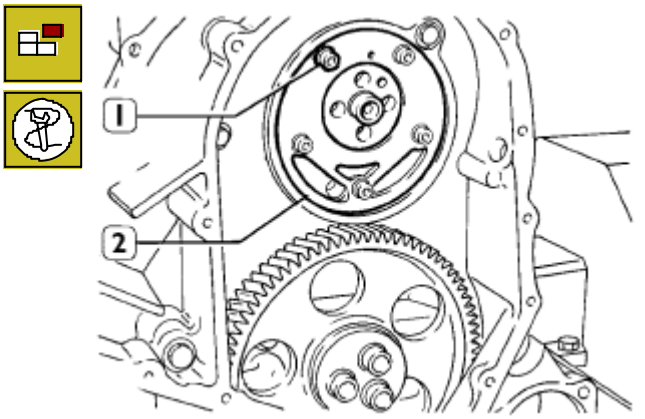
Figure 36




45661

Unscrew the screws (2), by using the proper wrench and remove the gear (1) with the phonic wheel.

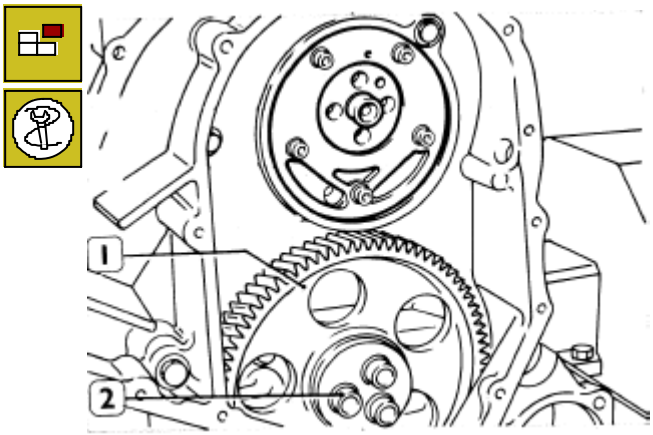
Figure 37




86289

Unscrew the screws (1); tighten a screw in a reaction hole and remove the shoulder plate (2), remove the sheet gasket.

Figure 38

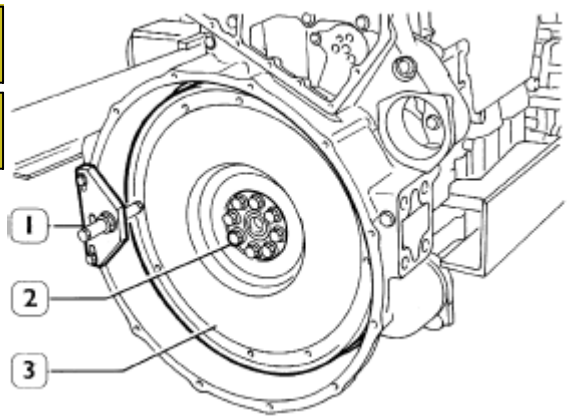



47568

By means of a properly splined wrench, untighten screws (2) and remove the transmission gear (1)

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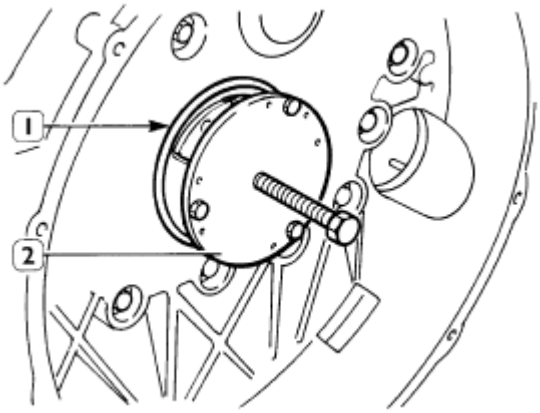
Figure 39




47568

Stop the flywheel (3) rotation by means of tool 99360351 (1), untighten the fixing screws (2) and remove the flywheel.

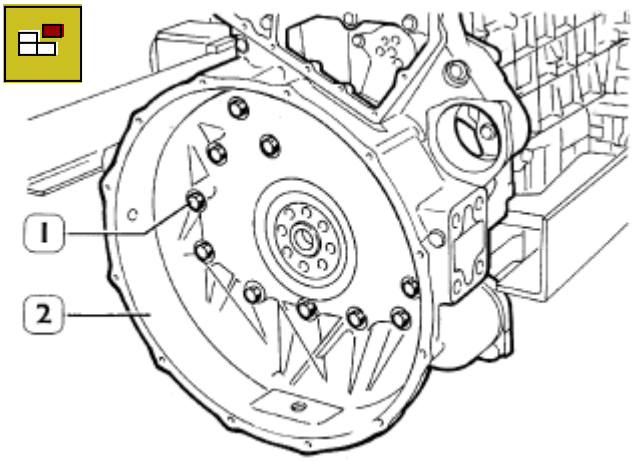
Figure 40




45257

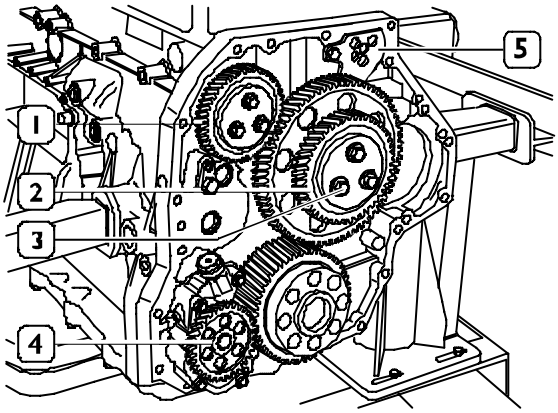
Apply extractor 99340052 (2) and pull out the seal gasket (1).

Figure 41




Untighten the screws (1) and take down the gear housing (2).

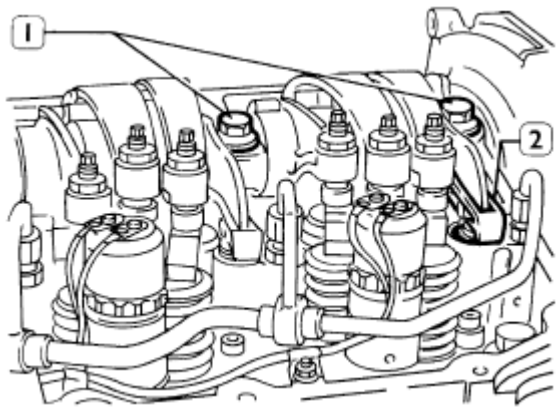
Figure 42




106219

Remove power take-off control gear (1), if any.
Remove screws (3) and dismount double gear (2).
Remove securing screw and dismount articulated rod (5).
Dismount oil pump (4).

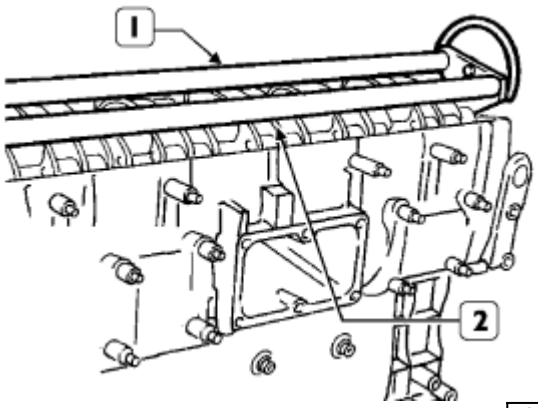
Figure 43




45259

- Remove the check springs (2) of the exhaust brake lever;
- Untighten the fixing screws (1) of rocker arm shaft.

Figure 44

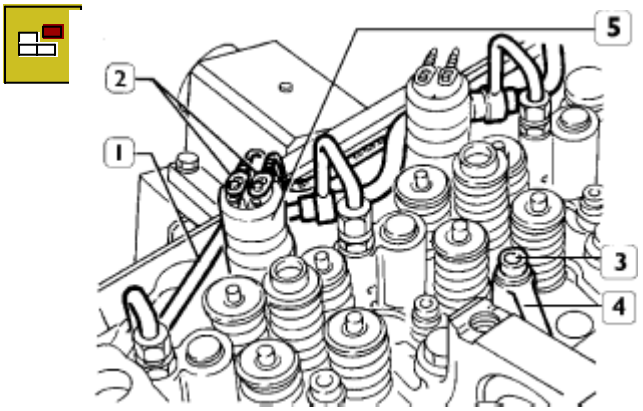



116190

- Apply tool 99360553 (1) to the rocker holder shaft (2) and remove the shaft (2) from the cylinder head.

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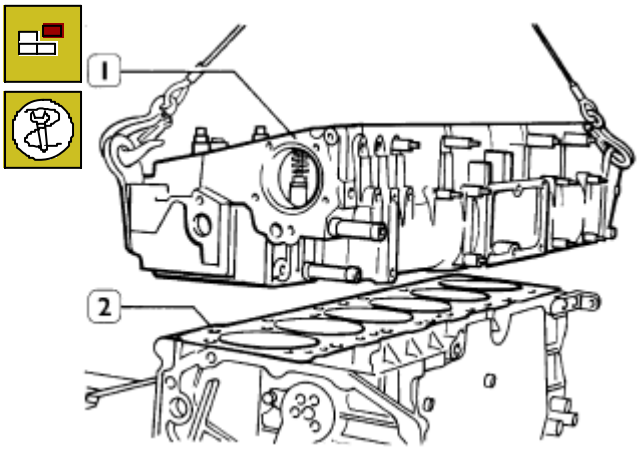
Figure 45




116232

- Remove the piping (1) for exhaust brake pins;
- Untighten screws and remove electric connections (2) from solenoid valves;
- Untighten fixing screws (3) of injector brackets (4).
- Remove injectors (5).
- Install plugs 99360177 instead of injectors.

Figure 46



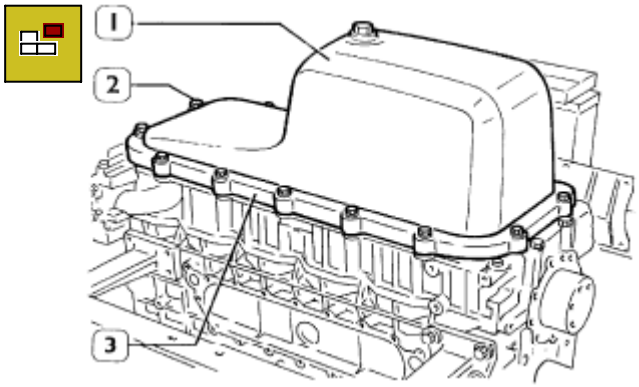

45266

Remove the camshaft and the fixing screws on cylinder heads

- By means of wire ropes, lift the cylinder head (1) and remove seals (2).

**NOTE** The cylinder head mount screws must be replaced at each removal operation.

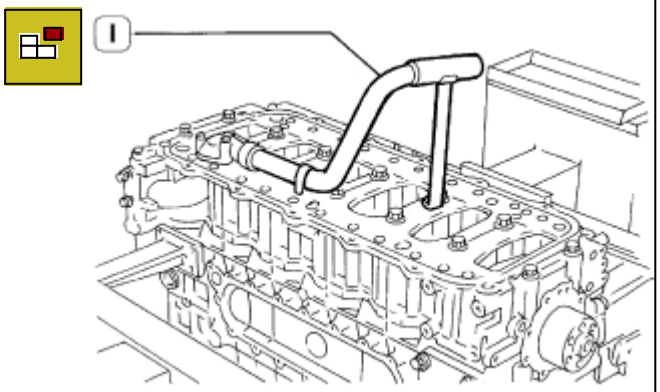
Figure 47




47573

Untighten screws (2) and remove the engine oil sump (1) with frame (3) and seal .

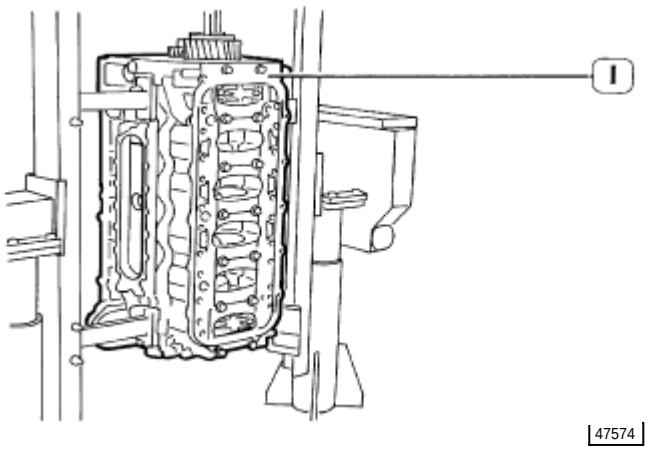
Figure 48




47572

Untighten screws and remove suction rose (1).

Figure 49

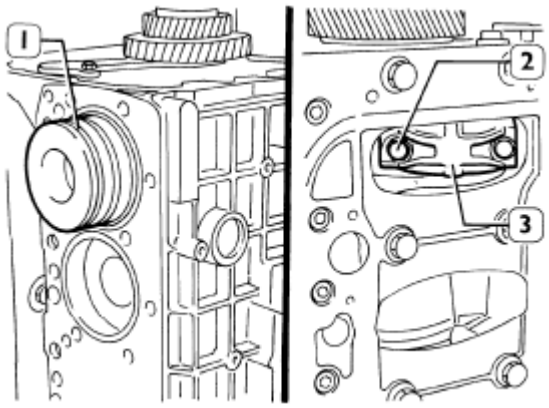



47574

Rotate the block (1) to the vertical position.

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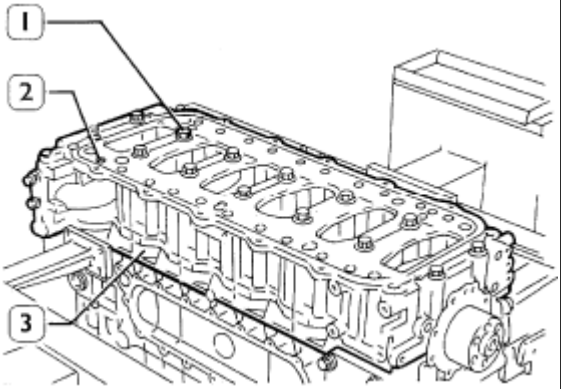
Figure 50




47575

Untighten screws (2) fixing the connecting rod cap (3) and remove it. Remove the connecting rod-piston assembly from the upper side. Repeat these operations for the other pistons.

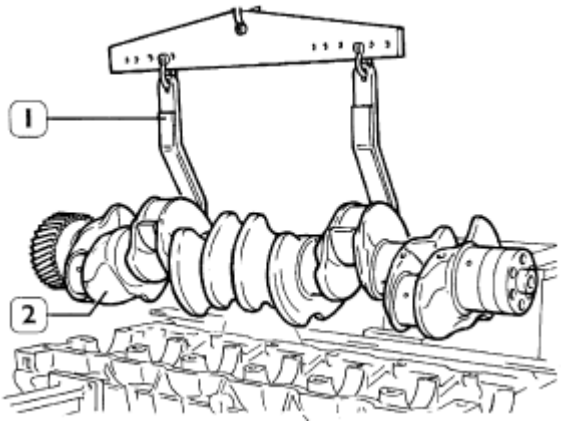
Figure 51




47576

By means of proper and splined wrenches, untighten the screws (1) and (2) and remove the lower crankcase (3).

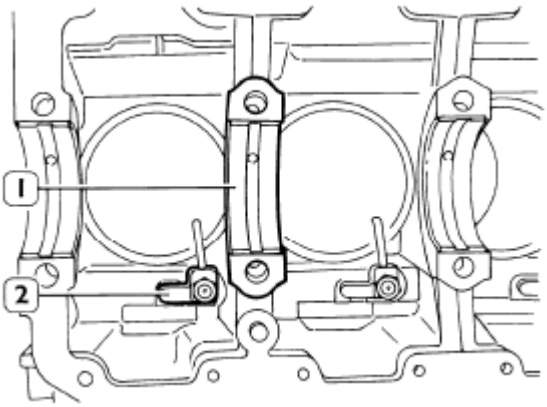
Figure 52




47570

Remove the crankshaft (2) with tool 99360500 (1).

Figure 53




47571

Remove the crankshaft half-bearings (1), untighten the screws and remove oil spray nozzles (2).
Take down cylinder liners as specified in the relative paragraph on page 56.

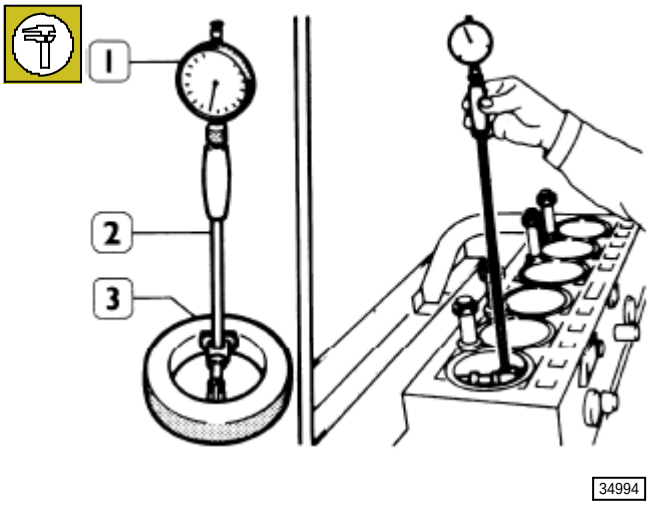
**NOTE** After disassembling the engine, thoroughly clean disassembled parts and check their integrity. Instructions for main checks and measures are given in the following pages, in order to determine whether the parts can be re-used.

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## REPAIR OPERATIONS

### 540410 CYLINDER BLOCK
### 540420 Checks and measurements

Figure 54 (Demonstration)

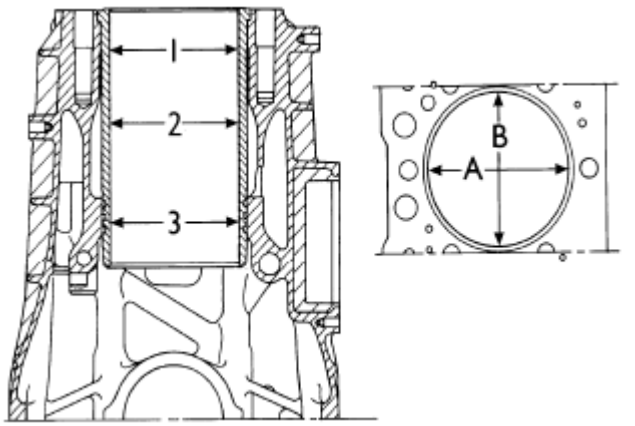



34994

Internal diameter of the cylinder liners is checked for ovalization, taper and wear, using a bore dial (1) centesimal gauge 99395687 (2) previously reset to ring gauge (3), diameter 115 mm.

**NOTE** If a 115 ring gauge is not available use a micrometer caliper.

Figure 55

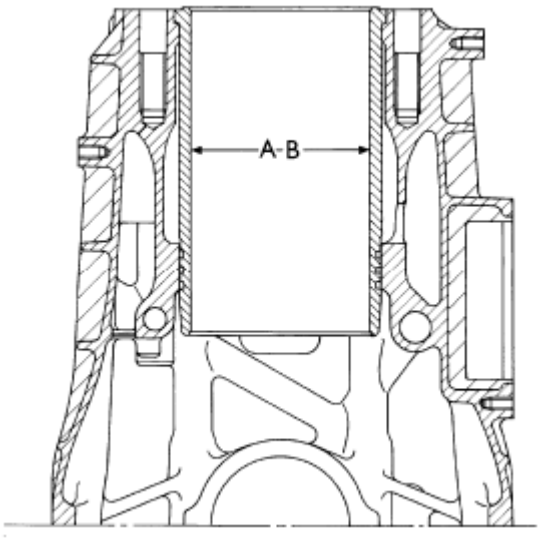



47439

1 = 1st measuring
2 = 2nd measuring
3 = 3rd measuring

Carry out measurings on each cylinder liner at three different levels and on two (A-B) surfaces, to one another perpendicular, as shown in Figure.

Figure 56




47440

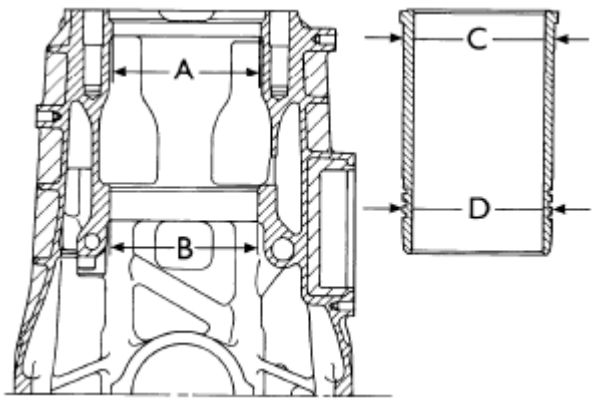
A = Selection class Ø 115 to 115.012 mm
B = Selection class Ø 115.010 to 115.022 mm

In case of maximum wear max 0.150 mm or maximum ovalization max 0.100 mm compared to the values indicated in the figure, the liners must be replaced as they cannot be ground, lapped or trued.

**NOTE**

Cylinder liners are equipped with spare parts with "A" selection class.

Figure 57




47441

A = Ø 130.200 to 130.225 mm
B = Ø 128.510 to 128.535 mm
C = Ø 130.161 to 130.186
D = Ø 128.475 to 128.500 mm

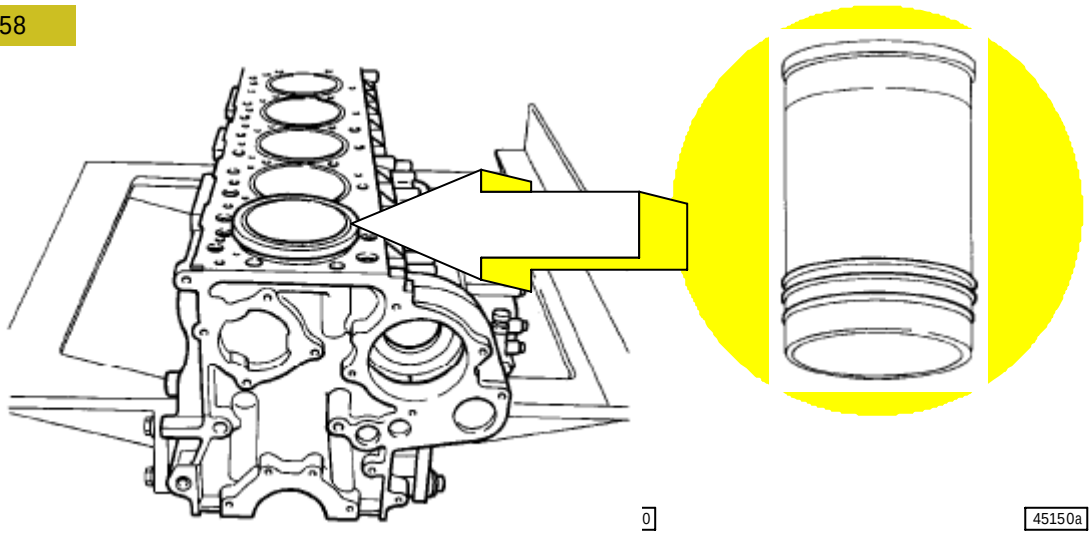
The figure shows the outer diameters of the cylinder liners and the relative seat inner diameters.

The cylinder liners can be extracted and installed several times in different seats, if necessary.

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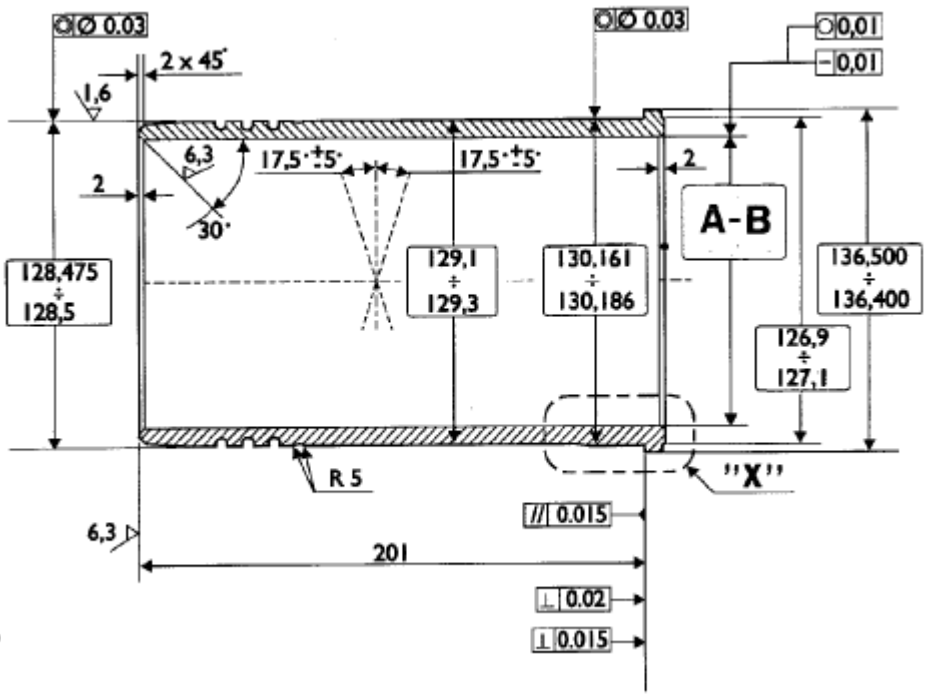
## CYLINDER LINERS

Figure 58




BLOCK WITH CYLINDER LINERS

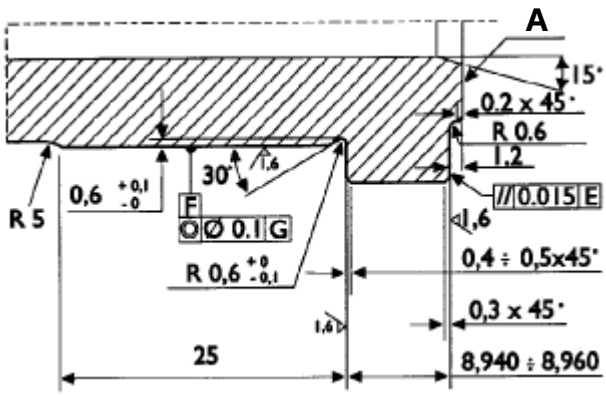
Figure 59




Selection class { A mm 115.000 / B mm 115.010

CYLINDER LINERS MAIN DATA

Figure 60



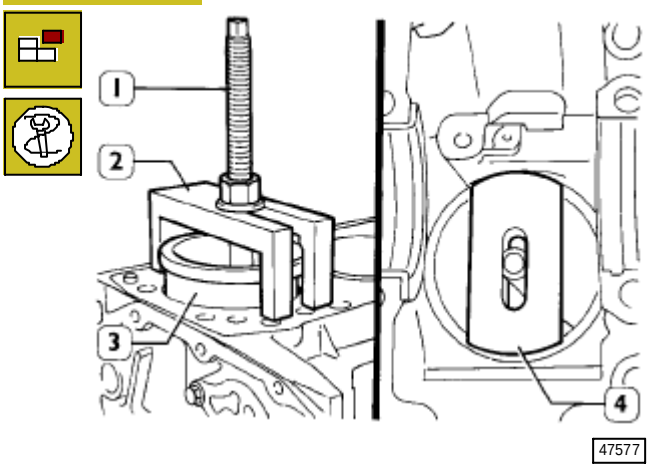

DETAIL "X"
"A" = Selection class marking area

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## 540420 Replacing cylinder liners

### Removal

Figure 61

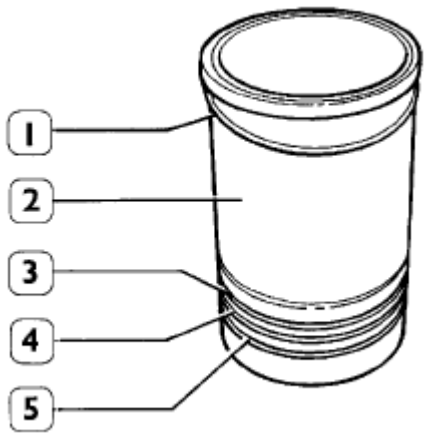



47577

Place details 99360706 (1 and 2) and plate 99360724 (4) as shown in the figure, by making sure that the plate (4) is properly placed on the cylinder liners.
Tighten the screw nut (1) and remove the cylinder liner (3) from the block.

### Fitting and checking protrusion

Figure 62

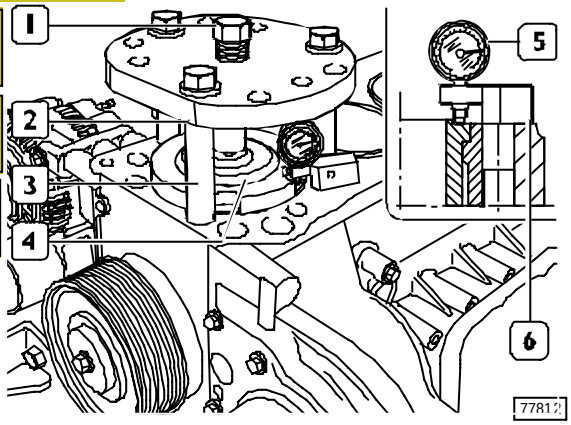



16798

Always replace water sealing rings (3, 4 and 5).
Install the adjustment ring (1) on the cylinder liner (2); lubricate lower part of liner and install it in the cylinder unit using the proper tool.

**NOTE** The adjustment ring (1) is supplied as spare parts in the following thicknesses: 0.08 mm - 0.10 mm - 0.12 mm.

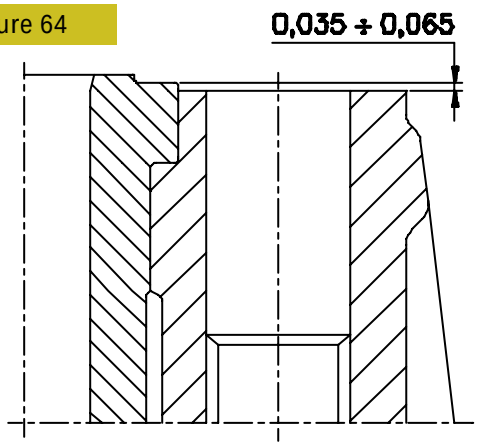
Figure 63




77812

Check cylinder barrel protrusion with tool 99360334 (1-2-3-4) and tighten screw (1) to 170 Nm.
With dial gauge 99395603 (5) placed on base 99370415 (6). Measure the cylinder barrel protrusion compared to the cylinder head supporting plane, it must be 0,035 to 0,065 mm (Figure 64); otherwise replace the adjusting ring (1, Figure 62) fitted with spare parts having different thickness.

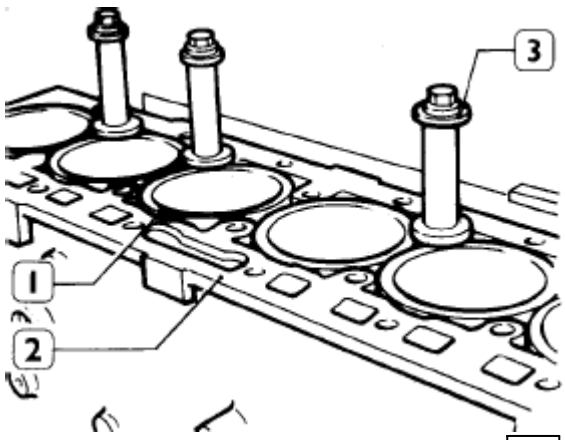
Figure 64




49017

CYLINDER LINER PROTRUSION

Figure 65 (Demonstration)



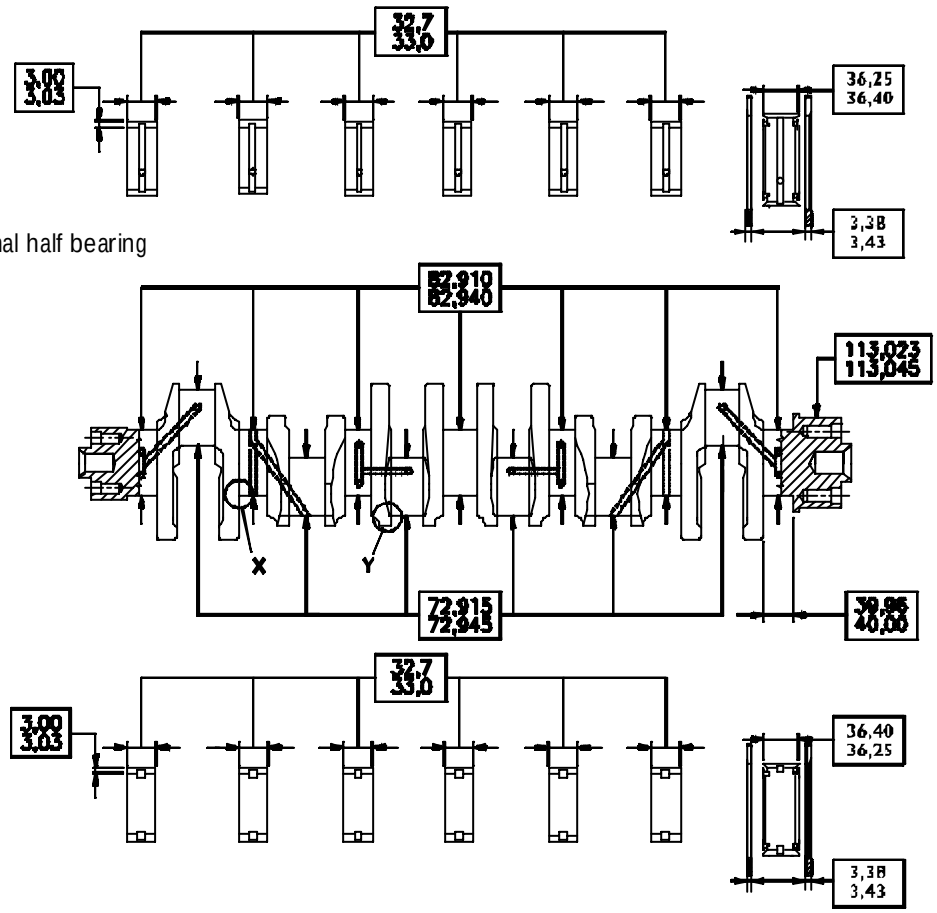

35012

When the installation is completed, block the cylinder liners (1) to the block (2) with studs 99360703 (3).

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## 5408 CRANKSHAFT

Figure 66




Upper main journal half bearing

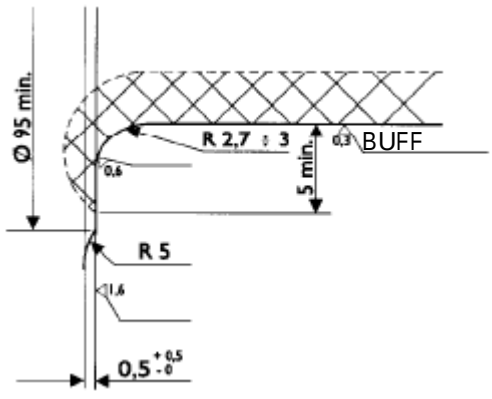
Lower main journal half bearings

116410

MAIN DATA FOR THE CRANK SHAFT PINS AND THE HALF BEARINGS

Check the condition of the journals and the big end pins; there must no be signs of scoring, ovalization or excessive wear.
The data given refer to the normal diameter of the pins.

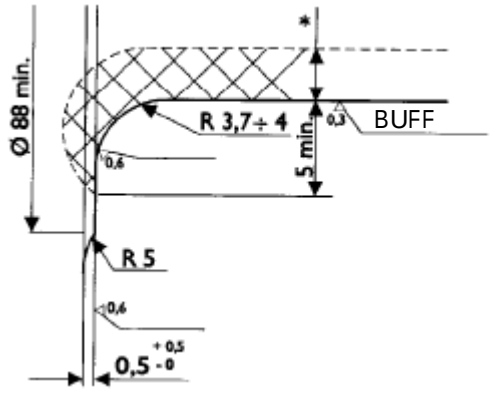
Figure 67




47537

**X.** Detail of main journals connections

Figure 68




47538

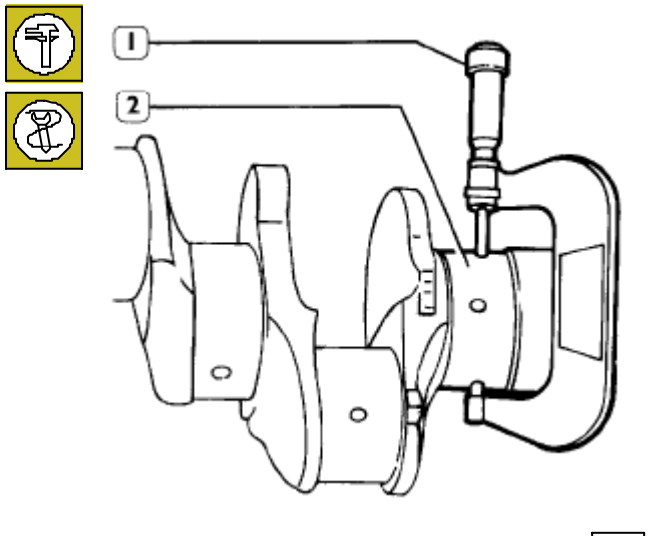
**Y.** Detail of crank pins connections

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## 540812 Measuring main journals and crank pins

Before grinding the crank pins using a micrometer (1), measure the main journals and the crank pins (2) and decide, on the basis of the undersizing of the bearings, the final diameter to which the pins are to be ground.

Figure 69

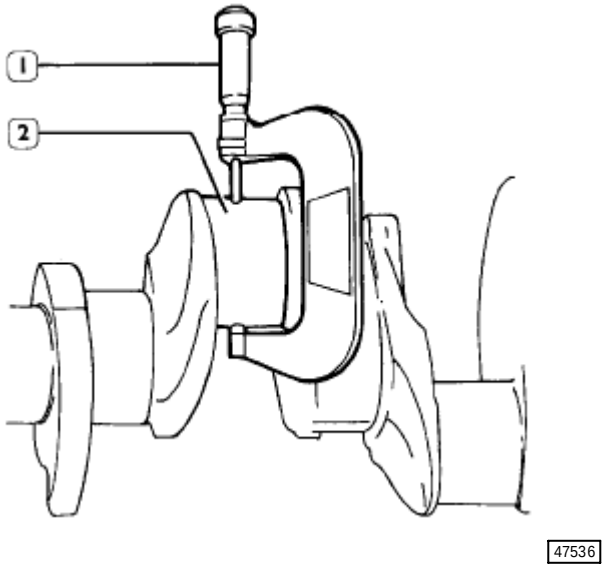



47535

MEASURING THE MAIN JOURNALS

**NOTE** It is advisable to enter the values found in a table (Figure 71).

Figure 70




47536

MEASURING CRANK PINS

During grinding, pay attention to journal and crank pins values specified in figures 68 and 69.

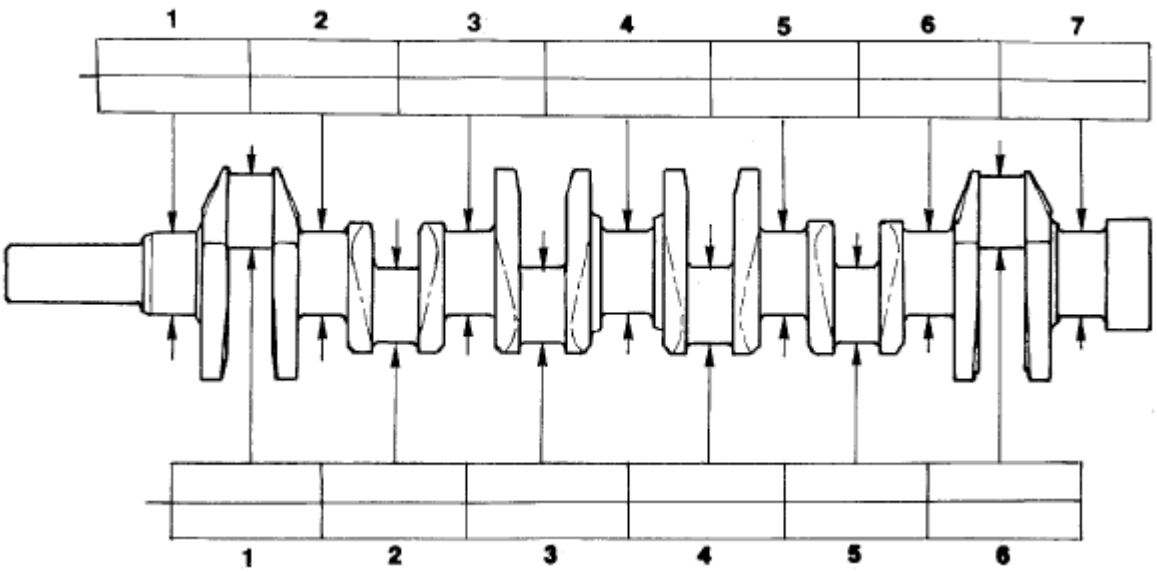
**NOTE** All journals and crank pins must also be ground to the same undersizing class, in order to avoid any alteration to shaft balance.

Figure 71

**Fill in this table with the measurements of the main journals and the crank pins.**

### MAIN JOURNALS

Ø MIN.
Ø MAX.




Ø MIN.
Ø MAX.

### CRANK PINS

36061

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# PRELIMINARY MEASUREMENT OF MAIN AND BIG END BEARING SHELL SELECTION DATA

For each of the journals of the crankshaft, it is necessary to carry out the following operations:

MAIN JOURNALS:

- Determine the class of diameter of the seat in the crankcase.
- Determine the class of diameter of the main journal.
- Select the class of the bearing shells to mount.

CRANKPINS:

- Determine the class of diameter of the seat in the connecting rod.
- Determine the class of diameter of the crankpin.
- Select the class of the bearing shells to mount.

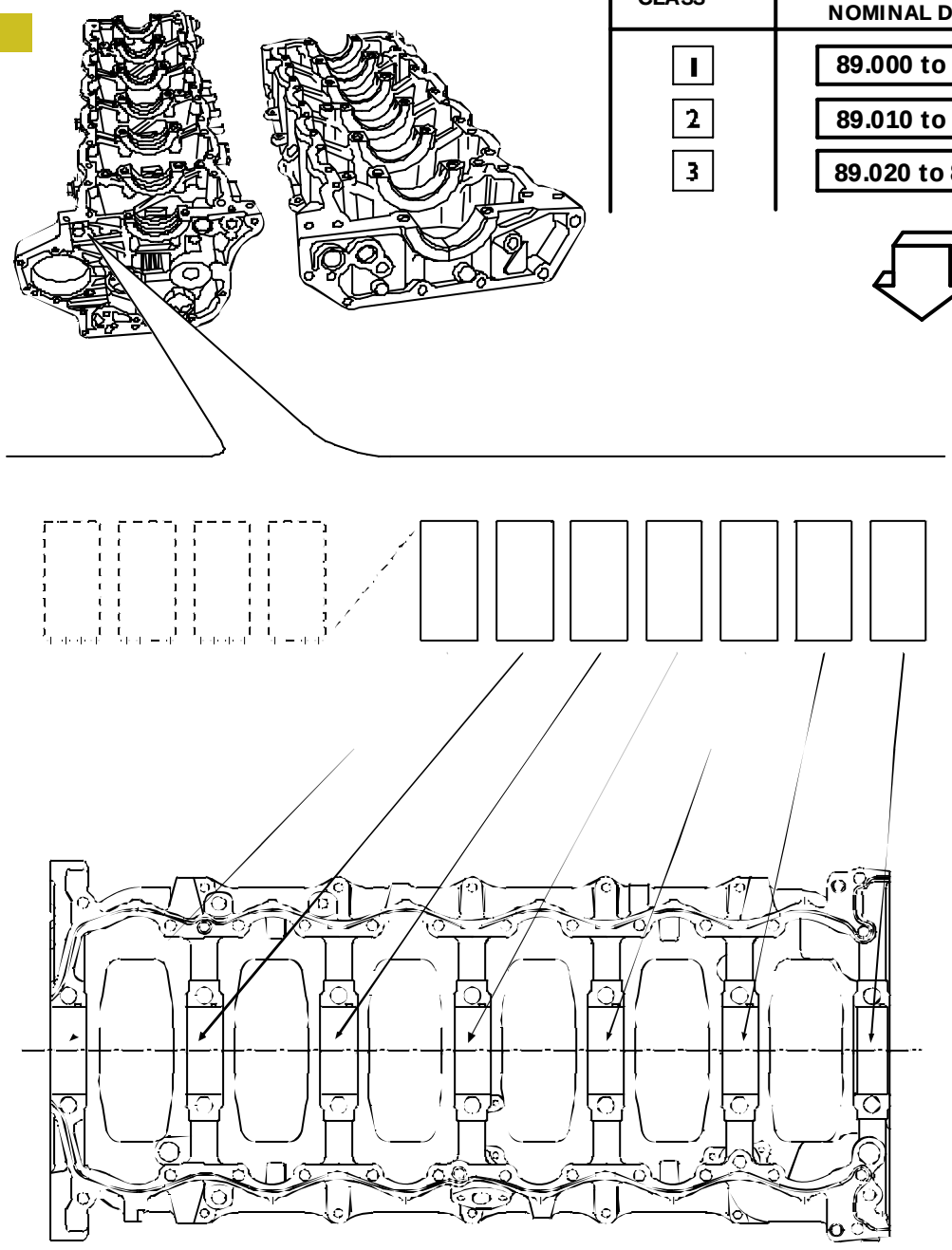
DEFINING THE CLASS OF DIAMETER OF THE SEATS FOR BEARING SHELLS ON THE CRANKCASE

On the front of the crankcase, two sets of numbers are marked in the position shown (Figure 72 at top).

- The first set of digits (four) is the coupling number of the crankcase with its base.
- The following seven digits, taken singly, are the class of diameter of each of the seats referred to (Figure 72 at bottom).
- Each of these digits may be **1**, **2** or **3**.

Figure 72

| CLASS | MAIN BEARING HOUSING NOMINAL DIAMETER |
|---|---|
| 1 | 89.000 to 89.009 |
| 2 | 89.010 to 89.019 |
| 3 | 89.020 to 89.030 |



47535

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## Selecting the main and big end bearing shells

**NOTE** To obtain the required assembly clearances, the main and big end bearing shells need to be selected as described hereunder.

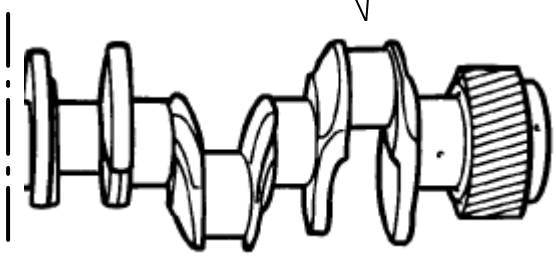
This operation makes it possible to identify the most suitable bearing shells for each of the journals (the bearing shells, if necessary, can have different classes from one journal to another).

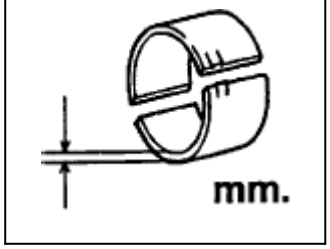
Depending on the thickness, the bearing shells are selected in classes of tolerance marked by a coloured sign (red-green – red/black – green/black).

The following tables give the specifications of the main and big end bearing shells available as spares in the standard sizes (STD) and in the permissible oversizes (+0.127, +0.254, +0.508).

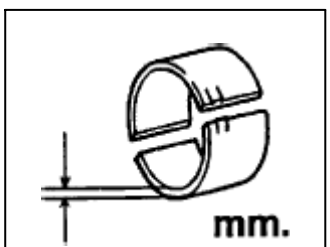
Figure 73

| | STD | +0.127 | +0.254 | +0.508 |
|---|---|---|---|---|
| red | 2.000 to 2.010 | | 2.127 to 2.137 | 2.254 to 2.264 |
| red/black | | 2.063 to 2.073 | | |
| green | 2.011 to 2.020 | | 2.138 to 2.147 | 2.265 to 2.274 |
| green/black | | 2.074 to 2.083 | | |
| yellow* | 2.021 to 2.030 | | | |
| yellow/black* | | 2.084 to 2.093 | | |






| | STD | +0.127 | +0.254 | +0.508 |
|---|---|---|---|---|
| red | 3.000 to 3.010 | | 3.127 to 3.137 | 2.254 to 3.264 |
| red/black | | 3.063 to 3.073 | | |
| green | 3.011 to 3.020 | | | |
| green/black | | 3.074 to 3.083 | | |
| yellow* | 3.021 to 3.030 | | | |
| yellow/black* | | 3.084 to 3.093 | | |




* Fitted in production only and not supplied as spares

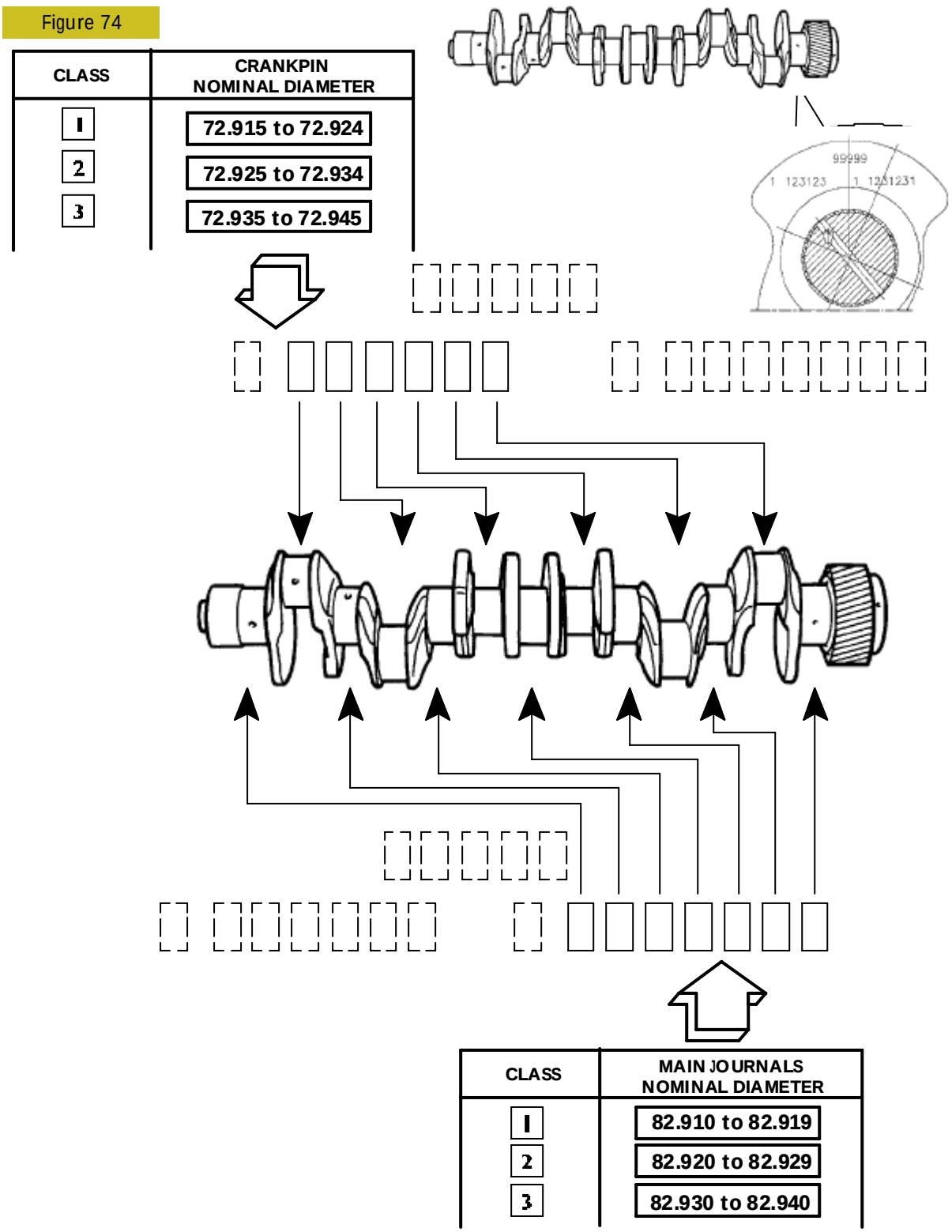
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## DEFINING THE CLASS OF DIAMETER OF THE MAIN JOURNALS AND CRANKPINS (Journals with nominal diameter)

Main journals and crankpins: determining the class of diameter of the journals.
Three sets of numbers are marked on the crankshaft in the position shown by the arrow (Figure 74 at top):

- The first number, of five digits, is the part number of the shaft.
- Under this number, on the left, a set of six digits refers to the crankpins and is preceded by a single digit showing the status of the journals (1 = STD, 2 = -0.127), the other six digits, taken singly, give the class of diameter of each of the crankpins they refer to (Figure 74 at top).
- The set of seven digits, on the right, refers to the main journals and is preceded by a single digit: the single digit shows the status of the journals (1 = STD, 2 = -0.127), the other seven digits, taken singly, give the class of diameter of each of the main journals they refer to (Figure 74 at bottom).

Figure 74




| CLASS | CRANKPIN NOMINAL DIAMETER |
|---|---|
| 1 | 72.915 to 72.924 |
| 2 | 72.925 to 72.934 |
| 3 | 72.935 to 72.945 |

| CLASS | MAIN JOURNALS NOMINAL DIAMETER |
|---|---|
| 1 | 82.910 to 82.919 |
| 2 | 82.920 to 82.929 |
| 3 | 82.930 to 82.940 |

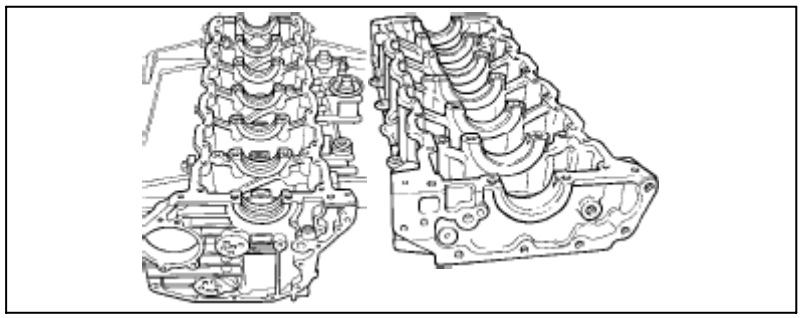
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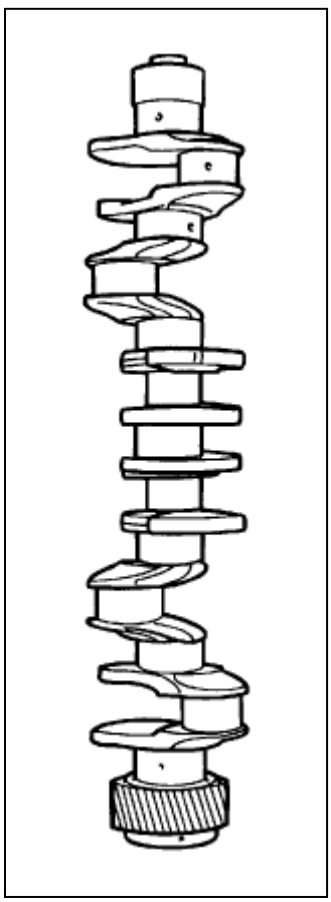
**Selection of main half-bearings (nominal diameter pins)**

After detecting, for each journal, the necessary data on block and crankshaft, select the type of half-bearings to be used, in compliance with the following table:

Figure 75

**STD.**



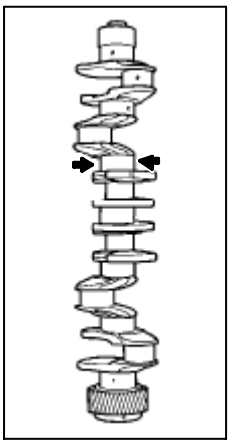
| | 1 | 2 | 3 |
|---|---|---|---|
|  | | | |
| 1 | green | green | green |
| | green | green | green |
| 2 | red | green | green |
| | red | green | green |
| 3 | red | red | red |
| | red | red | red |

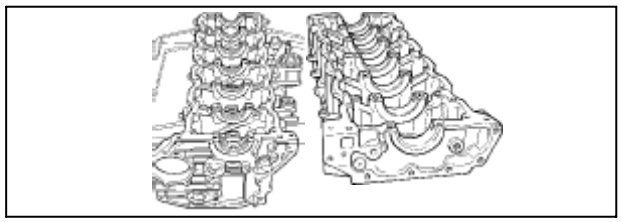
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**Selection of main half-bearings (rectified pins)**

If the journals have been rectified, the procedure described cannot be applied.
In this case, make sure that the new diameter of the journals is as specified on the table and install the only half-bearing type required for this undersizing.

Figure 76



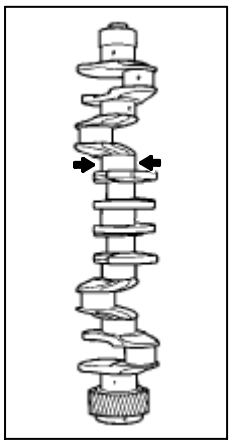


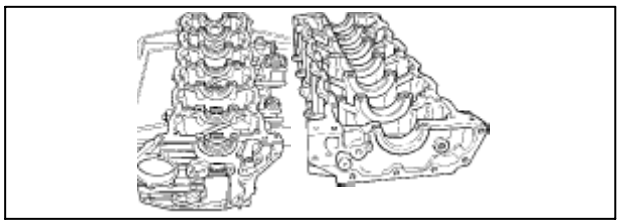
## -0.127

red/black = mm 3.063 to 3.073

green/black = mm 3.073 to 3.084

| | 1 | 2 | 3 |
|---|---|---|---|
| 82.784 82.793 | 1 | green/black<br>green/black | green/black<br>green/black | green/black<br>green/black |
| 82.794 82.803 | 2 | red/black<br>red/black | green/black<br>green/black | green /black<br>green/black |
| 82.804 82.814 | 3 | red/black<br>red/black | red/black<br>red/black | red/black<br>red/black |

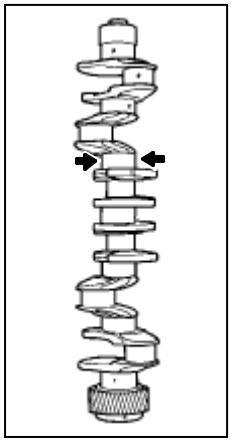


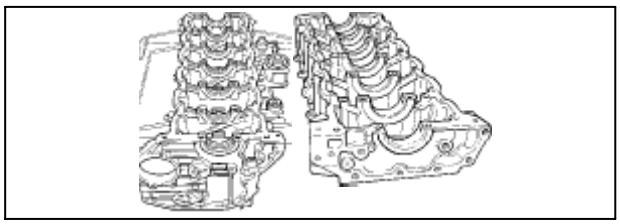


## -0.254

red = mm 3.127 to 3.137

| | 1 | 2 | 3 |
|---|---|---|---|
| 82,666 82,686 | red<br>red | red<br>red | red<br>red |





## -0.508

red = mm 3.254 to 3.264

| | 1 | 2 | 3 |
|---|---|---|---|
| 82.412 82.432 | red<br>red | red<br>red | red<br>red |

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SELECTING THE BIG END BEARING SHELLS (JOURNALS WITH NOMINAL DIAMETER)

There are three markings on the body of the connecting rod in the position shown in the view from "A":

1 Letter indicating the class of weight:

A = 2865 to 2895 g.
B = 2896 to 2925 g.
C = 2926 to 2955 g.

2 Number indicating the selection of the diameter of the big end bearing seat:

1 = 77.000 to 77.010 mm
2 = 77.011 to 77.020 mm
3 = 77.021 to 77.030 mm

3 Numbers identifying the cap-connecting rod coupling.

The number, indicating the class of diameter of the bearing shell seat may be **1**, **2** o **3**.

Determine the type of big end bearing to fit on each journal by following the indications in the table (Figure 78).

Figure 77

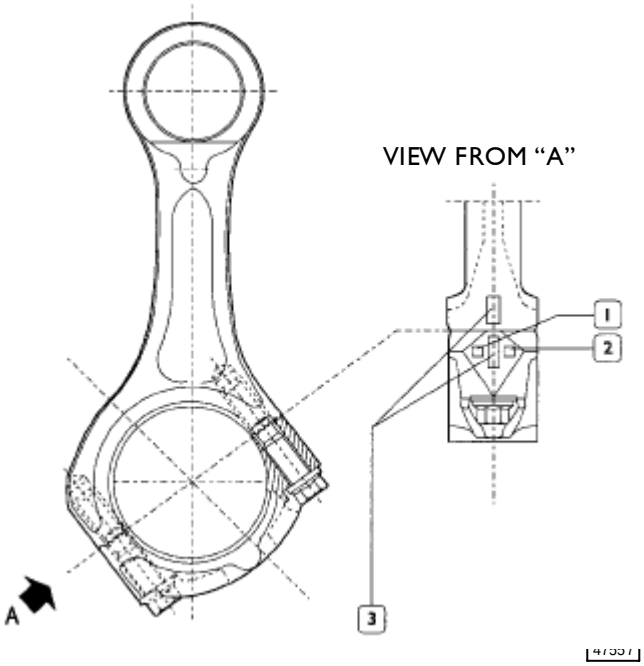
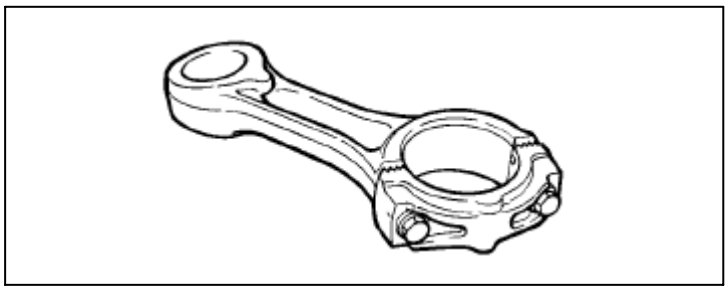
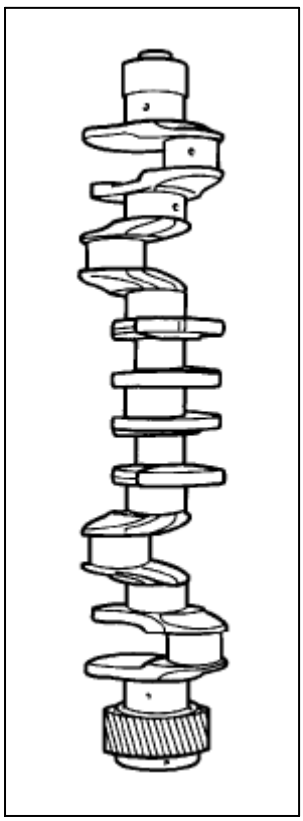



Figure 78

**STD.**





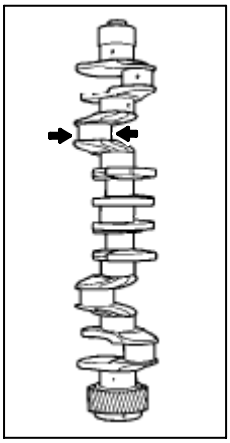
| Class | 1 | 2 | 3 |
|---|---|---|---|
| 1 | green<br>green | green<br>green | green<br>green |
| 2 | red<br>red | green<br>green | green<br>green |
| 3 | red<br>red | red<br>red | red<br>red |

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**Selection of connecting rod half-bearings (rectified pins)**

If pins have been rectified, the procedure described must be applied.
In this case, (for each undersizing) determine the tolerance field the new big end pins belong to, and install the half-bearings identified according to the relative table.

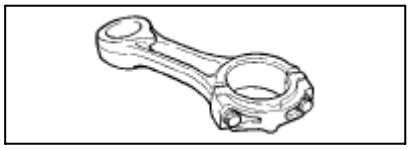
Figure 79



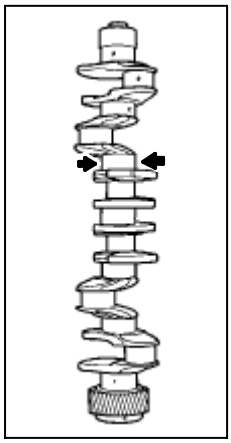
red/black = mm 2.074 to 2.083

green/black = mm 2.063 to 2.073

## -0.127

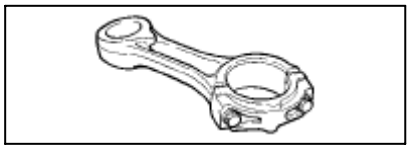


| | | 1 | 2 | 3 |
|---|---|---|---|---|
| 72.789 72.798 | 1 | green/black | green/black | green/black |
| | | green/black | green/black | green/black |
| 72.799 72.808 | 2 | red/black | green/black | green /black |
| | | red/black | green/black | green/black |
| 72.809 72.818 | 3 | red/black | red/black | green/black |
| | | red/black | red/black | green/black |

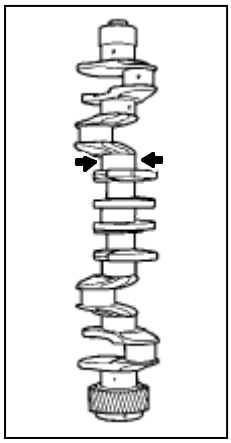


## -0.254

red mm 2.127 to 2.137
green = mm 2.138 to 2.147

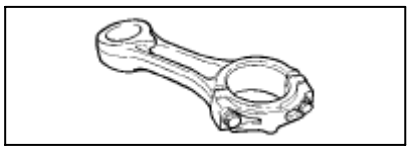


| | 1 | 2 | 3 |
|---|---|---|---|
| 72.671 72.680 | red | green | green |
| | red | green | green |
| 72.681 72.691 | red | red | green |
| | red | red | green |



## -0.508

red = mm 2.254 to 2.264
green = mm 2.265 to 2.274



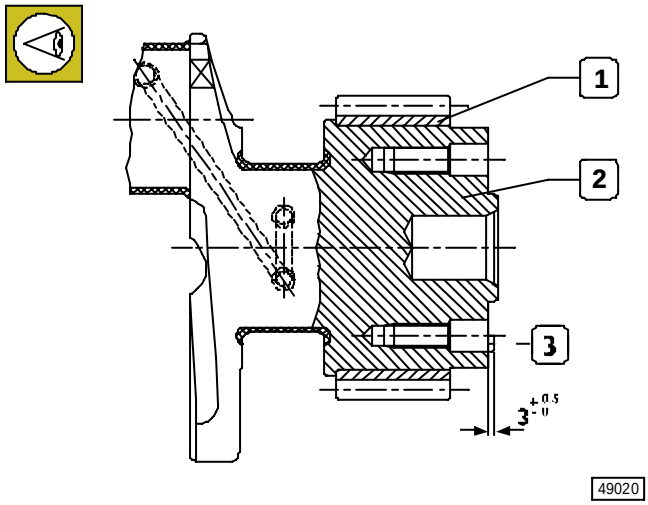
| | 1 | 2 | 3 |
|---|---|---|---|
| 72.417 72.426 | red | green | green |
| | red | green | green |
| 72.427 72.437 | red | red | green |
| | red | red | green |

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## 540815 Replacing the valve drive gear and the oil pump drive gear

Check that the teeth of the gears are not damaged or worn, otherwise remove them using the appropriate extractor.

Figure 80



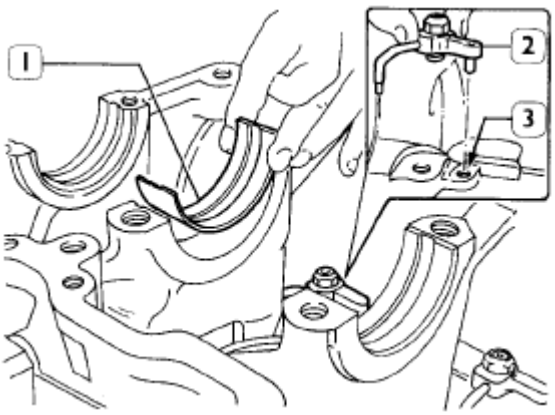

49020

After fitting the gear (1) on the crankshaft (2), heat it for ~15 minutes in an oven at temperature not higher than 180°C.
Let them cool down after the installation.

If changing the pin (3), after fitting it on, check it protrudes from the crankshaft as shown in the figure.

## 540811 Checking main journal installation clearance

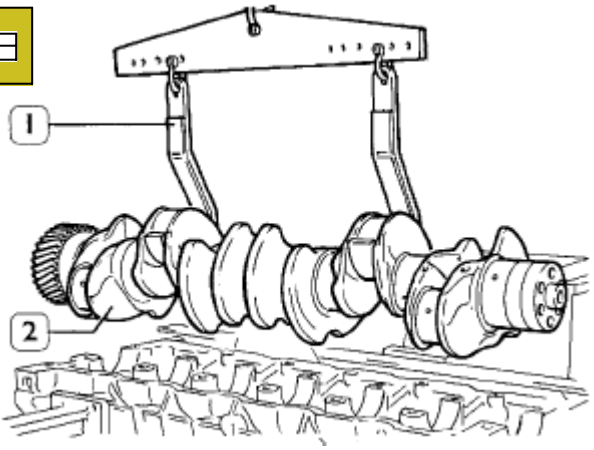
Figure 81




47579

Install the oil spray nozzles (2) and have the dowel coincide with the block hole (3).
Install the half-bearings (1) on the main bearings.

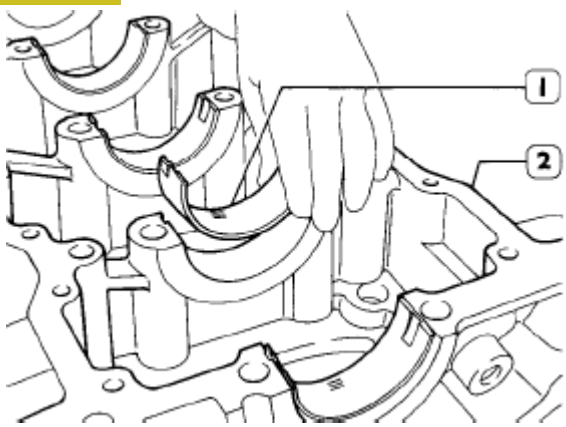
Figure 82




47578

Using the hoist and hook 99360500 (1) mount the crankshaft (2).

Figure 83

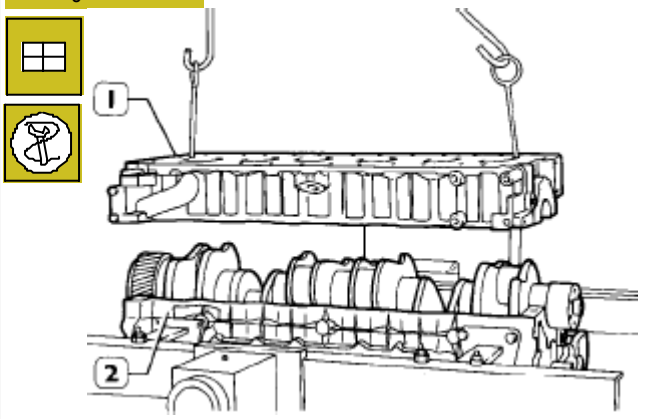



49021

Install the half-bearings (1) on the main bearings in the lower crankcase (2).
Check the installation clearance between the main journals and the relative bearings as follows:

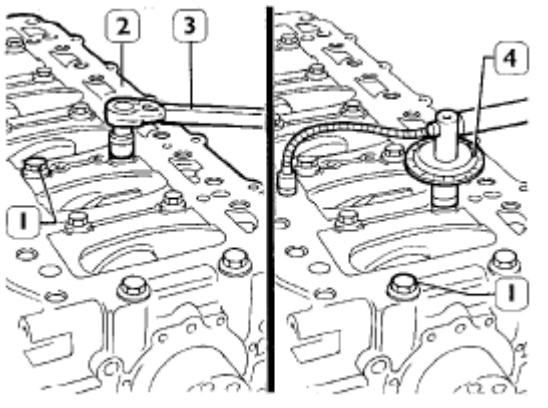
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Figure 84




Place a piece of calibrated wire on the journal of the crankshaft (2), parallel to the longitudinal axis; install the lower crankcase (1), by hoist and appropriate hooks.

Figure 85




- Lubricate inside screws (1) con UTDM oil, and tighten them by torque wrench to 140 Nm torque, thus with 60° angle closing, following the diagram in Figure 86.

Figure 86

FRONT SIDE

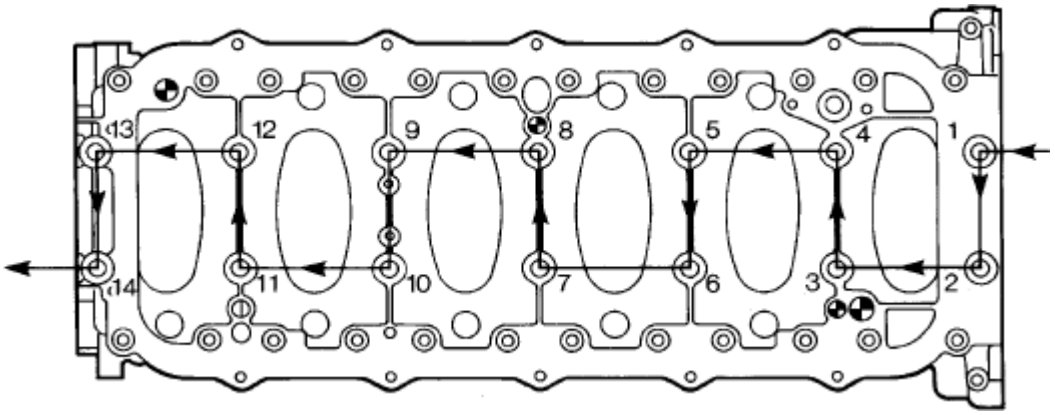
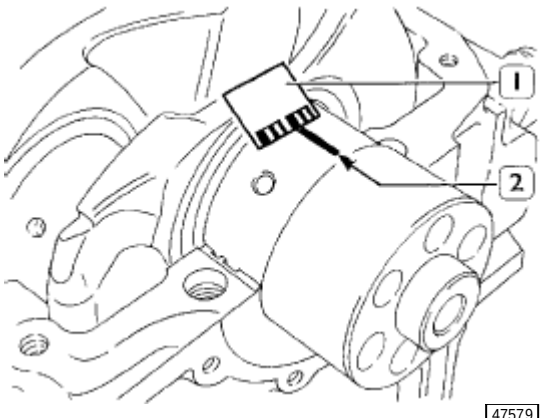



Diagram showing the tightening order of the screws fixing the lower crankcase to the block

Figure 87

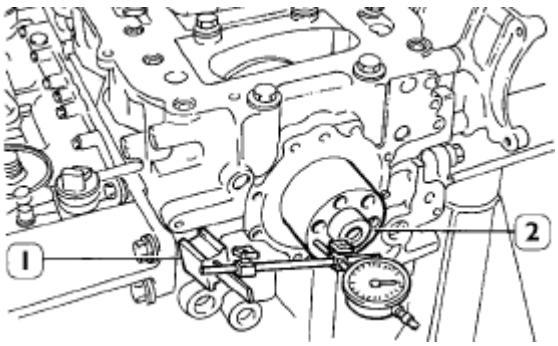



- Remove the lower crankcase

The clearance between the main bearings and the journals is obtained by comparing the calibrated wire length (2) at the maximum deflection point, with the calibrated scale on the coating (1) containing the calibrated wire (1).
Numbers shown on the scale specify the clearance in coupling millimeters. If the clearance obtained is different from the clearance required, replace the half-bearings and repeat this check.

## Checking crankshaft end float

Figure 88

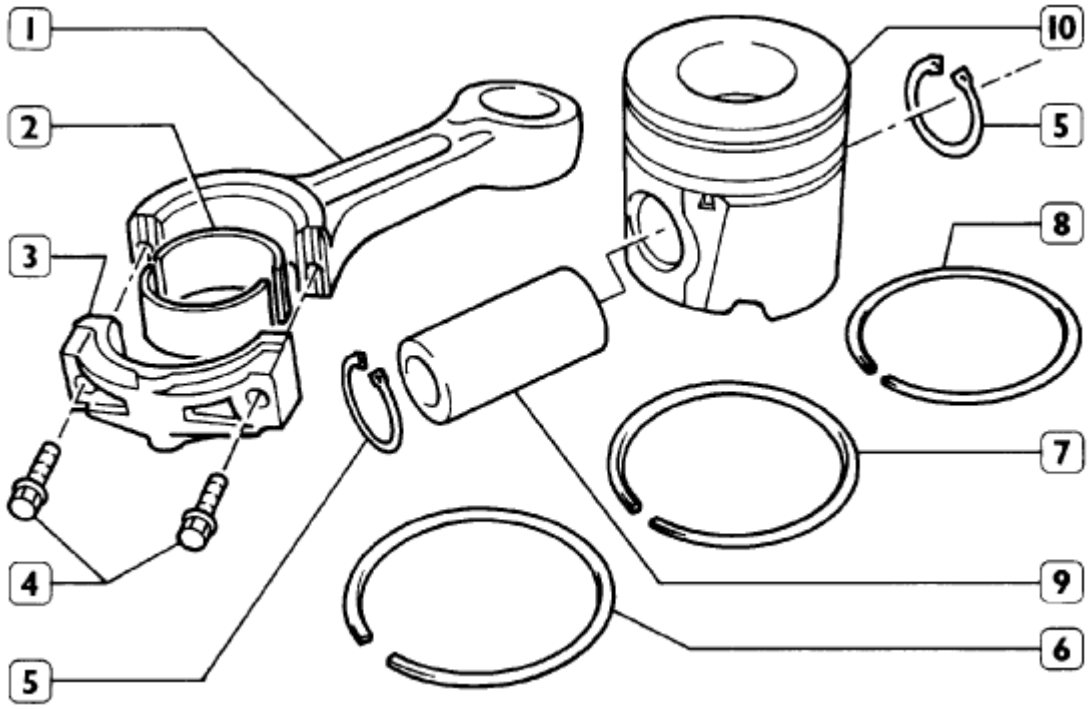



End float is checked by placing a magnetic dial gauge (1) on the crankshaft (2), as shown in the figure. If the value obtained is higher than specified, replace the rear thrust half-bearings and repeat this check.

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## 5408 PISTON-CONNECTING ROD ASSEMBLY

Figure 89



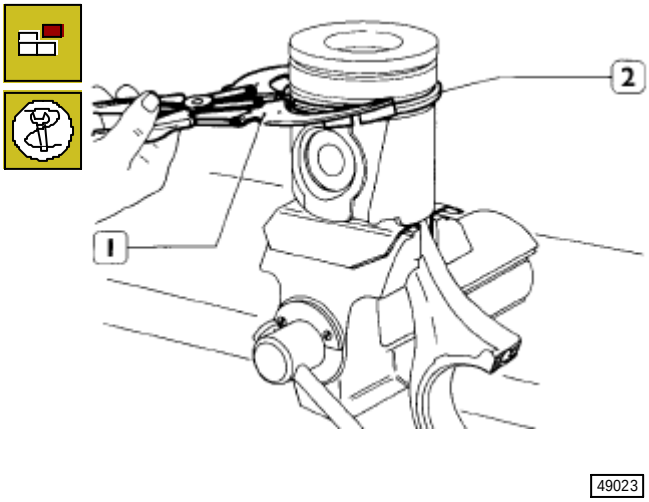

PISTON CONNECTING ROD ASSEMBLY

1. Connecting rod body - 2. Half bearings - 3. Connecting rod cap - 4. Cap fastening screws - 5. Seeger ring - 6. Slotted oil control ring - 7. Scraper ring - 8. Compression ring - 9. Gudgeon pin - 10. Piston

Make sure the piston does show any trace of seizing, scoring, cracking; replace as necessary.

### Removal

Figure 90

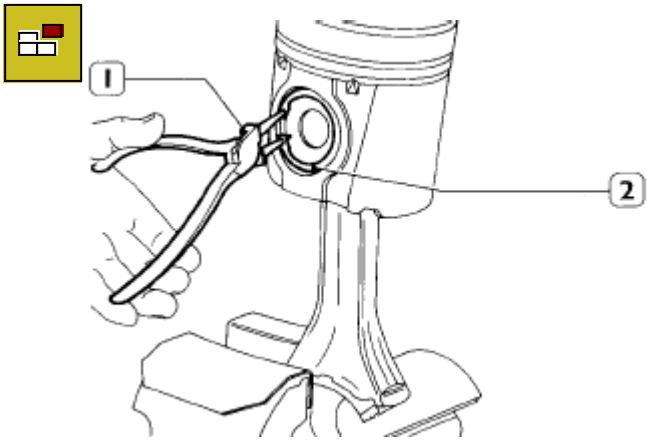



Removal of the piston rings (2) using the pliers 99360184 (1).

Pistons are equipped with three elastic rings: a sealing ring, a trapezoidal ring and a scraper ring.

Pistons are grouped into classes A and B for diameter.

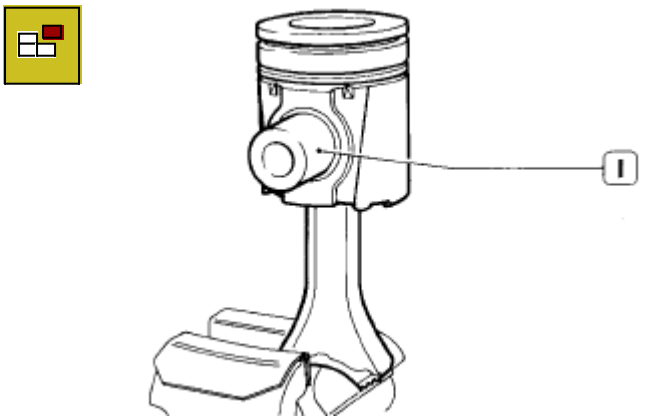
Figure 91




Remove the piston pin seeger rings (2) using the round tipped pliers (1).

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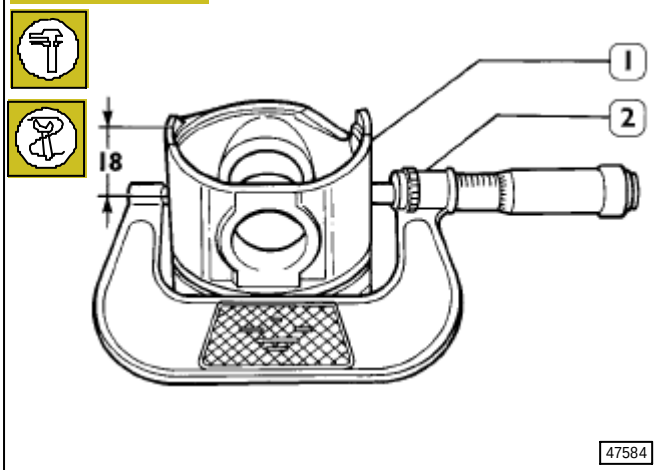
Figure 92




Remove the gudgeon pin (1).
If removal is difficult use the appropriate beater.

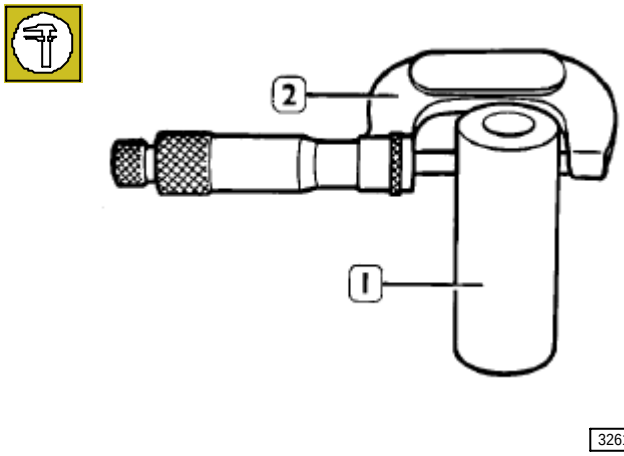
## Measuring the diameter of the pistons

Figure 93




Using a micrometer (2), measure the diameter of the piston (1) to determine the assembly clearance; the diameter should be measured at the specified value.

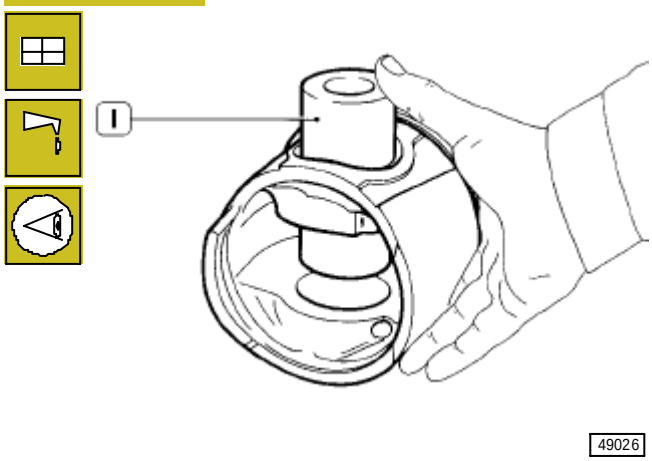
Figure 94




Measuring the gudgeon pin diameter (1) with a micrometer (2).

## Conditions for correct gudgeon pin-piston coupling

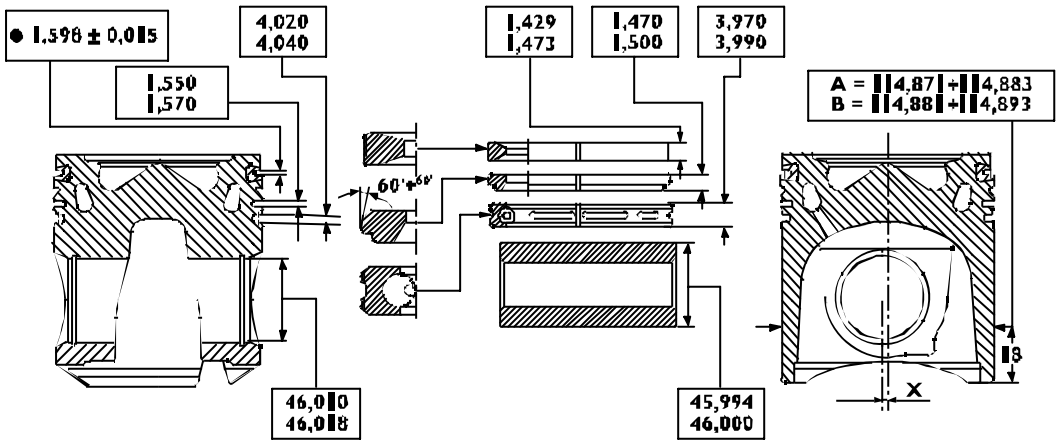
Figure 95




Lubricate the pin (1) and the relevant housing on the piston hubs with engine oil; piston must be inserted with a slight finger pressure and it should not come out by gravity.

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Figure 96



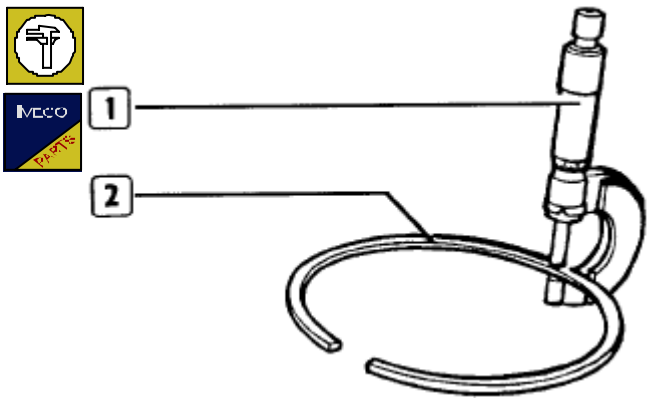

MAIN DATA OF PISTON, RINGS AND PIN

X = 0,6 ± 0,15 mm

• The dimension is measured on a ∅ 111 mm

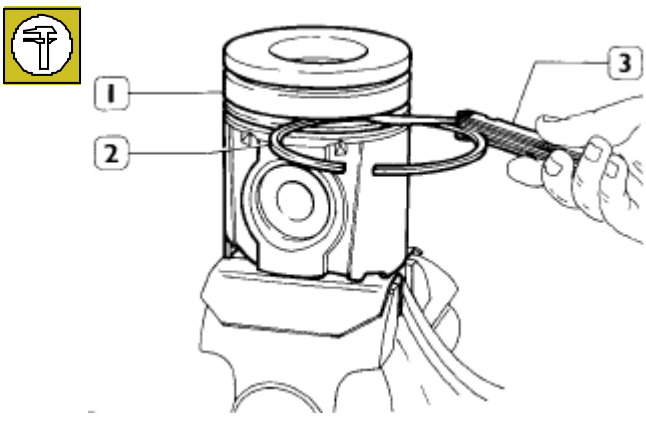
## 540842 Piston rings

Figure 97



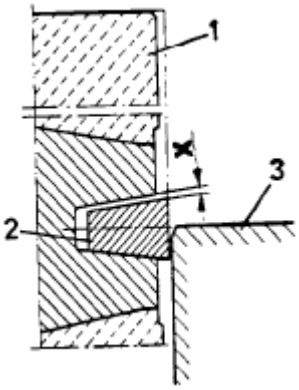

Check the thickness of the piston ring (2) using a micrometer (1).

Figure 98



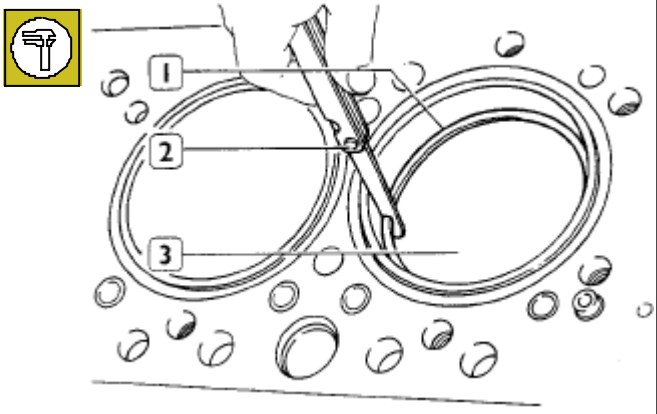

Check the clearance between the rings (2) and the relative piston housings (1) using a filler gauge (3).

Figure 99




The compression ring (2) of the 1º cavity is trapezoidal. Clearance "X" between the sealing ring and its housing is measured by placing the piston (1) with its ring in the cylinder liner (3), so that the sealing ring is half-projected out of the cylinder liner.

Figure 100




Check the gap between the ends of the sealing rings (1), using a filler gauge (2), entered in the cylinder liner (3).
If the distance between ends is lower or higher than the value required, replace the rings.

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## 540830 CONNECTING ROD

Figure 101

Data concerning the class section of connecting rod housing and weight are stamped on the big end.

When installing connecting rods, make sure they all belong to the same weight class.

### CONNECTING ROD MARKS

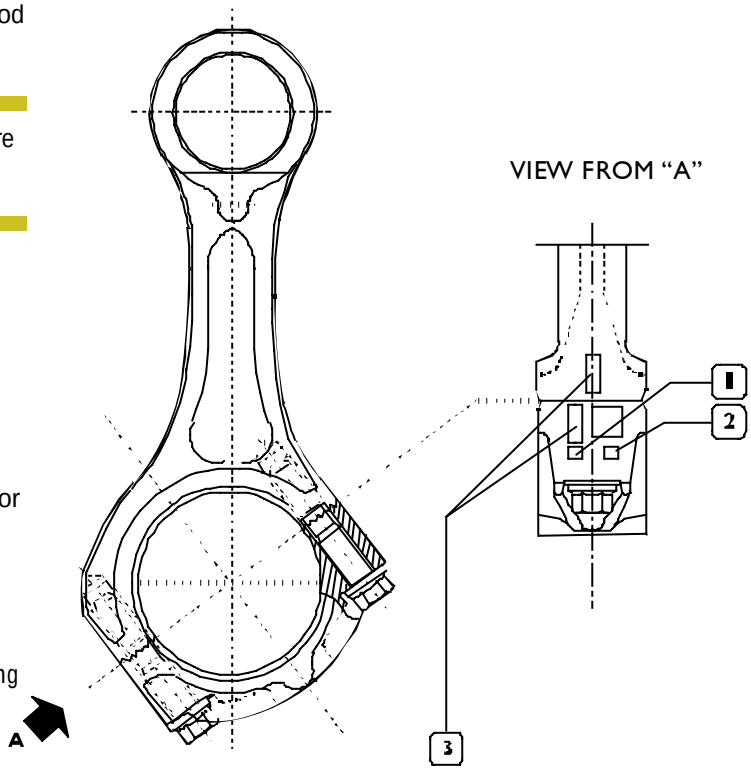
1 Letter indicating the weight class:

A = 2865 to 2895 g.
B = 2896 to 2925 g.
C = 2926 to 2955 g.

2 Number indicating the selection of diameter for the big end bearing housing:

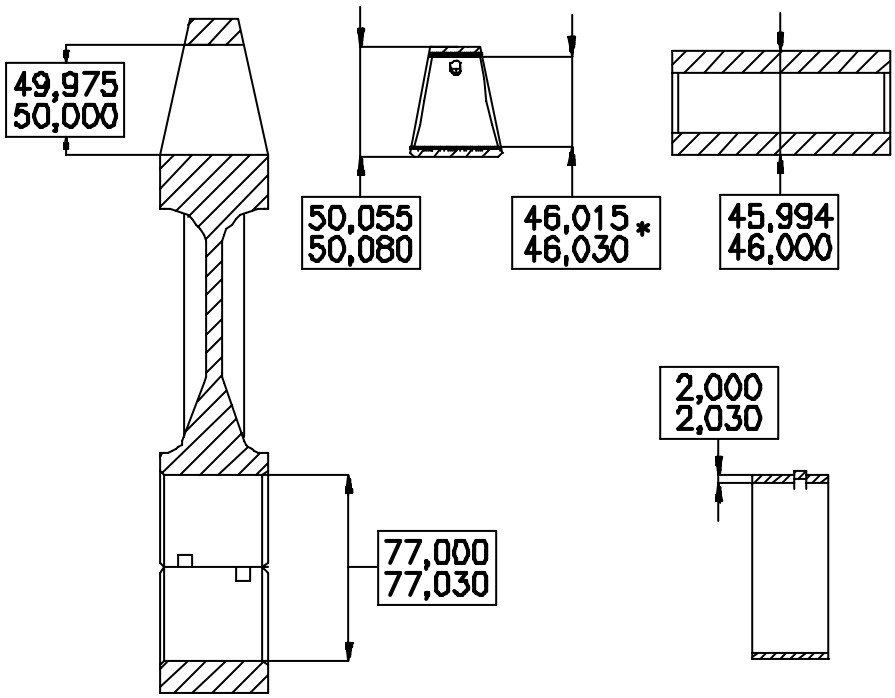
1 = 77.000 to 77.010 mm
2 = 77.011 to 77.020 mm
3 = 77.021 to 77.030 mm

3 Numbers identifying cap-connecting rod coupling




117178

Figure 102



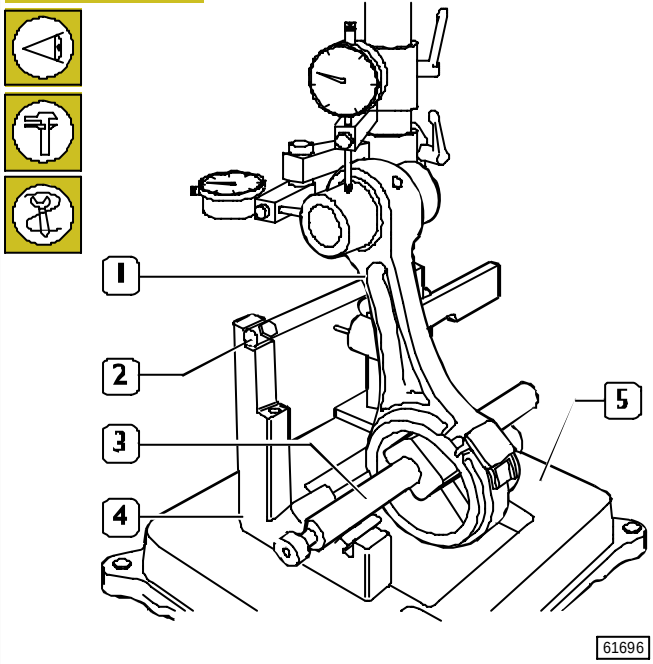

44927

MAIN DATA - BUSH, CONNECTING ROD, PIN AND HALF-BEARINGS
* Values to be obtained after installing the bush

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## Checking connecting rod squareness

Figure 103 (Demonstration)



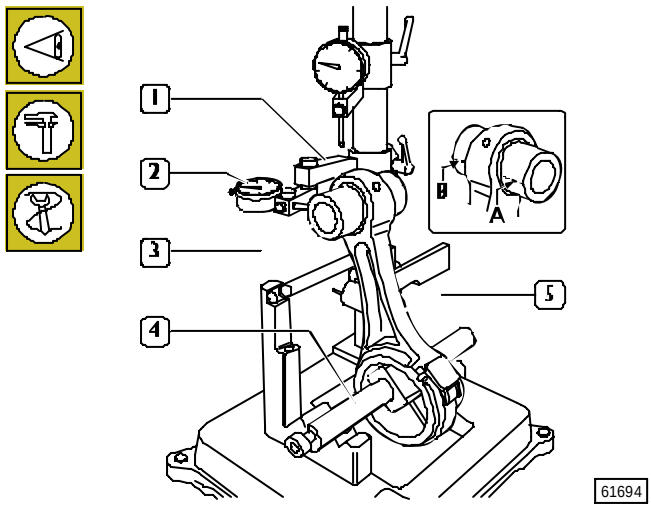

Checking axis alignment

Check the alignment of the axes of the connecting rods (1) using a suitable device (5), proceeding as follows:

- Fit the connecting rod (1) on the spindle of the tool (5) and lock it with the screw (4).
- Set the spindle (3) on the V-prisms, resting the connecting rod (1) on the stop bar (2).

Checking torsion

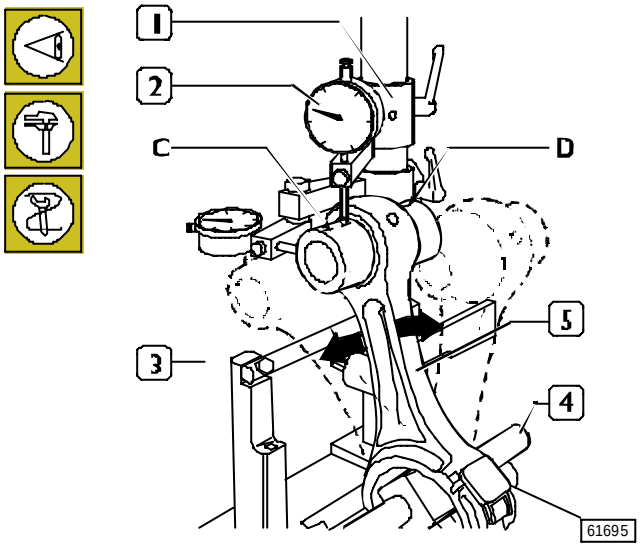
Figure 104 (Demonstration)




Check the torsion of the connecting rod (5) by comparing two points (A and B) of the pin (3) on the horizontal plane of the axis of the connecting rod.
Position the mount (1) of the dial gauge (2) so that this pre-loads by approx. 0.5 mm on the pin (3) at point A and zero the dial gauge (2). Shift the spindle (4) with the connecting rod (5) and compare any deviation on the opposite side B of the pin (3): the difference between A and B must be no greater than 0.08 mm.

Checking bending

Figure 105 (Demonstration)




Check the bending of the connecting rod (5) by comparing two points C and D of the pin (3) on the vertical plane of the axis of the connecting rod.
Position the vertical mount (1) of the dial gauge (2) so that this rests on the pin (3) at point C.
Swing the connecting rod backwards and forwards seeking the highest position of the pin and in this condition zero the dial gauge (2).
Shift the spindle (4) with the connecting rod (5) and repeat the check on the highest point on the opposite side D of the pin (3). The difference between point C and point D must be no greater than 0.08 mm.

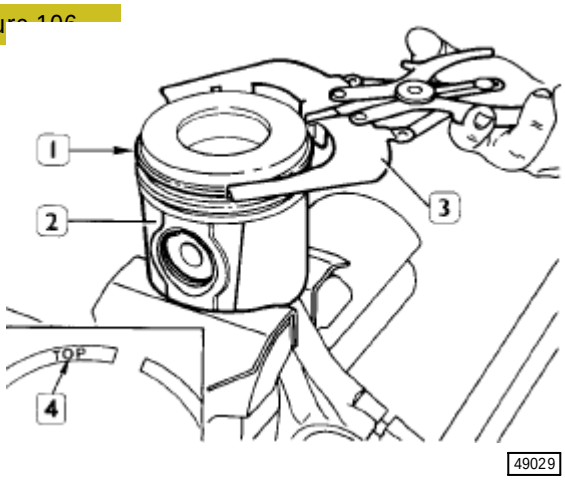
## Fitting the connecting rod - piston assembly

Carry out the steps for removal described on pages 68 and 69 in reverse order.

**NOTE** The connecting rod screws can be reused as long as the diameter of the thread is not less than 13.4 mm.

## Fitting the piston rings

Figure 106

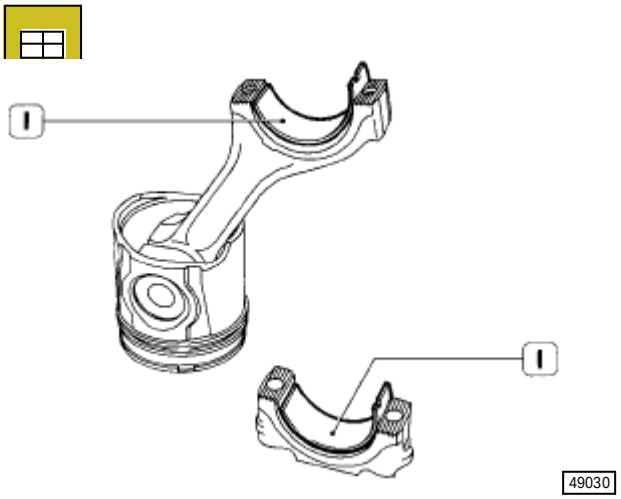



To fit the piston rings (1) on the piston (2) use the pliers 99360184 (3).
The rings need to be mounted with the word "TOP" (4) facing upwards. Direct the ring openings so they are staggered 120° apart.

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## Fitting the connecting rod-piston assembly into the cylinder liners

Figure 107



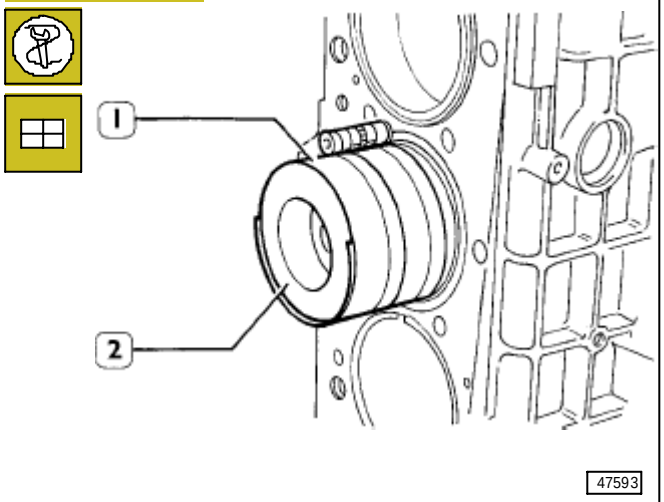

Fit the half-bearings (1), selected as described on pages 59 to 65, both on the connecting rod and on the stand.

**NOTE** As spares, class A pistons are provided and can be fitted also to cylinder liners belonging to class B.

Fit the connecting rod-piston assemblies (1) into the cylinder liners (2) using band 99360605 (1, Figure 109). Check the following:

- the rings gaps are offset by 120°;

Figure 109



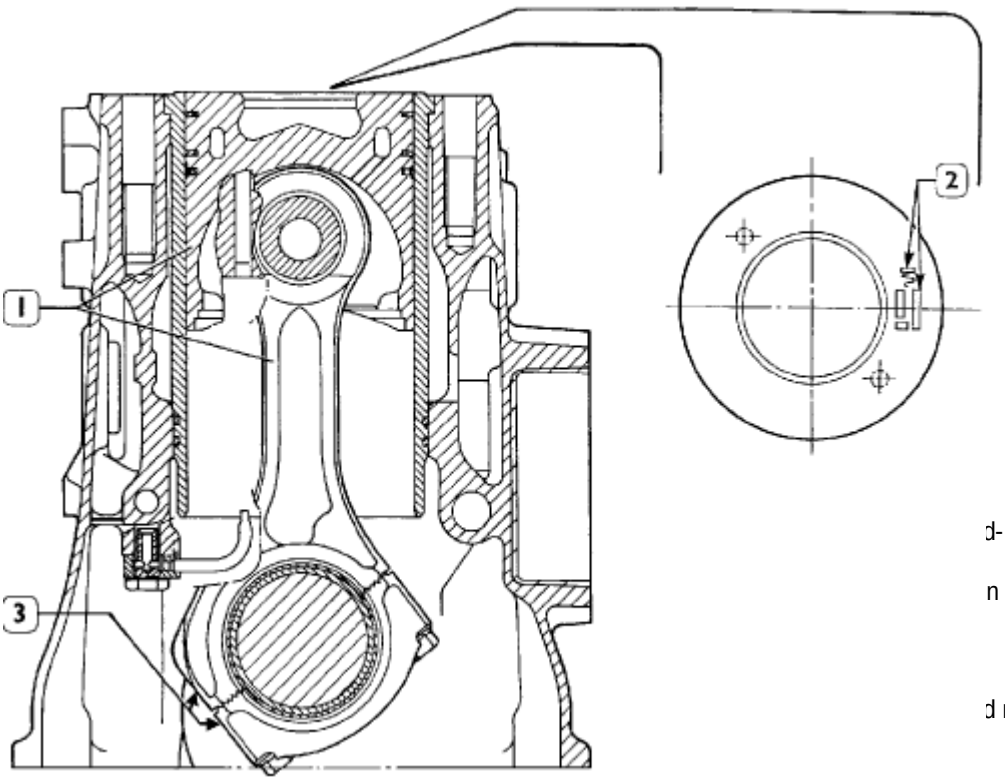

- all pistons belong to the same class, A or B;
- ideogram stamped on the piston crown is placed toward the engine flywheel, or the cavity, on the piston cover, corresponds to the position of the oil spray nozzles.

Be very careful that the connecting rod does not strike the cylinder walls.

### Piston protrusion check

Once assembly is complete, check piston protrusion from cylinder barrels: it must be 0.32-0.69 mm.

Figure 108




d-piston assembly

n the piston crown of ideogram assembly position and the

d marking area (see Figure 101).

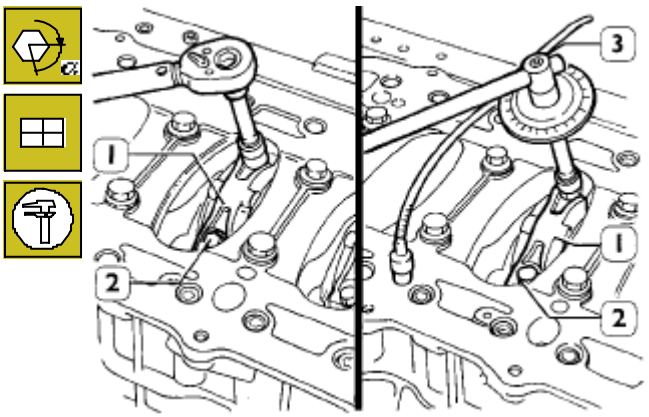
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## 540831 Checking assembly clearance of big end pins

To check the clearance proceed as follows:

Connect the connecting rods to the relative main journals, place a length of calibrated wire on the latter.

Figure 110




47594

Install the connecting rod caps (1) with half-bearings; tighten the connecting rod cap fixing screws (2) to 50 Nm (5 kgm) torque. By tool 99395216 (3), tighten the screws further at 40° angle.

Remove the caps and check the clearance by comparing the width of the calibrated wire with the scale calibration on the envelope containing the wire.

## 540610 CYLINDER HEAD

Before dismounting cylinder head, check cylinder head for hydraulic seal by proper tooling; in case of leaks not caused by cup plugs or threaded plugs, replace cylinder head.

When replacing, the cylinder head is supplied as a spare part with a threaded plug, which must be removed during assembly.

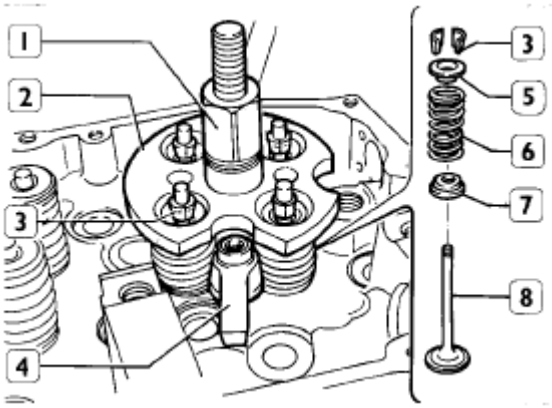
**NOTE** In case of plugs dismounting/replacement, on mounting, apply sealant Loctite 270 on plugs.

### Dismounting the valves

**NOTE** Before dismounting cylinder head valves, number them in view of their remounting in the position observed on dismounting should they not have to be overhauled or replaced.

Intake valves are different form exhaust valves in that they have a notch placed at valve head centre.

Figure 111

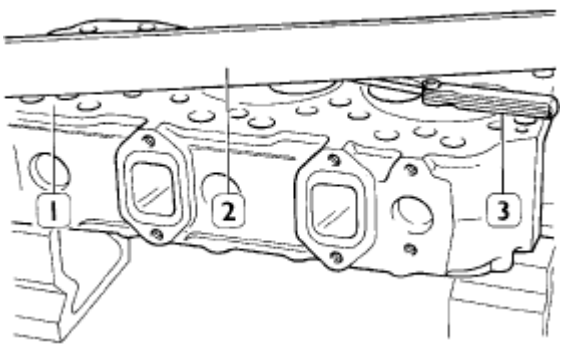



47583

Install and fix tool 99360264 (2) with bracket (4); tighten by lever (1) until cotters are removed (3); remove the tool (2) and the upper plate (5), the spring (6) and the lower plate (7). Repeat the operation on all the valves. Turn the cylinder head upside down and remove the valves (8).

### Checking the planarity of the head on the cylinder block

Figure 112 (Demonstration)




36159

The planarity (1) is checked using a ruler (2) and a feeler gauge (3). If deformations exist, surface the head using proper surface grinder; the maximum amount of material to be removed is 0.2 mm.

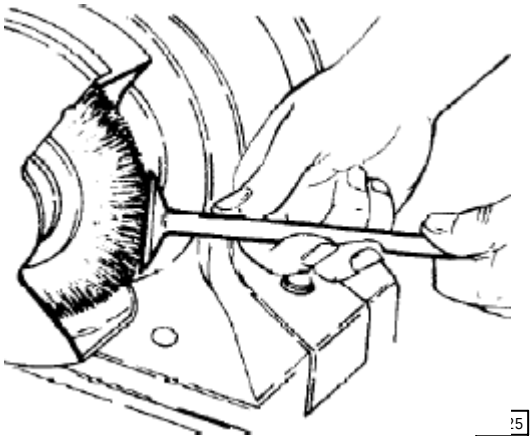
**NOTE** After leveling, make sure that valve sinking and injector protrusion are as described in the relative paragraph.

Aquila Trucks Centres

## 540622 VALVE

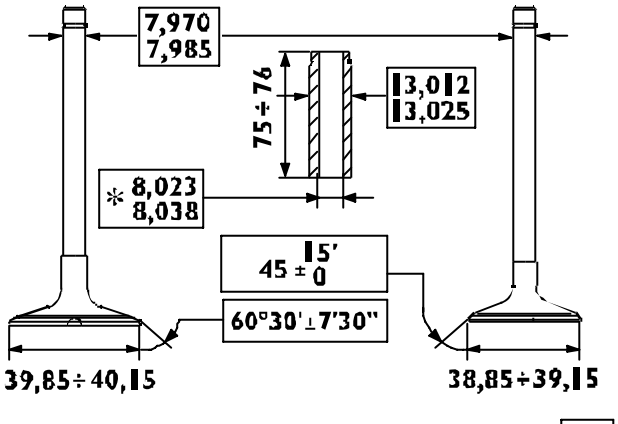
### Removing dust and checking the valves

Figure 113



Remove carbon dust using the metal brush supplied. Check that the valves show no signs of seizure or cracking. Check the diameter of the valve stem using a micrometer (see Figure 114) and replace if necessary.

Figure 114



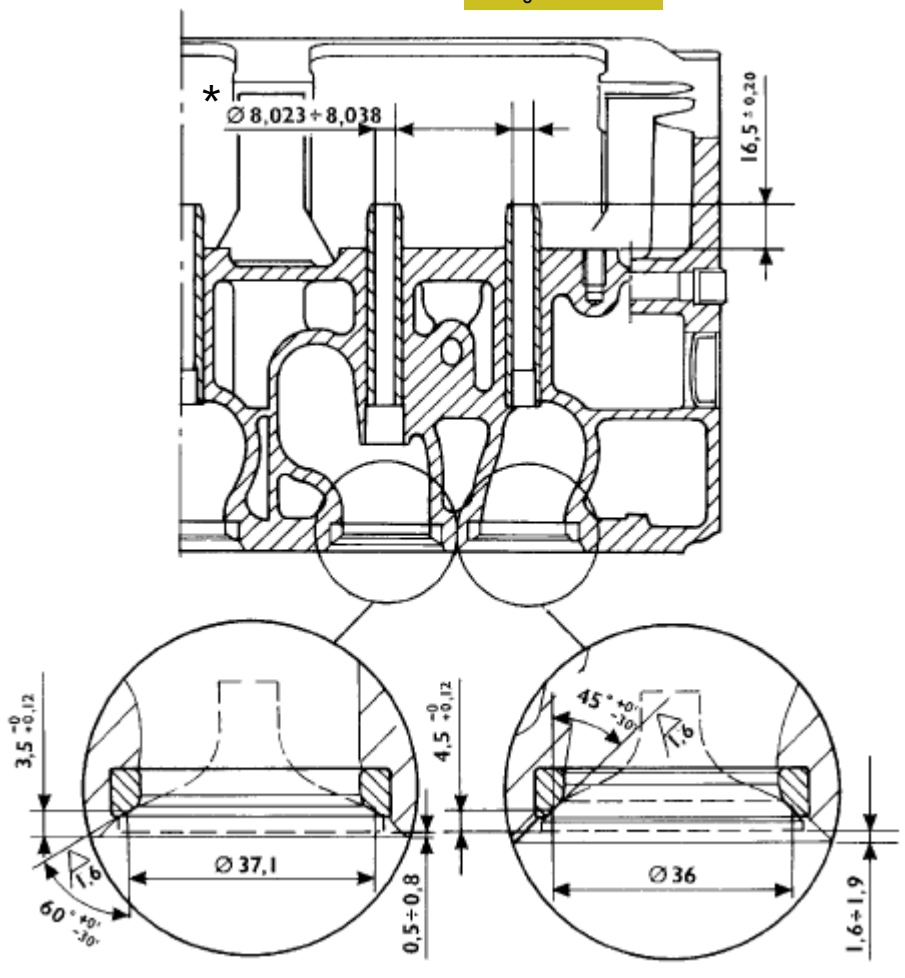

MAIN DATA - VALVES AND VALVE GUIDES

* Values to be obtained after installing the valve guides

Check, by means of a micrometer, that valve stem diameters are as specified; if necessary, grind the valves seat with a grinder, removing the minimum quantity of material.

## 540667 VALVE GUIDES

Figure 115




INSTALLATION DIAGRAM FOR VALVE GUIDES AND VALVES

* Values to be obtained after installing the guide valves

Aquila Trucks Centres

## 540613 REPLACING INJECTOR HOLDERS

### Replacing of valve guides

Remove valve guides by means of tool 99360288.

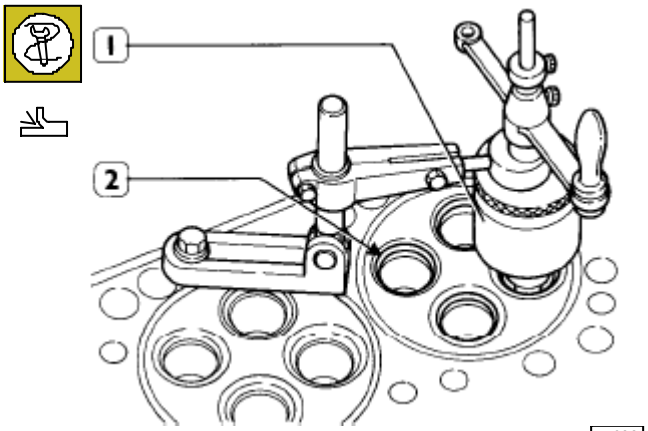
Install by means of tool 99360288 equipped with part 99360294, which determines the exact installation position of valve guides into the cylinder heads; if they are not available, install the valve guides in the cylinder head so that they project out by mm 16.3 to 16.7 (Figure 114).

After installing the valve guides, smooth their holes with sleeker 99390310.

### Replacing - Reaming the valve seats

To replace the valve seats, remove them using the appropriate tool.

Figure 116 (Demonstration)




Ream the valve seats (2) on cylinder head using a suitable tool (1).

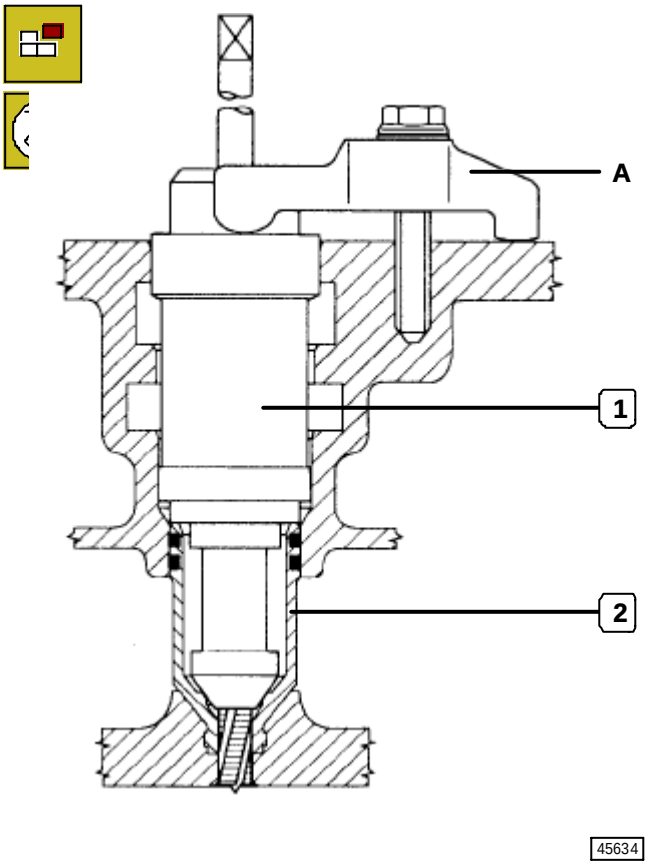
**NOTE** Valve seats must be reamed whenever valves or valve guides are replaced or ground.

After reaming the valve seats, use tool 99370415, to make sure that the valve position, with respect to the cylinder head surface, is the following:

- -0.5 to -0.8 mm (recessing) of exhaust valves;
- -1.6 to 1.9 mm (recessing) of discharge valves.

### Removal

Figure 117



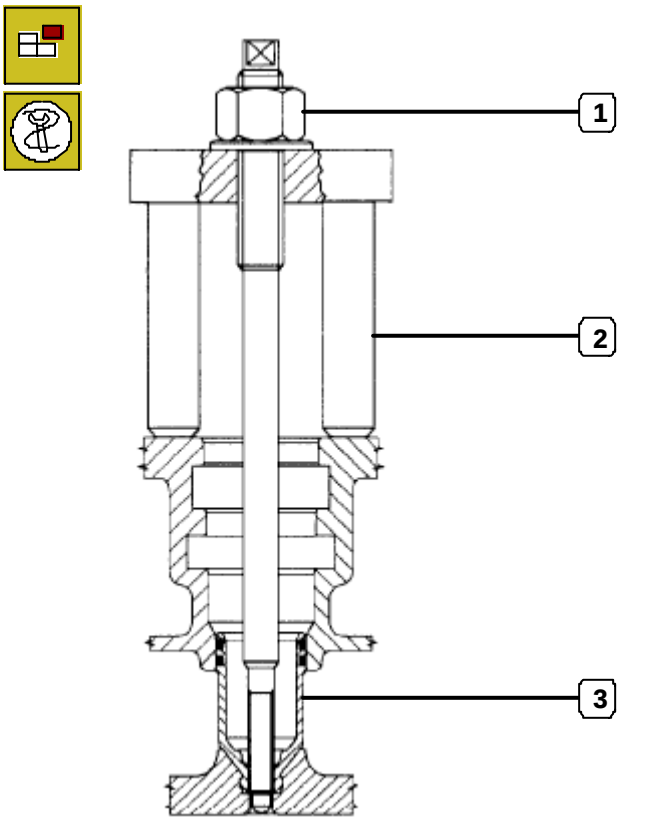

To replace the injector holder (2), act as follows:

- thread the holder (2) with tool 99390804 (1).

Carry out operations described in figs. 118-121-122-123 - 124 by fixing tools to the cylinder head by means of braket A.

Aquila Trucks Centres

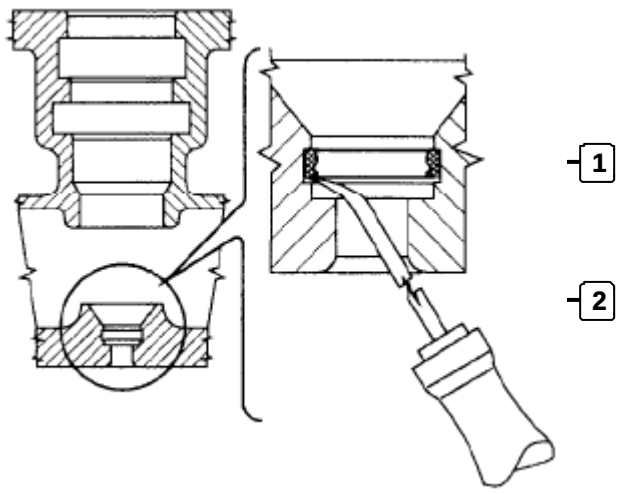
Figure 118




45631

- fasten extractor 99342149 (2) to case (3), by tightening the nut (1), and pull out the case from cylinder head.

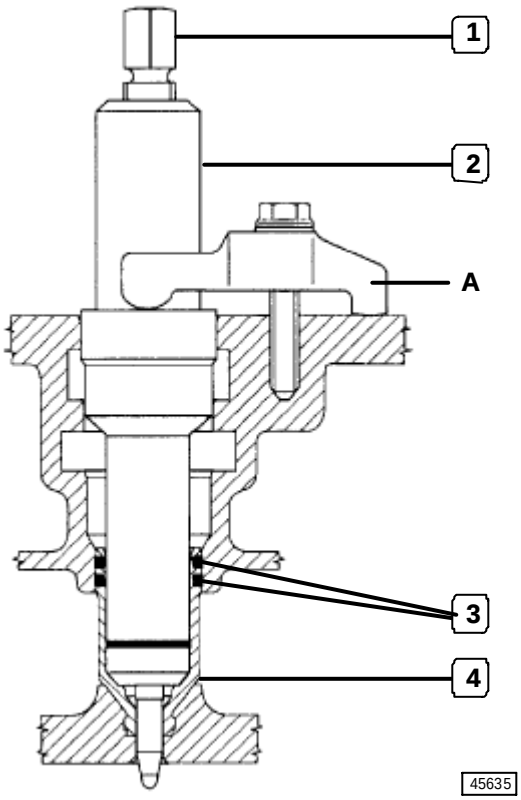
Figure 119




45633

- Remove any residue (1), with tool 99390772 (2), from the cylinder head groove.

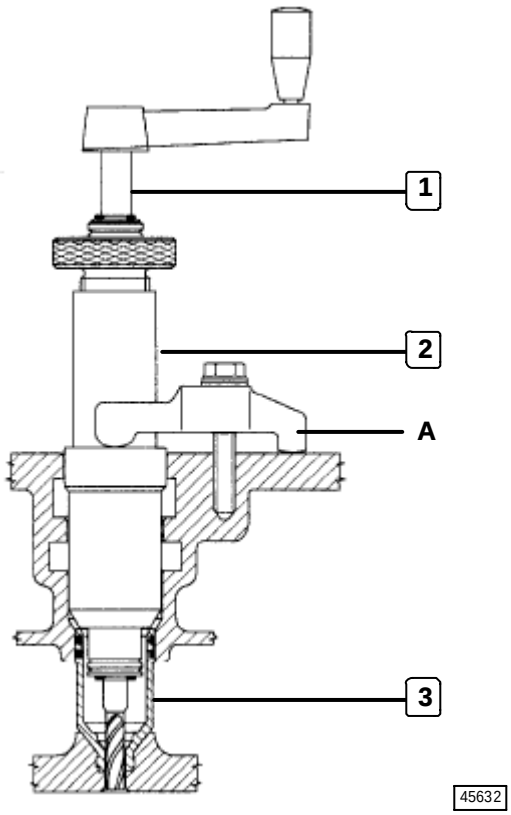
Figure 1




45635

- Lubricate sealing rings (3) and fit them to the case (4); fix tool 99360554 (2) to the cylinder head by means of bracket A, install the new case, tighten the screw (1), upsetting the case lower part.

Figure 121

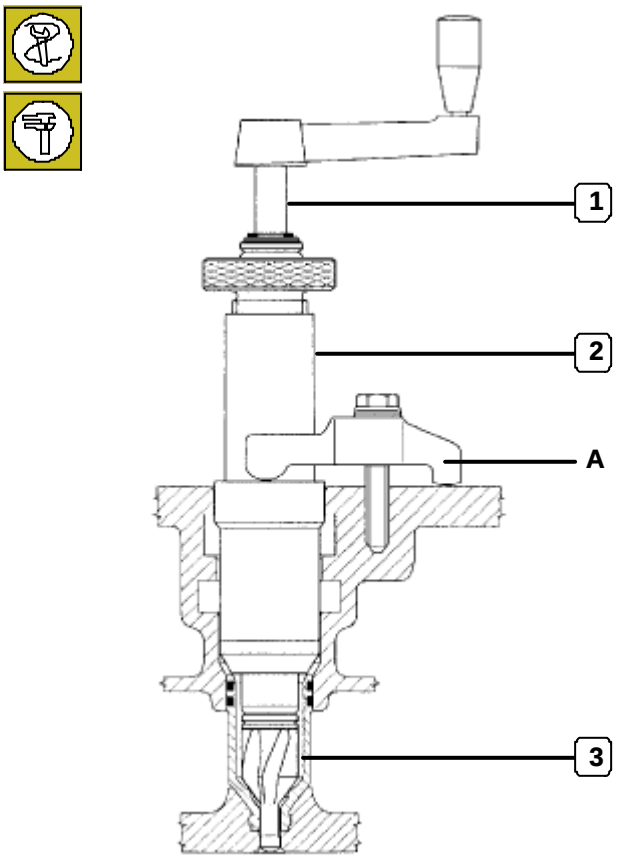



45632

- Adjust the casing hole (3) with borer 99394043 (1) and guide bushing 99394014 (2).

Aquila Trucks Centres

Figure 122

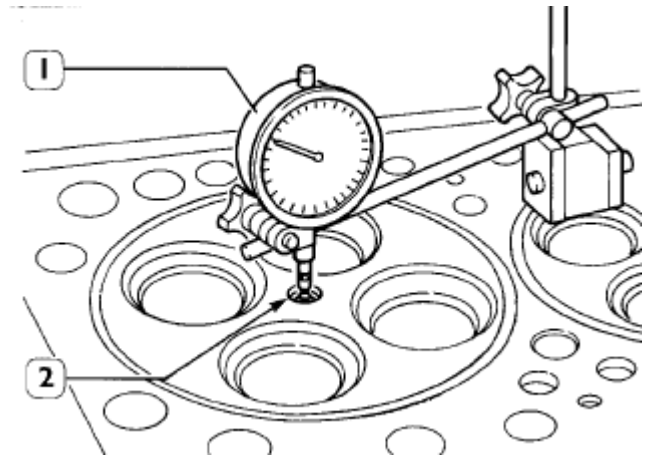



45636

- Through miller 99394041 (1) and bushing 99394014 (2), ream the injector seat in the holder (3), check the injector protrusion from the cylinder head plane which must be 0.7 mm.

## Checking protrusion of injectors

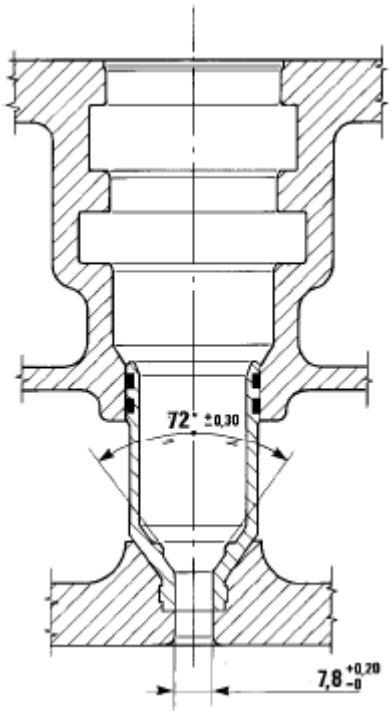
Figure 123




47585

Using dial gauge (1), check the protrusion of the injector (2) which must be 0.7 mm.

Figure 124




44909

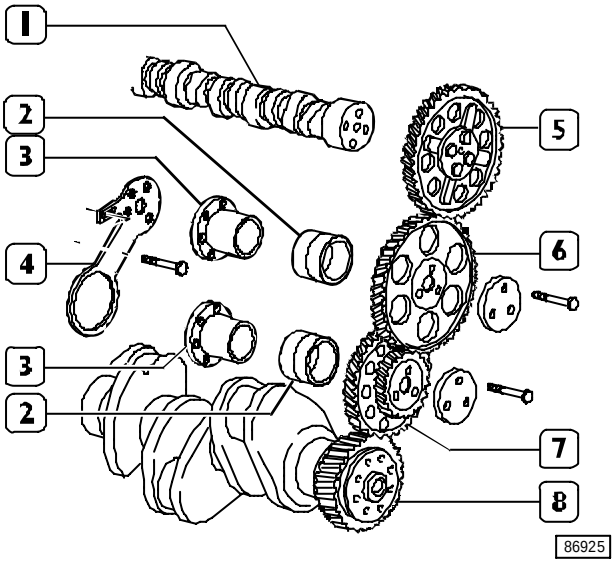
INSTALLATION DIAGRAM FOR INJECTOR HOLDER

Aquila Trucks Centres

# 5412 TIMING GEAR

## Camshaft drive

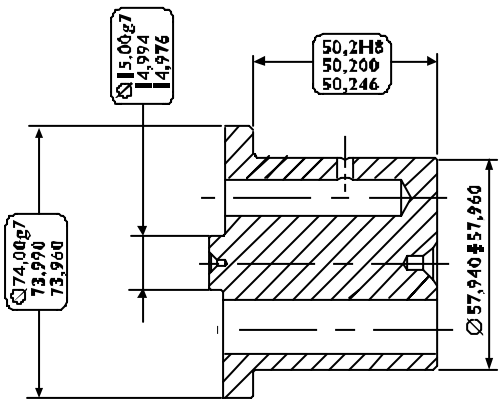
Figure 125




TIMING CONTROL COMPONENT PARTS
1. Camshaft - 2. Bushing - 3. Pin - 4. Articulated rod - 5. Camshaft control gear - 6. Idler gear - 7. Twin idler gear - 8. Drive shaft driving gear.

## 541253 Intermediate gear pin

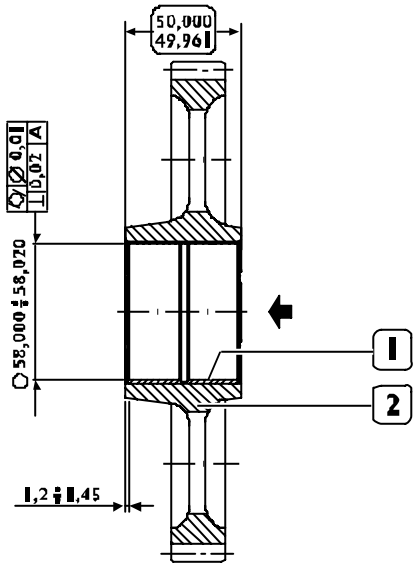
Figure 126




Rated assembling play between idler gear bushings and pins: 0.040 ÷ 0.080 mm.

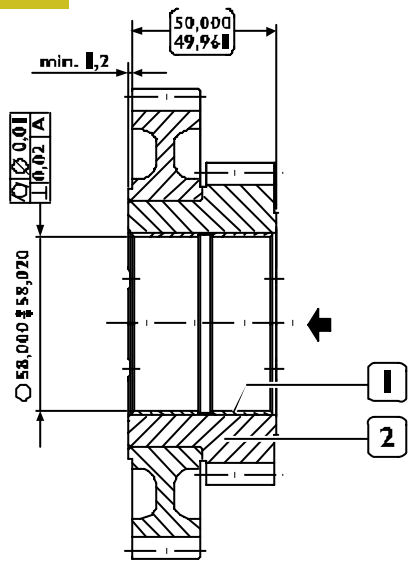
## 541252 Idler gear

Figure 127




## 541252 Twin idler gear

Figure 128




## 541254 Replacing the bushings

Bushings (1, Figures 128 - 129) can be replaced when they are worn. Put up the bushing, then grind it so as to bring it to a dimension of ∅ 58.010 ± 0.10 mm.

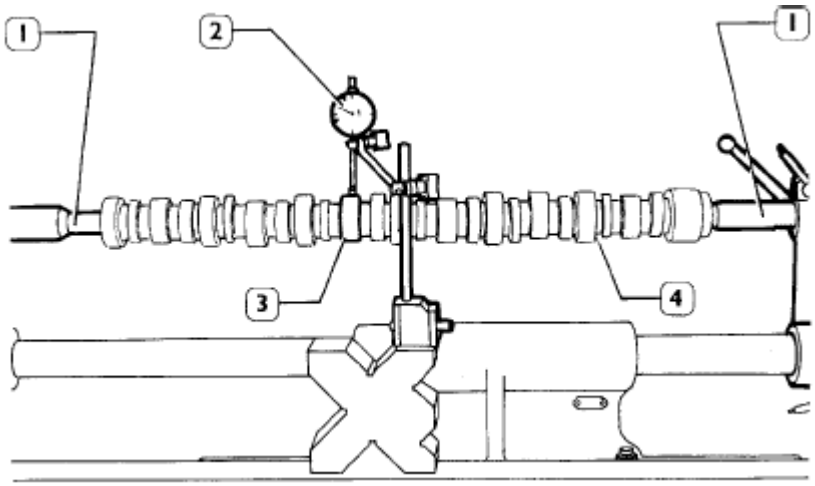
**NOTE** Bushings must be forced into gears (2, Figures 128 - 129) by following the direction of the arrow: they must be positioned at the level shown in the figures.

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Aquila Trucks Centres

## 541210 Camshaft

### 541211 Checking cam lift and pin alignment

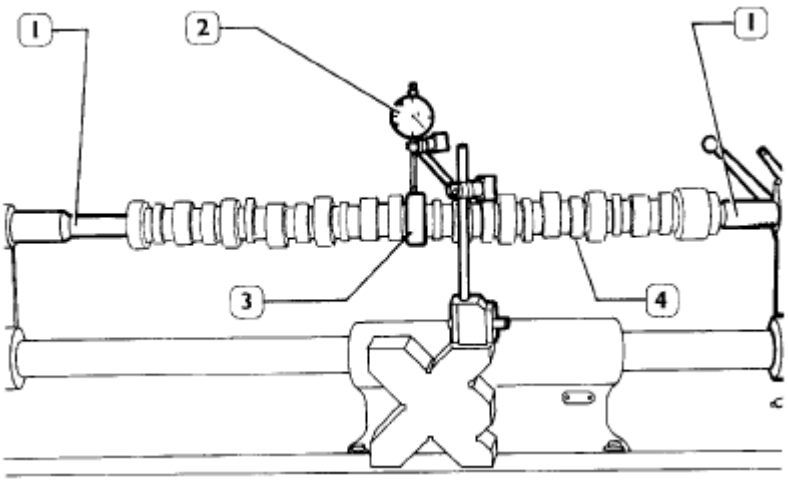
Figure 129




47506

Place the camshaft (4) on the tailstock (1) and check cam lift (3) using a centesimal gauge (2); values are shown in table on page 19.

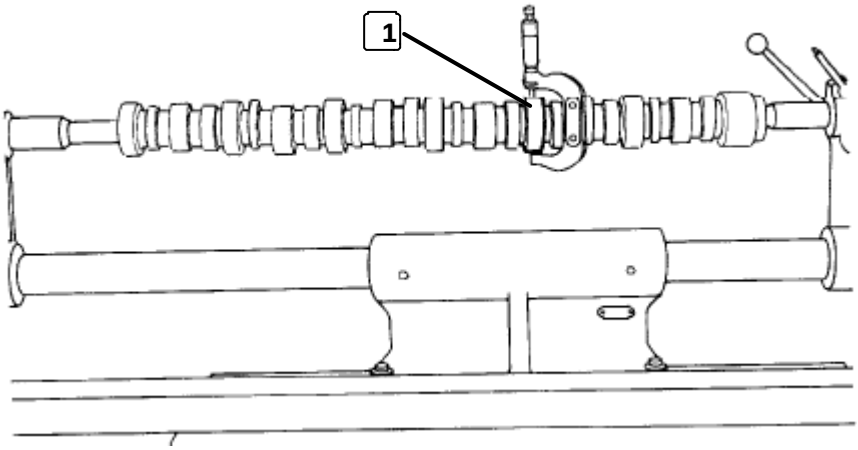
Figure 130




47507

When the camshaft (4) is on the tailstock (1), check alignment of supporting pin (3) using a centesimal gauge (2); it must not exceed 0.030 mm. If misalignment exceeds this value, replace the shaft.

Figure 131

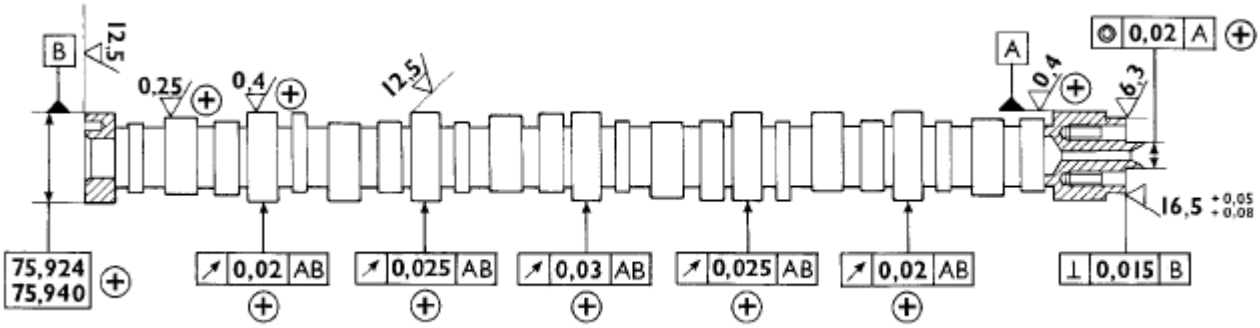



47505

In order to check installation clearance, measure bush inner diameter and camshaft pin (1) diameter; the real clearance is obtained by their difference.
If clearance exceeds 0.150 mm, replace bushes and, if necessary, the camshaft.

Aquila Trucks Centres

Figure 132



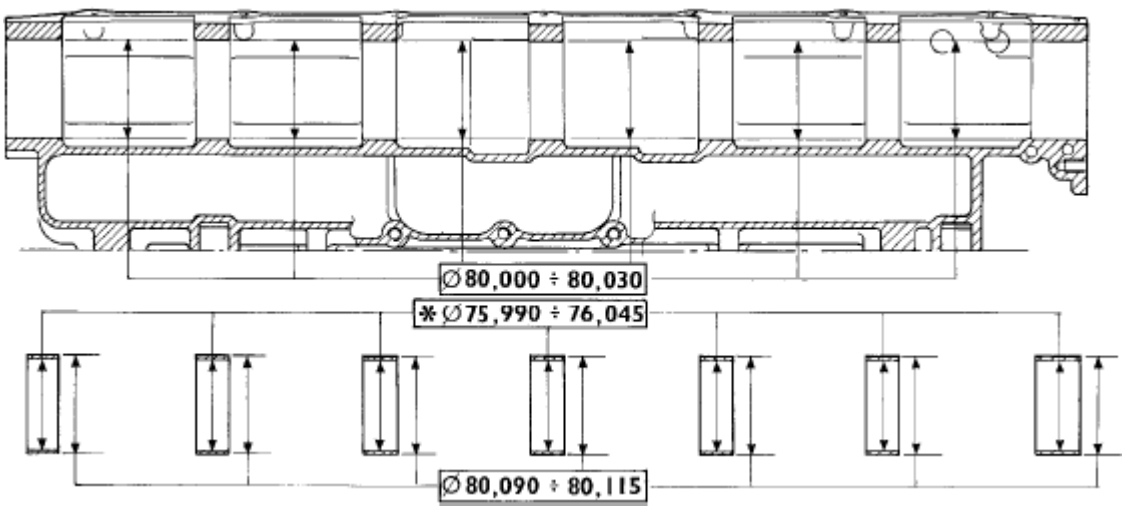

MAIN DATA - CAMSHAFT AND TOLERANCES

The surfaces of shaft supporting pin and cams must be extremely smooth; if you see any sign of seizing or scoring, replace the shaft and the relative bushes.

| TOLERANCES | TOLERANCE CHARACTERISTIC | SYMBOL |
|---|---|---|
| ORIENTATION | Perpendicularity | ⊥ |
| POSITION | Concentricity or coaxial alignment | ◎ |
| OSCILLATION | Circular oscillation | ↗ |
| IMPORTANCE CLASS ASSIGNED TO PRODUCT CHARACTERISTICS | | SYMBOL |
| CRITICAL | | ⊜ |
| IMPORTANT | | ⊕ |
| SECONDARY | | ⊖ |

## 541213 Bushes

Figure 133




MAIN DATA - CAMSHAFT BUSHES AND RELATIVE BLOCK SEATS

* Bush inner diameter after installation

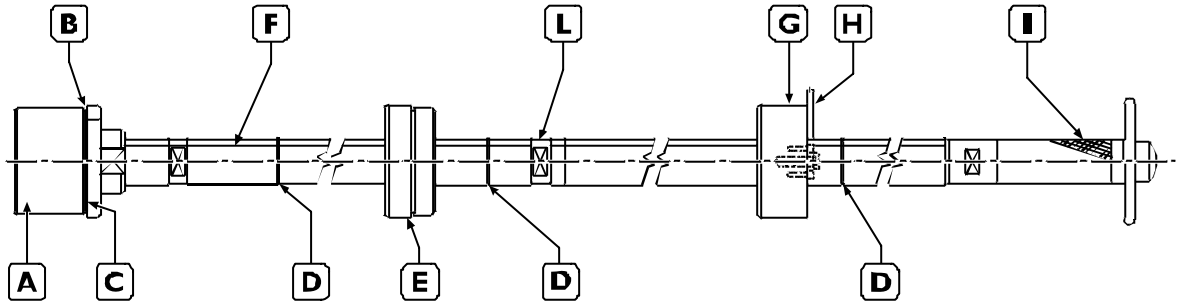
The bush surfaces must not show any sign of seizing or scoring; if they do replace them.

Measure the bush inner diameters with a baremeter and replace them, if the value measured exceeds the tolerance value.
To take down and fit back the bushes, use the proper tool 99360487.

Aquila Trucks Centres

## 541213 Replacing camshaft bushes using beater 99360487

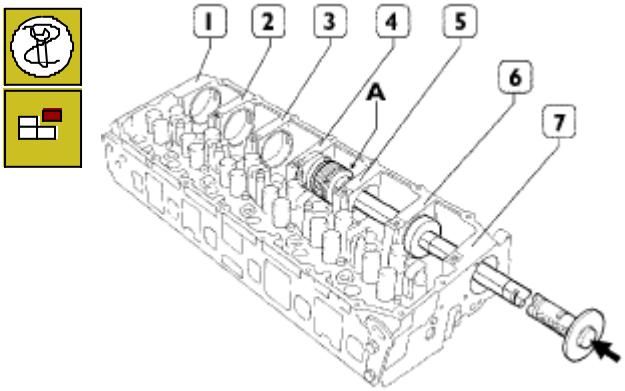
Figure 134




A. Drift with seat for bushings to insert/extract. - B. Grub screw for positioning bushings. - C. Reference mark to insert seventh bushing correctly. - D. Reference mark to insert bushings 1, 2, 3, 4, 5, 6 correctly (red marks). - E. Guide bushing. - F. Guide line. - G. Guide bushing to secure to the seventh bushing mount. - H. Plate fixing yellow bushing to cylinder head. - I. Grip. - L. Extension coupling.

### Removal

Figure 135

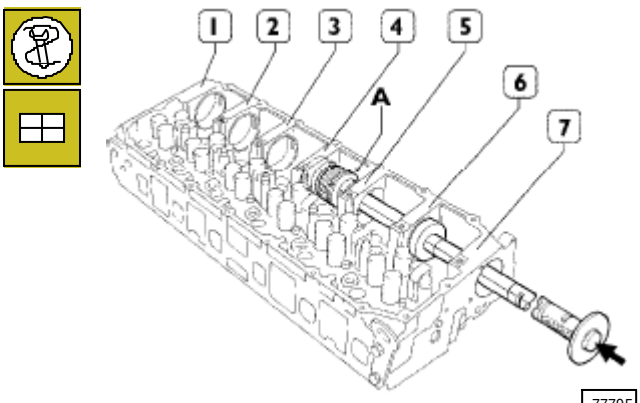



Rear

The sequence for removing the bushings is 7, 6, 5, 4, 3, 2, 1.
The bushings are extracted from the front of the single seats.
Removal does not require the drift extension for bushings 5, 6 and 7 and it is not necessary to use the guide bushing.
For bushings 1, 2, 3 and 4 it is necessary to use the extension and the guide bushings.
Position the drift accurately during the phase of removal.

### Assembly

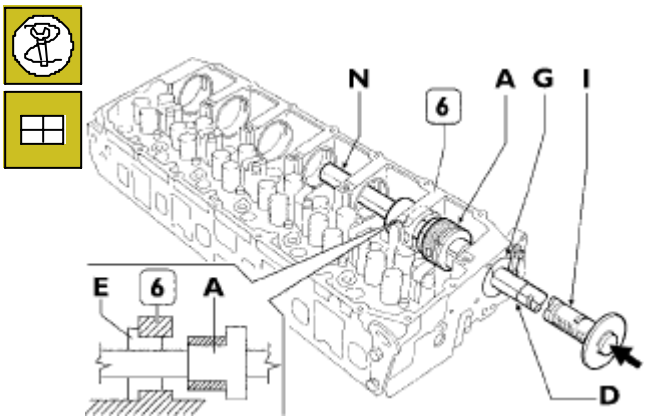
Figure 136




Assemble the drift together with the extension.
To insert bushings 1, 2, 3, 4 and 5, proceed as follows:

1 Position the bushing to insert on the drift (A) making the grub screw on it coincide with the seat (B) (Figure 134) on the bushing.
2 Position the guide bushing (E) and secure the guide bushing (G) (Figure 134) on the seat of the 7th bushing with the plate (H).
3 While driving in the bushing, make the reference mark (F) match the mark (M). In this way, when it is driven home, the lubrication hole on the bushing will coincide with the oil pipe in its seat.
The bushing is driven home when the 1st red reference mark (D) is flush with the guide bushing (G).

Figure 137



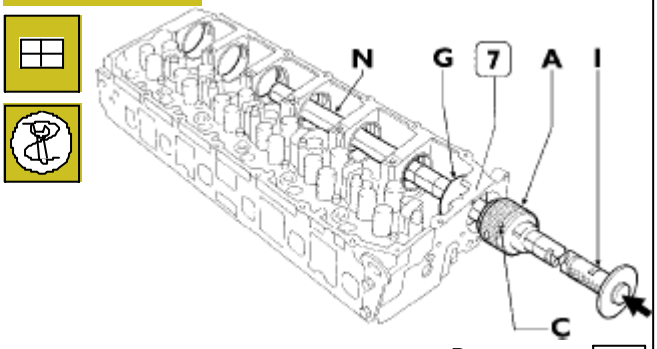

Rear

To insert the bushing (6), proceed as follows:

- Unscrew the grip (I) and the extension (N).
- Position the extension (N) and the guide bushing (E) as shown in the figure.
- Repeat steps 1, 2, 3.

Aquila Trucks Centres

Figure 138



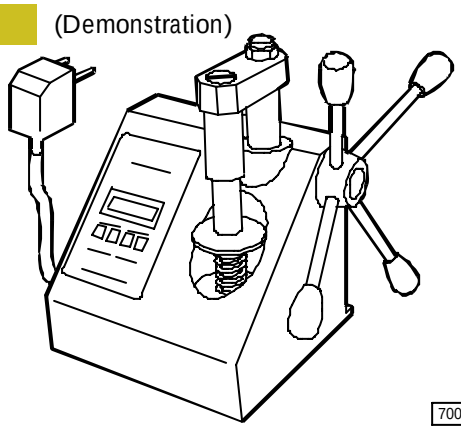

Rear 71724

To insert bushing (7), proceed as follows:

- Unscrew the grip (I) and the extension (N).
- Refit the guide (G) from the inside as shown in the figure.
- Position the bushing on the drift (A) and bring it close up to the seat, making the bushing hole match the lubrication hole in the head. Drive it home.
  The 7th bushing is driven in when the reference mark (C) is flush with the bushing seat.

## 540665 VALVE SPRINGS

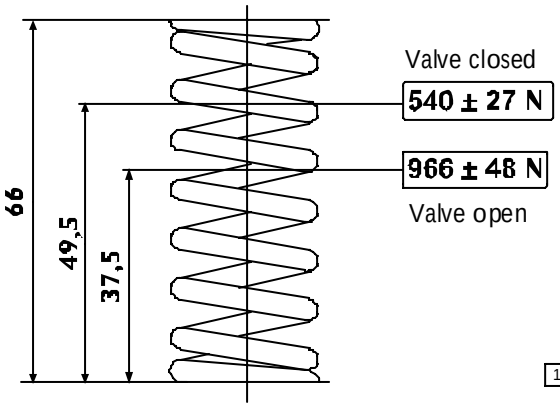
Figure 139 (Demonstration)



70000

Before assembly, the flexibility of the valve springs has to be checked using a suitable tool.
Compare the load and elastic deformation data with those of the new springs given in the following figure.

Figure 140

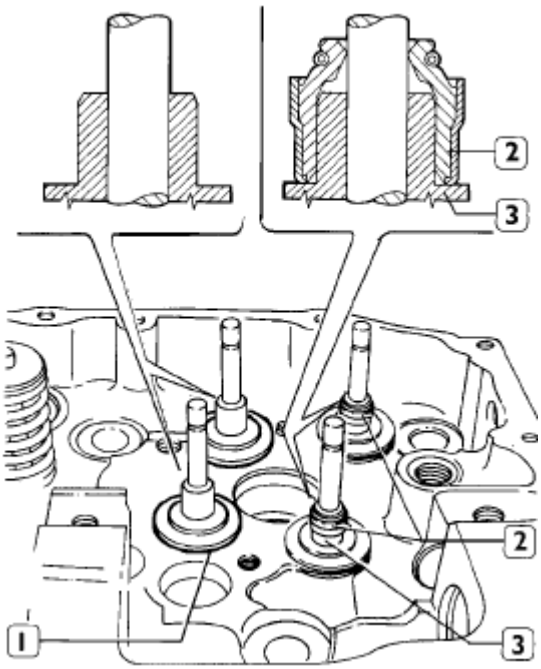



109107

MAIN DATA TO CONTROL EXHAUST AND DISCHARGE VALVE SPRING

## Fitting the valves and oil seal ring

Figure 141



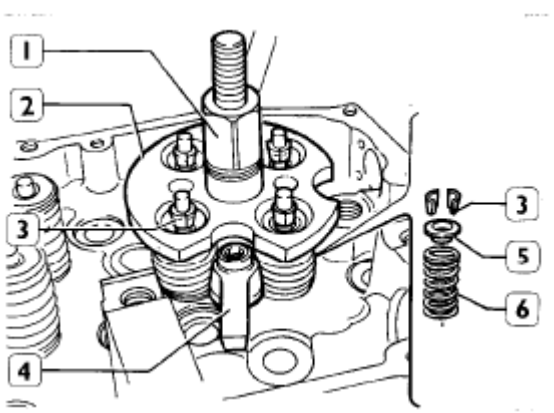

87051

Lubricate the valve stem and insert the valves in the respective valve guides; fit the lower caps (1). Use tool 99360329 to fit the oil seal (2) on the valve guides (3) of the exhaust valves; then, to fit the valves, proceed as follows.

**NOTE** Should valves not have been overhauled or replaced, remount them according to numbering performed on dismounting.

Intake valves are different form exhaust valves in that they have a notch placed at valve head centre.

Figure 142



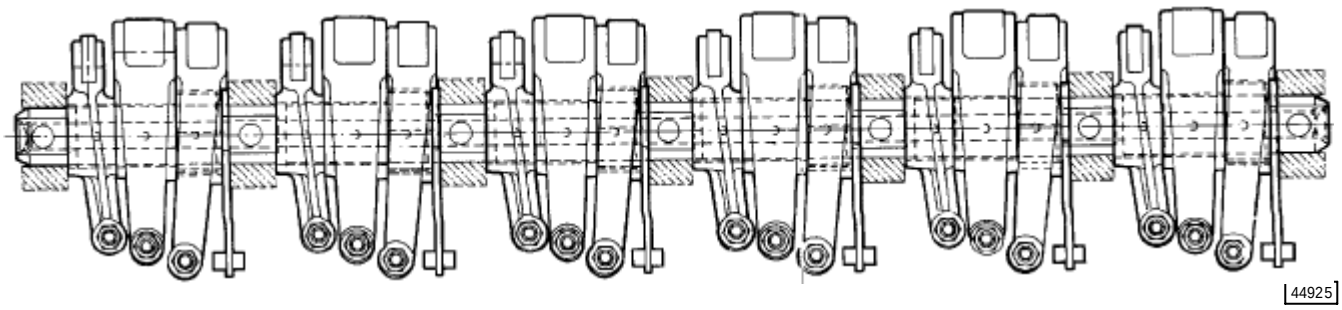

86290

- fit springs (6) and the upper plate (5);
- apply tool 99360264 (2) and block it with bracket (4); tighten the lever (1) until cotters are installed (3), remove tool (2).

Aquila Trucks Centres

## 5412 ROCKER SHAFT

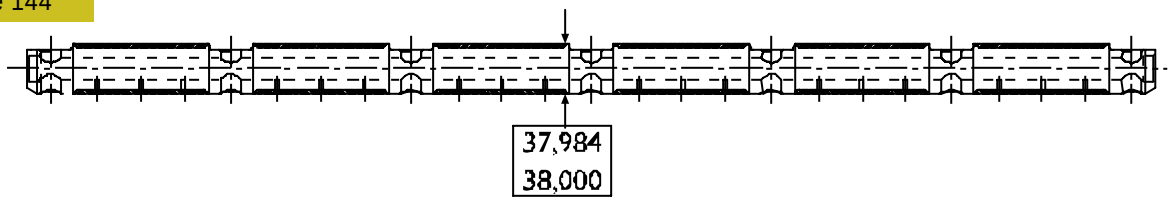
Figure 143




The camshaft cams directly control rockers: 6 for injectors and 12 for valves.
Injectors and intake valves control rocker arms are keyed on rocker arms shaft directly. Exhaust intake valves control rocker arms are keyed on rocker arms shaft putting in between the levers with engine brake control eccentric pin.
Rockers slide directly on the cam profiles via rollers. The other end acts on a bar directly supported by the two valves stems.
A pad is placed between the rocker adjusting screw and the bar. Two lubrication holes are obtained inside the rockers. The rocker shaft practically covers the whole cylinder head; remove it to have access to all the underlying components.

### Shaft

Figure 144

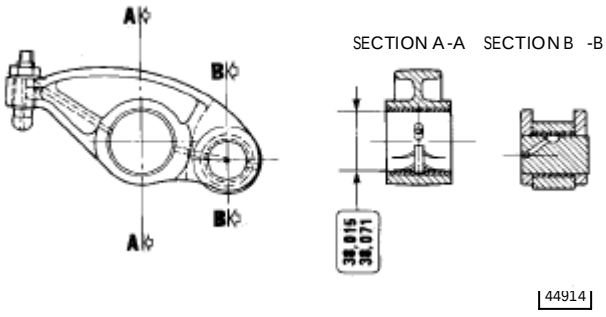



MAIN DATA OF THE ROCKER ARM SHAFT

Check that the surface of the shaft shows no scoring or signs of seizure; if it does, replace it.

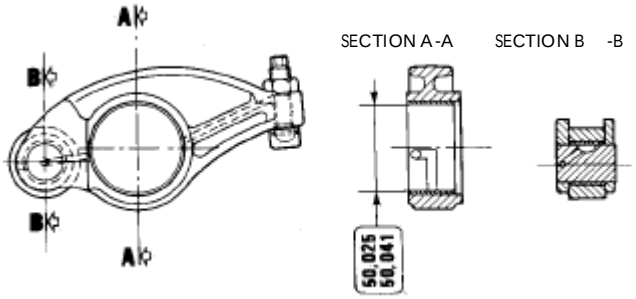
### Rocker

Figure 145



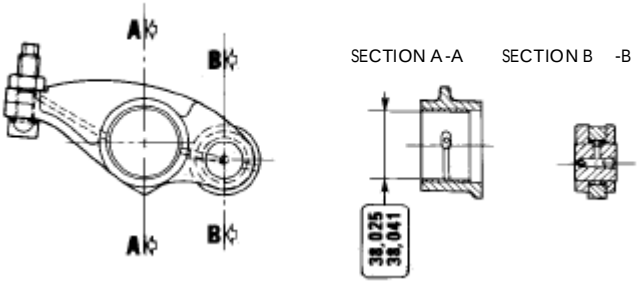

PUMP INJECTOR ROCKER

Figure 147



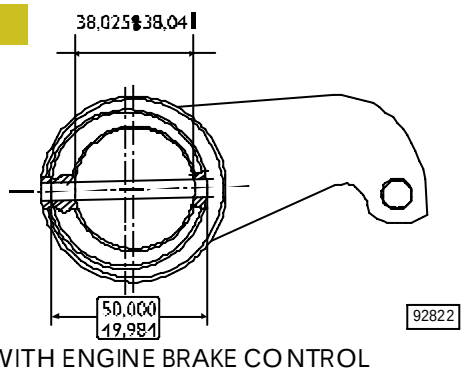

DISCHARGE VALVE ROCKER

Figure 146




EXHAUST VALVES ROCKER

Figure 148




LEVER WITH ENGINE BRAKE CONTROL ECCENTRIC PIN

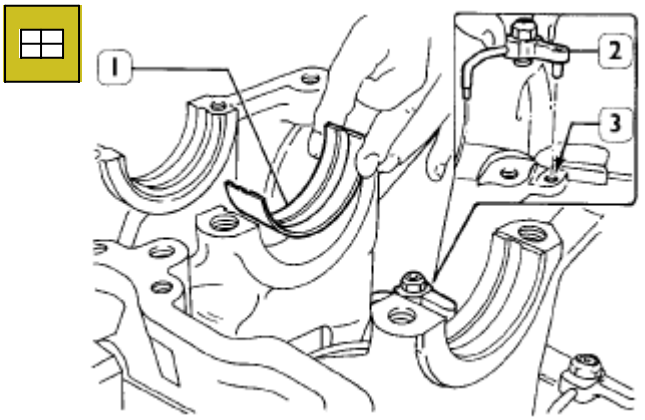
The bush surfaces must not show any trace of scoring of excessive wear; otherwise, replace bushes or the whole rocker.

Aquila Trucks Centres

## ASSEMBLING THE ENGINE

Fix the engine block to the stand 99322230 by means of brackets 99361035.
Install the cylinder liners as described in page 56.

Figure 149

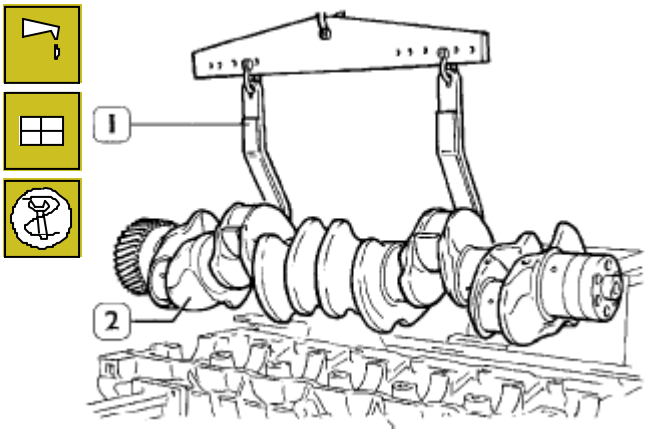



47586

Fit the oil spray nozzles (2), so that the dowel coincides with the block hole (3).

Place the half bearings (1) on the main bearings.

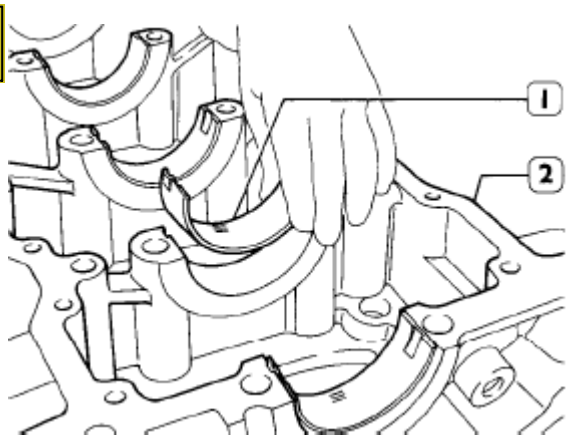
Figure 150




47570

Lubricate the half bearings, then install the crankshaft (2) by means of hoist and hook 99360500 (1).

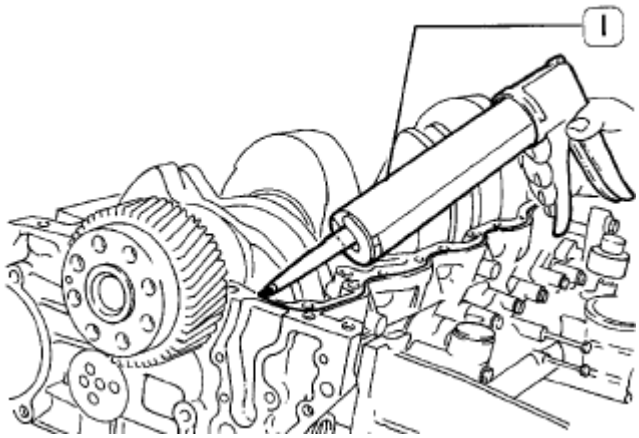
Figure 151




49021

Place the half-bearings (1) on the main bearings in the underblock (2).

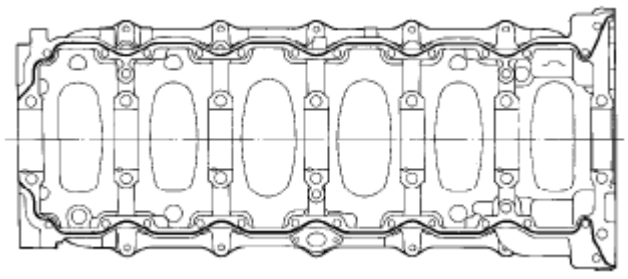
Figure 152




47595

By means of suitable equipment (1) apply silicone LOCTITE 5970 IVECO No. 2995644 to the block, as shown in the figure.

Figure 153



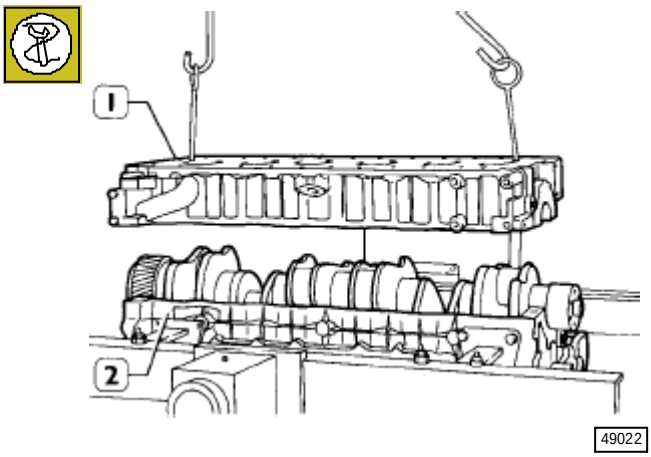
47596

Sealant application diagram

**NOTE** Fit the lower crankcase underblock within 10' of the application of the sealant.

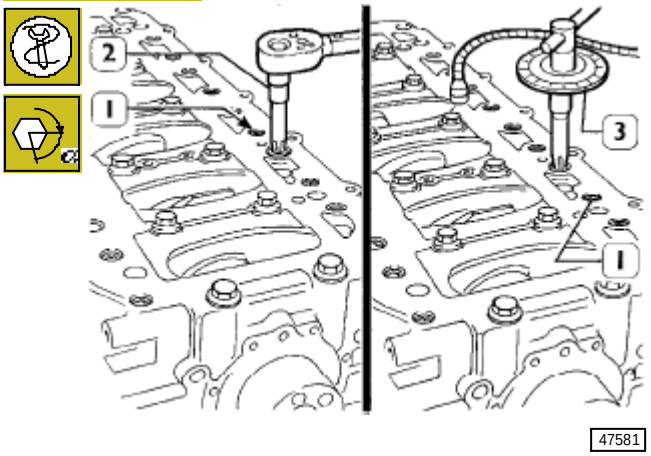
Aquila Trucks Centres

Figure 154




Fit the lower crankcase by means of a suitable hoist and hooks (1).

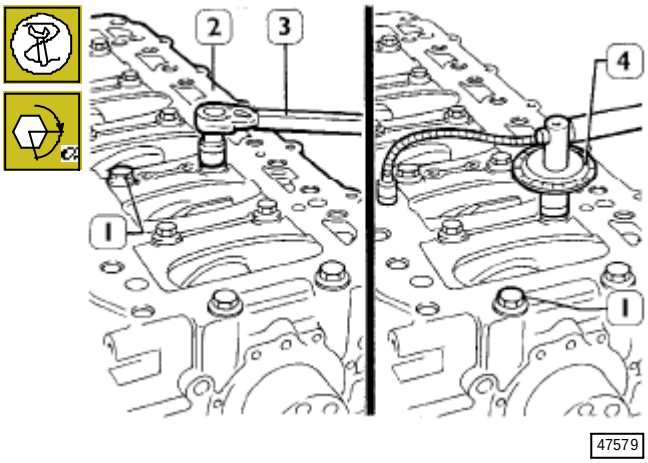
Figure 155




**NOTE** Use new screws whenever removing the bed-plate.

Fit the lower crankcase and use a torque wrench (2) to tighten the outer screws (1) to 25 Nm according to the diagrams on the following page.

Figure 156



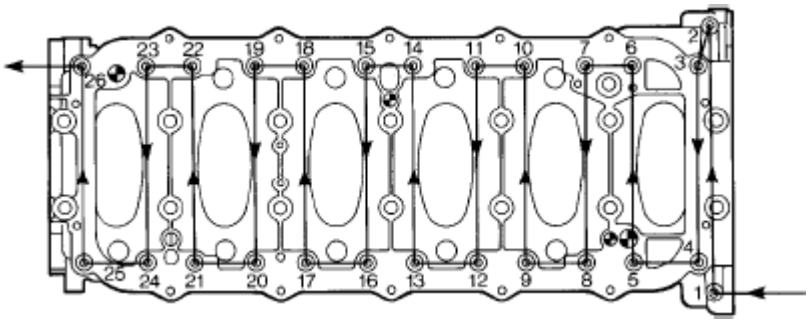

Tighten the inner screws (1) to 140 Nm torque by means of a torque wrench (3), then with two further angular phases 60° + 60°, using tool 99395216 (4). Tighten again the outer screws (1, Figure 155) with 90° angular closing, using tool 99395215 (3, Figure 155).

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## DIAGRAM SHOWING THE LOWER CRANKCASE FIXING SCREWS TIGHTENING ORDER

Figure 157

FRONT SIDE

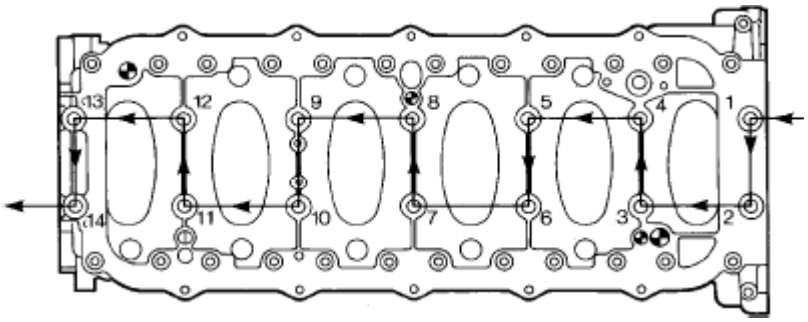



44897

First phase: outer screws preliminary tightening

(25 Nm)

FRONT SIDE

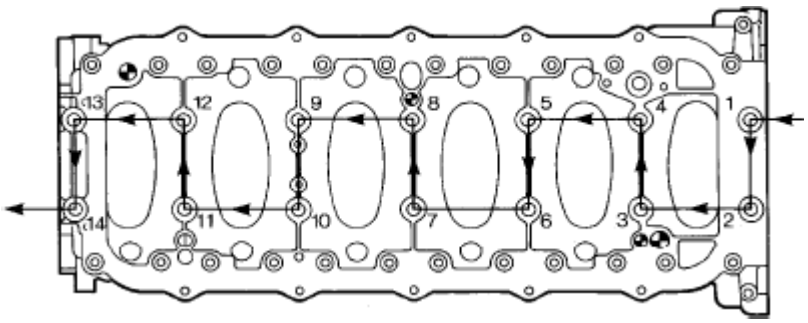



44898

Second phase: inner screws preliminary tightening

(140 Nm)

FRONT SIDE

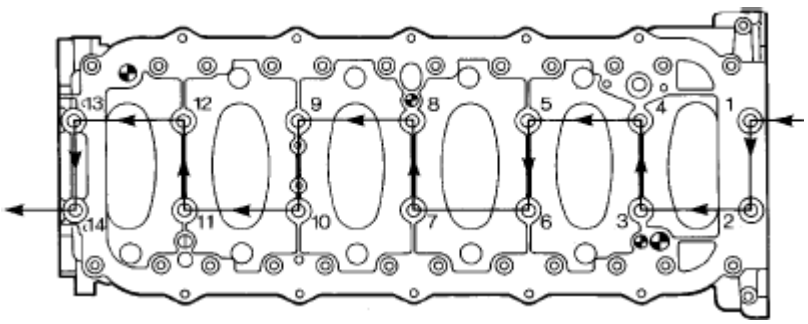



44898

Third phase: inner screws angle closing

(60°)

FRONT SIDE

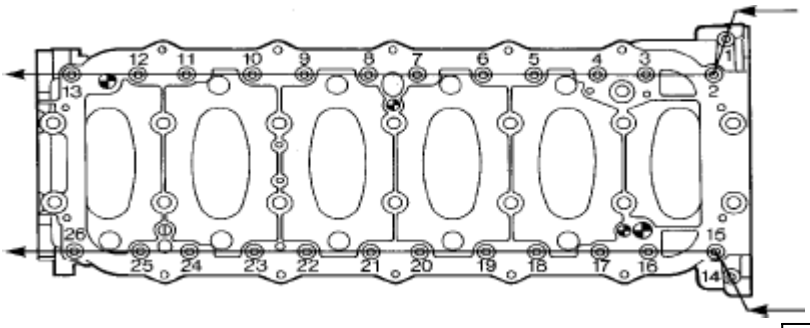



44898

Fourth phase: inner screws angle closing

(60°)

FRONT SIDE



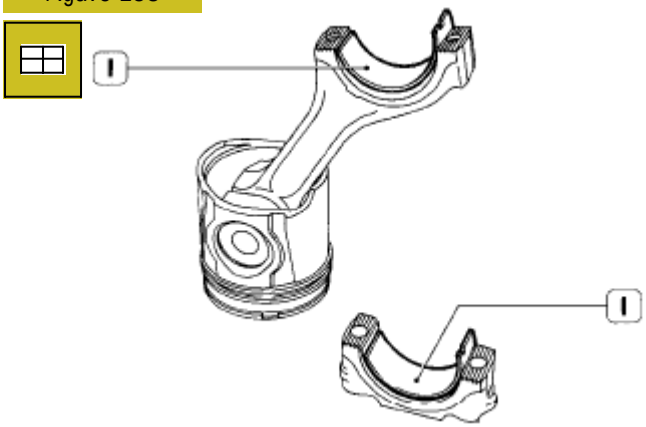

44899

Fifth phase: outer screws angle closing

(90°)

Aquila Trucks Centres

Figure 158



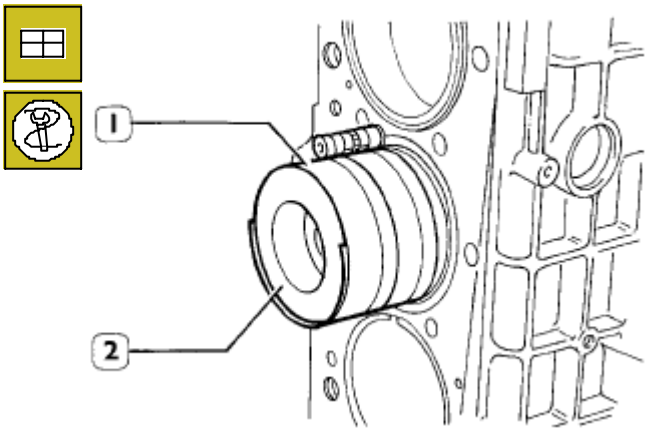

Rotate the cylinder assembly placing it vertically.
Lubricate the half-bearings (1) and fit them in the connecting rod and the cap.

**NOTE** Not finding it necessary to replace the connecting rod bearings, you need to fit them back in exactly the same sequence and position as in removal.
If the big end bearings need to be replaced, choose them according to the description given from page 59 to page 65.

Lubricate half bearings (1), then mount them on the connecting rod and cap

**NOTE** Do not make any adjustment on the bearing shells.

Figure 160



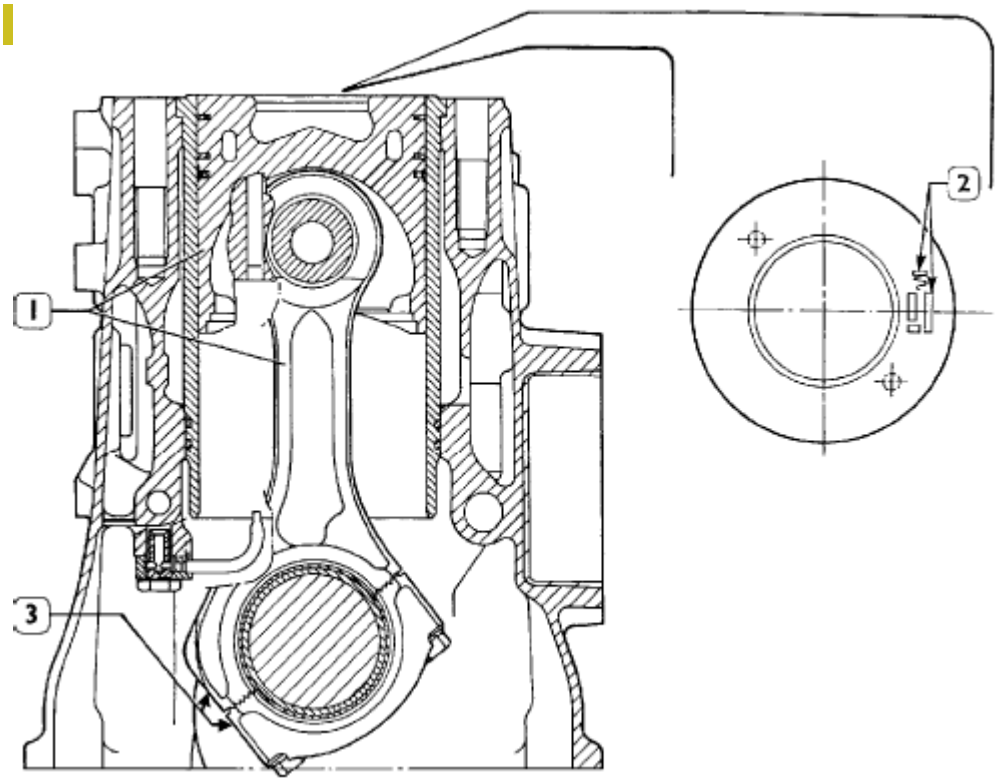

47593

Fit the connecting rod-piston assemblies (2) into the piston liners, using the band 99360605 (1). Check the following:

- the rings gaps are offset by 120°;
- all pistons belong to the same class, A or B;
- ideogram (2, Figure 159), stamped on the piston crown, is placed toward the engine flywheel, or the cavity, on the piston skirt, corresponds to the position of the oil spray nozzles

**NOTE** The pistons are supplied as spares in class A and can also be fitted in class B cylinder liners.

## Fitting the connecting rod-piston assembly into the cylinder liners




ıg rod-piston assembly

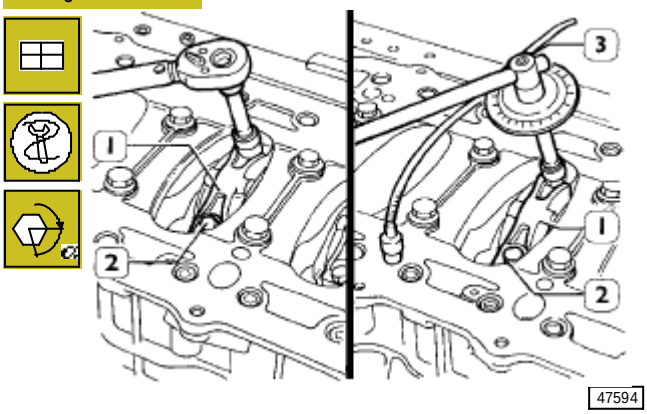
rea of ideogram on the piston

ıg rod marking area

61831

Aquila Trucks Centres

Figure 161

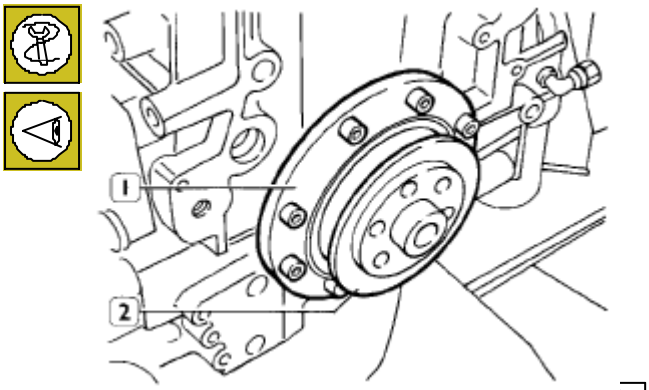



47594

Connect the connecting rods to the relative journals, fit the connection rod caps (1) with half bearings; tighten the fixing screws (2) of the connecting rod caps to 50 Nm torque (5 kgm). Using tool 99395216 (3), further tighten screws with 40° angle.

**NOTE** Before reusing the screws (2), measure the diameter of the thread; it must be no less than 11.4 mm; if it is, change the screw.
Lubricate the thread of the screws with engine oil before assembly.

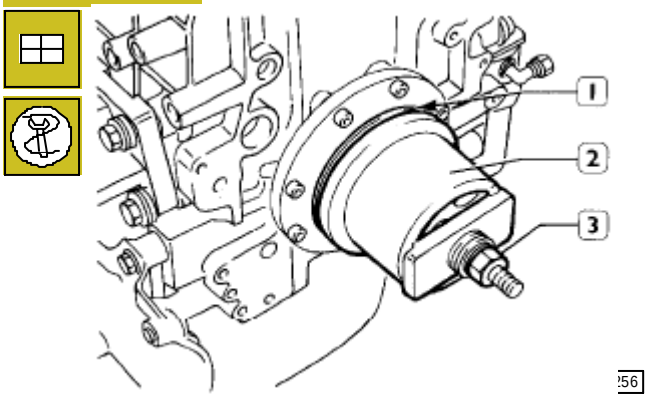
Figure 162




45255

By means of centering ring 99396033 (2), check the exact cover position (1), otherwise act as necessary and tighten the screws.

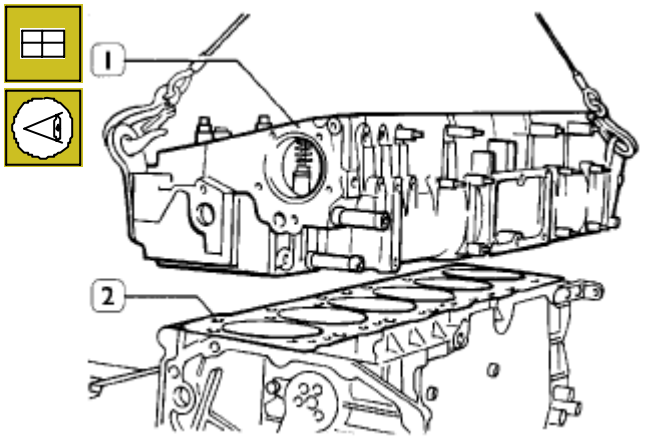
Figure 163




256

Fit the sealing gasket (1), install the fitting tool 99346245 (2) and drive the sealing gasket (1) by screwing nut (3).

Figure 164

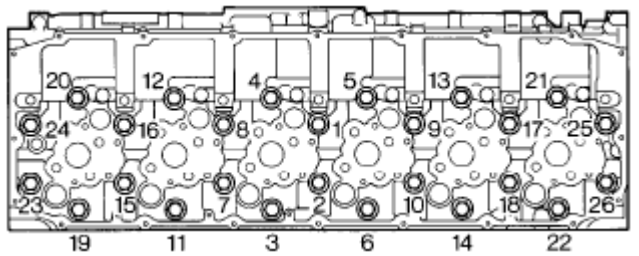



45266

Make sure that pistons 1-6 are exactly at the TDC Place the gasket (2) on the block. Fit the cylinder head (1) and tighten screws as shown in figs. 166, 167 and 168.

**NOTE** Use new screws whenever removing the cylinder head.

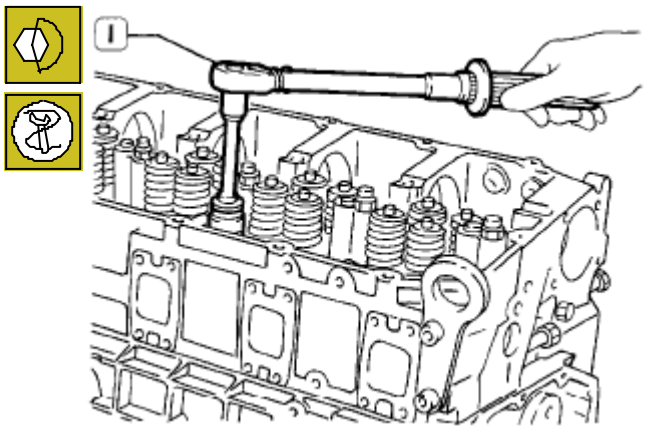
Figure 165




44900

Diagram showing the cylinder head fixing screws tightening order

Figure 166

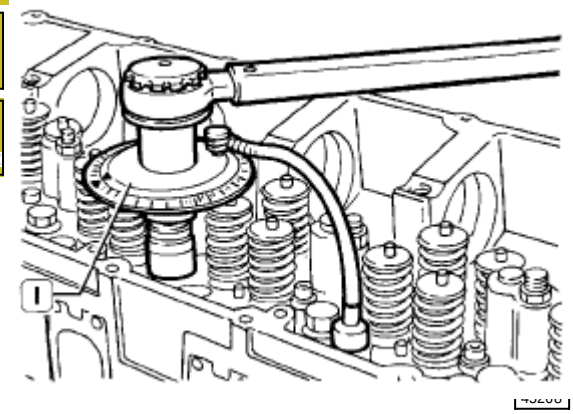



45267

- Preliminary tightening by means of a torque wrench (1):
  1st phase: 50 Nm (5 kgm:
  2nd phase: 100 Nm (10 kgm)

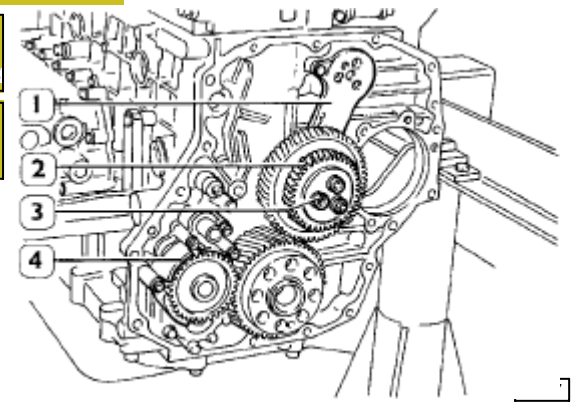
Aquila Trucks Centres

Figure 167



- Angle closing by means of tool 99395216 (1):
  3rd phase: 90° angle
  4th phase: 75° angle

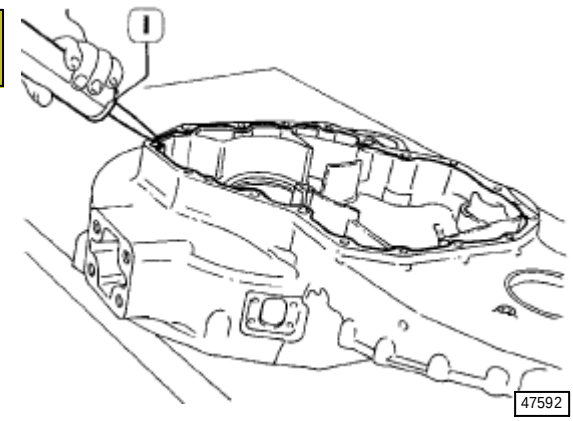
Figure 168



Fit the oil pump (4), intermediate gears (2) with rod (1) and tighten screws (3) in two phases:

| | |
|---|---|
| preliminary tightening | 30 Nm |
| angle closing | 90° |

Figure 169



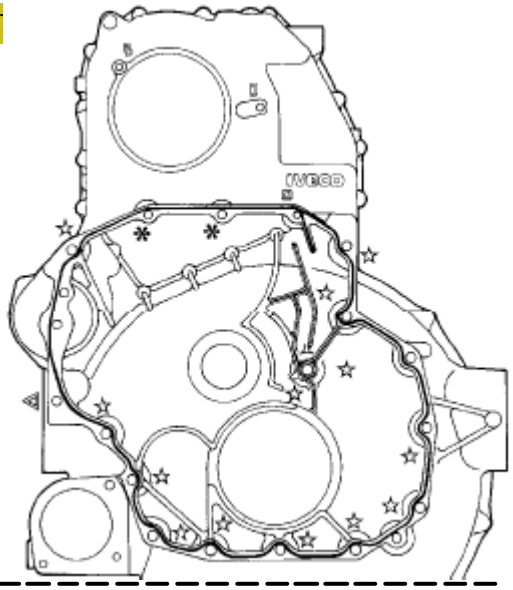
Apply sealant LOCTITE 5970 IVECO No. 2995644 to the gear housing using the proper equipment (1).

The sealer string (1) diameter is to be $1,5 \pm^{0,5}_{0,2}$

**NOTE** Install the gear housing within 10' of the application of the sealant.

Tighten the screws shown in the figure by means of a torque wrench, in compliance with the following order and tightening torque:

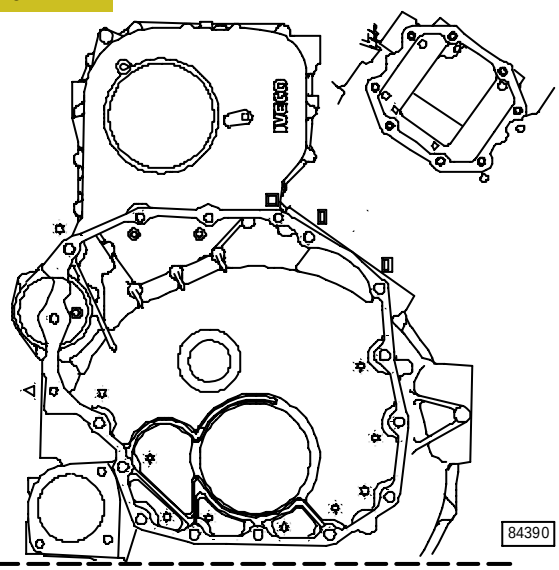
Figure 1



**Engines without power take-off**

- ☆ no. 13 screws M12 x 1.75 x 80 tightening torque 63 Nm
- : no. 3 screws M10 x 1.5 x 35 tightening torque 42 Nm
- □ no. 1 screw M10 x 1.5 x 100 tightening torque 42 Nm
- △ no. 1 screw M10 x 1.5 x 180 tightening torque 42 Nm
- ▭ no. 2 screws M18 x 1.25 x 125 tightening torque 24 Nm

Figure 171

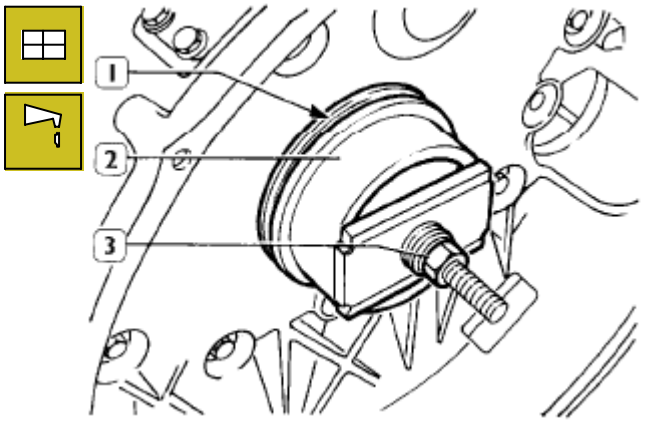


**Engines with power take-off**

- ☆ no. 10 screws M12 x 1.75 x 80 tightening torque 63 Nm
- ⌐ no. 3 screws M10 x 1.5 x 35 tightening torque 42 Nm
- □ no. 1 screw M10 x 1.5 x 170 tightening torque 42 Nm
- △ no. 1 screw M10 x 1.5 x 180 tightening torque 42 Nm
- ▭ no. 2 screws M12 x 1.75 x 125 tightening torque 63 Nm
- d no. 8 screw M10 x 1,5 x 120
- ◊ no. 2 screw M10 x 1,5 x 120 (apply to the thread LOCTITE 275)

Aquila Trucks Centres

Figure 172




45258

Fit the sealing gasket (1), install the fitting tool 99346246 (2) and drive the sealing gasket by screwing the nut (3).

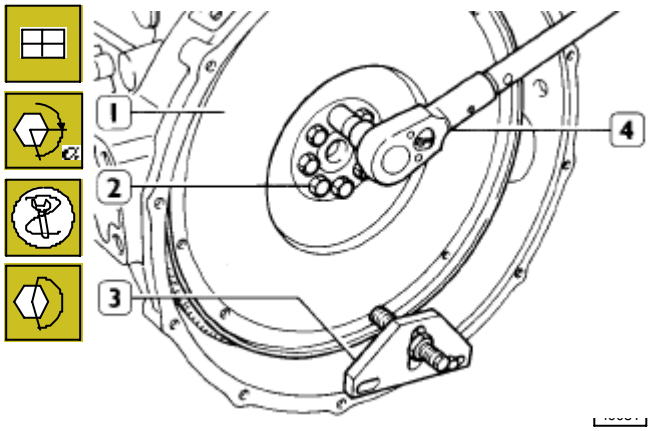
## 540850 FLYWHEEL

**NOTE** If the teeth of the ring gear mounted on the flywheel, for starting the engine, are very damaged, replace the ring gear. It must be fitted after heating the ring gear to a temperature of approx. 200°C.

### Fitting flywheel

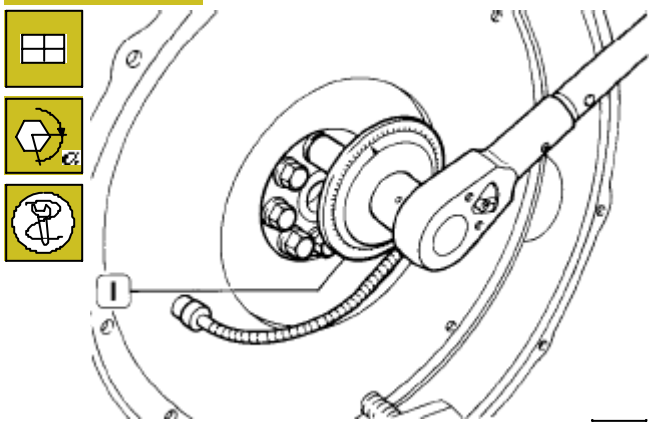
**NOTE** The crankshaft has a locating peg that has to couple with the relevant seat on the engine flywheel.

Figure 174



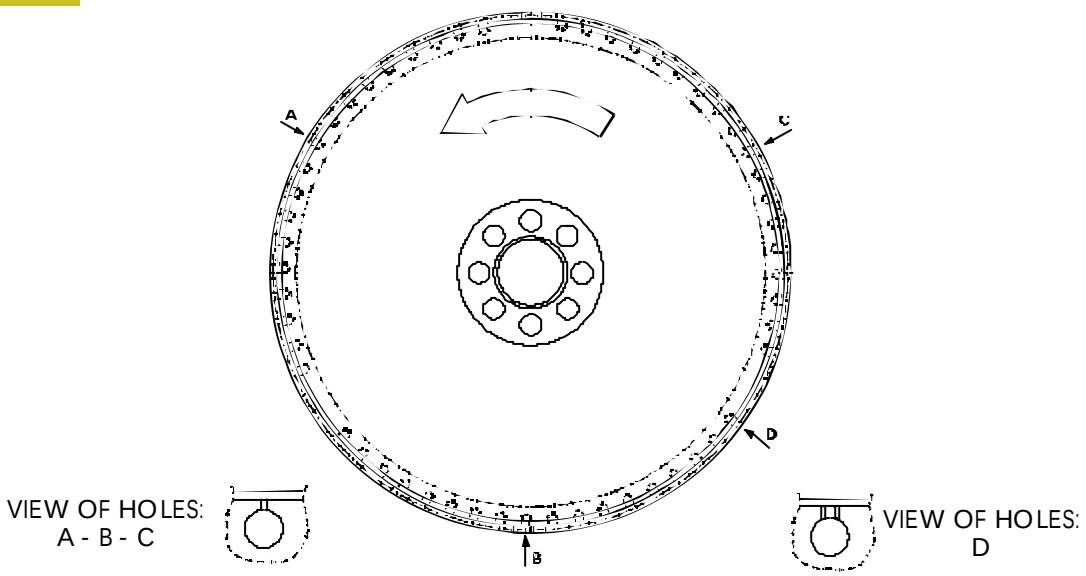

Position the flywheel (1) on the crankshaft, lubricate the thread of the screws (2) with engine oil and screw them down. Lock rotation with tool 99360351 (3). Lock the screws (2) in two phases.
First phase: pre-tightening with torque wrench (4) to a torque of 100 Nm (10 kgm).

Figure 175




Second phase: closing to angle of 60° with tool 99395216 (1).

Figure 173




60668

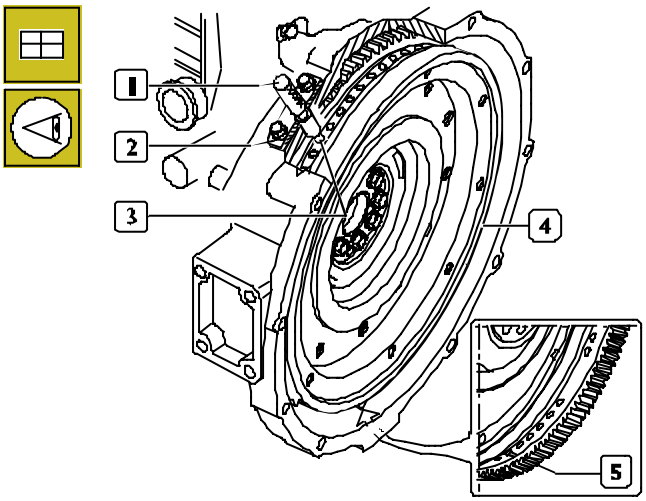
DETAIL OF PUNCH MARKS ON ENGINE FLYWHEEL FOR PISTON POSITIONS

A. Hole on flywheel with one reference mark, corresponding to the TDC of pistons 3-4. - B. Hole on flywheel with one reference mark, corresponding to the TDC of pistons 1-6. - C. Hole on flywheel with one reference mark, corresponding to the TDC of pistons 2-5. - D. Hole on flywheel with two reference marks, position corresponding to 54°.

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## Fitting camshaft

Figure 176



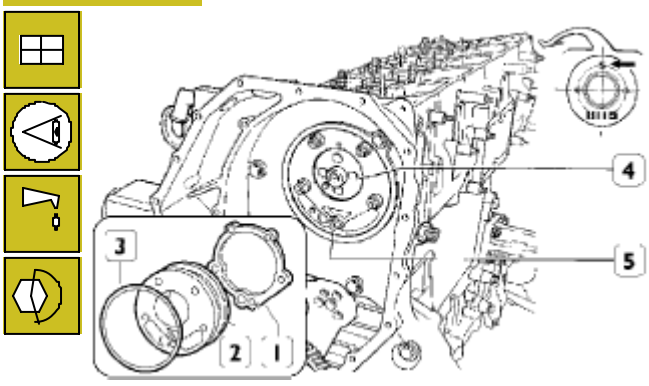

72436

Position the crankshaft with the pistons 1 and 6 at the top dead centre (T.D.C.).
This situation occurs when:

1. The hole with reference mark (5) of the engine flywheel (4) can be seen through the inspection window.
2. The tool 99360612 (1), through the seat (2) of the engine speed sensor, enters the hole (3) in the engine flywheel (4).

If this condition does not occur, turn the engine flywheel (4) appropriately.
Remove the tool 99360612 (1).

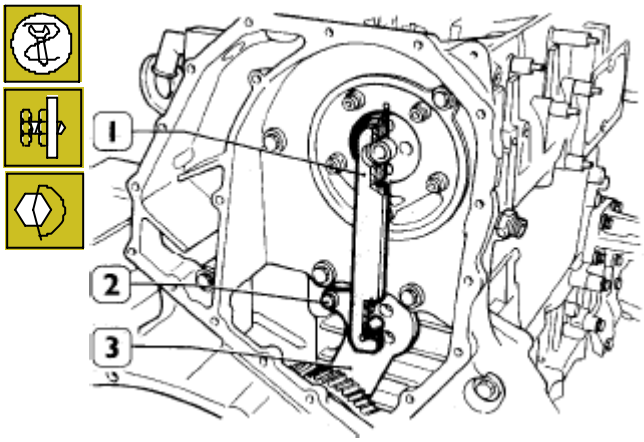
Figure 177




73843

Fit the camshaft (4), positioning it observing the reference marks (→) as shown in the figure.
Lubricate the seal (3) and fit it on the shoulder plate (2).
Mount the shoulder plate (2) with the sheet metal gasket (1) and tighten the screws (5) to the required torque.

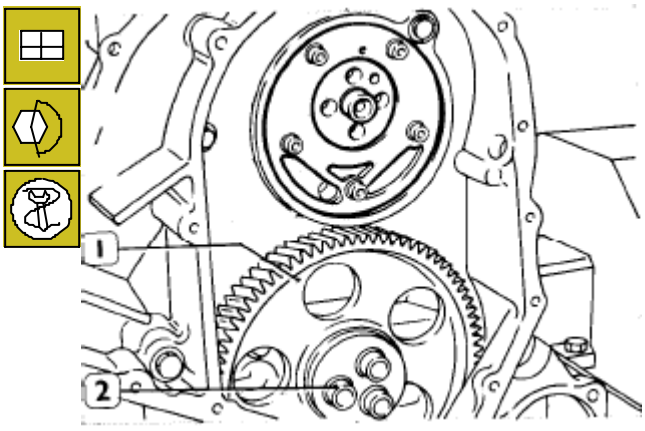
Figure 178




45376

- Apply gauge 99395215 (1), check and record the position of the rod (3) for the gear, tighten the screw (2) to the prescribed torque.

Figure 179



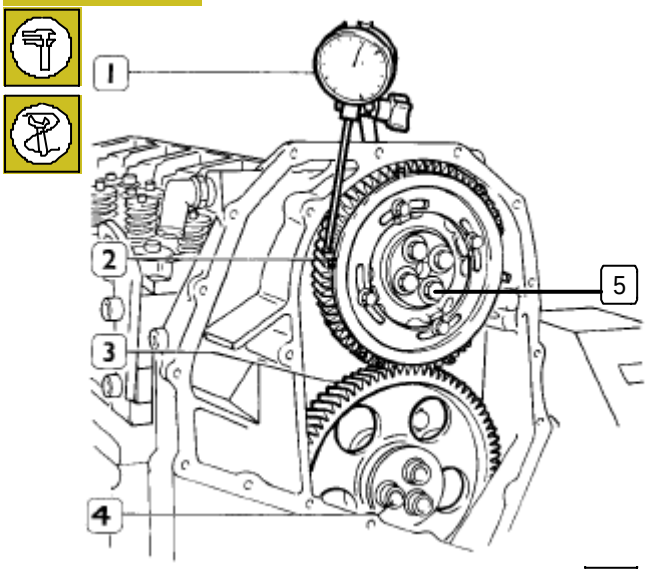

45269

- Remove the gear (1) and tighten screws (2) by means of proper wrench, to the prescribed torque.

**NOTE** Replace the idle gear bushing (1) when wear is detected. After installing the bushing, adjust it to ∅ 58.010 ± 0.10 mm.

Aquila Trucks Centres

Figure 180

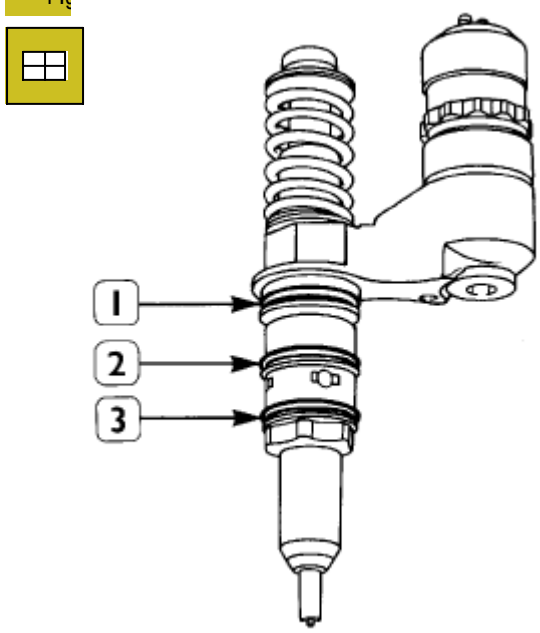



Position the gear (2) on the camshaft so that the 4 slots are centred with the holes for fixing the camshaft, without fully locking the screws (5).
Using the dial gauge with a magnetic base (1), check that the clearance between the gears (2 and 3) is 0.073 – 0.195 mm; if this is not so, adjust the clearance as follows:

- Loosen the screws (4) fixing the idle gear (3).
- Loosen the screw (2, Figure 178) fixing the link rod. Shift the link rod (3, Figure 178) to obtain the required clearance.
- Lock the screw (2, Figure 178) fixing the link rod and screws (4) fixing the idle gear to the required torque.

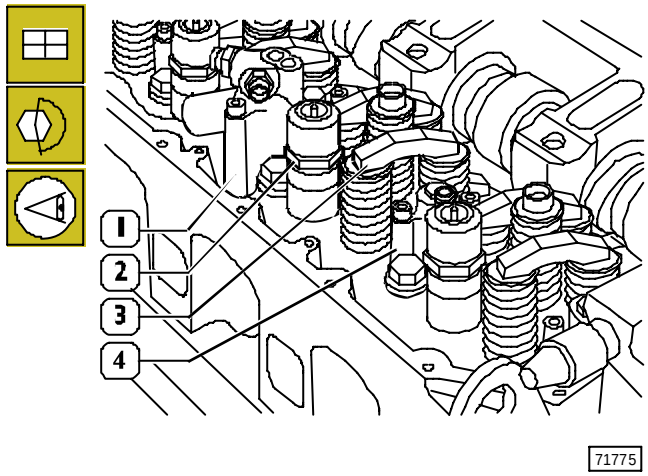
## Fitting pump-injectors

Figure 181




Fit the seals (1) (2) (3) on the injectors.

Figure 182



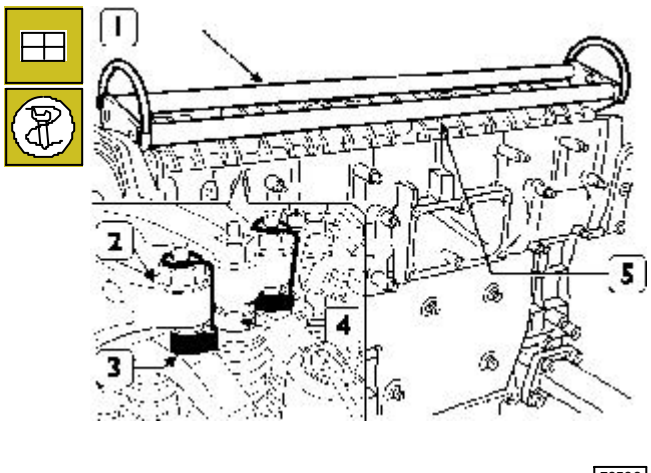

Mount:

- The injectors (2) and, using a torque wrench, lock the bracket fixing screws to a torque of 36,5 Nm.
- The exhaust brake cylinders (1) and (4) and, using a torque wrench, fix them to a torque of 19 Nm.
- The crosspieces (3) on the valve stem, all with the largest hole on the same side.

## Fitting rocker-arm shaft assembly

Figure 183

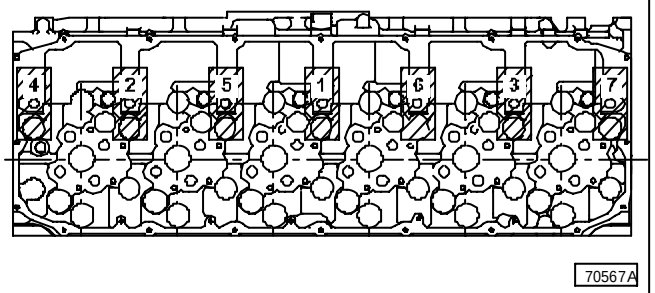
**NOTE** Before refitting the rocker-arm shaft assembly, make sure that all the adjustment screws have been fully unscrewed.




Using tool 99360144 (3), fasten the blocks (4) to the rocker arms (2).
Apply the tool 99360558 (1) to the rocker arm shaft (5) and mount the shaft on the cylinder head.

Aquila Trucks Centres

Figure 184

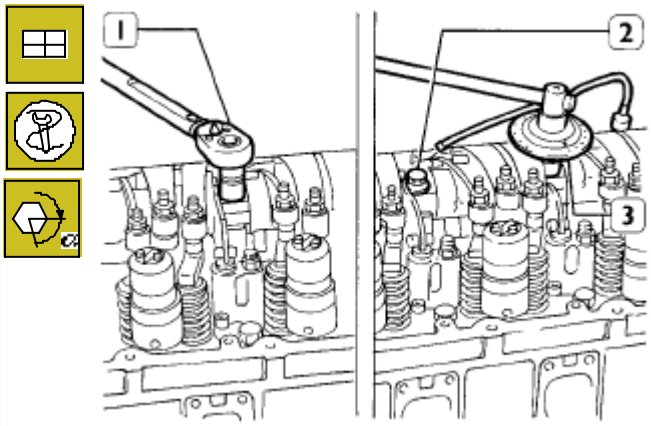



70567A

SCHEME OF SCREW TIGHTENING SEQUENCE SECURING ROCKER ARMS

Screw screws (1 - 2 - 3) until rocker arms are brought to contact relating seats on cylinder head, tighten the screws according to sequence indicated in figure operating in two steps as indicated in successive figure.

Figure 185

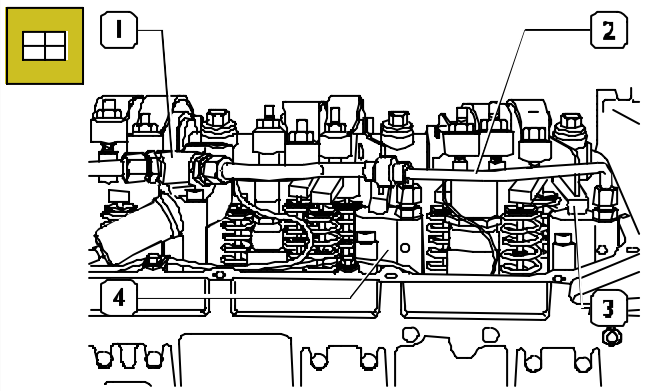



45261

Lock the screws (2) fixing the rocker-arm shaft as follows:

- 1st phase: tightening to a torque of 40 Nm (4 kgm) with the torque wrench (1).
- 2nd phase: closing with an angle of 60° using the tool 99395216 (3).

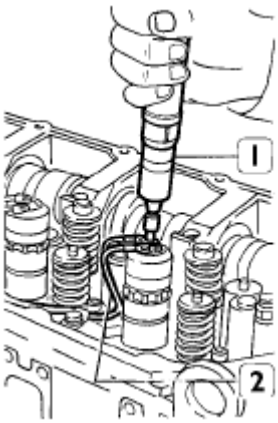
Figure 186




60574

- Mount the engine brake lever retaining springs (3).
- Connect the pipe (2) to the engine brake cylinders (4) and to the cylinder with the engine brake solenoid valve (1).

Figure 187

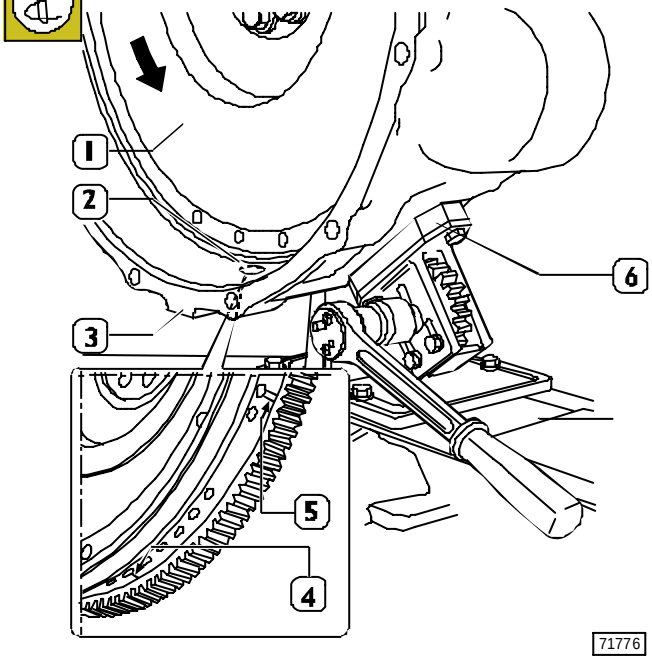



71777

Mount the electric wiring (2), securing it on the electro-injectors with a torque screwdriver (1) to a torque of 1.36 - 1.92 Nm.

## Camshaft timing

Figure 188



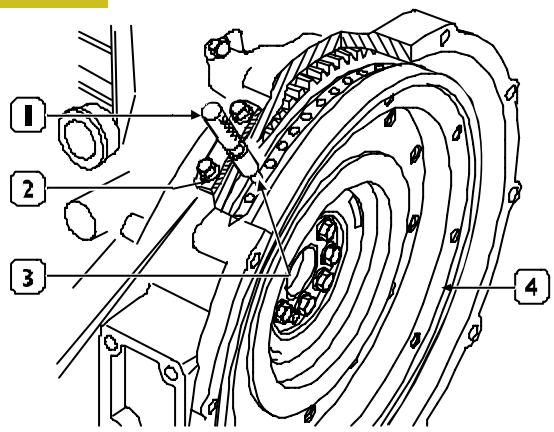

71776

Apply the tool 99360321 (6) to the gear housing (3).

**NOTE** The arrow shows the direction of rotation of the engine when running.
Using the above-mentioned tool, turn the engine flywheel (1) in the direction of rotation of the engine so as to take the piston of cylinder n.o.1 to approximately the T.D.C. in the phase of combustion. This condition occurs when the hole with one reference mark (4), after the hole with two reference marks (5) on the engine flywheel (1), can be seen through the inspection window (2).

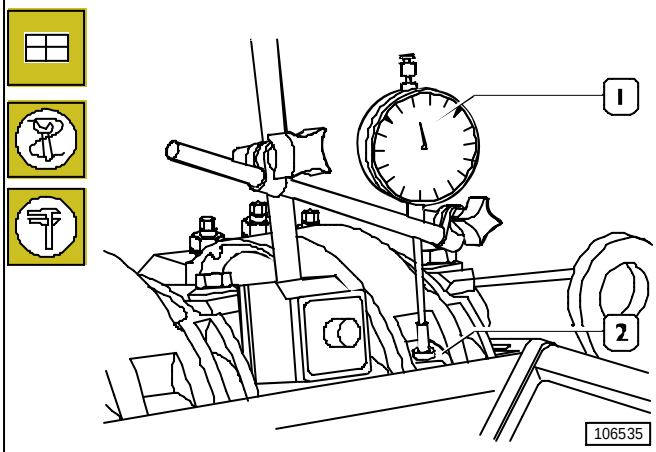
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Figure 189




The exact position of piston no.1 at the T.D.C. is obtained when in the above-described conditions the tool 99360612 (1) goes through the seat (2) of the engine speed sensor into the hole (3) in the engine flywheel (4).
If this is not the case, turn and adjust the engine flywheel (4) appropriately.
Remove the tool 99360612 (1).

Figure 190




Set the dial gauge with the magnetic stand (1) with the rod (flat based) on the roller (2) of the rocker arm that governs the injector of cylinder no.1 and pre-load it by 6 mm.

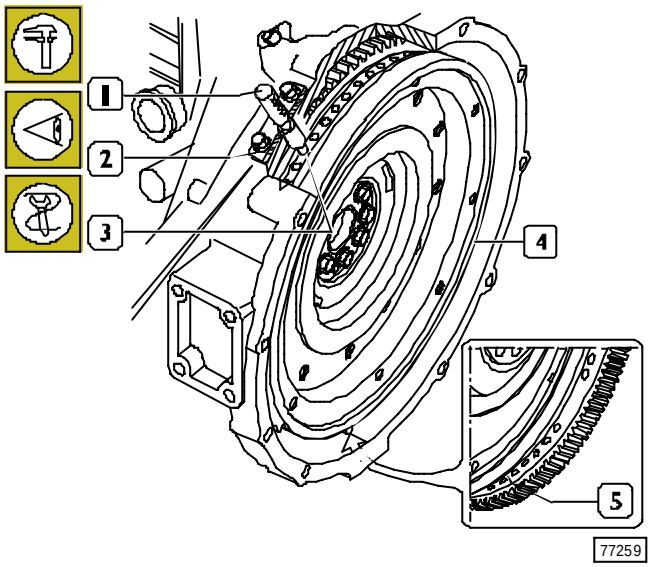
**NOTE** During the measurement, the dial gauge rod must always be at right angles to the engine centre line and NOT to the head surface.

With tool 99360321 (6, Figure 188), turn the crankshaft clockwise until the pointer of the dial gauge reaches the minimum value beyond which it can no longer fall.

Reset the dial gauge.

Turn the engine flywheel anticlockwise until the dial gauge gives a reading for the lift of the cam of the camshaft of 4.90 ± 0.05 mm.

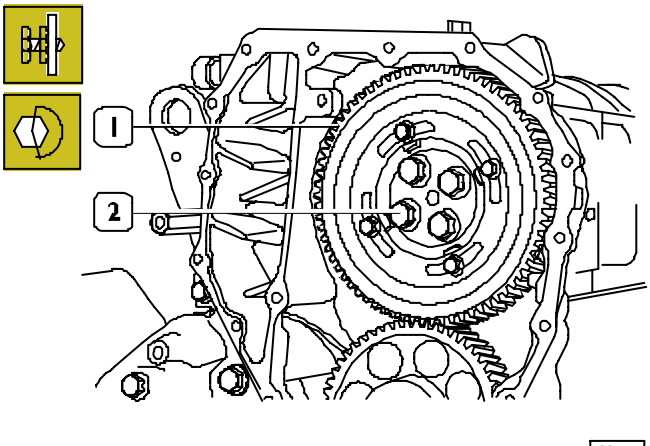
Figure 191




The camshaft is in step if at the cam lift values of 4.90±0.05 mm there are the following conditions:

1) The hole marked with a notch (5) can be seen through the inspection window
2) The tool 99360612 (1) through the seat (2) of the engine speed sensor goes into the hole (3) in the engine flywheel (4).

Figure 192

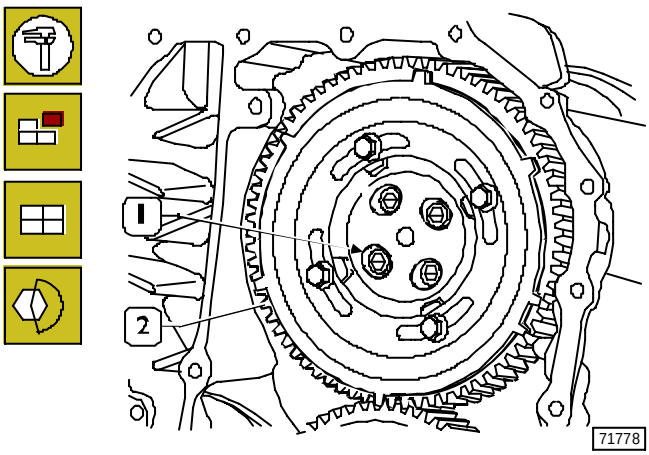



If you do not obtain the conditions illustrated in Figure 191 and described in points 1 and 2, proceed as follows:

1) Loosen the screws (2) securing the gear (1) to the camshaft and utilize the slots (1, Figure 193) on the gear (2, Figure 193).
2) Turn the engine flywheel appropriately so as to bring about the conditions described in points 1 and 2 Figure 191, it being understood that the cam lift must not change at all.
3) Lock the screws (2) and repeat the check as described above.
4) Tighten the screws (2) to the required torque.

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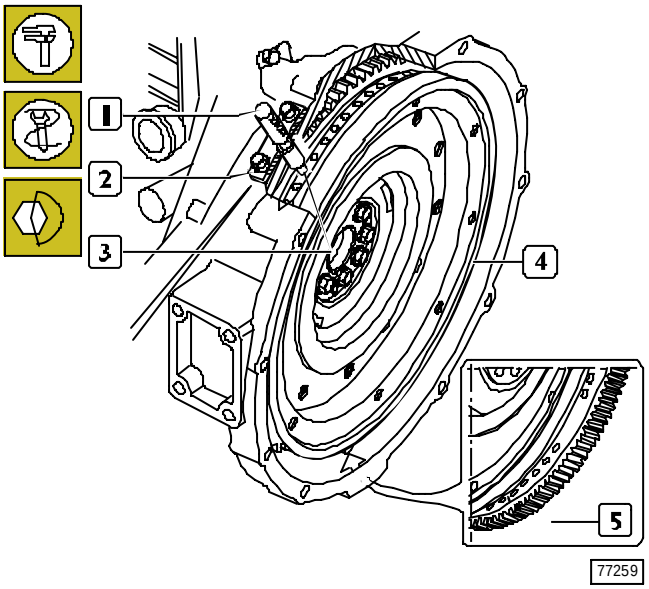
Figure 193




When it is not possible to adjust advance through the slots (1) and the camshaft turns because integral with the gear (2); thus the cam lift reference value varies and it is necessary to proceed in the following way:

1) Fasten the screws (2, Figure 192) and rotate the engine flywheel clockwise by ~1/2 turn;
2) Turn the engine flywheel anticlockwise until the dial gauge gives a reading of the lift of the cam of the camshaft of 4.90 ± 0.05 mm
3) Take out the screws (2, Figure 192) and remove the gear (2) from the camshaft.

Figure 194




Turn the flywheel (4) again to bring about the following conditions:

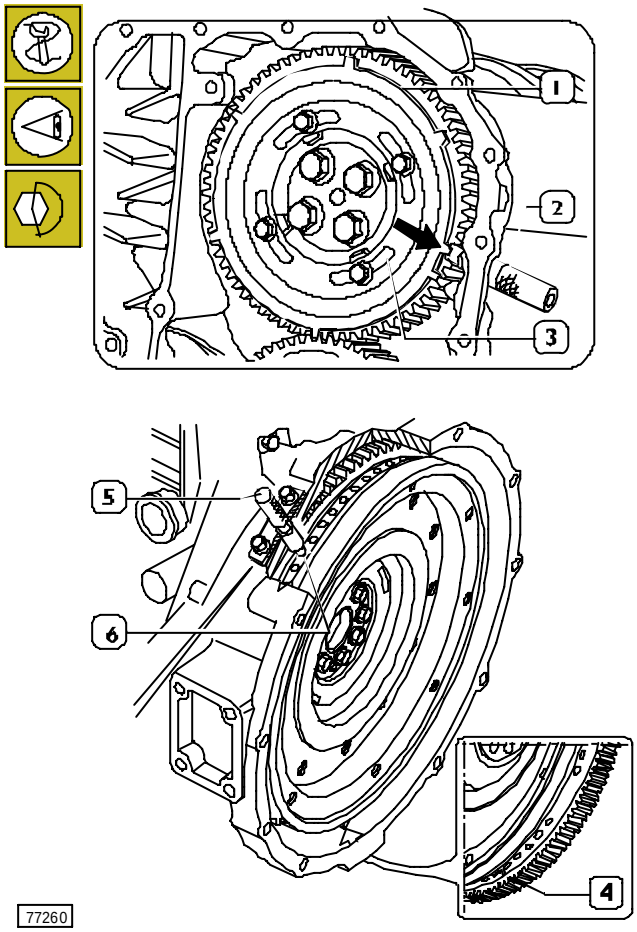
- Notch (5) visible through the lower inspection window;
- The tool 99360612 (1) inserted in the hole (3) in the engine flywheel (4) through the seat (2) of the engine speed sensor.

Mount the gear (2, Figure 193) with the 4 slots (1, Figure 193) centred with the fixing holes of the camshaft, locking the relevant screws to the required tightening torque. Check the timing of the shaft by first turning the flywheel clockwise to discharge the cam completely and then turn the flywheel anticlockwise until the dial gauge gives a reading of: 4.90 ± 0.05 mm

Check the timing conditions described in Figure 191.

## Phonic wheel timing

Figure 195

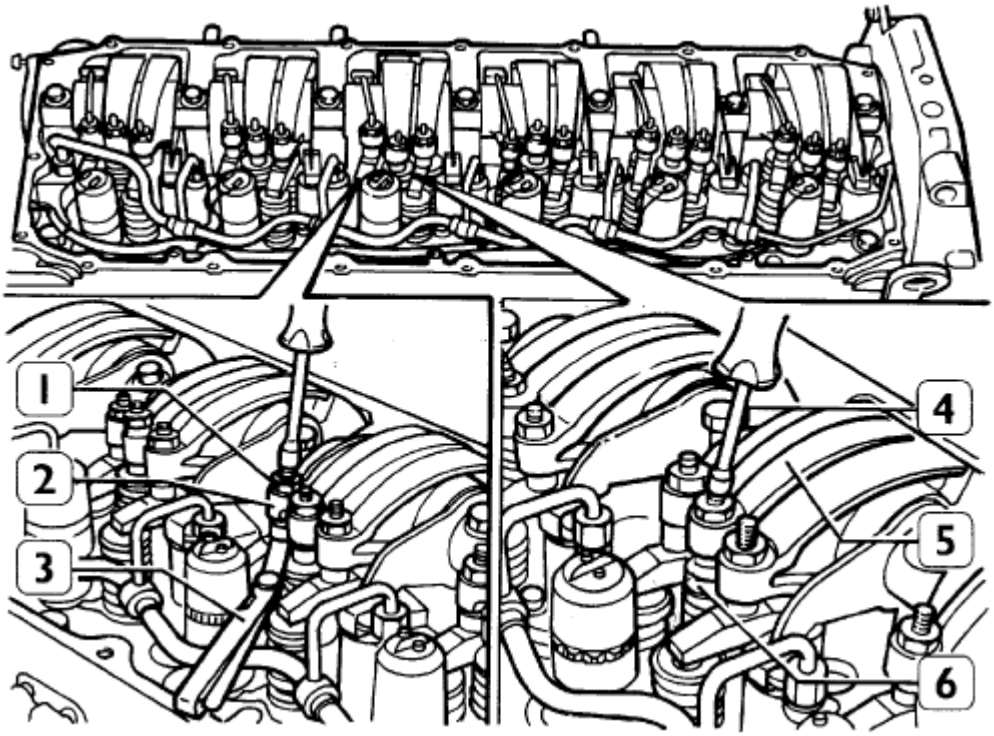



Turn the output shaft bringing cylinder piston 1 at compression stage to TDC.; turn the flywheel by about 1/4 turn in opposite direction than normal direction of rotation. Turn the flywheel again according to normal direction of rotation until the hole marked with the double notch (4) can be seen through the inspection hole set under the flywheel housing. Fit tool 99360612 (5) into the flywheel sensor seat (6).
Fit tool 99360613 (2), through the timing sensor seat, on the tooth (↑) obtained on the phonic wheel.
Should tool (2) fitting be difficult, slacken screws (3) and direct the phonic wheel (1) properly to position the tool (2) on the tooth. Tighten the screws (3).

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## Intake and exhaust rocker clearance adjustment and pre-loading of rockers controlling pump injectors

Figure 196




ADJUSTMENT OF INTAKE, EXHAUST AND INJECTION ROCKERS

Adjustment of clearances between rockers and valve studs and preloading of pump injector rockers should be carried out with extreme care.

Take the cylinder where clearance must be adjusted to the bursting phase; its valves are closed while balancing the symmetric cylinder valves.
Symmetric cylinders are 1-6, 2-5 and 3-4.
In order to properly operate, follow these instructions and data specified on the table.

Adjustment of clearance between the rockers and rods controlling intake and exhaust valves:

- Use a polygonal wrench to slacken the locking nut (1) of the rocker arm adjusting screw (2).
- Insert the strip of feeler gauge (3) corresponding to the working clearance (page 13);
- Tighten or untighten the adjustment screw with the appropriate wrench;
- Make sure that the gauge blade (3) can slide with a slight friction;
- Lock the nut (1), by blocking the adjustment screw.

Pre-loading of rockers controlling pump injectors:

- Using a polygonal wrench, loosen the nut locking the rocker adjustment screw (5) controlling the pump injector (6);
- Using an appropriate wrench (4), loosen the adjustment screw until the pumping element is at the end-of-stroke;
- Tighten the adjustment screw, with a dynamometric wrench, to 5 Nm tightening torque (0.5 kgm);
- Untighten the adjustment screw by 1/2 to 3/4 rotation;
- Lock nut at prescribed torque.

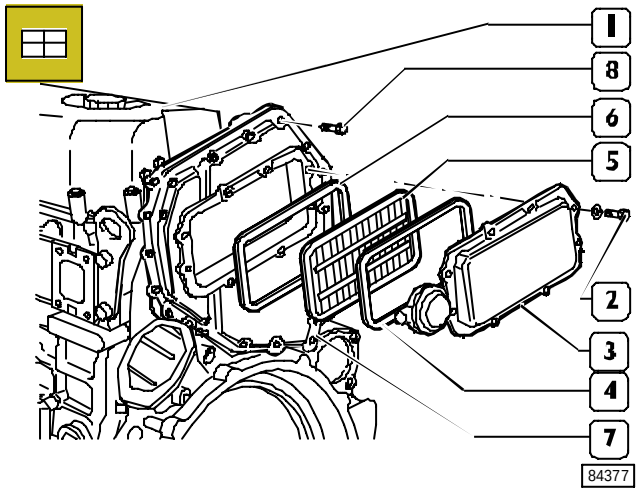
FIRING ORDER 1-4-2-6-3-5

| Clockwise start-up and rotation | Balancing cylinder valve no. | Adjusting clearance of cylinder valve no. | Adjusting pre-loading of cylinder injector no. |
|---|---|---|---|
| 1 and 6 at P.M.S. | 6 | 1 | 5 |
| 120° | 3 | 4 | 1 |
| 120° | 5 | 2 | 4 |
| 120° | 1 | 6 | 2 |
| 120° | 4 | 3 | 6 |
| 120° | 2 | 5 | 3 |

**NOTE** In order to carry out operations above correctly, perform sequence indicated in table, checking, at each rotation phase, that position correct using pin 99360612 to be inserted in hole identified by a notch on flywheel, corresponding to the position of pistons (see detail fig. 173).

Aquila Trucks Centres

Figure 197



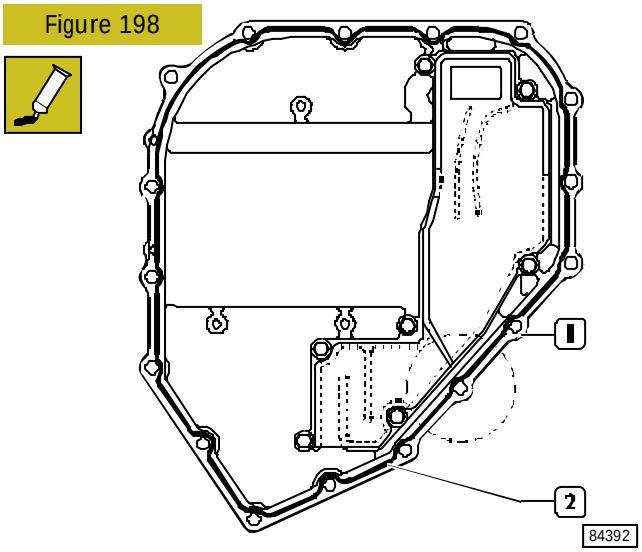

Fit the rocker cover (1).
Fit the blow-by case (7) and its gasket and then tighten the screws (8) to the prescribed torque.
Install the filter (5) and the gaskets (4 and 6).

**NOTE** The filter (5) operation is unidirectional, therefore it must be assembled with the two sight supports as illustrated in the figure.

Thoroughly clean cover (3) drain hole and suction ducts.
Fit the cover (3) and tighten the fastening screws (2) to the prescribed torque.

**NOTE** Apply silicone LOCTITE 5970 IVECO No. 29955644 on the blow-by case (7) surface of engines fitted with P.T.O. according to the procedure described in the following figure.

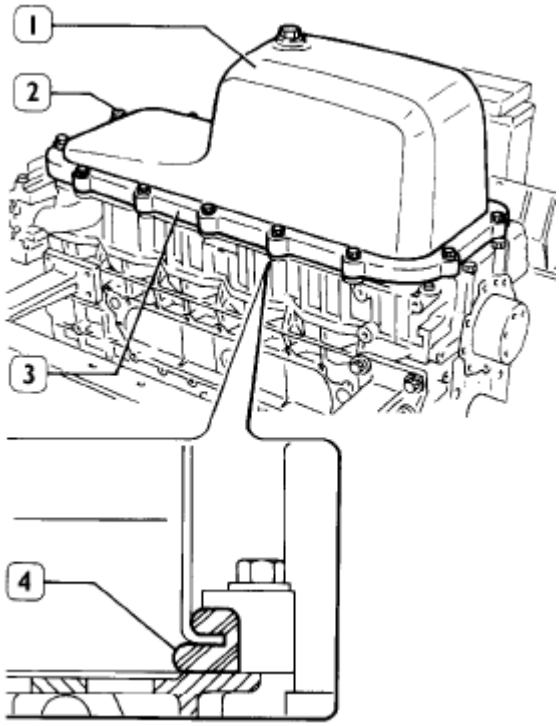
Figure 198




Apply silicone LOCTITE 5970 IVECO No. 2995644 on the blow-by case and form a string (2) of ∅ 1.5 $\pm^{0.5}_{0.2}$ as shown in the figure.

**NOTE** Fit the blow-by case (1) within 10' from sealer application.

Figure 199




Rotate the engine, then fit the oil suction strainer.
Place gasket (4) on oil sump (1), then position frame (3) and fit the sump onto the engine base by tightening screws (2) to the specified torque.

## ENGINE COMPLETION

Make the engine complete by either fitting or disconnecting the items below:

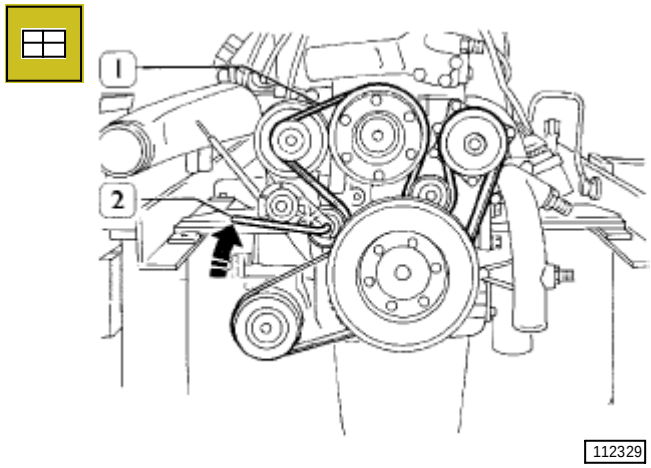
- power take-off (P.T.O.), if any, and its respective pipes;
- air compressor complete with power steering pump;
- fuel pump;
- full fuel filter support and pipes;
- EDC control unit;
- intake manifold;
- preheating resistor;
- heat exchanger;
- oil filter (lubricate the gasket);
- exhaust manifold;
- turboblower and its respective water and oil pipes;
- damper flywheel and pulley;
- thermostat unit;
- belt stretcher, water pump and alternator;
- electromagnetic joint;
- drive belt;
- belt stretcher (if any), air-conditioner compressor;
- drive belt;
- oil level dipstick;
- electric connections and sensors.

**NOTE** The fittings of the cooling water and lubricating oil pipes of the turbocharger have to be tightened to a torque of:

- 35 ±5 Nm, water pipe fittings;
- 55 ±5 Nm, oil pipe female fitting;
- 20-25 Nm, oil pipe male fitting.

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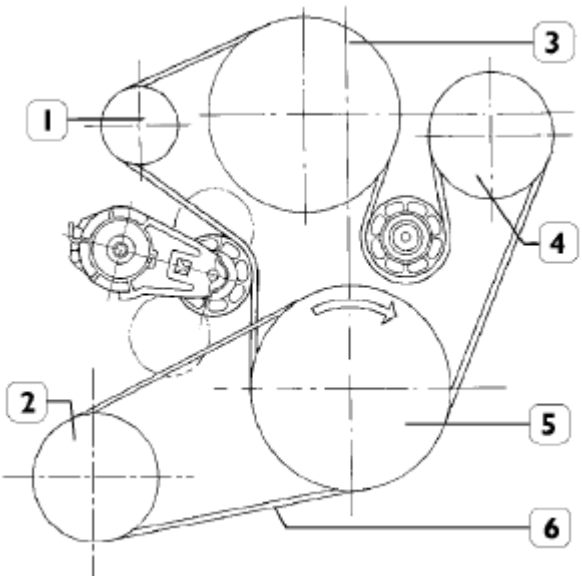
Figure 200




To fit the belt (1) use appropriate equipment (2) to adjust the belt tensioner in the direction indicated by the arrow.

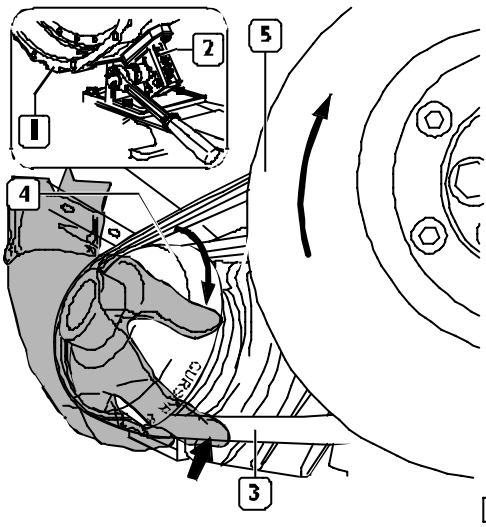
**NOTE** Automatic tensioners do not require further adjustments after the installation.

Figure 201




COMPRESSOR CONTROL BELT ASSEMBLY DIAGRAM
1. Alternator - 2. Air conditioner compressor - 3. Electromagnetic joint; - 4. Water pump - 5. Crankshaft - 6. Spring belt

Figure 202




**NOTE** To fit the elastic belt commanding the climate control compressor, you must use tool number 99360192 (4). Any other method might cause tension that would be harmful to the elastic belt itself.

Apply tool 99360321 (2) to gears box (1).
Mount spring belt (3) on driving shaft pulley, mount chock 99360192 (4) on compressor pulley (5) for climate control system. Position spring belt (3) in the opening of tool 99360192 marked with "cursor 8".
By tool 99360321, rotate driving shaft (6) according to the direction of the arrow (→) until spring belt (5) is correctly positioned on compressor pulley (3).

**NOTE** While operating, keep tool 99360192 (4) in contact to pulley (3) and at the same time guide spring belt (5) in order to prevent it from twisting.

**NOTE** Spring belt must be replaced by a new one after every dismounting operation.

- Supply engine with oil provided quantity.
  Dismount engine from stand and mount starter.

Mount:

- sound deadening guard;
- pipes.

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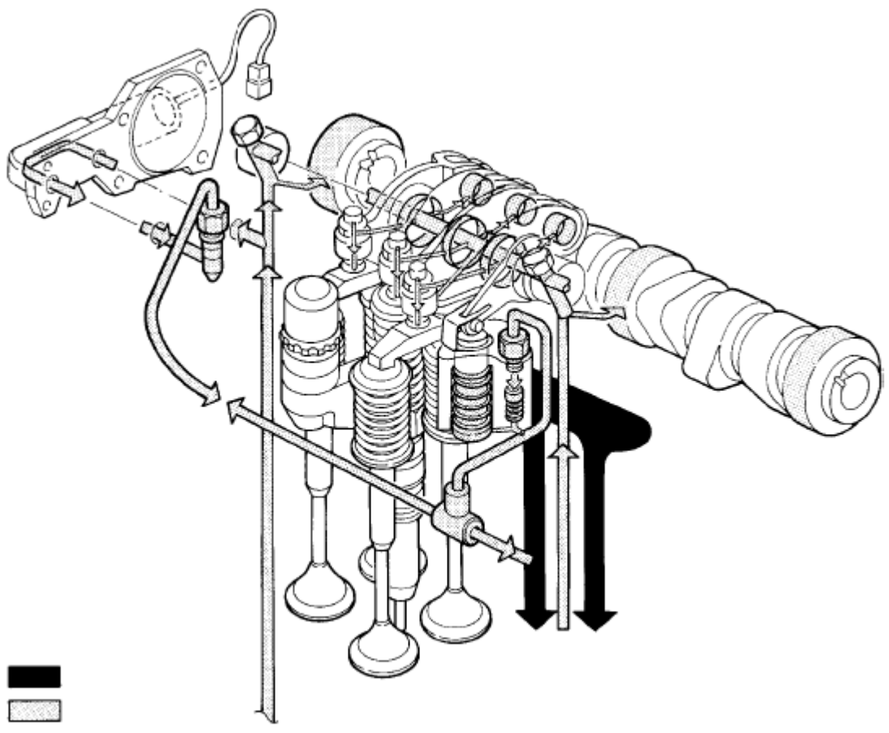
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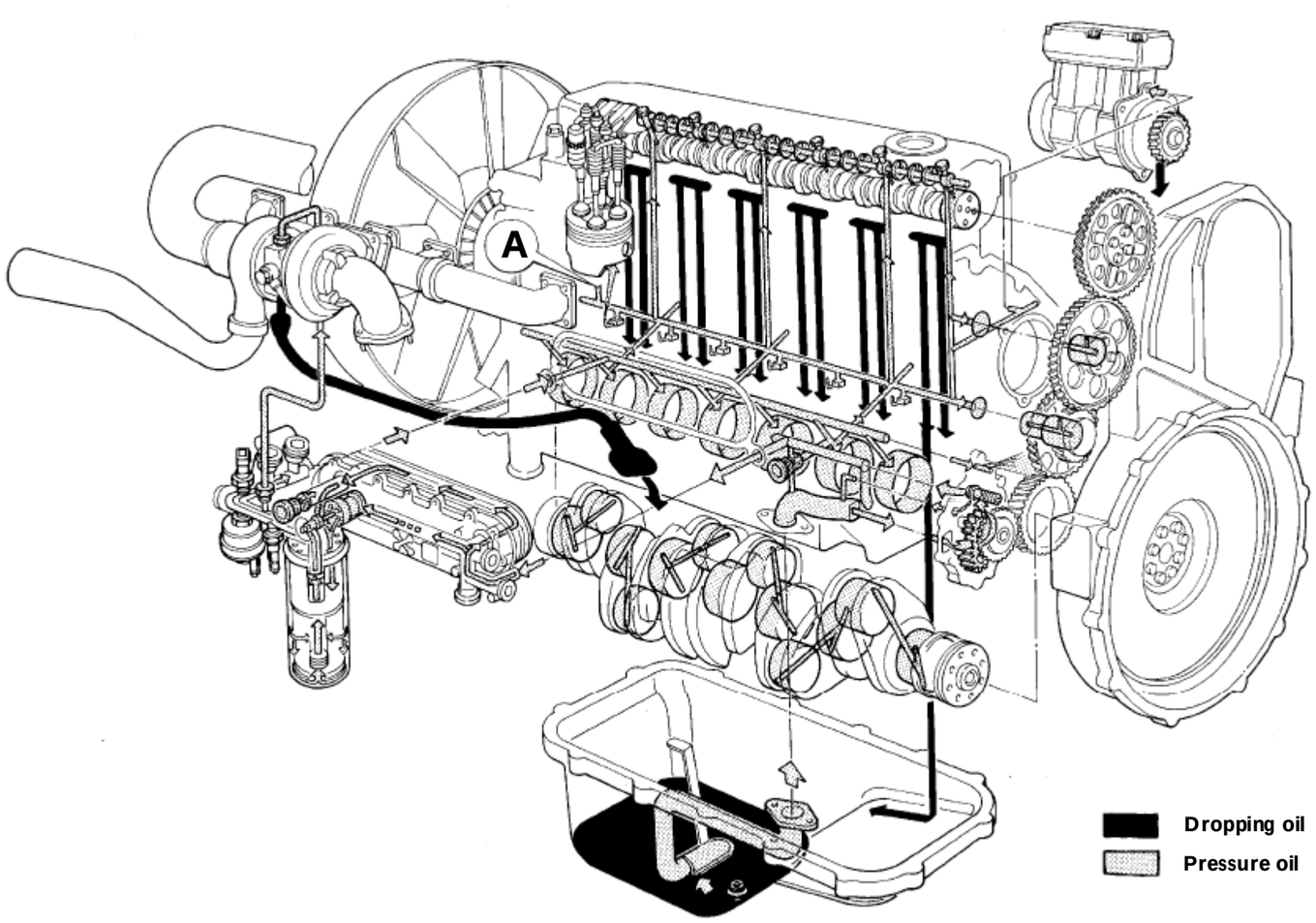
https://truckmanualshub.com/
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## 5430 LUBRICATION

Engine lubrication is obtained with a gear pump driven by the crankshaft via gears.
A heat exchanger governs the temperature of the lubricating oil.
The oil filter, signalling sensors and safety valves are installed in the intercooler.

Figure 203






**Lubrication circuit**

44918

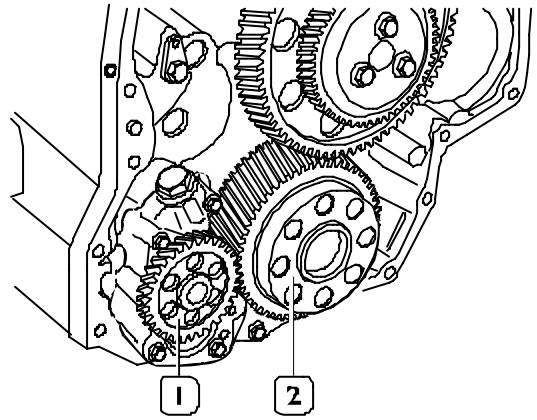
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## 543010 Oil pump

Figure 204



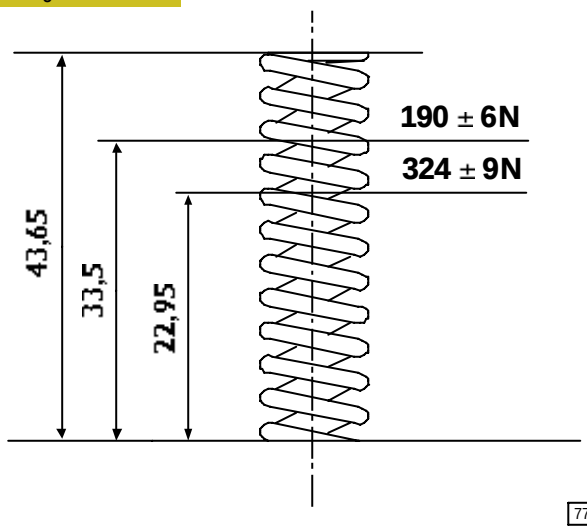

60560

The oil pump (1) cannot be overhauled. On finding any damage, replace the oil pump assembly.

See under the relevant heading for replacing the gear (2) of the crankshaft.

### Safety relief valve

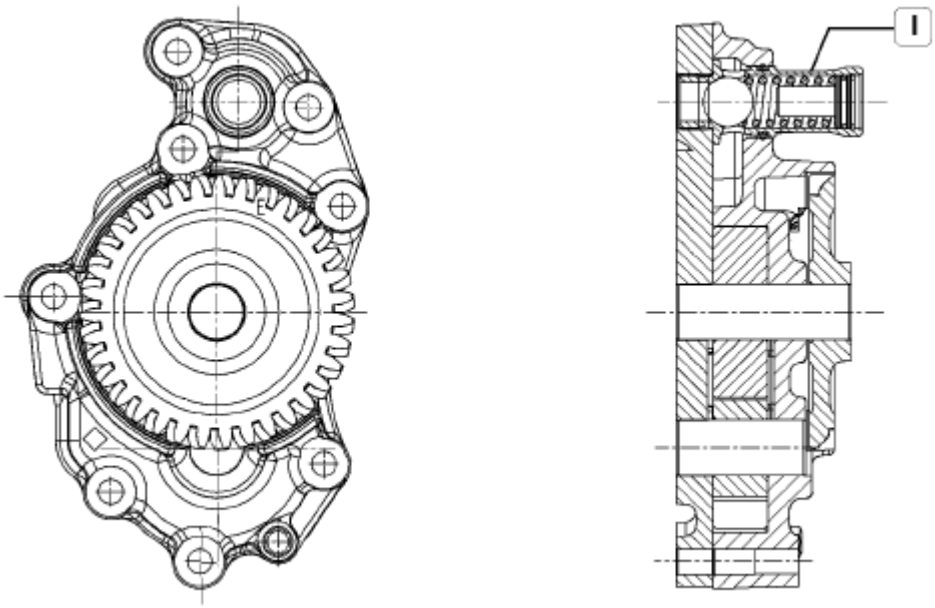
Figure 206




77820

MAIN DATA TO CHECK THE SAFETY RELIEF VALVE SPRING

Figure 205



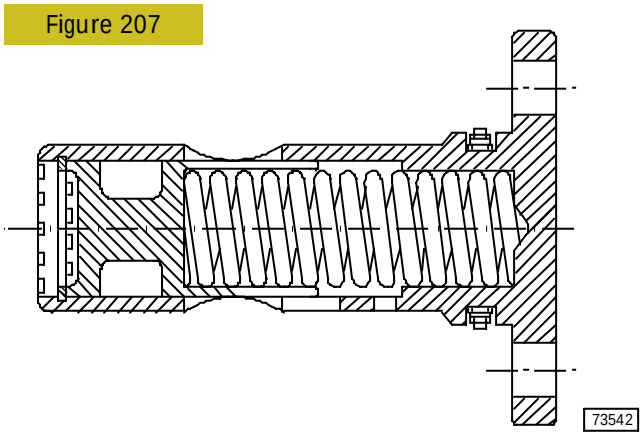

112327

OIL PUMP CROSS-SECTION
1. Safety relief valve – Start of opening pressure 10.1 ± 0.1 bars

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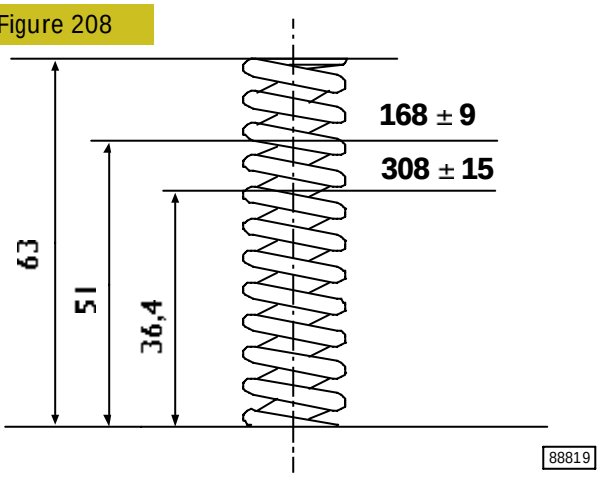
## Oil overpressure valve

Figure 207




The oil overpressure valve is located on the left-hand side of the crankcase.
Start of opening pressure 5 bars.

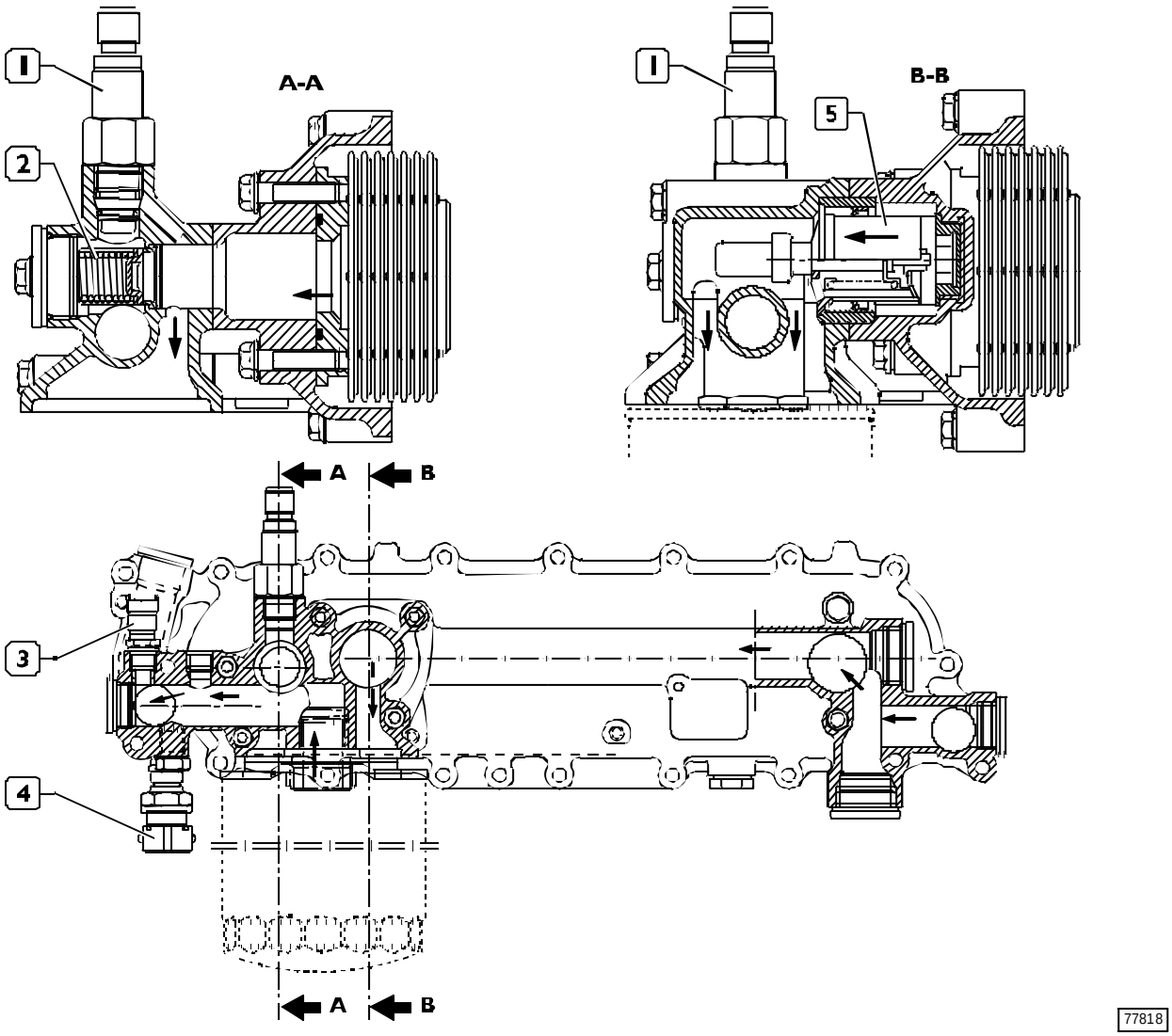
Figure 208




MAIN DATA TO CHECK THE OIL OVERPRESSURE VALVE SPRING

## 543110 Heat exchanger

Figure 209



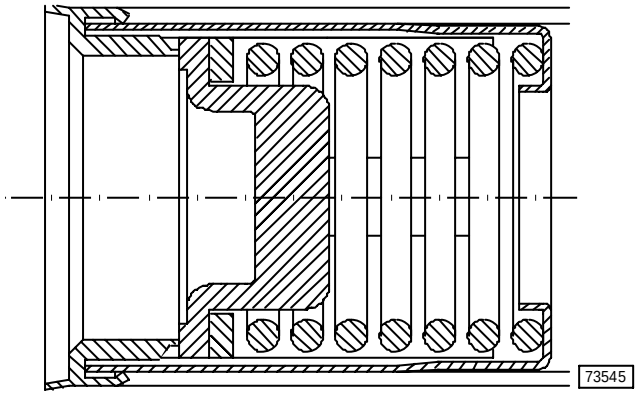

HEAT EXCHANGER

The following elements are fitted on the intercooler: 1. Transmitter for low pressure warning lamp - 2. By-pass valve - 3. Oil temperature sensor - 4. Oil pressure sensor for single gauge - 5. Heat valve. Number of intercooler elements: 7

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## By-pass valve

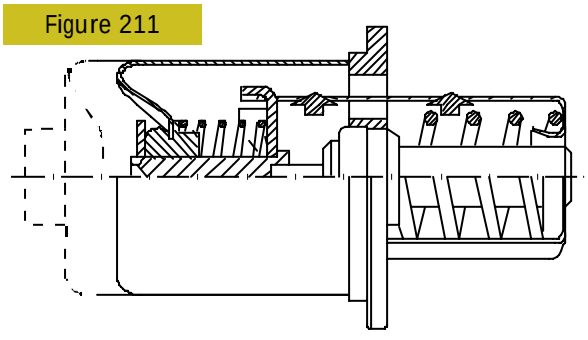
Figure 210




The valve quickly opens at a pressure of: 3 bars.

## Thermostatic valve

Figure 211




Start of opening:

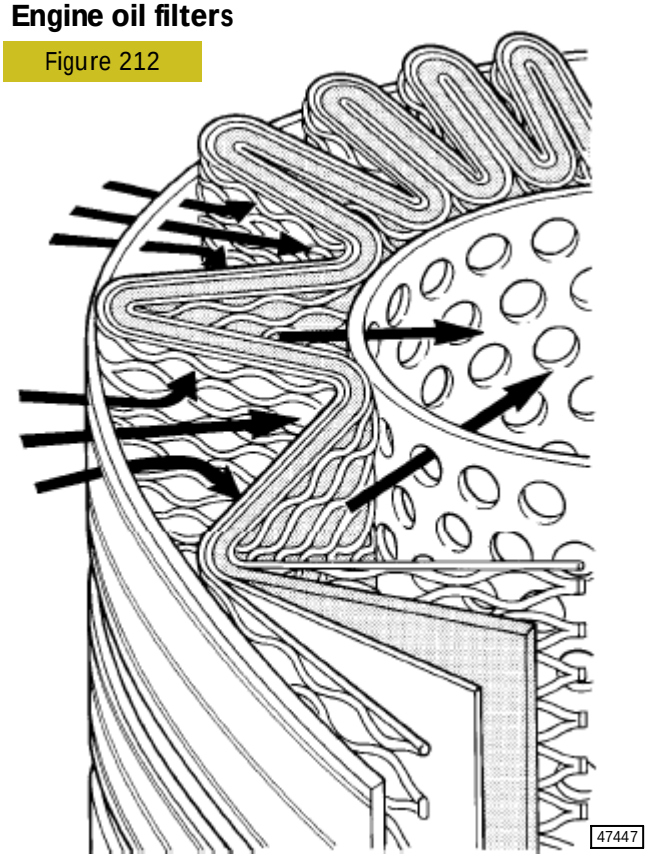
- travel 0.1 mm at a temperature of 82 ± 2°C.

End of opening:

- travel 8 mm at a temperature of 97°C.

## Engine oil filters

Figure 212




This is a new generation of filters that permit much more thorough filtration as they are able to holder back a greater amount of particles of smaller dimensions than those held back by conventional filters with a paper filtering element.

These high-filtration devices, to date used only in industrial processes, make it possible to:

- reduce the wear of engine components over time;
- maintain the performance/specifications of the oil and thereby lengthen the time intervals between changes.

### External spiral winding

The filtering elements are closely wound by a spiral so that each fold is firmly anchored to the spiral with respect to the others. This produces a uniform use of the element even in the worst conditions such as cold starting with fluids with a high viscosity and peaks of flow. In addition, it ensures uniform distribution of the flow over the entire length of the filtering element, with consequent optimization of the loss of load and of its working life.

### Mount upstream

To optimize flow distribution and the rigidity of the filtering element, this has an exclusive mount composed of a strong mesh made of nylon and an extremely strong synthetic material.

### Filtering element

Composed of inert inorganic fibres bound with an exclusive resin to a structure with graded holes, the element is manufactured exclusively to precise procedures and strict quality control.

### Mount downstream

A mount for the filtering element and a strong nylon mesh make it even stronger, which is especially helpful during cold starts and long periods of use. The performance of the filter remains constant and reliable throughout its working life and from one element to another, irrespective of the changes in working conditions.

### Structural parts

The o-rings equipping the filtering element ensure a perfect seal between it and the container, eliminating by-pass risks and keeping filter performance constant. Strong corrosion-proof bottoms and a sturdy internal metal core complete the structure of the filtering element.

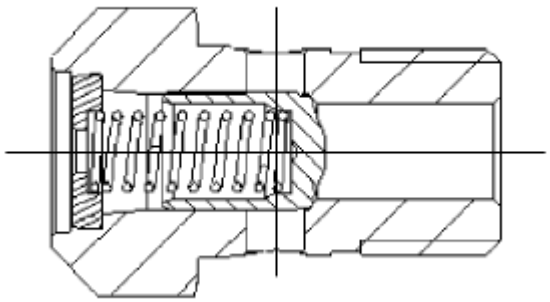
When mounting the filters, keep to the following rules:

- Oil and fit new seals.
- Screw down the filters to bring the seals into contact with the supporting bases.
- Tighten the filter to a torque of 35÷40 Nm.

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## Valve integrated in piston cooling nozzle

Figure 213



109080

The valve allows oil to enter only above the threshold pressure of 1.7 ± 0.2 bar. This permits filling the circuit and therefore lubricating the most stressed parts even when working at lower pressures.

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## 5432 COOLING

### Description

The engine cooling system works with forced circulation inside closed circuit and can be connected to an additional heater (if any) and to the intarder intercooler.
It consists mainly of the following components:

- an expansion reservoir whose plug (1) incorporates two valves – discharge and charge – controlling the system pressure.
- a coolant level sensor placed at the bottom of the expansion reservoir with two coupling points.
  Right drive vehicles:
  - D coupling point for sensor S1 6.2 litres
  - D coupling point for sensor S2 3.7 litres

  Left drive vehicles:
  - D coupling point for sensor S1 6 litres
  - D coupling point for sensor S2 3.7 litres
- an engine cooling unit to dissipate the heat taken by the coolant from the engine through the intercooler.
- a heat exchanger to cool down lubrication oil;
- a water pump with centrifugal system incorporated in the cylinder block;
- an electric fan consisting of a 2-speed electro-magnetic joint equipped with a neutral wheel shaft hub fitted with a metal plate moving along the axis and where the fan is installed. It is controlled electronically by the vehicle Multiplex system.
- a 3-way thermostat controlling the coolant circulation.

### Operation

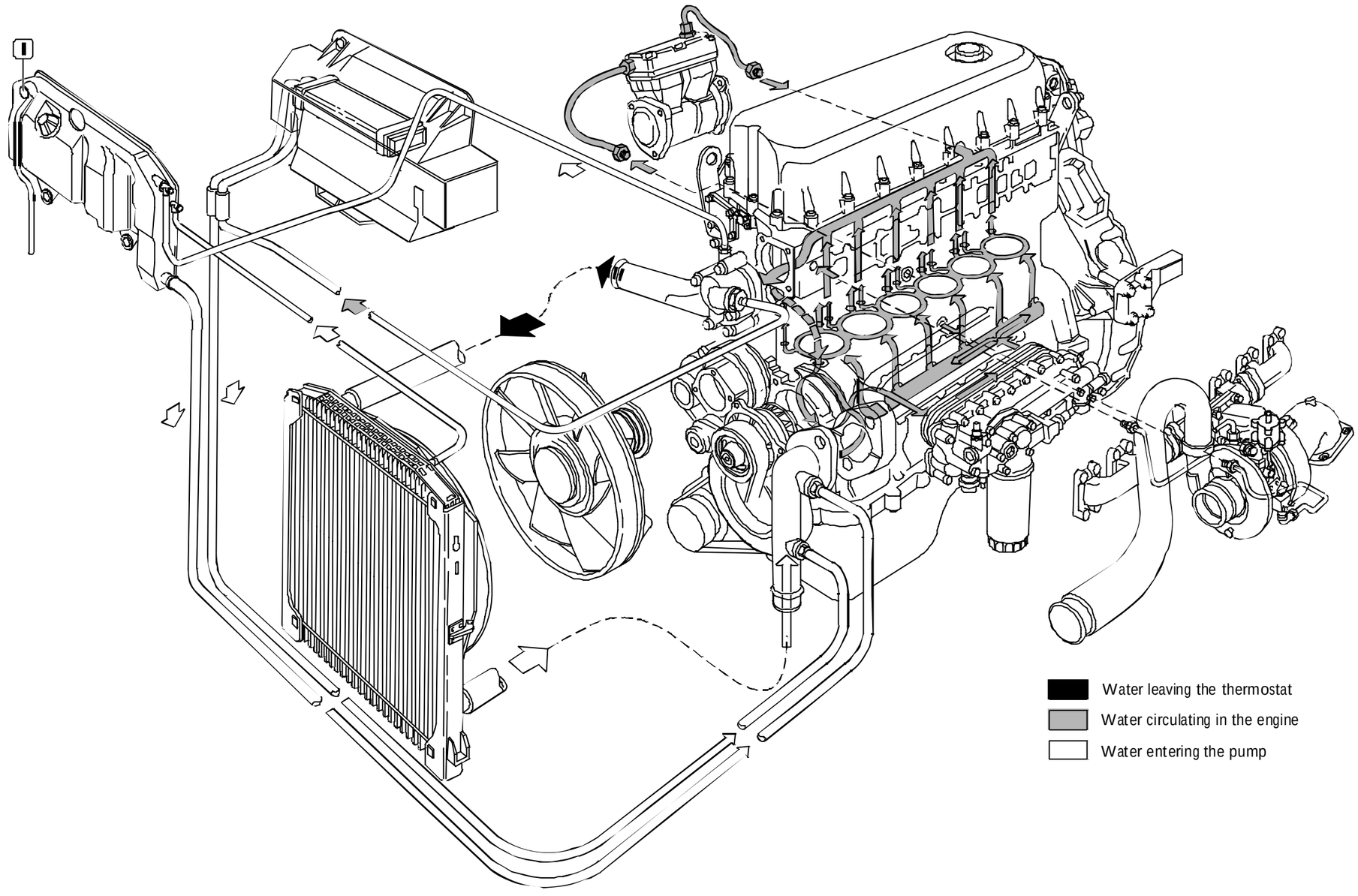
The water pump is actuated by the crankshaft through a poli-V belt and sends coolant to the cylinder block, especially to the cylinder head (bigger quantity). When the coolant temperature reaches and overcomes the operating temperature, the thermostat is opened and from here the coolant flows into the radiator and is cooled down by the fan.
The pressure inside the system depending on the temperature variation is controlled by the discharge and charge valves incorporated in the expansion reservoir filling plug (1).
The discharge valve has a double function:

- keep the system under light pressure in order to raise the coolant boiling point;
- discharge the pressure surplus in the atmosphere as a result of the coolant high temperature.

The charge valve makes it possible to transfer the coolant from the expansion reservoir to the radiator when a depression is generated inside the system as a result of the coolant volume reduction depending on the fall in the coolant temperature.
Discharge valve opening:

| | | |
|---|---|---|
| D 1st breather | 0.9 $^{+0.2}_{-0.1}$ | bar |
| D 2nd breather | 1.2 $^{+0.2}_{-0.1}$ | bar |
| Charge valve opening | -0.03 $^{+0}_{-0.02}$ | bar |
| Cap (1) tightening torque (1) | 8 ± 1 | Nm |

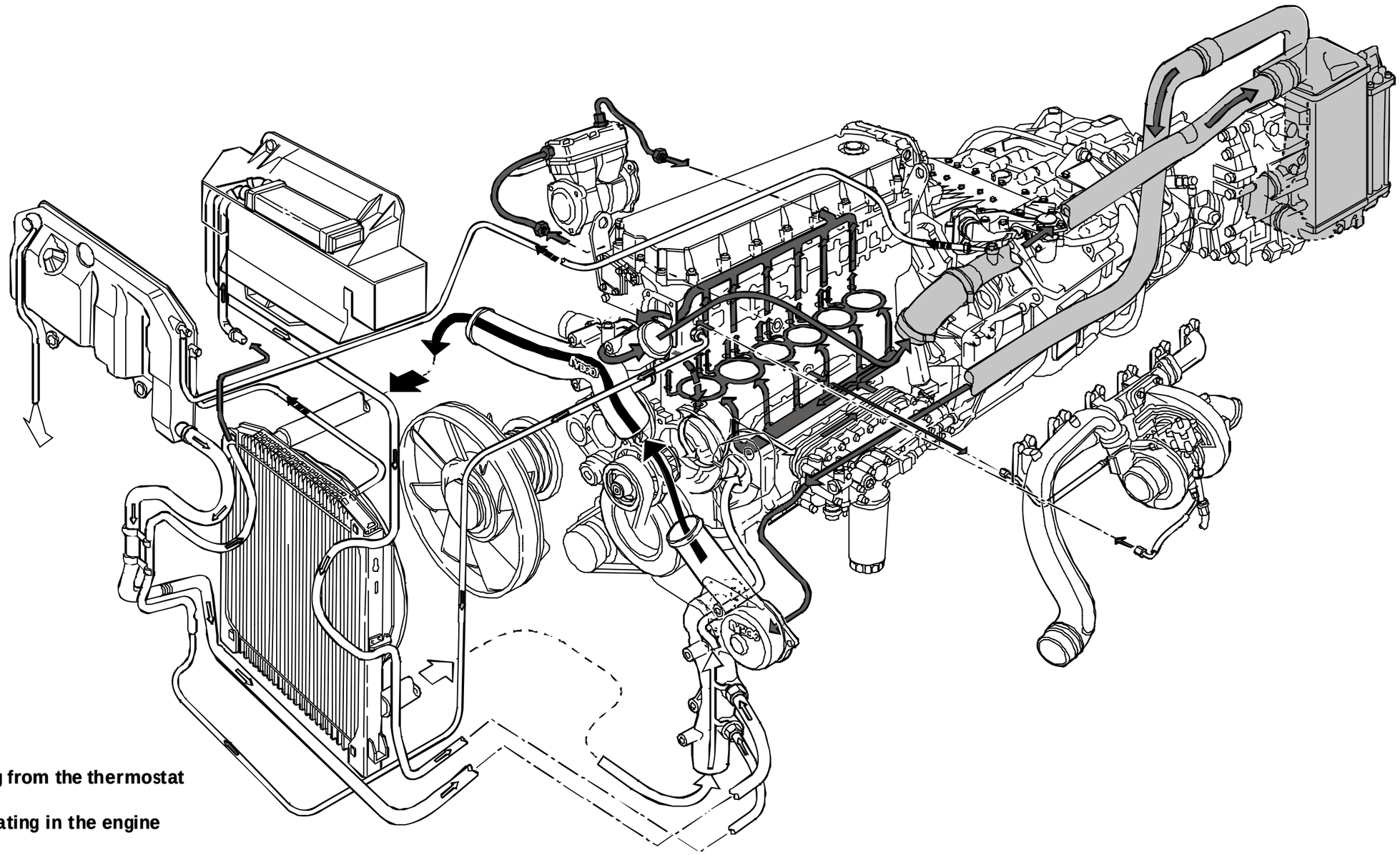
Figure 214




COOLING CIRCUIT VERSION WITHOUT INTARDER

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Figure 215

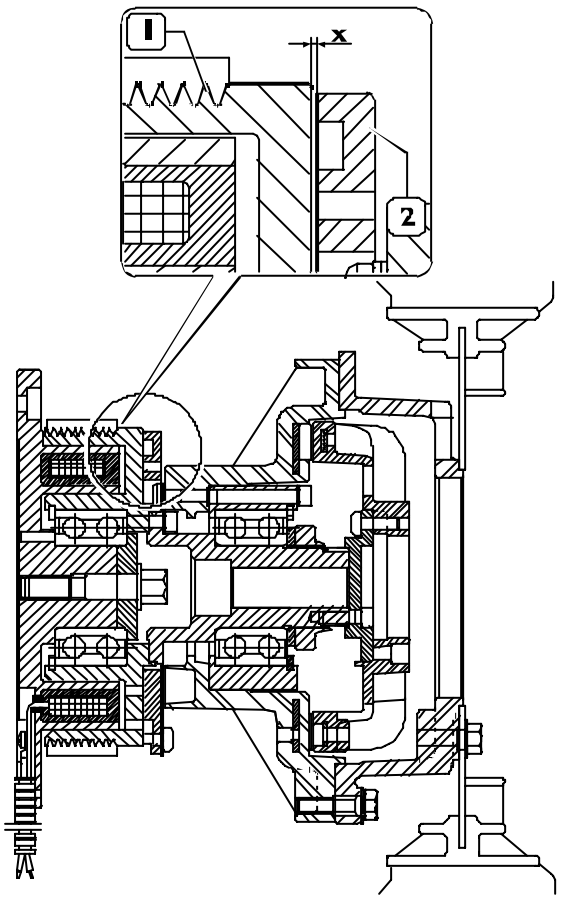



COOLING CIRCUIT VERSION WITH INTARDER

Aquila Trucks Centres

## 543210 Electromagnetic fan drive

Figure 216




78842

ELECTROMAGNETIC FAN DRIVE SECTION

The electro-magnetic fan drive action depends on:
- the coolant temperature;
- the climate control system fluid pressure (if any);
- the slowing down action of the intarder on (if any).

Coolant temperature for:

| | |
|---|---|
| - engagement | 93°C |
| - disengagement | 88°C |

With climate control system

Climate control system fluid pressure:

| | |
|---|---|
| - 2nd speed engagement | 22 bar |

With intarder

With braking power below 41% of maximum power.

Coolant temperature for:

| | |
|---|---|
| - 2nd speed engagement | 93°C |
| - disengagement | 88°C |

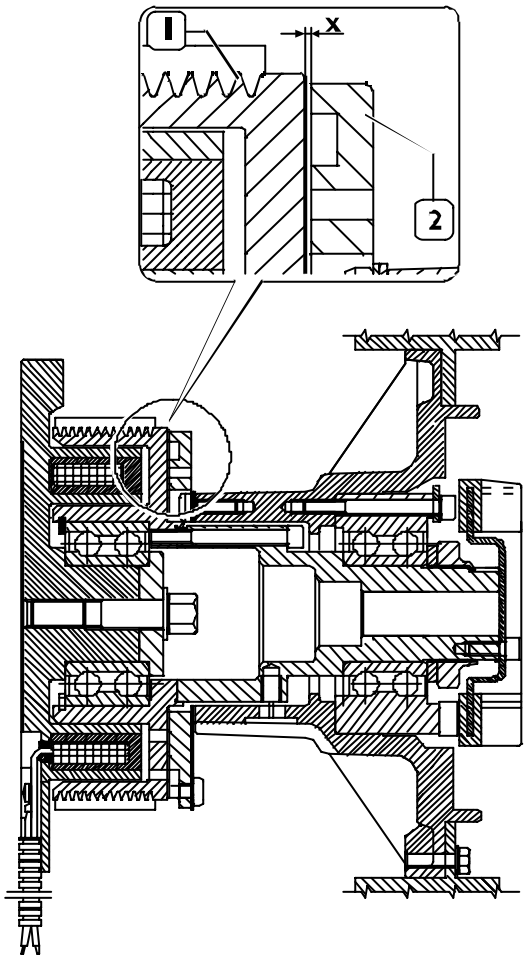
With braking power over 41% of maximum power:

Coolant temperature for:

| | |
|---|---|
| - 2nd speed engagement | 85°C |
| - disengagement | 80°C |

Using a feeler gauge, check the gap between the anchor assembly (2) and the pulley (1), it must be no greater than 2.5 mm.
As to the description of the electro-magnetic joint operation and servicing, see the Volume 3.

Figure 217

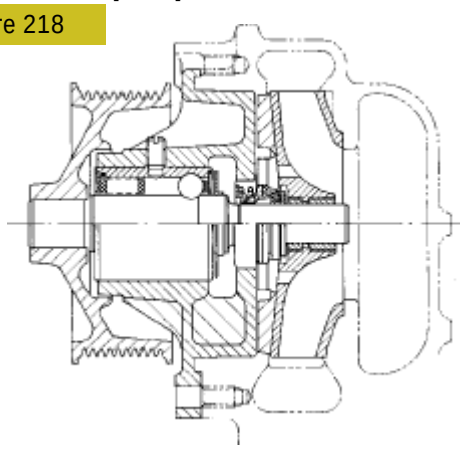



92826

ELECTROMAGNETIC FAN DRIVE SECTION
NEW VERSION

## 543210 Water pump

Figure 218



44915

WATER PUMP SECTION

The water pump consists of: rotor, seal bearing and control pulley.

**NOTE** Make sure that the pump casing has no cracking or water leakage; otherwise, replace the entire pump.

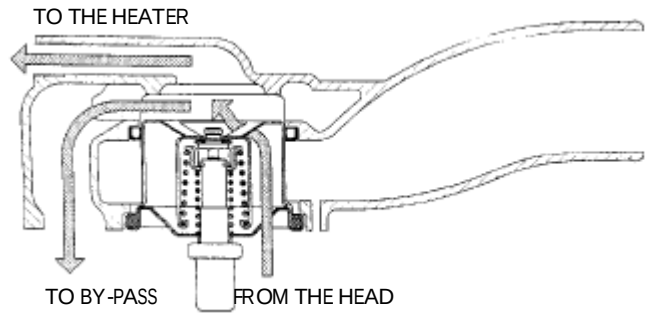
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## 543250 Thermostat

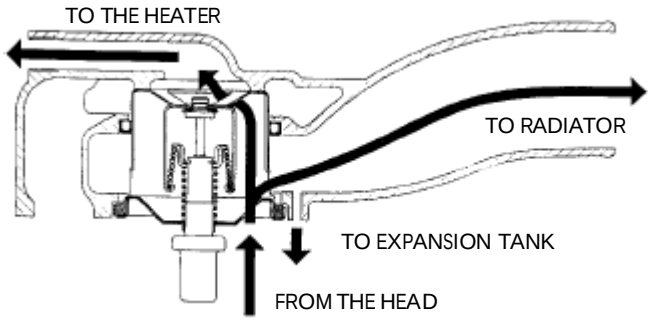
THERMOSTAT OPERATION VIEW

Figure 219




Water circulating in the engine

Figure 220




Water issuing from thermostat

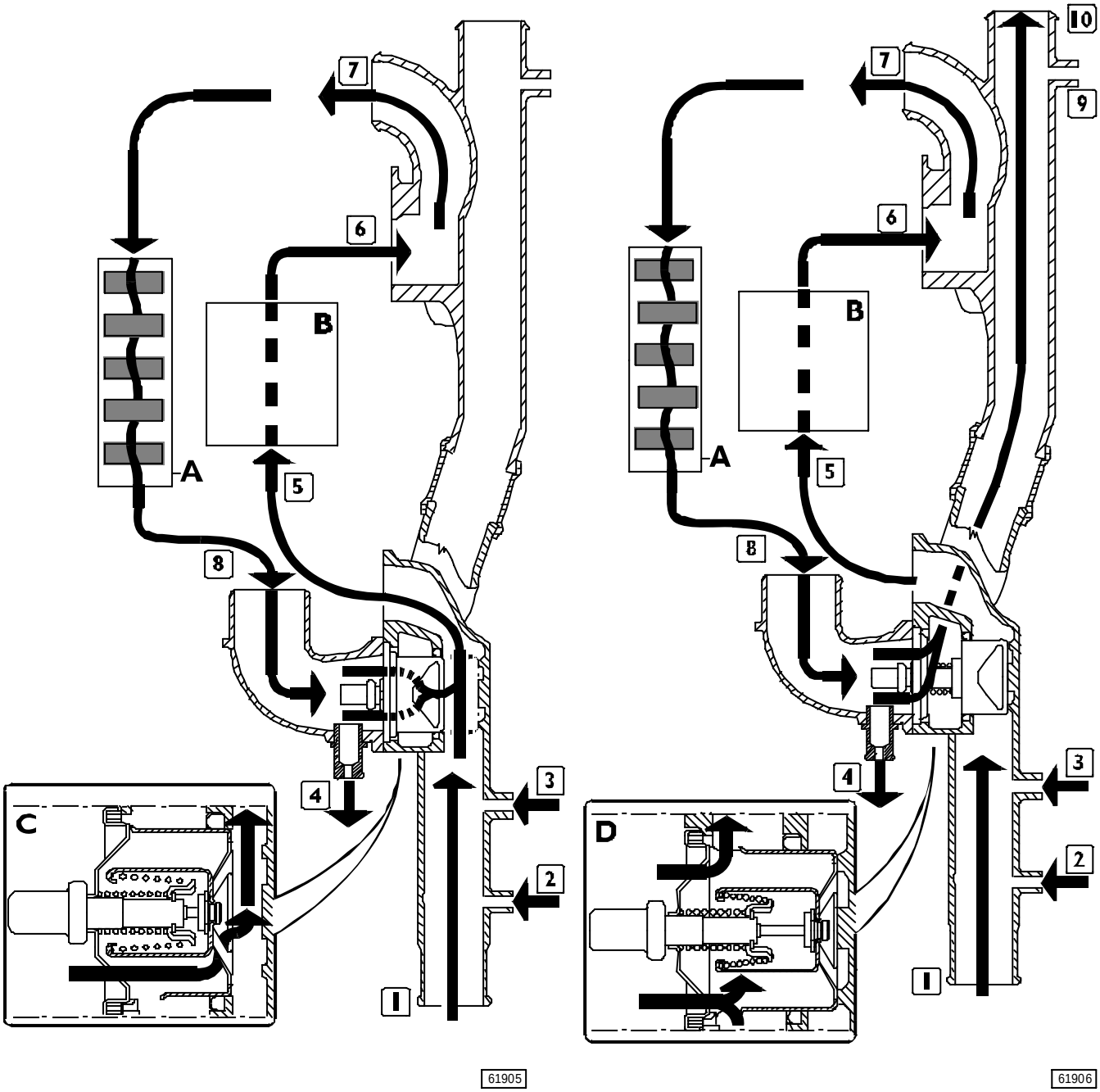
Check the thermostat works properly; replace it if in doubt.

Temperature of start of travel 84°C ±2°C.
Minimum travel 15 mm at 94°C ±2°C.

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VIEWS OF RADIATOR THERMOSTAT OPERATION FOR GEARBOX WITH INTARDER

Figure 221




SYSTEM WITH THERMOSTAT OFF

SYSTEM WITH THERMOSTAT ON

A. Gearbox heat exchanger - B. Engine - C. Thermostat closed - D. Thermostat open - 1. Inlet from radiator - 2. Return from cabin heater - 3. Inlet from header tank - 4. Delivery to cabin heater - 5. To engine water pump - 6. Outlet from the head - 7. Delivery to gearbox heat exchanger - 8. Return from heat exchanger to thermostat - 9. Engine re-circulation (breather) to header tank - 10. Delivery to radiator.

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## 5424 TURBOCHARGING

The turbocharging system consists of:

- air filter;
- A turbocharger with fixed geometry (330CV and 360CV engines) or with variable geometry (310CV engines);
- "intercooler" radiator.

Figure 222

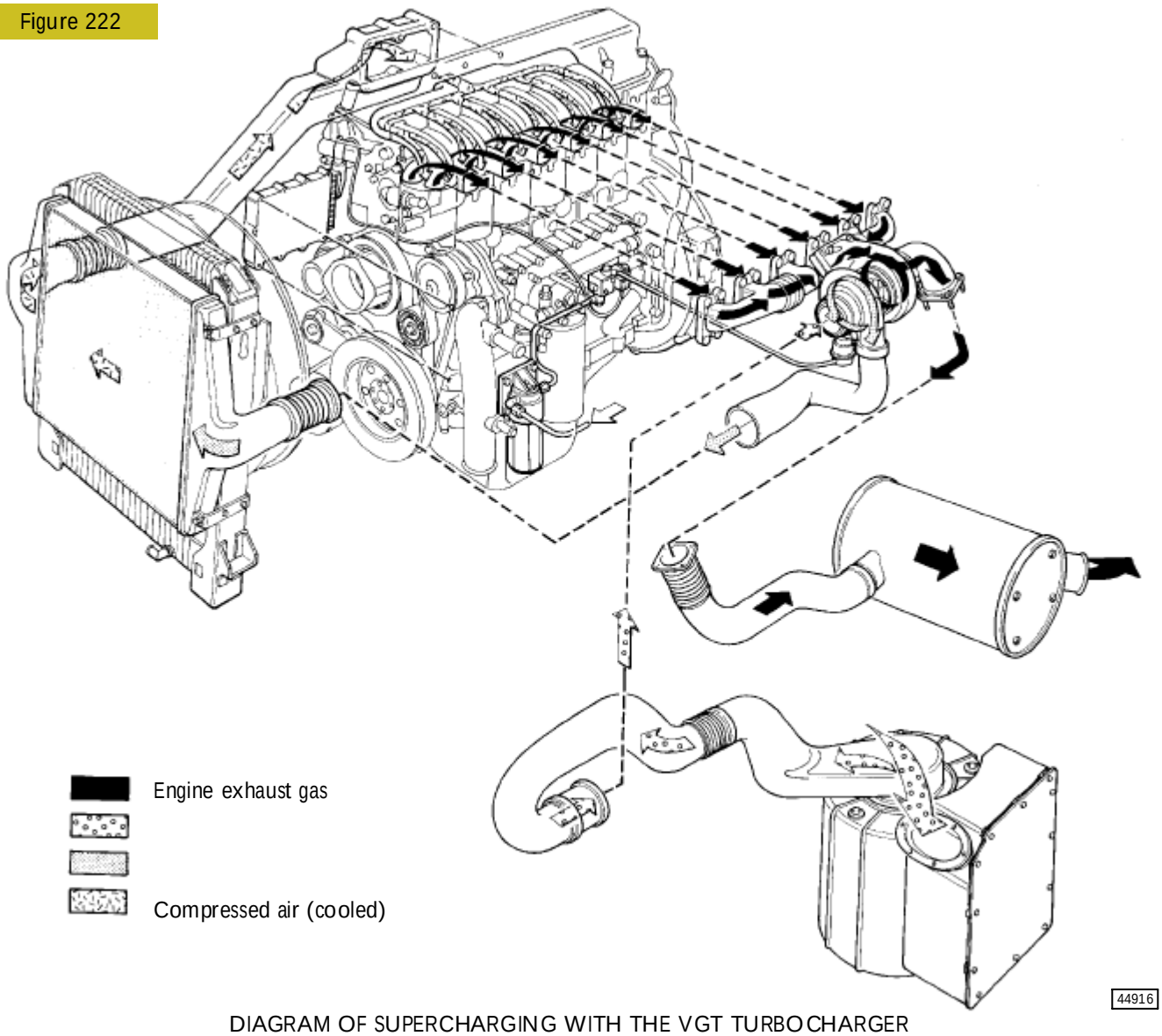



DIAGRAM OF SUPERCHARGING WITH THE VGT TURBOCHARGER

### VGT TURBOCHARGER

Operating principle

The variable geometry turbocharger (VGT) consists of a centrifugal compressor and a turbine, equipped with a mobile device which adjusts the speed by changing the area of the passing section of exhaust gases to the turbine.

Thanks to this solution, gas velocity and turbine speed can be high even when the engine is idling.

If the gas is made to go through a narrow passage, in fact, it flows faster, so that the turbine rotates more quickly.

The movement of the device, choking the exhaust gas flowing section, is carried out by a mechanism, activated by a pneumatic actuator.

This actuator is directly controlled by the electronic control unit by a proportional solenoid valve.

The device is in maximum closing condition at idle speed.

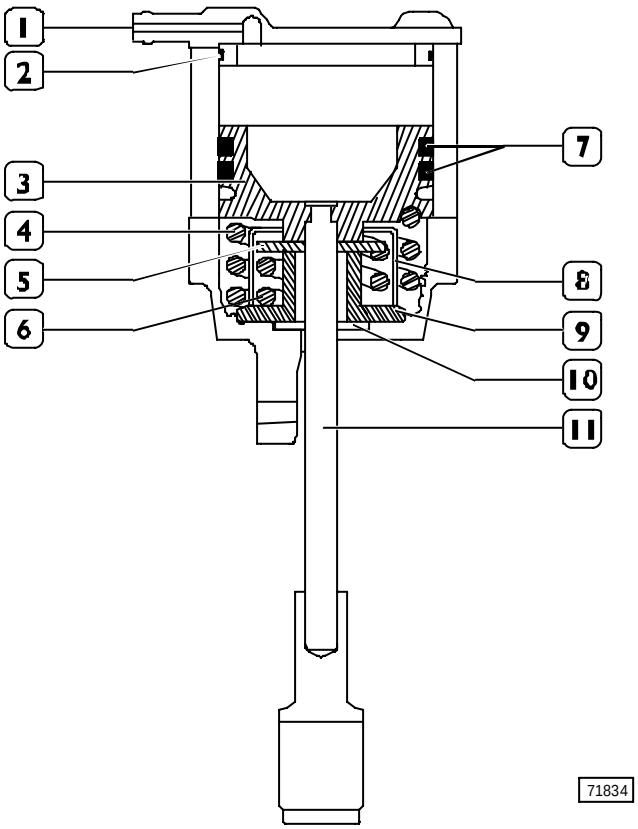
At high engine operating speed, the electronic control system is activated and increases the passing section, in order to allow the in-coming gases to flow without increasing their speed.

A toroidal chamber is obtained during the casting process in the central body for the passage of the coolant.

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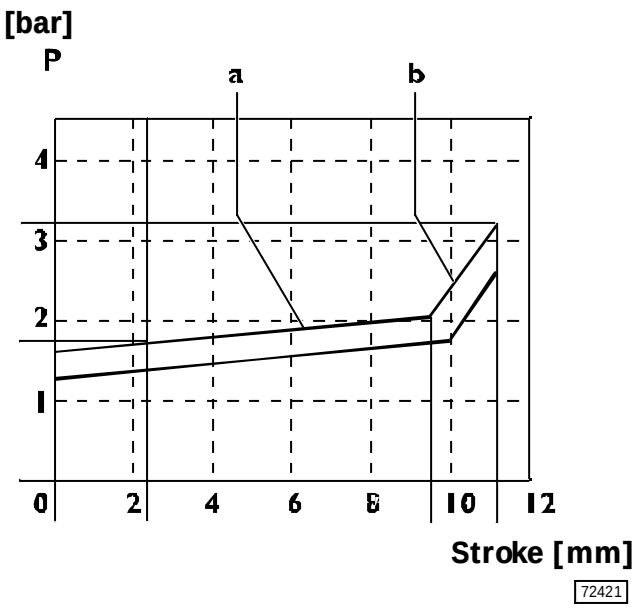
## Actuator

Figure 223




1. Air inlet - 2. Gasket - 3. Piston - 4. External spring - 5. Internal spring control disc - 6. Internal spring - 7. O-ring - 8. Spring holder - 9. Limit stop - 10. Dust seal - 11. Control rod

Figure 224




a Gradient characterized by the effect of the external spring (4, Figure 223).

b Gradient characterized by the effect of the external (4, Figure 223) and internal (6) springs.

Working principle (See Figure 223)

The actuator piston, connected to the drive rod, is controlled with the compressed air introduced through the air inlet (1) on the top of the actuator.

Modulating the air pressure varies the movement of the piston and turbine control rod. As the piston moves, it progressively compresses the external spring (4) until the base of the piston reaches the disc (5) controlling the internal spring (6).

On further increasing the pressure, the piston, via the disc (5), interferes with the bottom limit stop (10).

Using two springs makes it possible to vary the ratio between the piston stroke and the pressure. Approximately 85% of the stroke of the rod is opposed by the external spring and 15% by the internal one.

## Solenoid valve for VGT control

This N.C. proportional solenoid valve is located on the left-hand side of the crankcase under the turbine.

The electronic control unit, via a PWM signal, controls the solenoid valve, governing the supply pressure of the turbine actuator, which, on changing its position, modifies the cross-section of the flow of exhaust gases onto the blades of the impeller and therefore its speed.

The resistance of the coil is approx. 20-30 Ohms.

## REPAIRING ACTIONS

**NOTE** If anomalous engine operation is found, which is due to the boosting system, it is advisable that you check the efficiency of seal gaskets and the fastening of connecting sleeves prior to carrying out the checks on the turboblower. Also check for obstructions in the sucking sleeves, air filter. If the turbocharger damage is due to a lack of lubrication, check that the oil circulation pipes are not damaged. If so, change them or eliminate the cause.

After carrying out the above mentioned checks, check the turbocharger operation with an Engine Test by using IVECO diagnosis equipment (Modus - IT 2000 - E.A.SY.) according to the relevant procedure.

**NOTE** The test must be performed in following conditions:

- engine coolant temperature >50 °C;
- battery up (voltage >22V) for compression test;
- efficient recharging system.

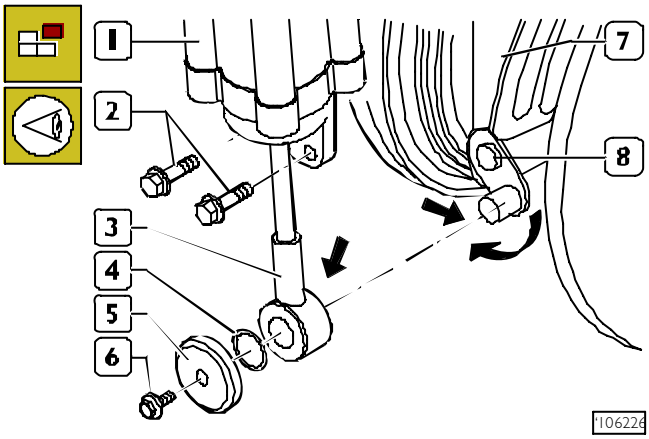
If values beyond tolerance are detected, check the efficiency of:

- shut-off valve;
- pressure sensor;
- engine cable pressure sensor connection (if oxidised, clean with a specific product);
- lack of electrical defects in solenoid valve VGT (continuity connection);
- actuator moved by active diagnosis as described in relating chapter, in case of locking, grease bushing with lubricant Kernite (for high temperatures); if the trouble persists, replace the actuator;
- sliding sleeve: it must slide freely when operated manually. If locked and if the bush check is not sufficient or effective, or no faults are detected in the other points, upon authorization of the "Help Desk" market operator, change the turbocharger according to the standard procedures.

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## Variable geometry movement control

Figure 225




Remove screws (2) and take actuator (1) off turbocompressor (7).
Remove screw (6), underlying disk (5), ring (4) and disconnect tie rod (3) of actuator (1) from the pin of variable geometry driving lever (8).
Accurately clean pin (→) of lever (8) and bushing (→) of tie rod (3) using a cloth made of non abrasive micro fibre.

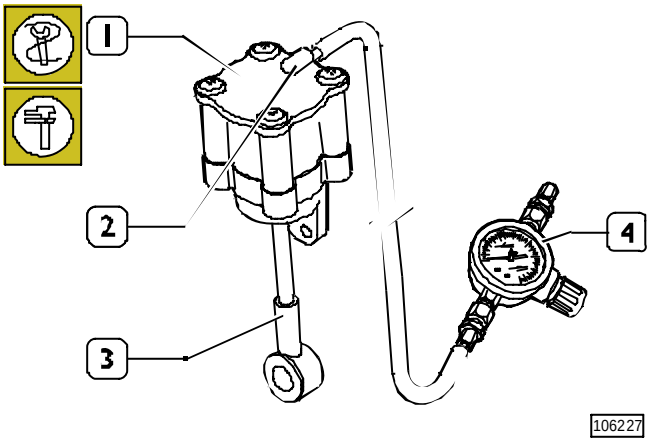
**NOTE** Do not use abrasive paper of any kind.

Visually check the conditions of bushing (→) of tie rod (3) and pin (→) of lever (8); where they are found to be worn out, replace actuator (1) or turbocompressor (7).

Check variable geometry inner driving mechanism movement by operating on lever (8); jamming must not occur; otherwise, clean turbine body, as described in relating chapter.

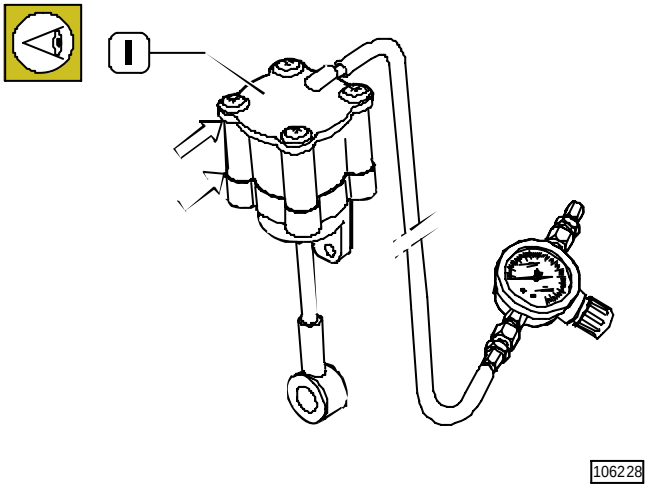
## Checking the actuator

Figure 226




Check actuator efficiency (1) operating as follows.
Apply, to fitting (2) of actuator (1), compressed air feed piping provided with pressure regulator (4). By using the pressure regulator, introduce, into the actuator, compressed air slowly modulating it, from 0÷3.5 bar; tie rod (3) of actuator (1) must move without jamming; otherwise, replace actuator (1).

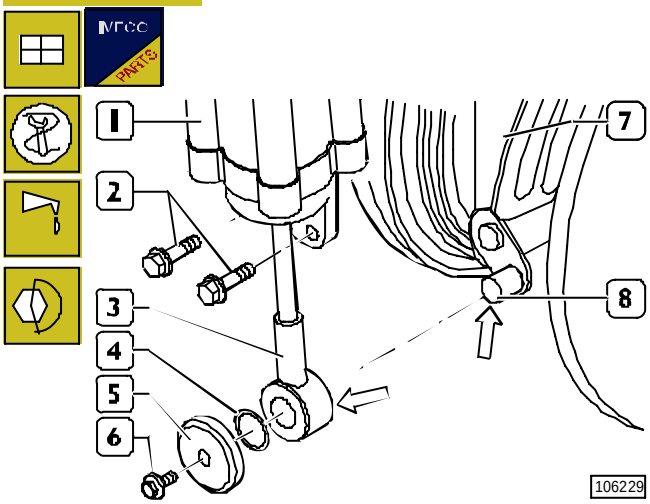
Figure 227




Check for any actuator leaks at indicated points (→) applying, on these points, a solution of suds.
When actuator (1) is fed with compressed air, no bubbles must be found at indicated points (→); otherwise, replace actuator (1).

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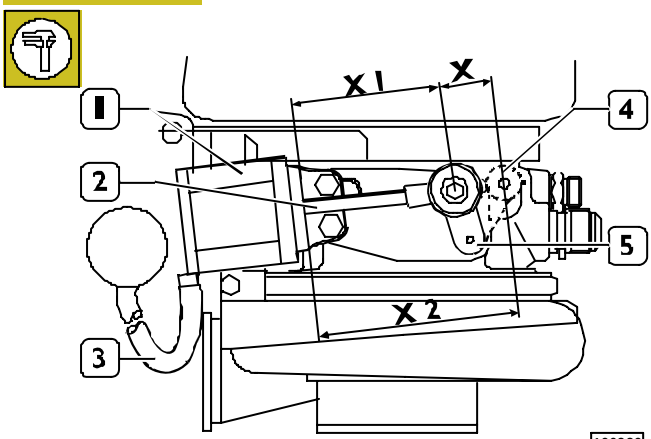
Figure 228




Lubricate bushing (→) of tie rod (3) and pin (→) of lever (8) with lithium-based Castrol LM GREASE type and reconnect actuator (1) to turbocompressor (7) operating as follows.
Connect tie rod (3) to lever (8).
Mount new ring (4), mount disk (5) and screw up screw (6).
Screw up screws (2) securing actuator (1) to turbocompressor (7).
Tighten screws (2 and 6) at 25 Nm torque.

## Checking actuator travel

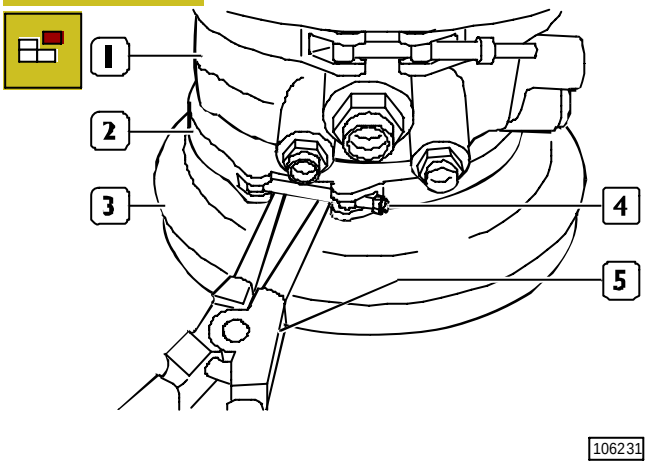
Figure 229




Check travel X of tie rod (2) of actuator (1) operating as follows.
Measure distance X1 between actuator (1) and cross-axis of eyelet (4).
Apply, to fitting of actuator (1), piping (3) for compressed air feed provided with pressure regulator. By using the pressure regulator, introduce, into actuator (1) compressed air slowly modulating it, from 0÷3,5 bar, until lever (5) is taken to its end of travel.
Measure again the distance between actuator (1) and cross-axis of eyelet (4) dimension X2.
Travel X of tie rod (2) of actuator (1) is given by following subtraction X = X2-X1 and must result to be equal to 11.5±0.5 mm.

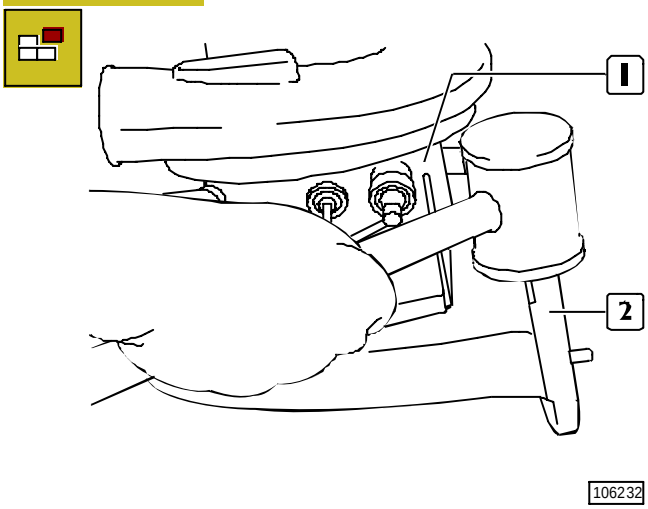
## Cleaning turbine body

Figure 230




Mark mounting position of clamp (2) on central body (1).
On threading and nut (4), apply antioxidant spray lubricant and, operating on nut (4), loosen clamp (2).
Slightly rotate clamp (2) using pliers (5).
Mark mounting position of turbine body (3) on central body (1).

Figure 231



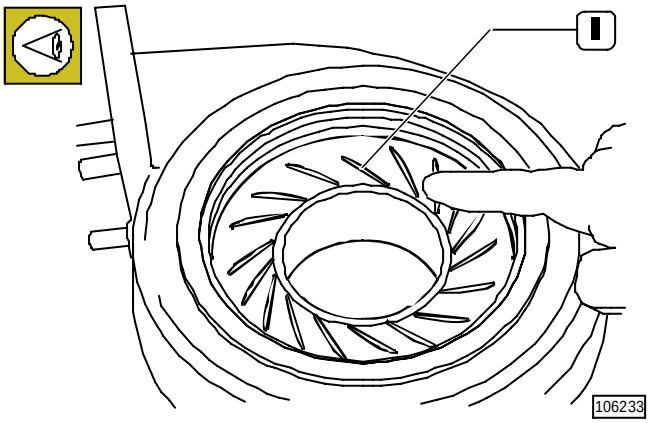

By a copper hammer, beat on two opposite points (~180°) on turbine body (2) to separate turbine body from central body (1).

**NOTE** In operation, take particular care to avoid damaging turbine rotor.

After dismounting turbine body, check variable geometry movement as described in relating chapter; where improvement in movement is not found with respect to previous check, replace turbocompressor.

Aquila Trucks Centres

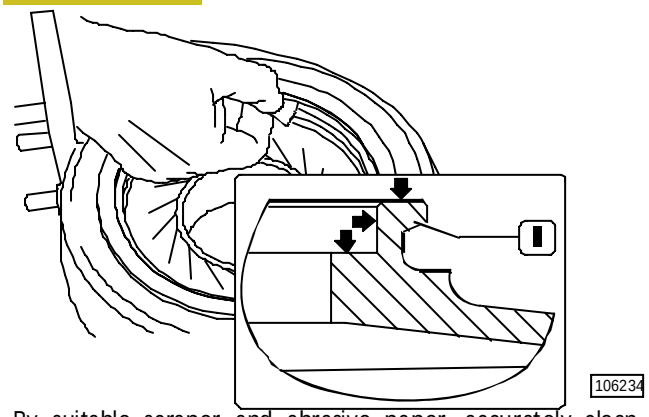
Figure 232




Accurately clean slot ring (1) and area around turbine body from carbonaceous deposits and check that the ring moves freely, otherwise, replace turbocompressor.

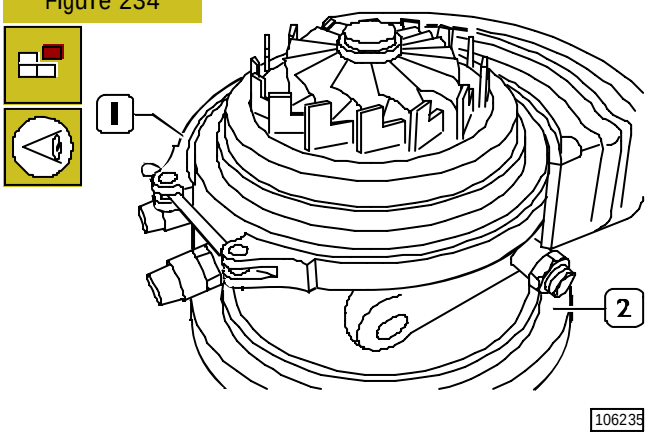
**NOTE** Any small cracks between slots and ring can be accepted, because they do not impair turbocompressor operation conditions.

Figure 233



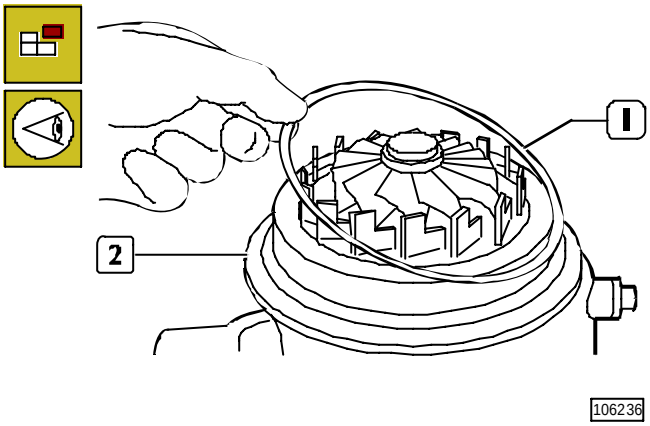

By suitable scraper and abrasive paper, accurately clean surfaces (→) of turbine body (1) from carbonaceous deposits, taking care to avoid damaging the surfaces.

Figure 234



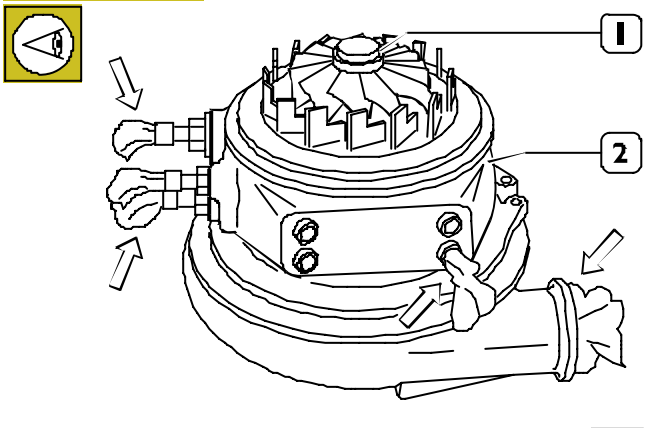

Dismount clamp (1) from central body (2) and check that the clamp does not result to be damaged; otherwise replace the clamp.

Figure 235




Dismount seal ring (1), external with respect to central body (2).
Accurately clean seal ring (1) and check that the ring does not result to be damaged; otherwise replace the ring.

Figure 236



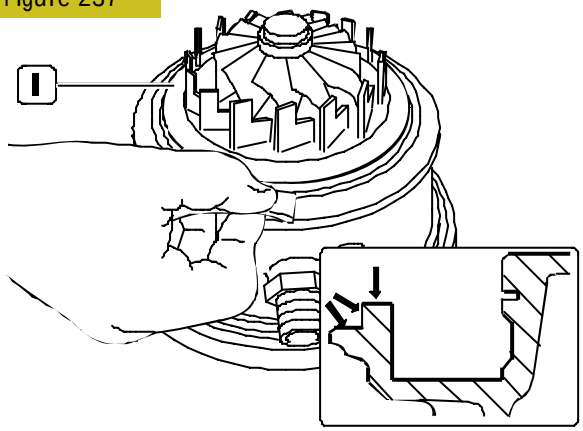

Check turbine rotor (1); there must not be found: carbonaceous deposits, deformation, cracks, blade scoring; also, turbine must turn freely.
By comparator, check clearance of turbine rotor stem (1); clearance must result to be:
- axial clearance: 0.025÷0.127 mm
- radial clearance: 0.254÷0.356 mm.

Where either clearance values over above ones or any one of above mentioned faults are found, replace turbocompressor.

**NOTE** Before cleaning turbine side central body, properly protect oil, water and air inlets and outlets (→) in order to prevent dirt or foreign bodies from entering turbocompressor.

Aquila Trucks Centres

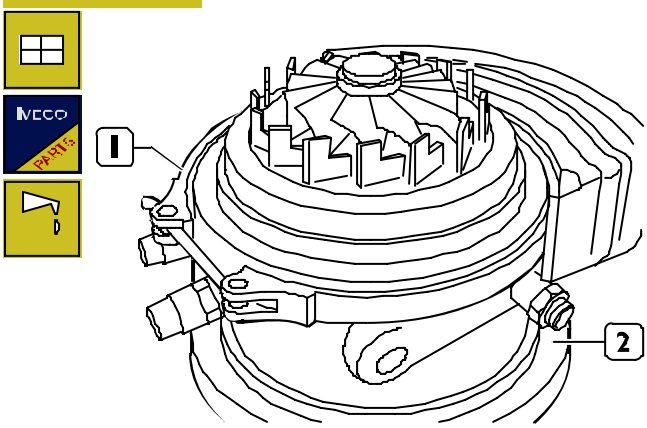
Figure 237




106238

By suitable scraper and abrasive paper, accurately clean surfaces (→) of central body (1) from carbonaceous deposits, taking care to avoid damaging the surfaces and variable geometry ring.
Then, with compressed air, clean variable geometry surfaces and ring from removed residues.
Check again, as described in relating chapters:
- variable geometry movement;
- actuator;
- actuator travel.

Figure 238



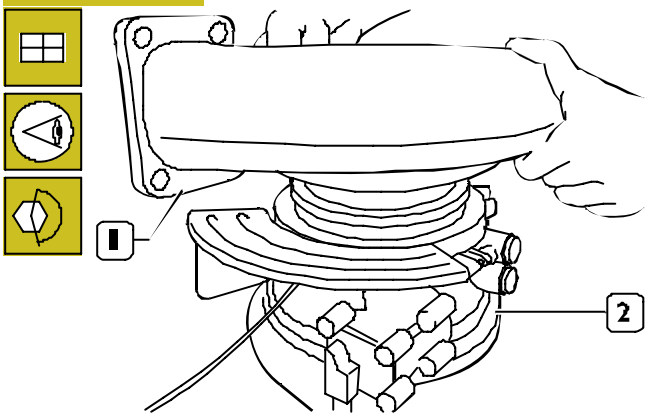

106235

Position clamp (1) on central body (2)

**NOTE** Should clamp (1) be replaced with an integrated heat guard, a new actuator has to be mounted with an integrated heat guard at the place of existing one.

Position accurately cleaned seal ring on central body.
Apply a thin layer of antiscuff paste on cleaned matching surfaces: central body / turbine body.

Figure 239




106240

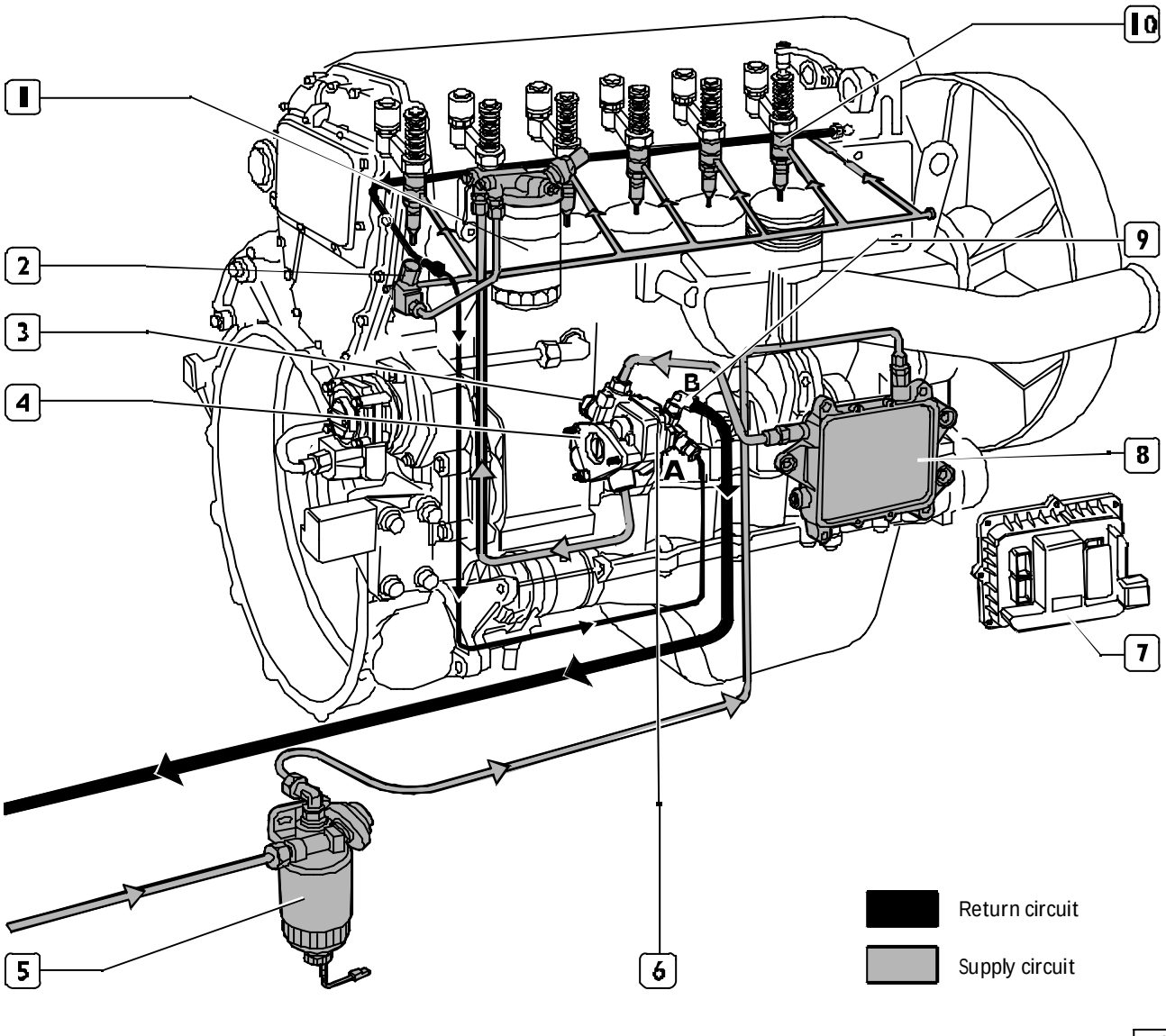
Mount turbine body (1) on central body (2) taking care to avoid damaging turbine rotor and align turbine body variable geometry slot ring. Do not force mounting operation: in case of jamming, it might damage variable geometry with consequent regulation system faulty operation.
Once mounting has been completed, make sure that turbine body results to be matched correctly on central body.
Position turbine body on central body and clamp on central body in such a way that marks, made on dismounting, are matching.
Tighten nut clamping the clamp at 11.3 Nm torque.
Check again, as described in relating chapters:
- actuator;
- actuator travel.

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## FUEL SYSTEM

Fuel is supplied via a fuel pump, filter and pre-filter, 6 pump-injectors governed by the camshaft via rocker arms and by the electronic control unit.

Figure 240




ENGINE FEED SCHEME

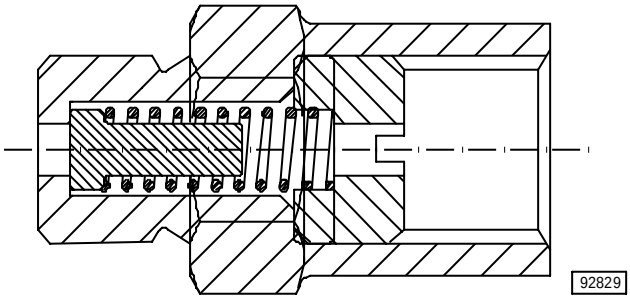
1. Fuel filter - 2. Pressure damping device - 3. Pressure control valve (start of opening at 5 bar) - 4. Feed pump - 5. Fuel pre-filter with priming pump - 6. Valve, to recirculate fuel from injectors, integrated in feed pump (start of opening at 3.5 bar) - 7. Central unit - 8. Heat exchanger - 9. One-way valve to return fuel to tank (start of opening at 0.2 bar) - 10. Pump injectors

A. Fuel arriving at injectors - B. Fuel returning to tank

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## Overpressure valve

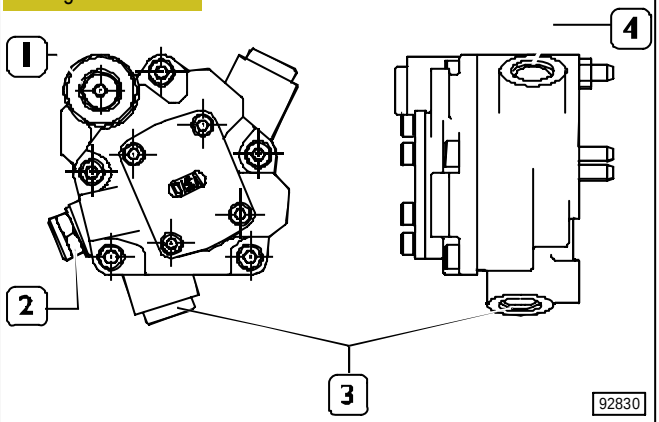
Figure 241




An overpressure valve is a single-acting valve, calibrated to 0.2 ÷ 0.3 bar, placed on the piping that returns fuel to tank. The overpressure valve prevents fuel duct in cylinder head from emptying with engine stopped.

## Feed pump

Figure 242




Fuel pump fitted onto the power steering pump
1. Overpressure valve - 2. Delivering fuel to injectors - 3. Sucking in fuel - 4. Pressure control valve

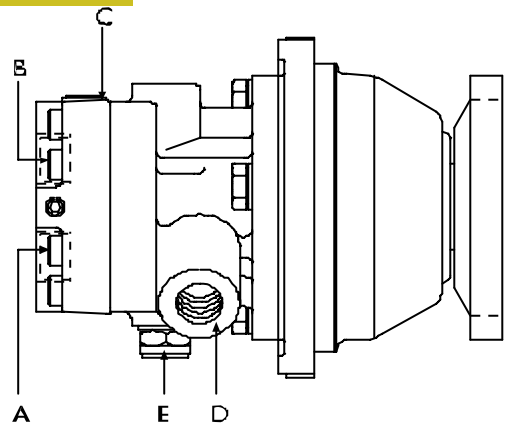
| Pump performances | | | | | |
|---|---|---|---|---|---|
| Pump rotation speed (rpm) | | 2600 | 600 | 170 | 100 |
| Minimum flow rate (l/h) | | 310 | 45 | 12 | |
| Test conditions | Negative pressure on aspiration (bar) | 0.5 | 0.3 | 0.3 | 0.3 |
| | Pressure on delivery (bar) | 5 | 3 | 0,3 | 0.3 |
| | Test liquid temperature (°C) | 30 | 30 | 30 | 30 |
| | Test liquid | ISO 4113 | | | |

| Field of use | |
|---|---|
| Pump rotation speed (rpm) | 2600 |
| Overrunning rotation speed (max 5 min) (rpm) | 4100 max |
| Diesel oil temperature (°C) | -25/+80 |
| Filtering rate on aspiration (micron) | 30 |
| Negative pressure on aspiration (bar) | 0.5 max |

| Pressure control valve | |
|---|---|
| Valve calibration | 5 ÷ 8.8 |

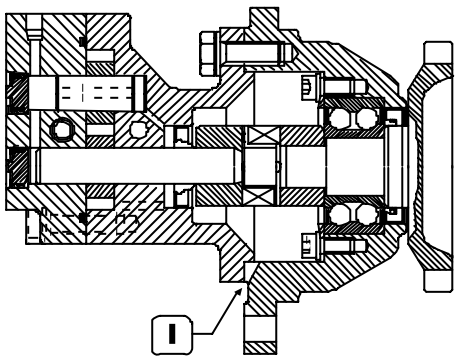
| Injectors return valve | |
|---|---|
| Valve calibration | 3.2 ÷ 3.8 |

Figure 243




Fuel pump fitted onto the camshaft drive
A. Fuel inlet – B. Fuel delivery – C. By-pass nut – D. Fuel return from the pump-injectors – E. Pressure relief valve – Opening pressure: 5-8 bars

Figure 244




SECTION ON FEED PUMP
1. Oil and fuel leaks indicator

| Pump performances | | | | | |
|---|---|---|---|---|---|
| Pump rotation speed (rpm) | | 4100 | 900 | 250 | 140 |
| Minimum flow rate (l/h) | | 310 | 45 | 12 | 6 |
| Test conditions | Negative pressure on aspiration (bar) | 0.5 | 0.3 | 0.3 | 0.3 |
| | Pressure on delivery (bar) | 5 | 3 | 0.3 | 0.3 |
| | Test liquid temperature (°C) | 50 | 50 | 50 | 20 |
| | Test liquid | ISO 4113 | | | |

| Field of use | |
|---|---|
| Pump rotation speed (rpm) | 4100 |
| Overrunning rotation speed (max 5 min) (rpm) | 5800 max |
| Diesel oil temperature (°C) | -25/+80 |
| Filtering rate on aspiration (micron) | 0.5 max |
| Negative pressure on aspiration (bar) | -25/+120 |

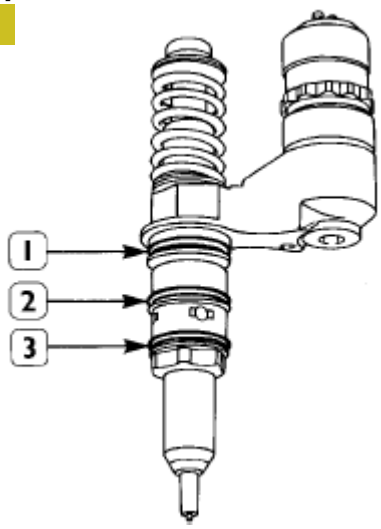
| Pressure control valve | |
|---|---|
| Valve calibration | 5 ÷ 5.8 |

| Injectors return valve | |
|---|---|
| Valve calibration | 3.4 ÷ 3.8 |

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## Injector-pump

Figure 245




1. Fuel/oil seal – 2. Fuel/diesel seal – 3. Fuel/exhaust gas seal

The injector-pump is composed of: pumping element, nozzle, solenoid valve.

Plunger

The plunger is operated by a rocker arm governed directly by the cam of the camshaft.

The plunger is able to ensure a high delivery pressure. The return stroke is made by means of a return spring.

Nozzle

Garages are authorized to perform fault diagnosis solely on the entire injection system and may not work inside the injector-pump, which must only be replaced.

A specific fault-diagnosis program, included in the control unit, is able to check the operation of each injector (it deactivates one at a time and checks the delivery of the other five).

Fault diagnosis makes it possible to distinguish errors of an electrical origin from ones of a mechanical/hydraulic origin. It indicates broken pump-injectors.

It is therefore necessary to interpret all the control unit error messages correctly.

Any defects in the injectors are to be resolved by replacing them.

Solenoid valve

The solenoid, which is energized at each active phase of the cycle, via a signal from the control unit, controls a slide valve that shuts off the plunger delivery pipe.

When the solenoid is not energized, the valve is open, the fuel is pumped but it flows back into the return pipe with the normal transfer pressure of approximately 5 bars.

When the solenoid is energized, the valve shuts and the fuel, not being able to flow back into the return pipe, is pumped into the nozzle at high pressure, causing the needle to lift.

The amount of fuel injected depends on the length of time the slide valve is closed and therefore on the time for which the solenoid is energized.

The solenoid valve is joined to the injector body and cannot be removed.

On the top there are two screws securing the electrical wiring from the control unit.

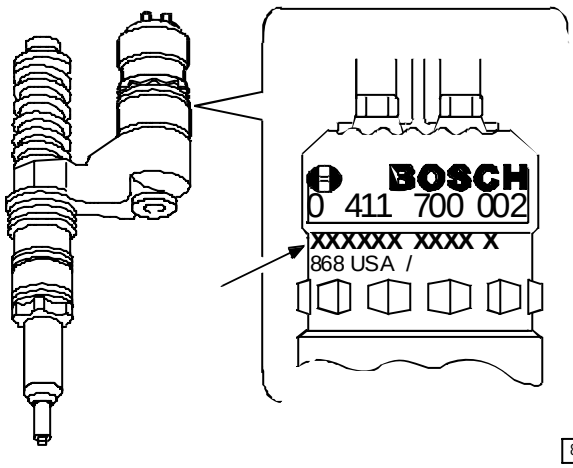
To ensure signal transmission, tighten the screws with a torque wrench to a torque of 1.36 – 1.92 Nm (0.136 – 0.192 kgm).

### 775010 Replacing injectors-pump

Injectors have to be replaced with great care (for their removal see the description on pages 51 and 52, for fitting them see the description on pages 93 and 94).

**NOTE** If this job is done with the engine on the vehicle, before removing the injectors-pump drain off the fuel contained in the pipes in the cylinder head by unscrewing the delivery and return fittings on the cylinder head.

Figure 246



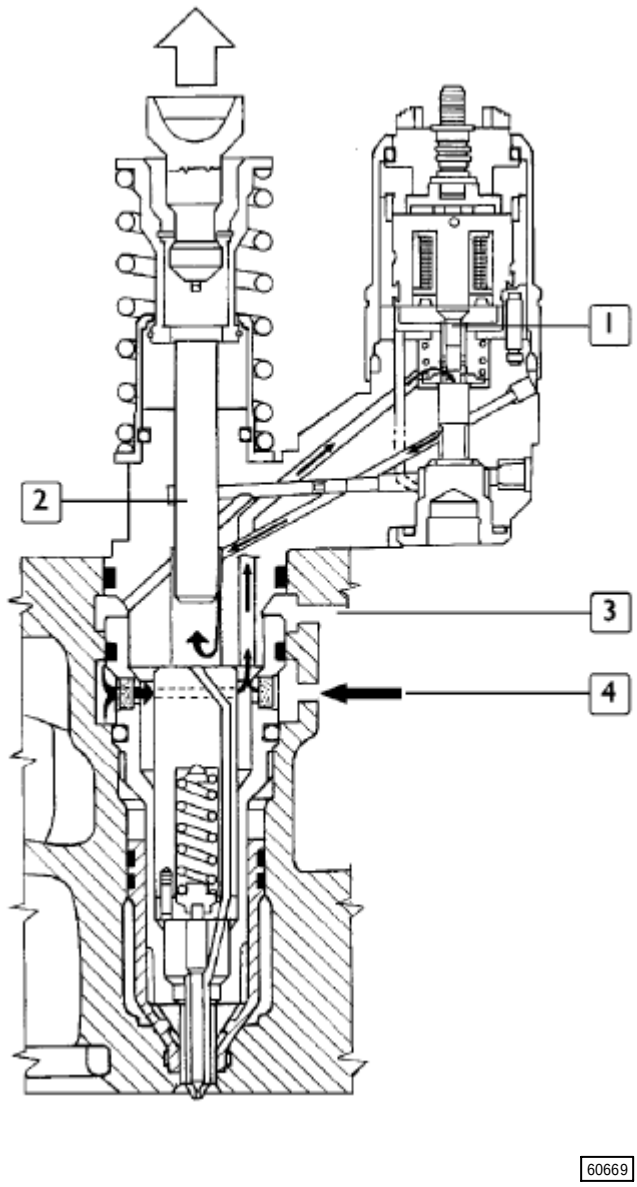

For each replaced injector, connect to MODUS or IT2000 station or to E.A.SY: then, when required by the program, enter the code, that is stamped on the injector (→), for reprogramming the central unit.

**NOTE** When checking the clearance of the rocker arms, it is important to check the injector-pump pre-load.

Aquila Trucks Centres

## Injector Phases

Figure 247

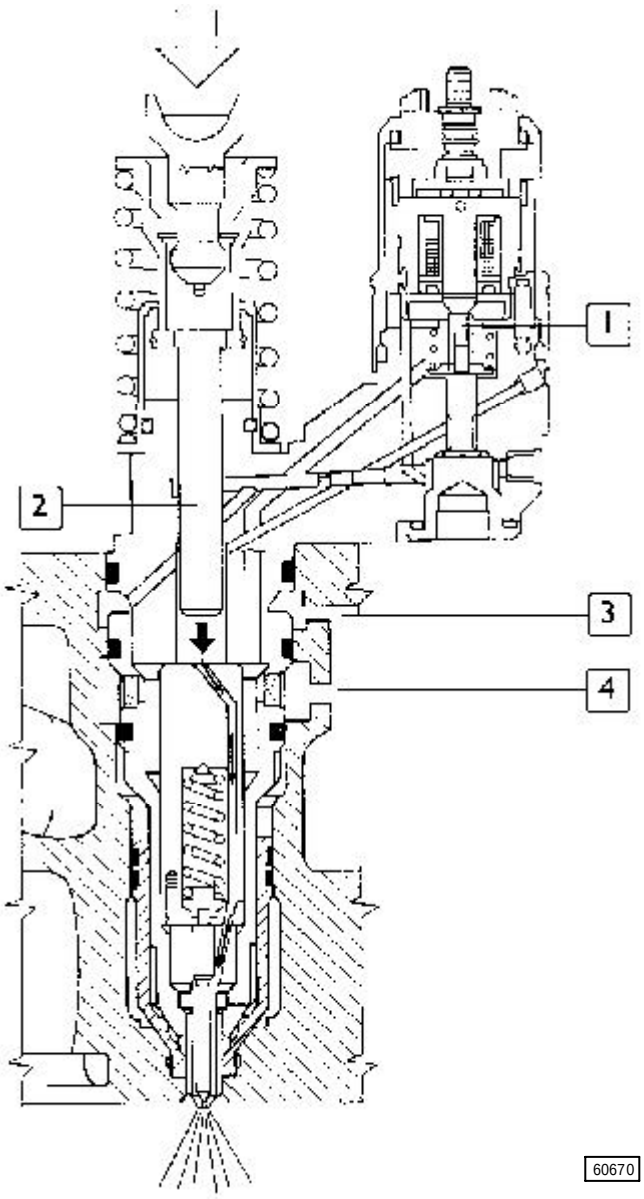



1. Fuel valve - 2. Plunger - 3. Fuel outlet - 4. Filling and backflow passage

### Filling phase

During the filling phase the plunger (2) runs up to the top position.
After passing the highest point of the cam, the rocker arm roller comes near the base ring of the cam.
The fuel valve (1) is open and fuel can flow into the injector via the bottom passage (4) of the cylinder head.
Filling continues until the plunger reaches its top limit.

Figure 248




1. Fuel valve - 2. Plunger - 3. Fuel outlet - 4. Filling and backflow passage

### Begin of injection

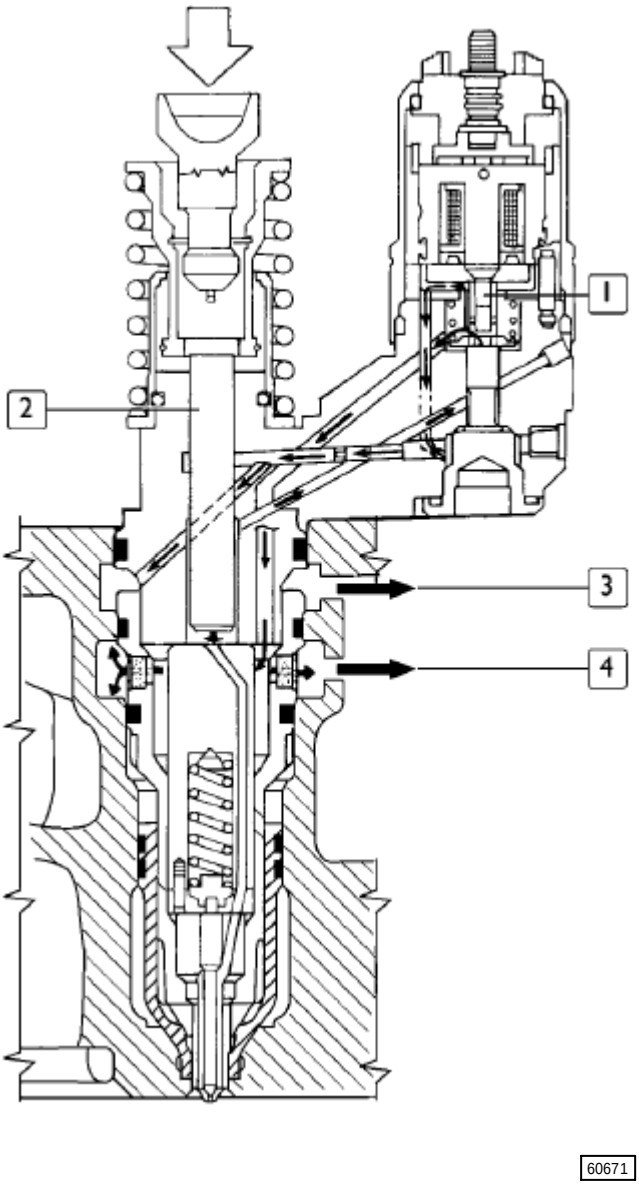
The injection phase begins when, at a certain point in the down phase of the plunger, the solenoid valve gets energized and the fuel valve (1) shuts.

The moment delivery begins, appropriately calculated by the electronic control unit, depends on the working conditions of the engine.

The cam continues with the rocker arm to push the plunger (2) and the injection phase continues as long as the fuel valve (1) stays shut.

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Figure 249




1. Fuel valve - 2. Plunger - 3. Fuel outlet - 4. Filling and backflow passage

**End of injection**

Injection ceases when the fuel valve (1) opens, at a certain point in the down stroke of the plunger, after the solenoid valve gets de-energized.

The fuel flows back through the open valve (1), the injector holes and the passage (4) into the cylinder head.

The time for which the solenoid valve stays energized, appropriately calculated by the electronic control unit, is the duration of injection (delivery) and it depends on the working conditions of the engine.

Aquila Trucks Centres

## F3B Engine


| | Page |
|---|---|
| VIEWS OF THE ENGINE | 125 |
| TECHNICAL DESCRIPTION | 128 |
| CHARACTERISTIC CURVES | 129 |
| MAIN DATA | 132 |
| ASSEMBLY DATA - CLEARANCE | 135 |
| TIGHTENING TORQUE | 142 |
| DIAGRAMS OF TIGHTENING SEQUENCE OF MAIN ENGINE COMPONENTS | 145 |
| TOOLS | 149 |
| ENGINE REMOVAL-REFITTING | 159 |
| - Removal | 159 |
| - Refitting | 162 |
| - Filling the cooling system | 163 |
| - Bleeding air from the fuel system | 164 |
| - Checks and tests | 164 |
| ELECTRO-MAGNETIC FAN DRIVE REPLACEMENT | 165 |
| - Removal | 165 |
| - Refitting | 166 |
| DISASSEMBLY OF THE ENGINE | 169 |
| REPAIRS | 177 |
| CYLINDER BLOCK | 177 |
| - Checks and measurements | 177 |
| - Cylinder liners | 178 |
| - Replacing the cylinder liners | 179 |
| - Crankshaft | 180 |
| - Measuring the main journals and crankpins | 181 |
| - Preliminary measurement of data to select main bearing and big end bearing shells | 182 |
| - Selecting the main bearing and big end bearing shells | 183 |
| - Replacing the timing gear and oil pump drive | 189 |
| - Checking main journal assembly clearance | 189 |
| - Checking crankshaft end float | 190 |
| - Connecting rod piston assembly | 191 |
| - Piston rings | 193 |
| - Connecting rod | 194 |
| - Bushings | 195 |
| - Checking connecting rods squareness | 195 |
| - Mounting the connecting rod – piston assembly | 196 |
| - Mounting the piston rings | 196 |
| - Fitting the big end bearing shells | 196 |
| - Fitting connecting rod - piston assemblies in the cylinder liners | 197 |
| - Checking piston protrusion | 197 |
| - Checking crankpin assembly clearance | 198 |
| CYLINDER HEAD | 198 |
| - Disassembly the valves | 198 |
| - Checking head bearing surface on cylinder block | 198 |
| - Valves | 199 |
| - Valve seats | 199 |
| - Checking clearance between valve-stem and associated valve guide | 200 |
| - Valve guides | 200 |
| - Replacing injector holders | 200 |
| - Checking injector protrusion | 202 |
| TIMING GEAR | 203 |
| - Camshaft drive | 203 |
| - Idler gear pin | 203 |
| - Idler gear | 203 |
| - Twin intermediate gear pin | 203 |
| - Twin idler gear | 203 |
| - Replacing the bushings | 203 |
| - Timing system | 204 |
| - Checking cam lift and pin alignment | 204 |
| - Bushings | 205 |
| - Valve springs | 207 |
| ROCKER SHAFT | 208 |
| - Shaft | 209 |
| - Rocker arms | 209 |

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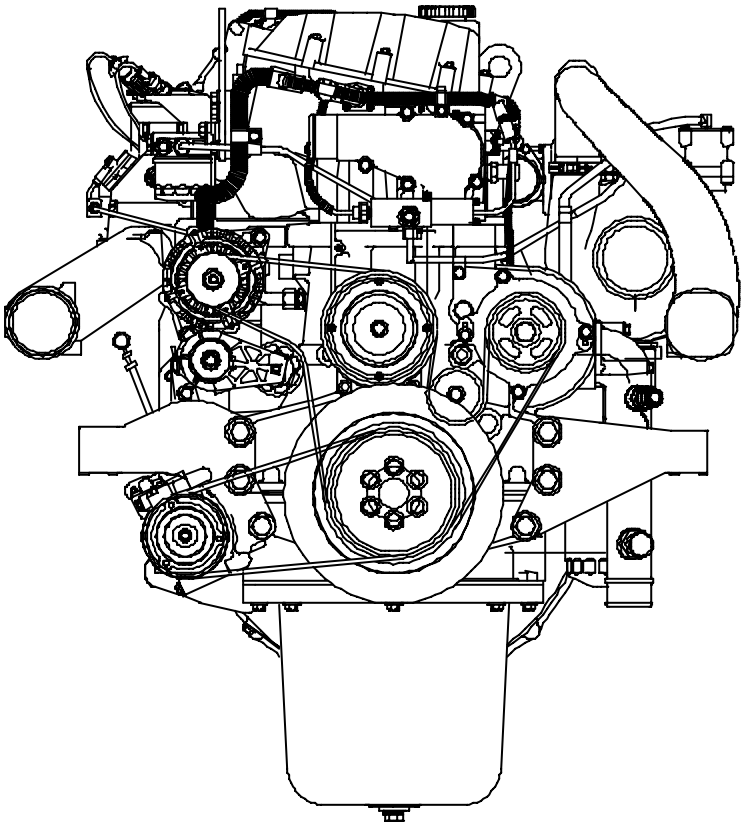

Aquila Trucks Centres


| | Page |
|---|---|
| ENGINE ASSEMBLY | 210 |
| - Fitting connecting rod - piston assemblies in cylinder liners | 213 |
| - Fitting the cylinder head | 214 |
| - Fitting flywheel box housing | 215 |
| ENGINE FLYWHEEL | 216 |
| - Fitting engine flywheel | 216 |
| - Fitting camshaft | 217 |
| - Fitting pump-injectors | 218 |
| - Fitting rocker-arm shaft assembly | 218 |
| - Camshaft timing | 219 |
| - Phonic wheel timing | 221 |
| - Adjust intake and exhaust rocker arm clearance, and pump injector preload | 222 |
| - Completing Engine Assembly | 223 |
| LUBRICATION | 227 |
| - Oil pump | 229 |
| - Safety relief valve | 229 |
| - Oil overpressure valve | 230 |
| - Heat exchanger | 230 |
| - By-pass valve | 231 |
| - Thermostatic valve | 231 |
| - Engine oil filters | 231 |
| - Valve integrated in piston cooling nozzle | 232 |
| COOLING | 233 |
| - Description | 233 |
| - Operation | 233 |
| - Electromagnetic fan drive | 235 |
| - Water pump | 235 |
| - Thermostat | 235 |
| - View of thermostat operation for versions with Intarder | 236 |
| TURBOCHARGING | 237 |
| - Turbocharger HOLSET HE 551 V | 237 |
| - Actuator | 238 |
| - Solenoid valve for VGT control | 238 |
| REPAIR | 238 |
| - Variable geometry movement control | 239 |
| - Checking the actuator | 239 |
| - Checking actuator travel | 240 |
| - Cleaning turbine body | 240 |
| - Turbocharger HOLSET HX 50W | 243 |
| REPAIRS | 243 |
| WASTEGATE | 243 |
| FUEL SYSTEM | 245 |
| - Overpressure valve | 246 |
| - Feed pump | 246 |
| - Injector-pump | 246 |
| - Pressure damper | 246 |

Aquila Trucks Centres

## VIEWS OF THE ENGINE

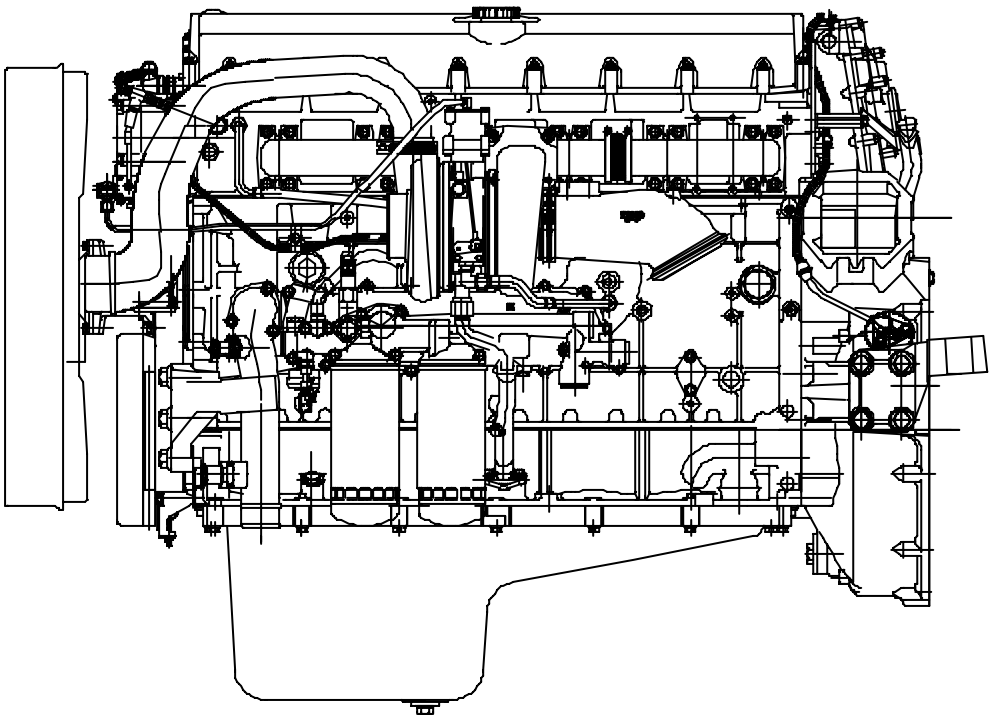
Figure 1



106682

FRONT VIEW OF ENGINE

Figure 2

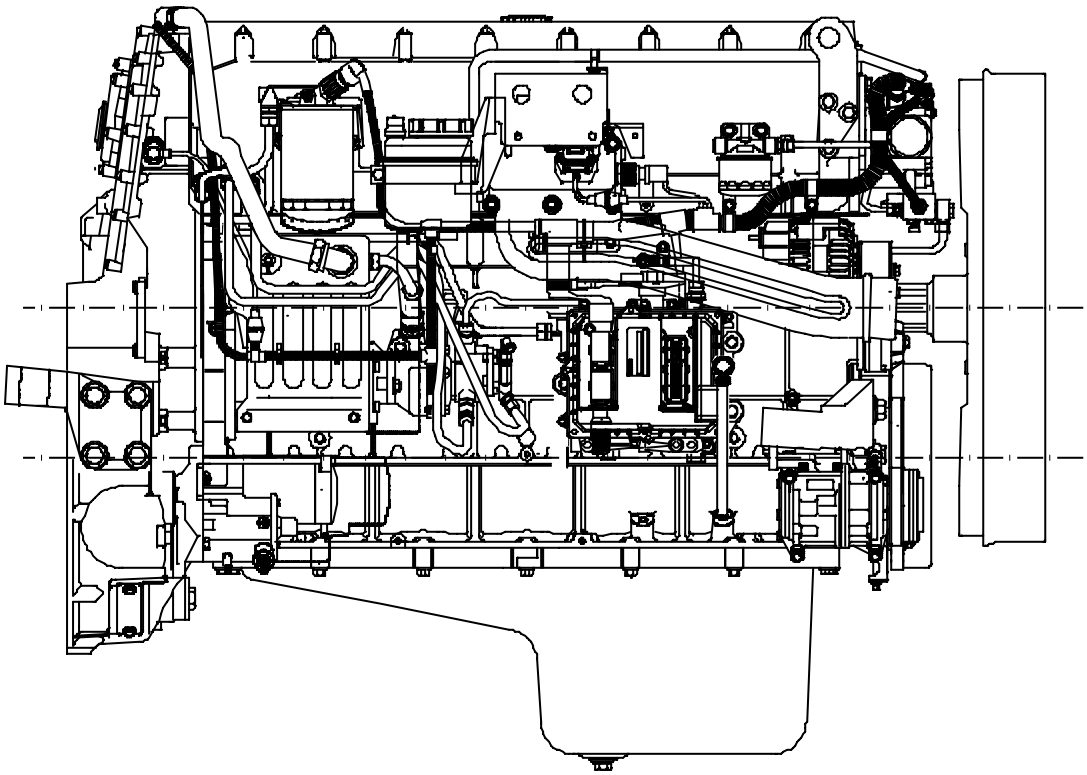


71695

LEFT SIDE VIEW OF ENGINE

Aquila Trucks Centres

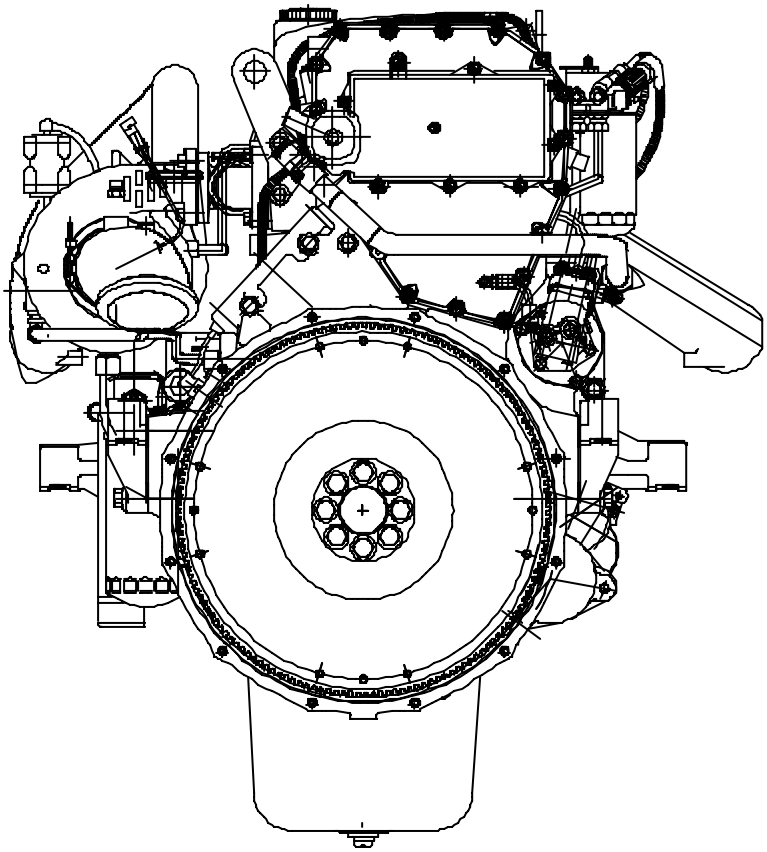
Figure 3



112172

RIGHT SIDE VIEW OF ENGINE

Figure 4

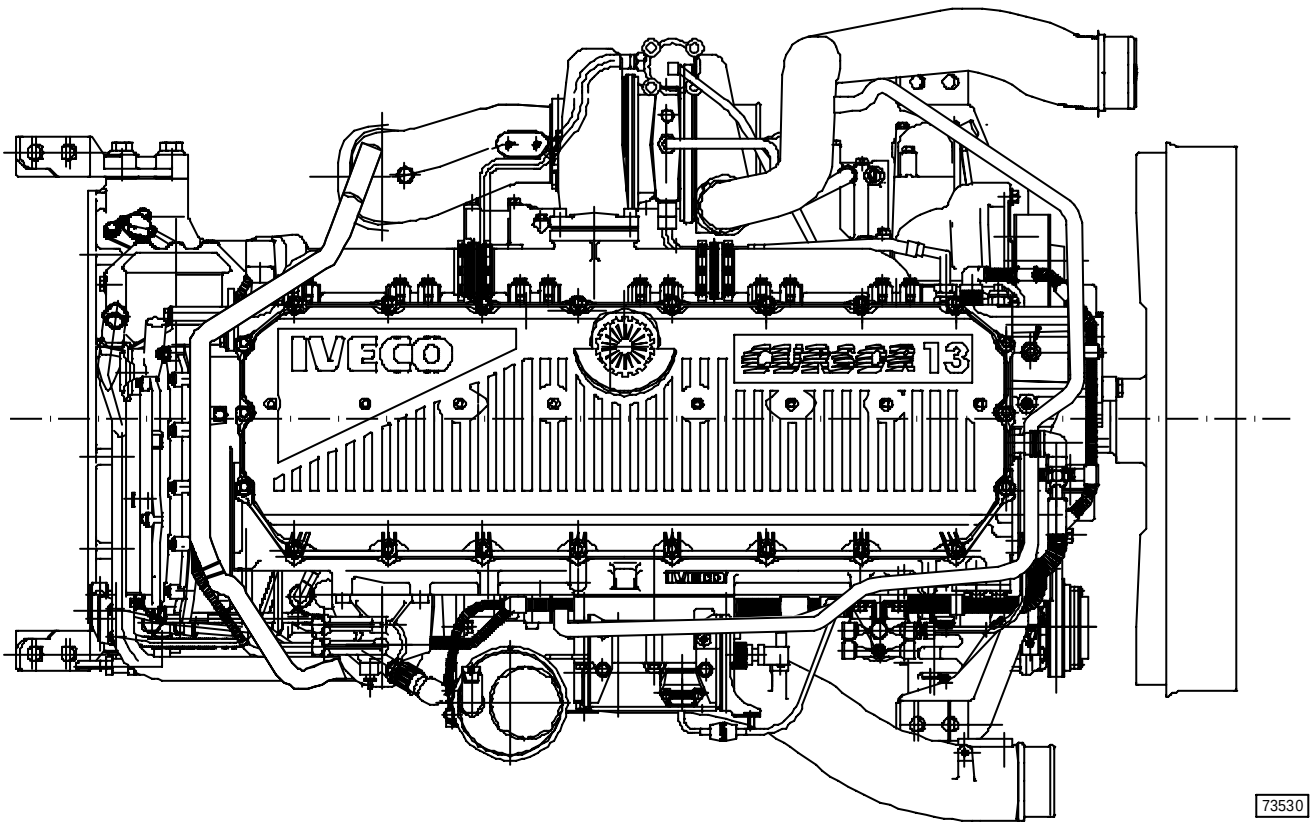


71694

REAR VIEW OF ENGINE

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Figure 5



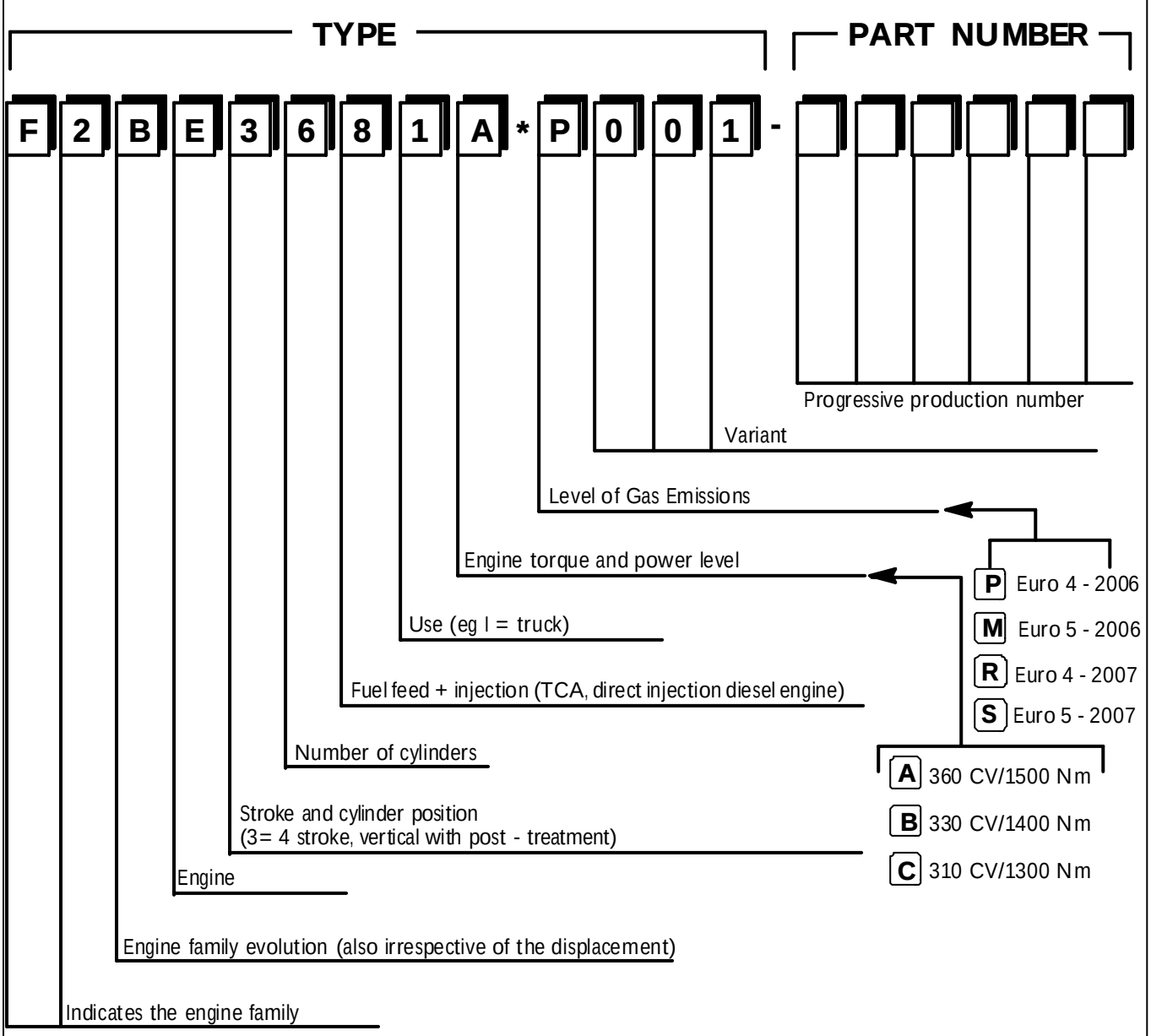

TOP VIEW OF ENGINE

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## TECHNICAL DESCRIPTION

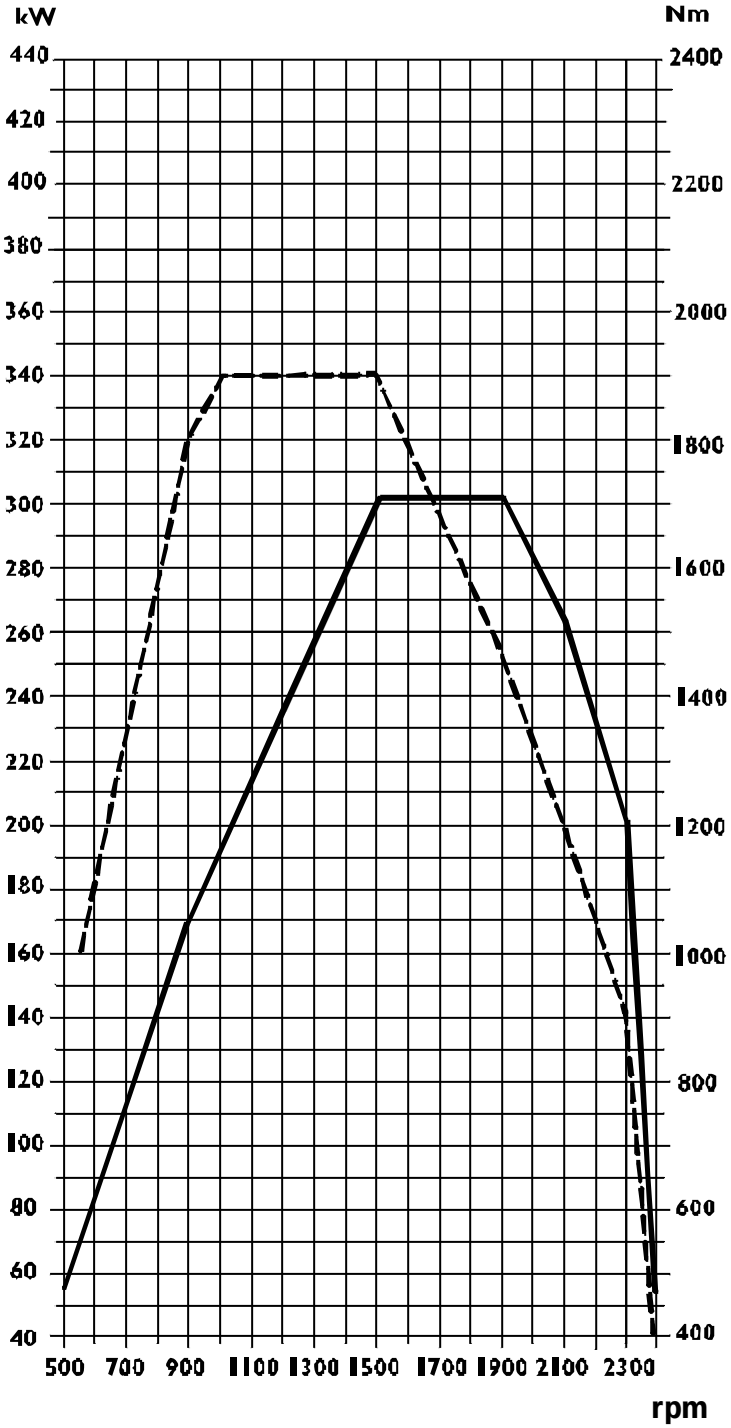
### ENGINE



Aquila Trucks Centres

## CHARACTERISTIC CURVES

Figure 6

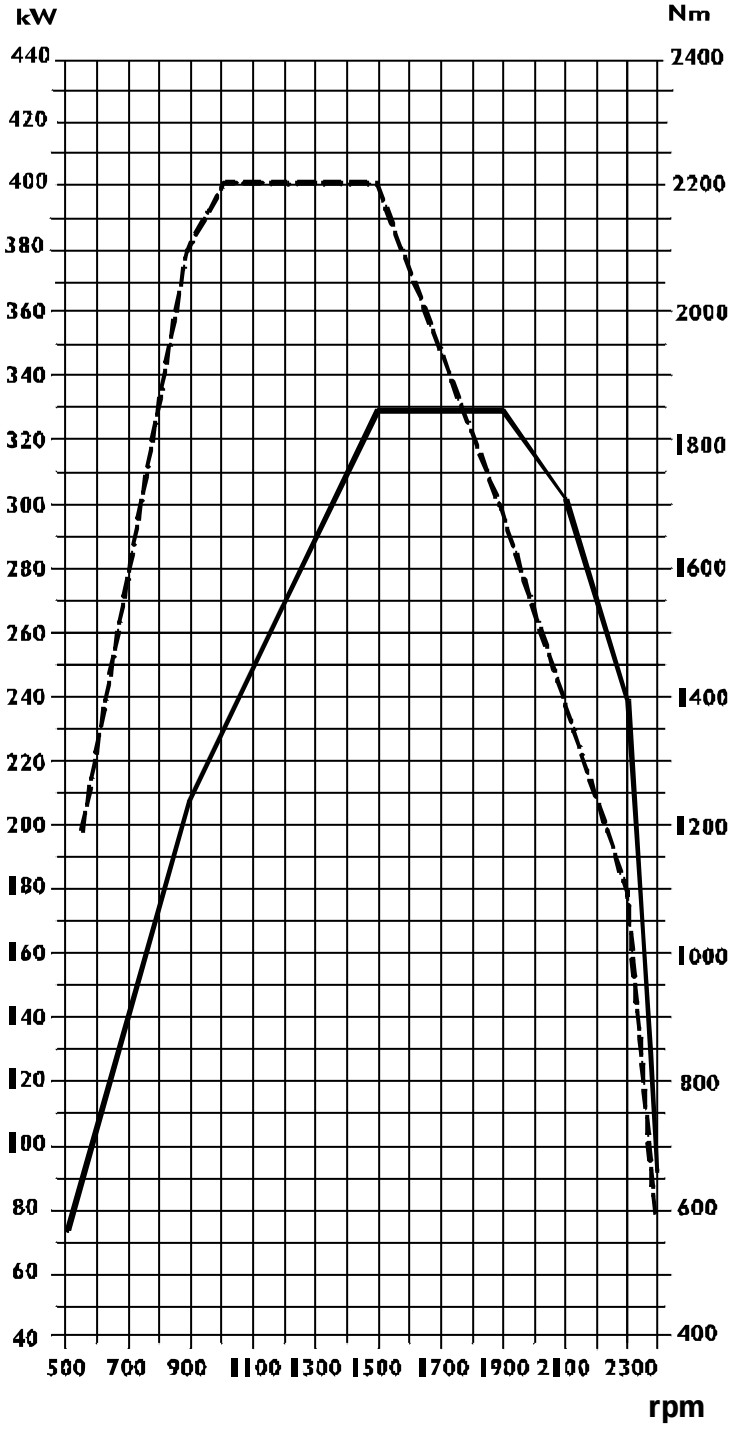



CHARACTERISTIC CURVES OF ENGINE F3BE3681D

| | | | |
|---|---|---|---|
| **Max. POWER :** | **302 kW** | **410 HP** | **1900 rpm** |
| **Max. TORQUE :** | **1900 Nm** | **194 kgm** | **1000 to 1515 rpm** |

Aquila Trucks Centres

Figure 7

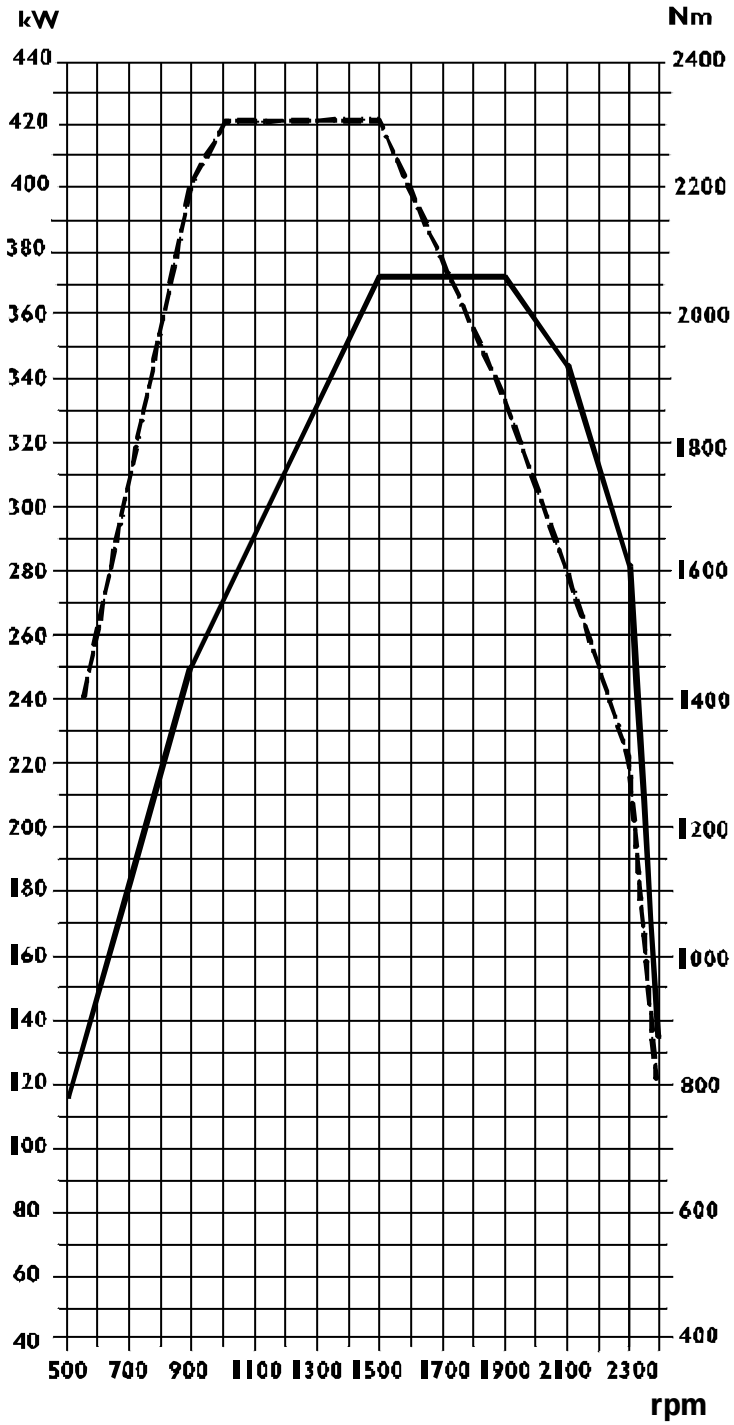



CHARACTERISTIC CURVES OF ENGINE F3BE3681C

| | | | |
|---|---|---|---|
| **Max. POWER :** | **332 kW** | **450 HP** | **1900 rpm** |
| **Max. TORQUE :** | **2200 Nm** | **224 kgm** | **1000 to 1435 rpm** |

Aquila Trucks Centres

Figure 8

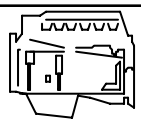
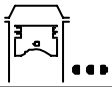
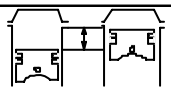
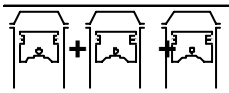
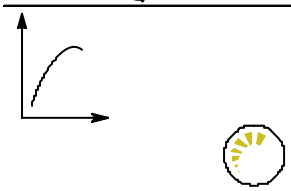
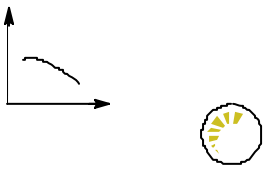



CHARACTERISTIC CURVES OF ENGINE F3BE3681B

| | | | |
|---|---|---|---|
| **Max. POWER :** | **368 kW** | **500 HP** | **1900 rpm** |
| **Max. TORQUE :** | **2300 Nm** | **234 kgm** | **1000 to 1525 rpm** |

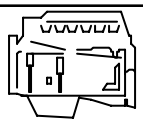
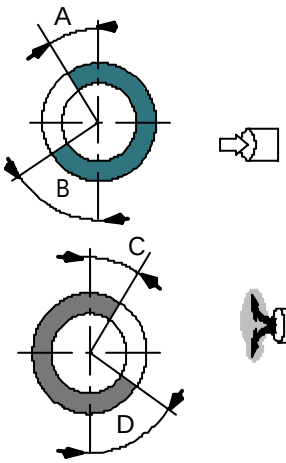
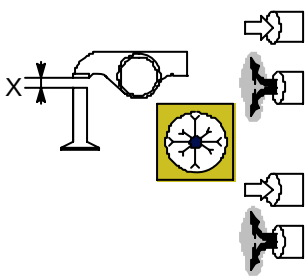
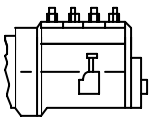
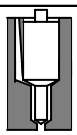
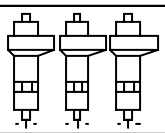
https://truckmanualshub.com/
Aquila Trucks Centres

## MAIN DATA

| | | | | |
|---|---|---|---|---|
|  | Type | F3BE3681D | F3BE3681C | F3BE3681B |
|  | Cycle<br>Supply<br>Injection | 4-stroke diesel<br>Turbocharged with intercooler<br>Direct | | |
|  | Number of cylinders | 6 in line | | |
|  | Bore mm | 135 | | |
|  | Stroke mm | 150 | | |
|  | Total displacement $cm^3$ | 12880 | | |
|  | Compression ratio | 16.5 : 1 | | |
|  | Maximum power kW (HP)<br>rpm | 302 (410)<br>1900 | 332 (450)<br>1900 | 368 (500)<br>1900 |
|  | Maximum torque Nm (kgm)<br>rpm | 1900 (194)<br>1000 to 1515 | 2200 (224)<br>1000 to 1435 | 2300 (234)<br>1000 to 1525 |
|  | Low idle speed no load<br>rpm | 550 ± 50 | | |
|  | Fast idling speed with no load<br>rpm | 2320 ± 50 | | |

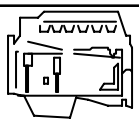
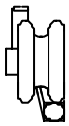
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Aquila Trucks Centres

| | | |
|---|---|---|
|  | Type | F3B |
|   | TIMING SYSTEM<br>Start before T.D.C. A<br>End after B.D.C. B<br>Start before B.D.C. D<br>End after T.D.C. C | <br>19°<br>36°<br>50°<br>9° |
|   | To check timing<br>X mm<br>mm<br>Operation<br>X mm<br>mm | <br>–<br>–<br><br>0.40 ± 0.05<br>0.60 ± 0.05 |
|  | SUPPLY | Via fuel pump - Filters |
| | Injection type Bosch | With UIN 31 injectors with electronic adjustment. Injectors-pump controlled by camshaft in head. |
|  | Nozzles type | - |
|  | Injection sequence | 1 - 4 - 2 - 6 - 3 - 5 |
|   | Injection pressure bar | 2000 |

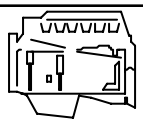
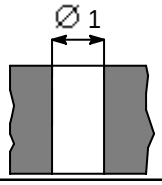
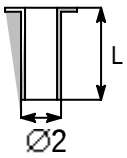
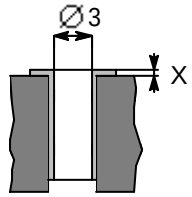
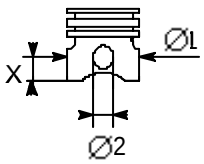
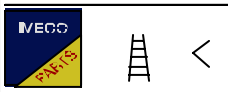
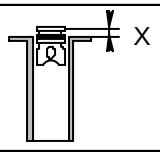
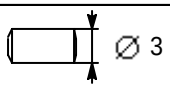
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Aquila Trucks Centres

| | | | |
|---|---|---|---|
|  | Type | F3B 410 CV | F3B 450 CV - 500 CV |
|  | TURBOCHARGING | Holset with fixed geometry and WASTEGATE | Holset variable geometry |
| | Turbocharger type | HX 50 W | HE 551 V |
| | LUBRICATION | Forced via gear pump, pressure relief valve, oil filter | |
|    | Oil pressure with engine warm (100 ± 5°C): | | |
| | at slow running bar | 1.5 | |
| | at fast idling speed bar | 5 | |
| | COOLING | Via centrifugal pump, thermostat, electro-magnetic drive fan, radiator, heat exchanger | |
| | Water pump drive | With belt | |
| | Thermostat | N. 1 | |
| | starts opening: | 84 ± 2 °C | |
| | full aperture | 94 ± 2 °C | |
| | REPLENISHING | | |
| | Total capacity 1st filling | | |
| | liters | 35 | |
| | kg | 31.5 | |
| | Capacity | | |
| | - engine sump at minimum level | | |
| | liters | 20 | |
| | kg | 18 | |
|  Urania FE 5W30 Urania LD7 | - engine sump at maximum level | | |
| | liters | 28 | |
| | kg | 25.2 | |
| | - quantity in circulation that does not return to sump | | |
| | liters | 7 | |
| | kg | 6.3 | |
| | - quantity contained in cartridge filter (to add when changing the cartridge filter) | | |
| | liters | 3 | |
| | kg | 2.7 | |

Aquila Trucks Centres

## ASSEMBLY DATA - CLEARANCE

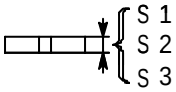
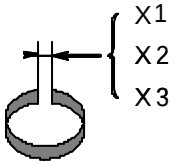
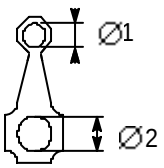
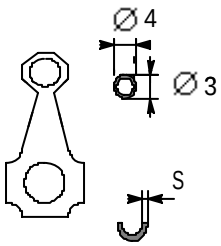
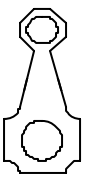
| | | | |
|---|---|---|---|
|  | Type | | F3B |
| CYLINDER ASSEMBLY AND CRANK MEMBER S | | | mm |
|  | Cylinder liner seats<br>Ø 1 | top<br>bottom | 153.500 to 153.525<br>152.000 to 152.025 |
|  | Cylinder liners:<br>outside diameter:<br>Ø 2<br>length | top<br>bottom<br>L | 153.461 to 153.486<br>151.890 to 151.915<br>– |
|  | Cylinder liners - crankcase seats | top<br>bottom | 0.014 to 0.039<br>0.085 to 0.135 |
|  | Outside diameter | Ø2 | – |
|  <br>* Selection class<br>** Under a load of 8000 kg | Cylinder liners:<br>inside diameter<br>inside diameter<br>protrusion | Ø3A*<br>Ø3B*<br>X ** | 135.000 to 135.013<br>135.011 to 135.024<br>0.045 to 0.075 |
|  | Pistons:<br>measurement<br>outside diameter<br>outside diameter<br>seat for pin | X<br>Ø1A[D]<br>Ø1B[DD]<br>Ø2 | FEDERAL MOGUL<br>18<br>134.861 to 134.873<br>134.872 to 134.884<br>54 .010 to 54.018 |
|  <br>* Selection class | Piston - cylinder liners | A*<br>B* | 0.127 to 0.152<br>0.127 to 0.152 |
|  | Piston diameter | Ø1 | – |
|  | Piston protrusion | X | 0.12 to 0.42 |
|  | Piston gudgeon pin | Ø3 | 53.994 to 54.000 |
|  | Piston gudgeon pin - pin seat | | 0.010 to 0.024 |

D Class A pistons supplied as spares.

DD Class B pistons are fitted in production only and are not supplied as spares.

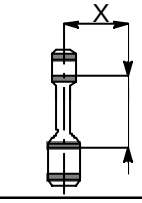
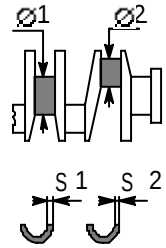
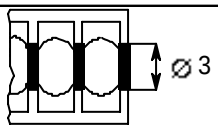
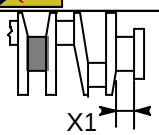
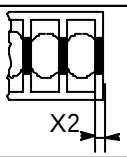
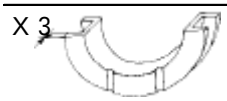
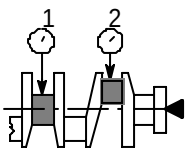
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Aquila Trucks Centres

| | Type | F3B |
|---|---|---|
| | | mm |
|  | Piston ring slots X1* | FEDERAL MOGUL |
| | X2 | 2.427 |
| | X3 | 1.550 to 1.570 (••) / 3.060 to 3.080 |
| | * measured on Ø of 130 mm | 0.020 to 5.040 |
|  | Piston rings: | |
| | - scraper trapezoidal S1* | 2.296 to 2.340 |
| | - compression bevelled S2 | 1.470 ÷ 1.500 (••) / 2.970 ÷2.990 |
| | - milled scraper ring with slots and internal spring S3 | 4.970 to 4.990 |
| | * measured at 2.5 mm from outer Ø | |
|  | Piston rings - slots 1 | 0.087 to 0.131 |
| | 2 | 0 .050 to 0.100 |
| | 3 | 0 .030 to 0.070 |
| | Piston rings | – |
|  | Piston ring end gap in cylinder liner | |
| | X1 | 0 .40 to 0.50 |
| | X2 | 0 .65 to 0.80 |
| | X3 | 0 .40 to 0.75 |
|  | Small end bushing seat Ø1 | 59.000 to 59.030 |
| | Connecting rod bearing seat Ø2 | |
| | Selection class Ø2 1 | 94.000 to 94.010 |
| | 2 | 94.011 to 94.020 |
| | 3 | 94.021 to 94.030 |
|  | Small end bushing diameter | |
| | outside Ø4 | 59 .085 to 59.110 |
| | inside Ø3 | 54.019 to 54.035 |
| | Big end bearing shells S | |
| | Red | 1.965 to 1.975 |
| | Green | 1.976 to 1.985 |
| | Yellow• | 1.986 to 1.995 |
|  | Small end pushing - seat | 0.055 to 0.110 |
|  | Piston gudgeon pin - bushing | 0.019 to 0.041 |
| | Big end bearing shells | - |
|  | Weight of connecting rod | |
| | Classes A | 4741 to 4780 g |
| | B | 4781 to 4820 g |
| | C | 4821 to 4860 g |

• Only mounted on production and not provided with spare.
•• Old part number

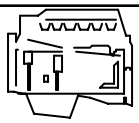
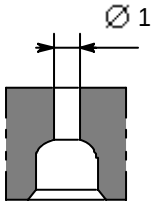
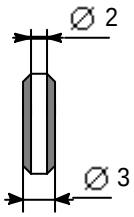
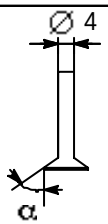
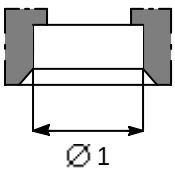
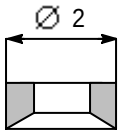
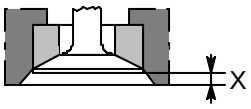
# Aquila Trucks Centres

| | Type | F3B |
|---|---|---|
| | | mm |
|  | Measurement X<br>**Maximum error** on alignment of connecting rod axe // | 125<br>0.08 |
|  | Main journals Ø1<br>- nominal<br>- class 1<br>- class 2<br>- class 3<br>Crankpins Ø2<br>- nominal<br>- class 1<br>- class 2<br>- class 3<br>Main bearing shells S 1<br>Red<br>Green<br>Yellow*<br>Big end bearing shells S 2<br>Red<br>Green<br>Yellow* | <br>99.970 to 100.000<br>99.970 to 99.979<br>99.980 to 99.989<br>99.990 to 100.000<br><br>89.970 to 90.000<br>89.970 to 89.979<br>89.980 to 89.989<br>89.990 to 90.000<br><br>3.110 to 3.120<br>3.121 to 3.130<br>3.131 to 3.140<br><br>1.965 to 1.975<br>1.976 to 1.985<br>1.986 to 1.995 |
|  | Main bearing housings Ø3 | 106.300 to 106.330 |
|  | Bearing shells - main journals f | 0,060 to 0,108 * - 0,061 to 0,119 ** - 0,060 to 0,130 *** |
| | Bearing shells - crankpins f | 0,050 to 0,108 * - 0,051 to 0,109 ** - 0,050 to 0,098 *** |
|  | Main bearing shells<br>Big end bearing shells | 0.127 - 0.254 - 0.508<br>0.127 - 0.254 - 0.508 |
|  | Main journal for shoulder X1 | 47.95 to 48.00 |
|  | Main bearing housing for shoulder X 2 | 40.94 to 40.99 |
|  | Half thrust washers X 3 | 3.38 to 3.43 |
|  | Crankshaft shoulder | 0.10 to 0.30 |
|  | Alignment // 1 - 2<br>Roundness 1 - 2 | 0.025<br>0.040 |

* Fitted in production only and not supplied as spares
f Supplied as spares: * standard; ** = 0.127; *** = 0.254 - 0.508

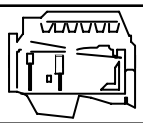
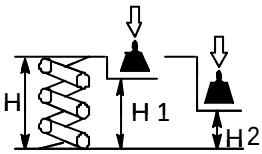
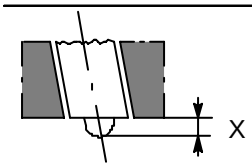
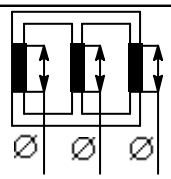
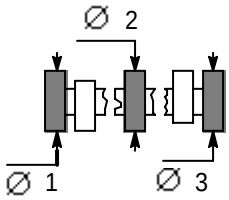
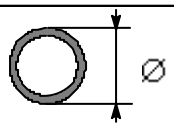
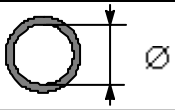
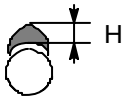
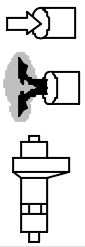
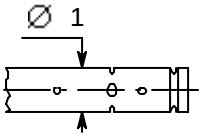
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# Aquila Trucks Centres

| | | | |
|---|---|---|---|
|  | Type | | F3B |
| CYLINDER HEAD - TIMING SYSTEM | | | mm |
|  | Guide valve seats on cylinder head | Ø1 | 15.980 to 15.997 |
|  | Valve guides | Ø2<br>Ø3 | 10.015 to 10.030<br>16.012 to 16.025 |
| | Valve guides and seats on head | | 0.015 to 0.045 |
| | Valve guides | | – |
|  | Valves: | | |
| | | Ø4<br>α | 9.960 to 9.975<br>60° 30' ± 7' 30'' |
| | | Ø4<br>α | 9.960 to 9.975<br>45° 30' ± 7' 30'' |
| | Valve stem and relevant guide | | 0.040 to 0.070 |
|  | Seat on head for valve seat: | | |
| | | Ø1 | 49.185 to 49.220 |
| | | Ø1 | 46.985 to 47.020 |
|  | Outside diameter of valve seats on cylinder head: | | |
| | | Ø2 | 49.260 to 49.275 / 49.460 to 49.475* |
| * provided with spare | | Ø2 | 47.060 to 47.075 / 47.260 to 47.275* |
| | Valve seats | | 0,2 |
|  | Recessing | X<br>X | 0.45 to 0.75<br>1.65 to 1.95 |

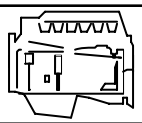
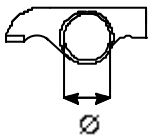
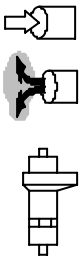
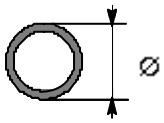
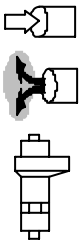
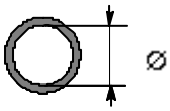
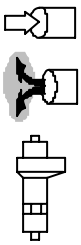
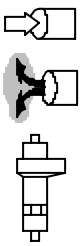
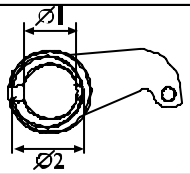
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Aquila Trucks Centres

|  | Type | F3B |
|---|---|---|
| | | mm |
|  | Between valve seat and head  | 0.040 to 0.090 |
|  | Valve spring height:<br>free spring H<br>under a load of:<br>775 ± 39 N H 1<br>1366 ± 68 N H 2 | <br>76<br><br>59<br>46 |
|  | Injector protrusion X | 0.52 to 1.34 |
|  | Seats for camshaft bushings in cylinder head:<br>1 ⇒ 7 Ø | 88.000 to 88.030 |
|  | Camshaft supporting pins:<br>1 ⇒ 7 Ø | 82.950 to 82.968 |
|  | Outside diameter of bushings for camshaft: Ø | 88.153 to 88.183 |
|  | Bushing inside diameter: Ø | 83.018 to 83.085 |
|  | Bushings and seats in cylinder head | 0.123 to 0.183 |
|  | Bushings and supporting pins | 0.050 to 0.135 |
|  | Useful cam height  | 9.231<br>9.5607<br>13.376 |
|  | Rocker arm shaft Ø1 | 41.984 to 42.000 |

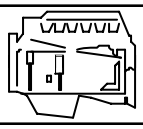
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Aquila Trucks Centres

|  | Type | F3B<br>mm |
|---|---|---|
|  | Seats for bushings in rocker arms:<br>  | 45.000 to 45.016<br>59.000 to 59.019<br>46.000 to 46.016 |
|  | Outside diameter of bushings for rocker arms:<br>  | 45.090 to 45.130<br>59.100 to 59.140<br>46.066 to 46.091 |
|  | Inside diameter of bushings for rocker arms:<br>  | 42.025 to 42.041<br>56.030 to 56.049<br>42.015 to 42.071 |
|  | Bushings and seats:<br>  | 0.074 to 0.130<br>0.081 to 0.140<br>0.050 to 0.091 |
|  | Rocker arm bushings and shaft:<br>  | 0.025 to 0.057<br>0.015 to 0.087 |
|  | Engine brake control lever<br>Eccentric pin outer diameter Ø2<br>Rocker arms shaft seat Ø1 | <br>55.981 to 56.000<br>42.025 to 42.041 |

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Aquila Trucks Centres

| | | |
|---|---|---|
|  | Type | F3B |
| | | mm |
|  | Rocker arms and engine brake control lever pin  | 0.030 to 0.068 |
|  | Rocker arm shaft and seat on engine brake control lever  | 0.025 to 0.057 |

| TURBOCHARGER | Holset with fixed geometry HX 50 | Holset with variable geometry HE 551V |
|---|---|---|
| Type | | |
| End play | 0.025 ÷ 0.127 | 0.051 ÷ 0.152 |
| Radial movement | 0.381 ÷ 0.610 | 0.381 ÷ 0.533 |

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Aquila Trucks Centres

## TIGHTENING TORQUE

| PART | | TORQUE Nm | TORQUE kgm |
|---|---|---|---|
| Screws fixing lower crankcase to crankcase (see Figure 9) ♦ | | | |
| Outside screws M12x1.75 | First phase: pre-tightening | 30 | (3) |
| Inside screws M18x2 | Second phase: pre-tightening | 120 | (12) |
| Inside screws M 18x2 | Third phase: closing to angle | 60° | |
| Inside screws M 18x2 | Fourth phase: closing to angle | 55° | |
| Outside screws M 12x1,75 | Fifth phase: closing to angle | 60° | |
| Piston cooling nozzle union | | 35 ±2 | (3.5 ±0.2) |
| Screws fixing heat exchanger to crankcase (see Figure 13) | | | |
| pre-tightening | | 11.5 ±3.5 | (1.15 ±0.35) |
| tightening | | 19 ±3 | (1.9 ±0.3) |
| Screws fixing suction strainer to lower crankcase | | 24.5 ±2.5 | (2.4 ±0.25) |
| Screws fixing oil sump spacer (see Figure 14) | | | |
| pre-tightening (1 ÷ 16) | | 38 | (3.8) |
| tightening (17 ÷ 32) | | 45 | (4.5) |
| Screws fixing gearbox to crankcase M12x1.75 (see Figure 16) | | 63 ±7 | (6.3 ±0.7) |
| Screws fixing control unit to lower crankcase ♦ | | 24 ±2.5 | (2.4 ±0.25) |
| Screws fixing cylinder head (see Figure 10) ♦ | | | |
| First phase | pre-tightening | 60 | (6) |
| Second phase | pre-tightening | 120 | (12) |
| Third phase | closing to angle | 90° | |
| Fourth phase | closing to angle | 65° | |
| Screws fixing rocker arm shaft ♦ | | | |
| First phase | pre-tightening | 80 | (8) |
| Second phase | closing to angle | 60° | |
| Lock nut for rocker arm adjustment screw | | 39 ±5 | (3.9 ±0.5) |
| Screws for injector brackets ♦ | | 30 ÷ 35 | (3 ÷ 3.5) |
| Screws fixing plastic cover | | 8.5 ±1.5 | (0.85 ±0.15) |
| Screws fixing shoulder plate to head | | 19 ±3 | (1.9 ±0.3) |
| Screws fixing engine mount bracket to cylinder head | | | |
| First phase | pre-tightening | 120 | (12) |
| Second phase | closing to angle | 45° | |

♦ Before assembly, lubricate with UTDM oil

• Before assembly, lubricate with graphitized oil

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Aquila Trucks Centres

| PART | | TORQUE Nm | TORQUE kgm |
|---|---|---|---|
| Screws fixing engine mount bracket to flywheel casing | | | |
| First phase | pre -tightening | 100 | (10) |
| Second phase | closing to angle | 60° | |
| Screws fixing camshaft gear ♦ | | | |
| First phase | pre -tighteningirst | 60 | (6) |
| Second phase | closing to angle | 60° | |
| Screws fixing phonic wheel on camshaft gear | | 8.5 ± 1.5 | (0.85 ± 0.15) |
| Screws fixing exhaust manifold • (see Figure 11) | | | |
| | pre-tightening | 40 ± 5 | (4 ± 0.5) |
| | tightening | 70 ± 5 | (3.2) |
| Screws fixing engine brake actuator cylinder | | 19 ± 3 | (1.9 ± 0.3) |
| Screws fixing connecting rod cap ♦ | | | |
| First phase | pre -tightening | 60 | (6) |
| Second phase | closing to angle | 60° | |
| Screws fixing engine flywheel ♦ | | | |
| First phase | pre -tightening | 120 | (12) |
| Second phase | closing to angle | 90° | |
| Screws fixing damper flywheel ♦ | | | |
| First phase | pre -tightening | 70 | (7) |
| Second phase | closing to angle | 50° | |
| Screws fixing middle gear pins ♦ | | | |
| First phase | pre -tightening | 30 | (3) |
| Second phase | closing to angle | 90° | |
| Screws fixing idle gear adjustment connecting rod: | | 24.5 ± 2.5 | (2.45 ± 0.25) |
| Screws fixing oil pump | | 24.5 ± 2.5 | (2.45 ± 0.25) |
| Screws fixing crankshaft gasket front cover | | 24.5 ± 2.5 | (2.45 ± 0.25) |
| Screws fixing fuel pump / filter mount | | 19 | (1.9) |
| Screw fixing control unit mount | | 19 ± 3 | (1.9 ± 0.3) |
| Screws and nuts fixing turbocharger • (see Figure 12) | | 74 ± 8 | (7.4 ± 0.8) |
| Screw fixing thermostat assembly | | 30 ± 3 | (3 ± 0.3) |
| Screws fixing water pump | | 24.5 ± 2.5 | (2.45 ± 0.25) |
| Screws fixing fan hub to spacer | | 30 | (3) |
| Screw fixing fan spacer to pulley | | 30 | (3) |
| Screws fixing fan mount to crankcase | | 100 | (10) |
| Screw securing steady tensioner | | 105 ± 5 | (10 ± 0.5) |
| Screw securing automatic belt tensioner | | 50 ± 5 | (5 ± 0.5) |
| Screws fixing fixed pulley for auxiliary member drive belt to crankcase | | 105 ± 5 | (10.5 ± 0.5) |
| Screws fixing starter motor | | 74 ± 8 | (7.4 ± 0.8) |
| Screws fixing air heater | | 50 ± 5 | (5 ± 0.5) |
| Screws fixing air compressor | | 74 ± 8 | (7.4 ± 0.8) |

♦ Before assembly, lubricate with UTDM oil

• Before assembly, lubricate with graphitized oil

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Aquila Trucks Centres

| PART | | | TORQUE | |
|---|---|---|---|---|
| | | | Nm | kgm |
| Nut fixing air compressor gear | | | 170 ± 10 | (17 ± 1) |
| Screws fixing alternator: | M 10x1.5 | l = 35 mm | 44 ± 4 | (4.4 ± 0.4) |
| | M 10x1.5 | l = 60 mm | 44 ± 4 | (4.4 ± 0.4) |
| Screws fixing hydraulic power steering pump | | | 46.5 ± 4.5 | (4.65 ± 0.45) |
| Screws fixing air-conditioner compressor to the mount | | | 24.5 ± 2.5 | (2.5 ± 0.25) |
| Screws fixing guard | | | 24.5 ± 2.5 | (2.5 ± 0.25) |
| Filter clogging sensor fixing | | | 55 ± 5 | (5.5 ± 0.5) |
| Water / fuel temperature sensor fixing | | | 35 | (3.5) |
| Transmitter / thermometric switch fixing | | | 25 | (2.5) |
| Air temperature transmitter fixing | | | 35 | (3.5) |
| Pulse transmitter fixing | | | 8 ± 2 | (0.8 ± 0.2) |
| Fixing engine brake solenoid valve | | | 32 ± 3 | (3.2 ± 0.3) |
| Engine | | | | |
| M14X70/80 screw securing front and rear silentblocks to chassis | | | 192.5 ± 19.5 | 19.2 ± 1.9 |
| M16X130 screw securing front and rear silentblocks to engine | | | 278 ± 28 | 27.8 ± 2.8 |
| M18X62 flanged hex screw for front crankcase | | | | |
| First stage | pre -tightening | | 120 | 12 |
| Second stage | angle closing | | 45° | |
| M14X60 socket cheese-head screw for front crankcase | | | | |
| First stage | pre -tightening | | 60 | 6 |
| Second stage | angle closing | | 45° | |
| Flanged hex screw for rear crankcase | | | | |
| First stage | pre -tightening | | 100 | 10 |
| Second stage | angle closing | | 60° | |

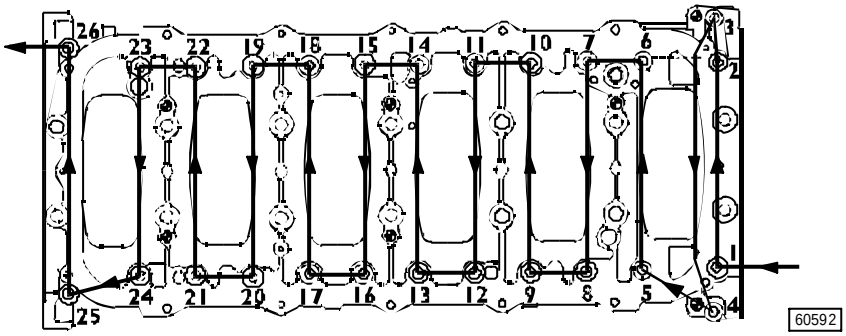
♦ Before assembly, lubricate with UTDM oil
• Before assembly, lubricate with graphitized oil

Aquila Trucks Centres

## DIAGRAMS OF TIGHTENING SEQUENCE OF MAIN ENGINE COMPONENTS

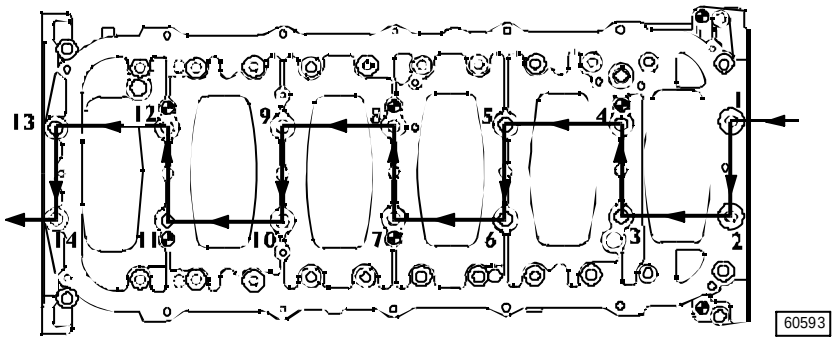
Figure 9

FRONT SIDE



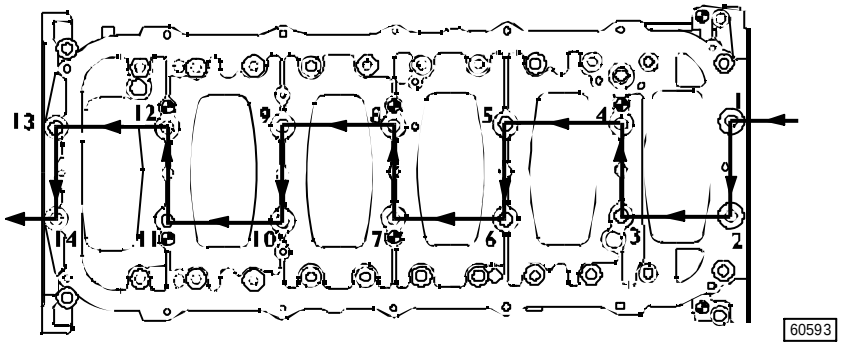

First phase: pre-tightening outside screws 30 Nm

FRONT SIDE



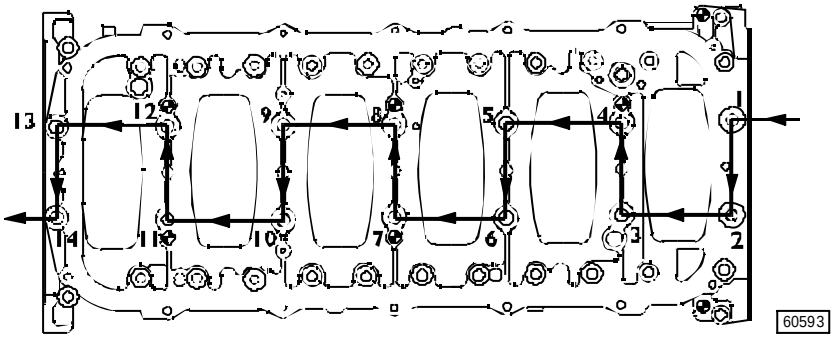

Second phase: pre-tightening inside screws 120 Nm

FRONT SIDE



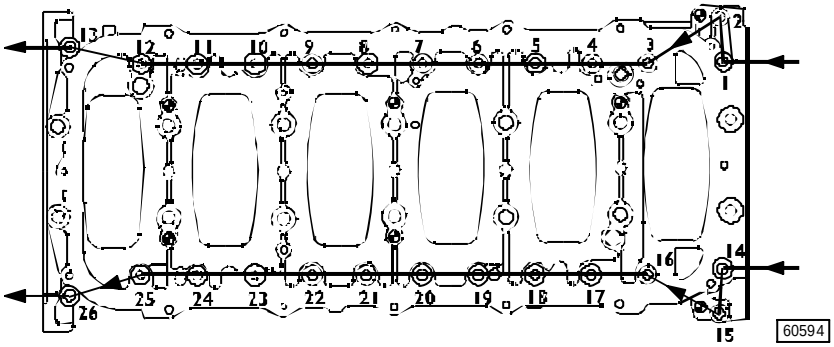

Third phase: closing inside screws to angle 60º

FRONT SIDE




Fourth phase: closing inside screws to angle 55º

FRONT SIDE




Fifth phase: closing outside screws to angle 60º

DIAGRAM OF TIGHTENING SEQUENCE OF LOWER CRANKCASE FIXING SCREWS

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Figure 10

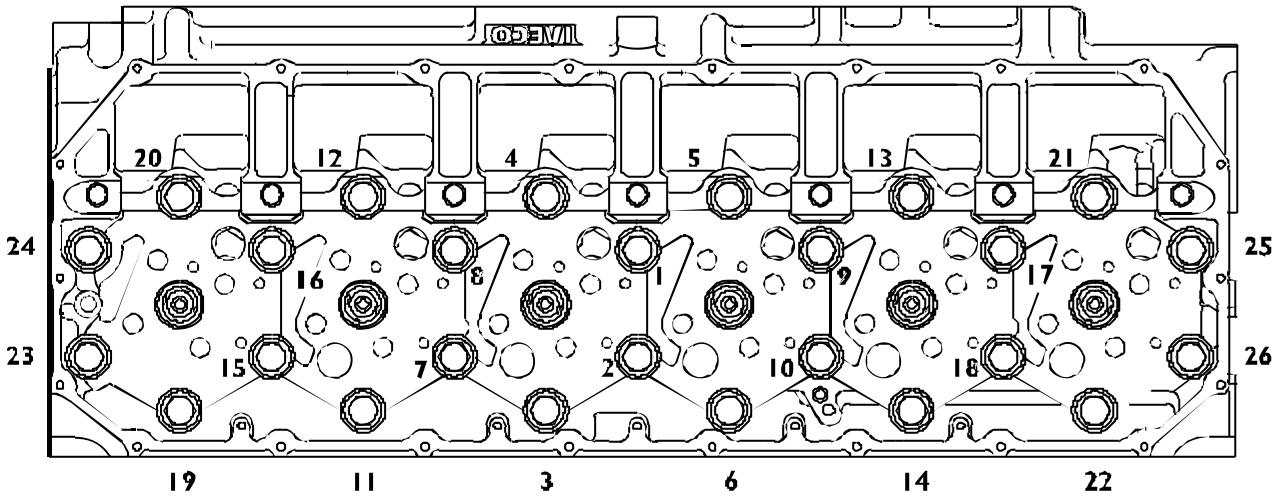



DIAGRAM OF TIGHTENING SEQUENCE OF CYLINDER HEAD FIXING SCREWS

Figure 11

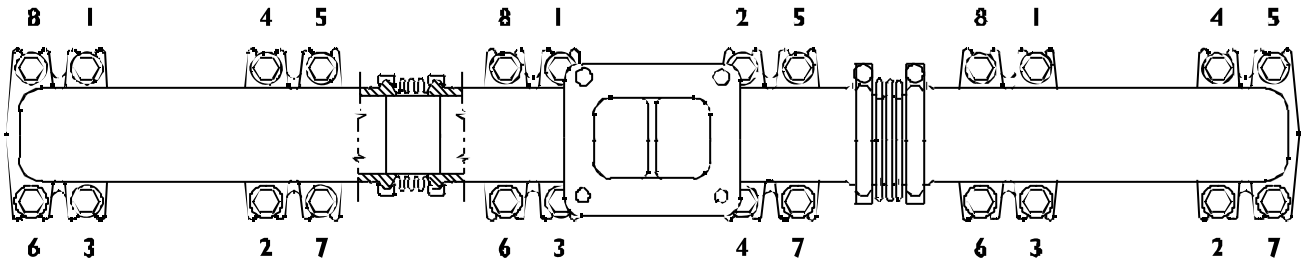



DIAGRAM OF TIGHTENING SEQUENCE OF EXHAUST MANIFOLD FIXING SCREWS

Figure 12

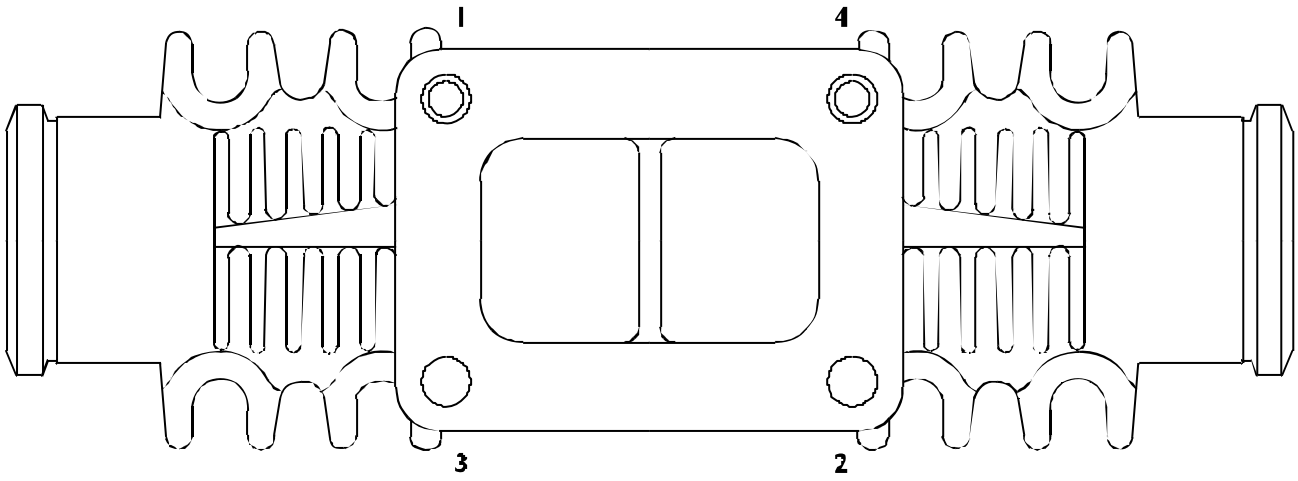



DIAGRAM OF TIGHTENING SEQUENCE OF SCREWS AND NUTS FIXING TURBOCHARGER ON EXHAUST MANIFOLD

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Figure 13

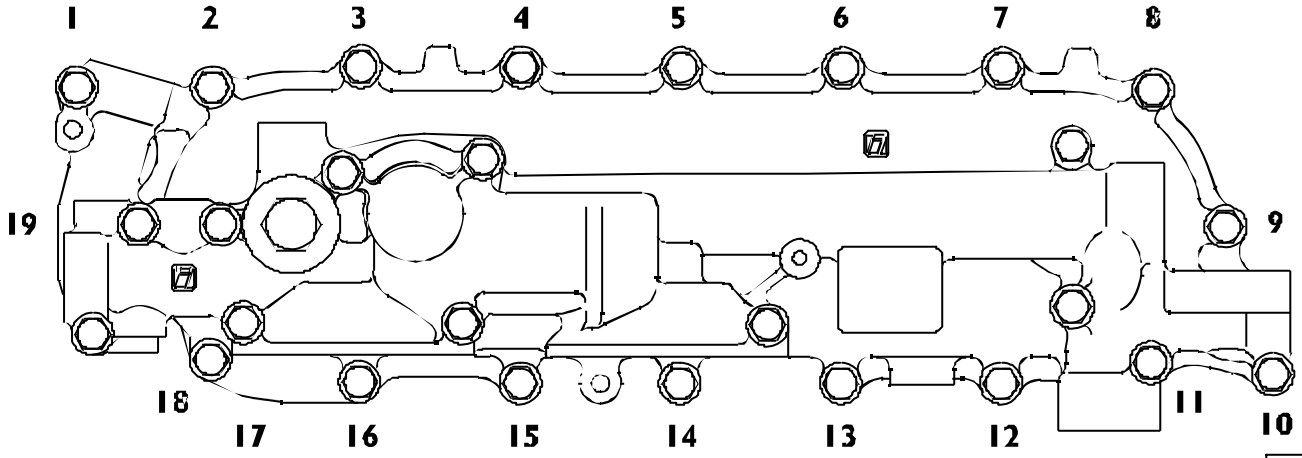



DIAGRAM OF TIGHTENING SEQUENCE OF HEAT EXCHANGER FIXING SCREWS

Figure 14

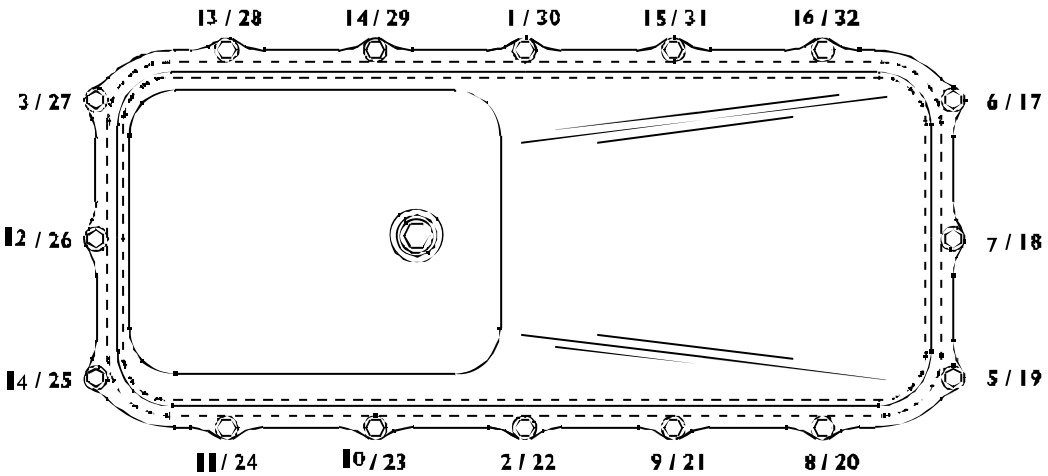



DIAGRAM OF TIGHTENING SEQUENCE OF ENGINE OIL SUMP FIXING SCREWS

Figure 15

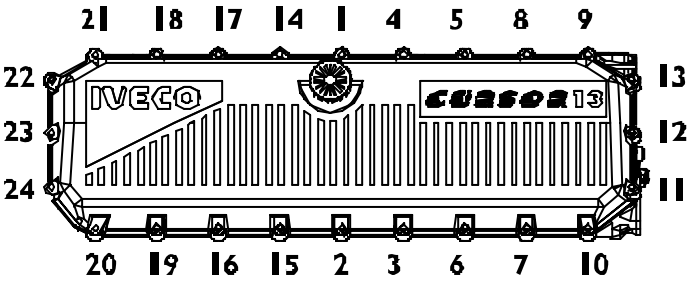
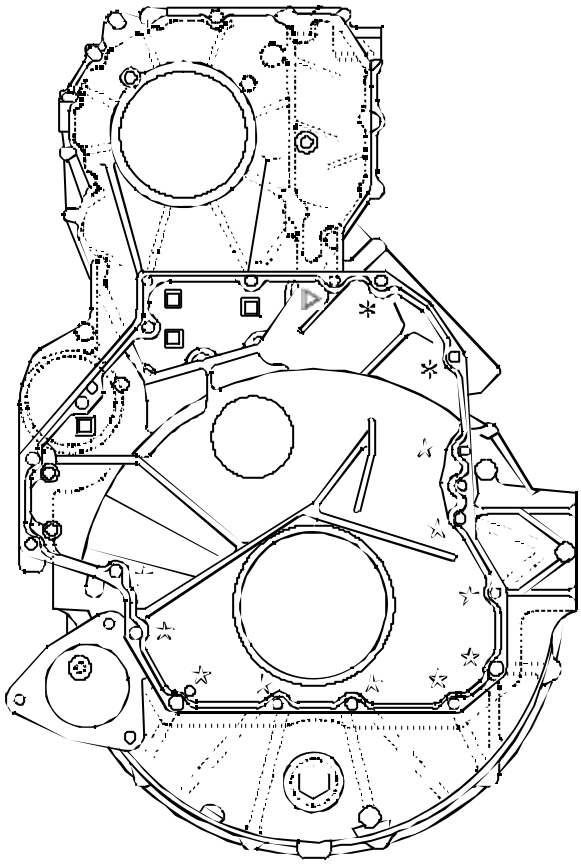



DIAGRAM OF TIGHTENING SEQUENCE FOR SCREWS FIXING ROCKER COVER

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Figure 16



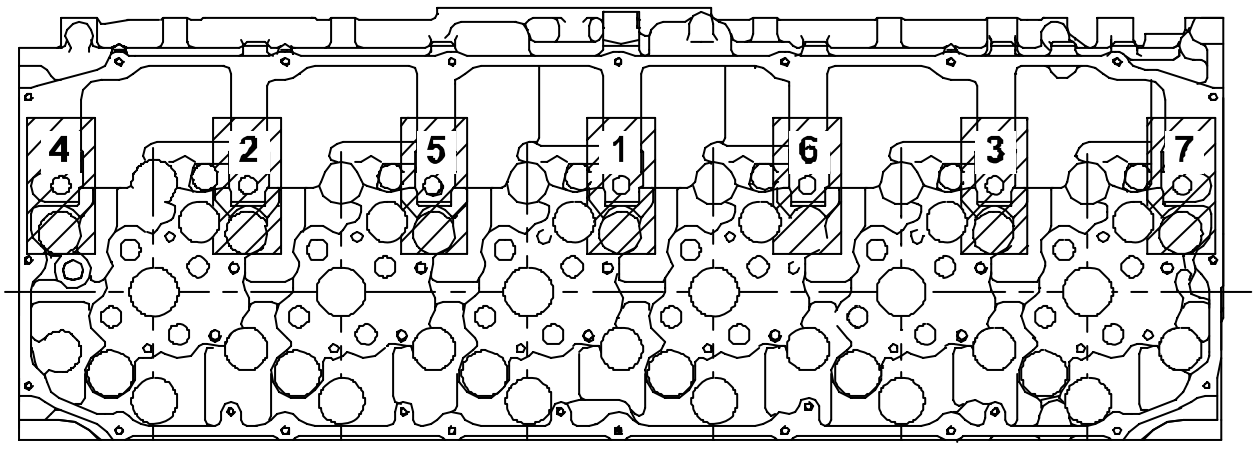
60633

DIAGRAM OF TIGHTENING SEQUENCE OF SCREWS FIXING GEAR HOUSING TO CRANKCASE

Tightening sequence

- 10 screws M12 x 1.75 x 100
- 2 screws M12 x 1.75 x 70
- 4 screws M12 x 1.75 x 35
- 1 screw M12 x 1.75 x 120
- 2 screws M12 x 1.75 x 193

Figure 17



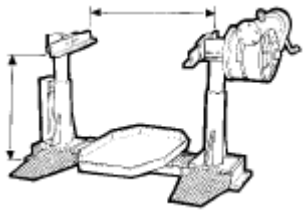
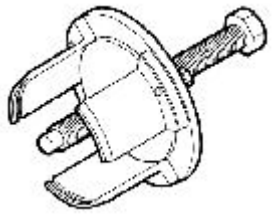
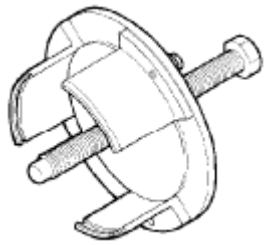
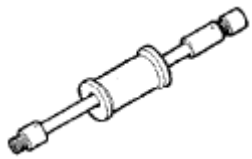
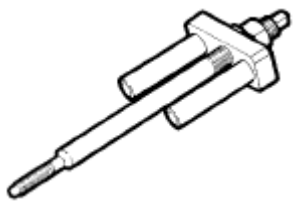
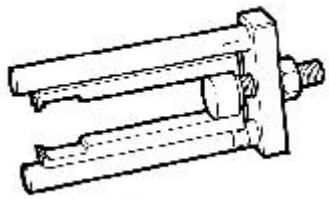

70567A

SCHEME OF THE TIGHTENING ORDER OF ROCKER ARMS SHAFTS FASTENING SCREWS

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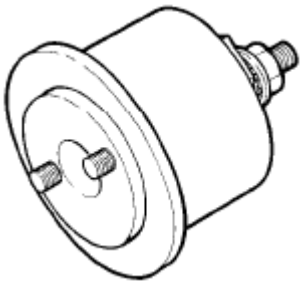
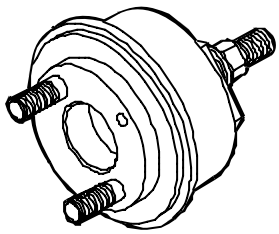
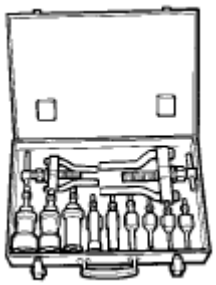
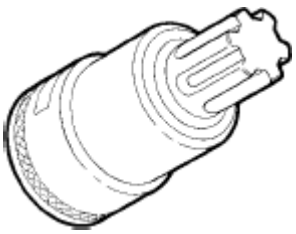
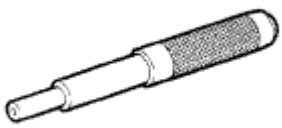
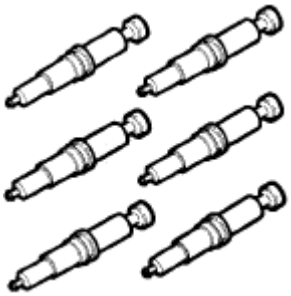
Aquila Trucks Centres

## TOOLS

| TOOL No. | | DESCRIPTION |
|---|---|---|
| **99322230** |  | Rotary telescopic stand<br>(capacity 2000 daN, torque 375 daN/m) |
| **99340053** |  | Tool to remove crankshaft front gasket |
| **99340054** |  | Tool to remove crankshaft rear gasket |
| **99340205** |  | Puller with slide hammer |
| **99342149** |  | Extractor for injector box |
| **99342155** |  | Tool to extract injectors |

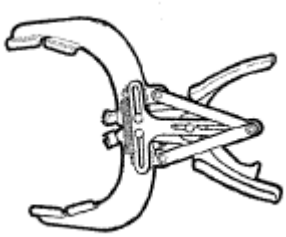
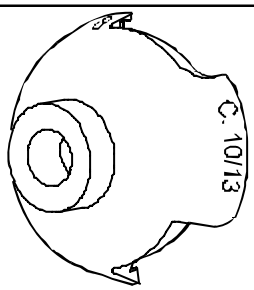
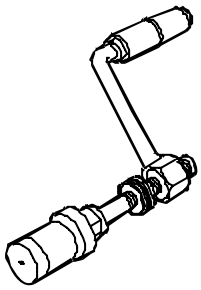
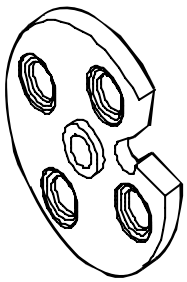
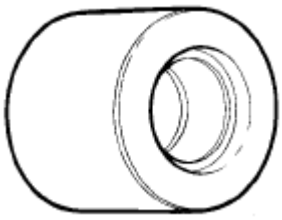
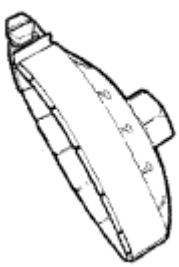
Aquila Trucks Centres

## TOOLS

| TOOL No. | | DESCRIPTION |
|---|---|---|
| **99346250** |  | Key to fit crankshaft front gasket |
| **99346251** |  | Key to fit crankshaft rear gasket |
| **99348004** |  | Universal extractor for interiors from 5 to 70 mm |
| **99350072** |  | Socket wrench for screws fastening lower crankcase to crankcase |
| **99360143** |  | Drift to fit - remove valve guide |
| **99360180** |  | Plugs (6) protecting injector seats |

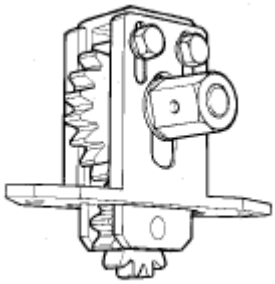
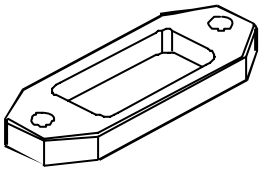
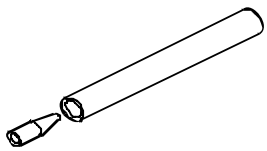
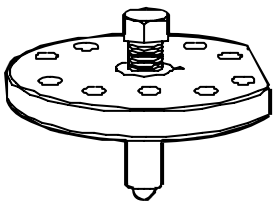
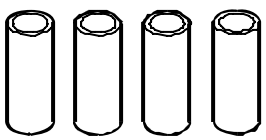
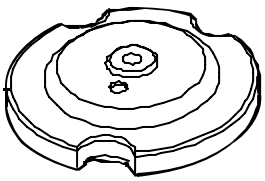
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## TOOLS

| TOOL No. | | DESCRIPTION |
|---|---|---|
| **99360184** |  | Pliers for removing and refitting piston rings (105-106 mm) |
| **99360192** |  | Guide for flexible belt |
| **99360261** |  | Tool for removing and refitting engine valves<br>(use with specific plates) |
| **99360263** |  | Plate for removing and refitting engine valves<br>(use with 99360261) |
| **99360296** |  | Drift for refitting valve guide (use with 99360143) |
| **99360314** |  | Tool to remove oil filter (engine) |

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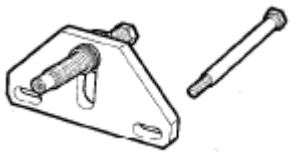
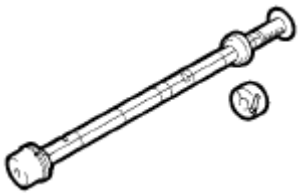
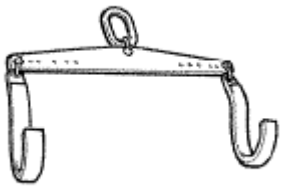
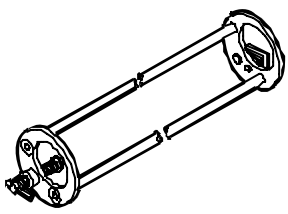
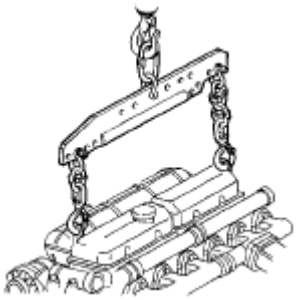
## TOOLS

| TOOL No. | | DESCRIPTION |
|---|---|---|
| **99360321** |  | Tool to rotate engine flywheel (use with 99360325) |
| **99360325** |  | Spacer (use with 99360321) |
| **99360329** |  | Keying device for mounting gasket on valve guide |
| **99360334** |  | Compression tool to measure cylinder liner protrusion (use with 99370415-99395603 and specific plates) |
| **99360336** |  | Spacers (use with 99360334) |
| **99360338** |  | Plate to compress cylinder liners (use with 99360334-99360336) |

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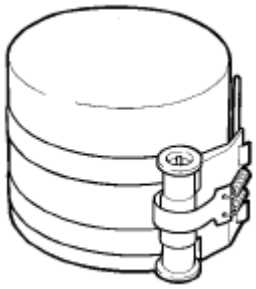
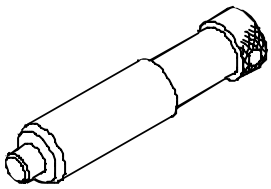
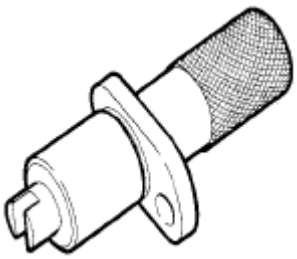
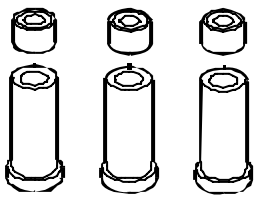
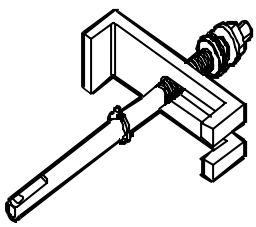
Aquila Trucks Centres

## TOOLS

| TOOL No. | | DESCRIPTION |
|---|---|---|
| **99360351** |  | Tool to hold engine flywheel |
| **99360499** |  | Drift to remove and refit camshaft bushings |
| **99360500** |  | Tool to lift crankshaft |
| **99360551** |  | Bracket to remove and refit engine flywheel |
| **99360553** |  | Tool to assemble and install rocker arm shaft |
| **99360585** |  | Beam to remove and refit engine |

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Aquila Trucks Centres

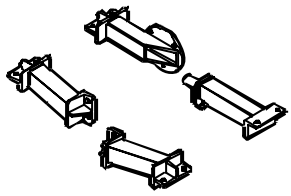
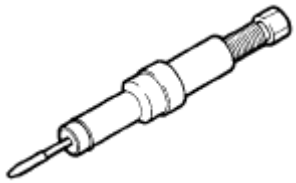
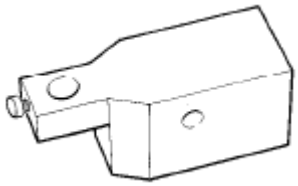
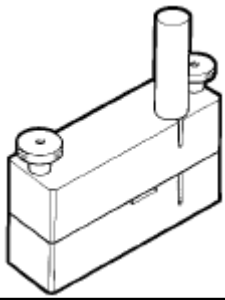
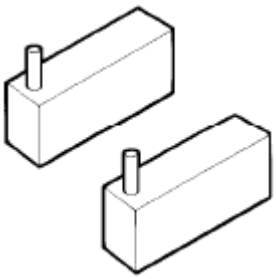
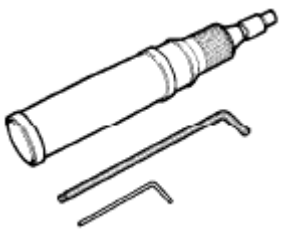
## TOOLS

| TOOL No. | | DESCRIPTION |
|---|---|---|
| **99360605** |  | Collar to insert piston in cylinder liner (60-125 mm) |
| **99360612** |  | Tool to position engine T.D.C. |
| **99360613** |  | Tool for phonic wheel timing on camshaft |
| **99360703** |  | Tool to hold cylinder liners |
| **99360706** |  | Tool to extract cylinder liners (use with specific rings) |
| **99360728** |  | Ring (135 mm) (use with 99360706) |

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Aquila Trucks Centres

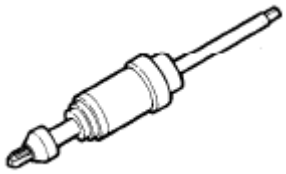
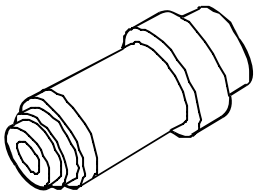
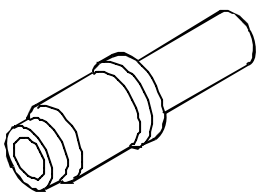
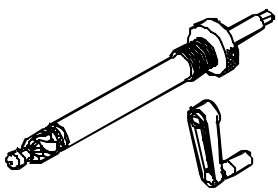
## TOOLS

| TOOL No. | | DESCRIPTION |
|---|---|---|
| **99361036** |  | Brackets fixing engine to rotary stand 99322230 |
| **99365056** |  | Tool to upset injector housing |
| **99370415** |  | Dial gauge base to measure cylinder liner protrusion (use with 99395603) |
| **99378100** |  | Tool to punch engine data plates (use with specific punches) |
| **99378130** |  | Punches for printing engine identification plates (consisting of: 99378101 (A) - 99378102 (B) - 99378103 (C) - 99378104 (D) - 99378105 (E) - 99378106 (F) - 99378107 (G) - 99378108 (V)) |
| **99389834** |  | Torque screwdriver to calibrate injector solenoid valve connector retaining nut |

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Aquila Trucks Centres

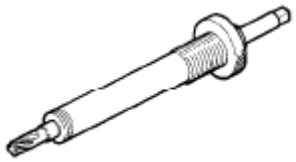
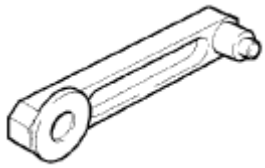
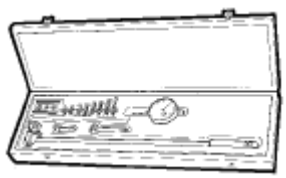
## TOOLS

| TOOL No. | | DESCRIPTION |
|---|---|---|
| **99390330** |  | Valve guide reamer |
| **99390772** |  | Tool to remove remains from injector housing seat |
| **99390804** |  | Tool to thread injector housing to extract (use with 99390805) |
| **99390805** |  | Guide bushing (use with 99390804) |
| **99394015** |  | Guide bushing (use with 99394041 or 99394043) |
| **99394041** |  | Milling cutter to regrind injector seat (use with 99394015) |

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## TOOLS

| TOOL No. | | DESCRIPTION |
|---|---|---|
| **99394043** |  | Reamer to regrind bottom of injector housing (use with 99394015) |
| **99395216** |  | Pair of meters for angular tightening with square 1/2" and 3/4" connection |
| **99395219** |  | Gauge to determine centre distance between camshaft and idle gear |
| **99395603** |  | Dial gauge (0 ÷ 5 mm) |
| **99395687** |  | Bore meter (50 ÷ 178 mm) |
| **99396035** |  | Crankshaft front gasket cover centring ring |

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## ENGINE REMOVAL-REFITTING

### Removal

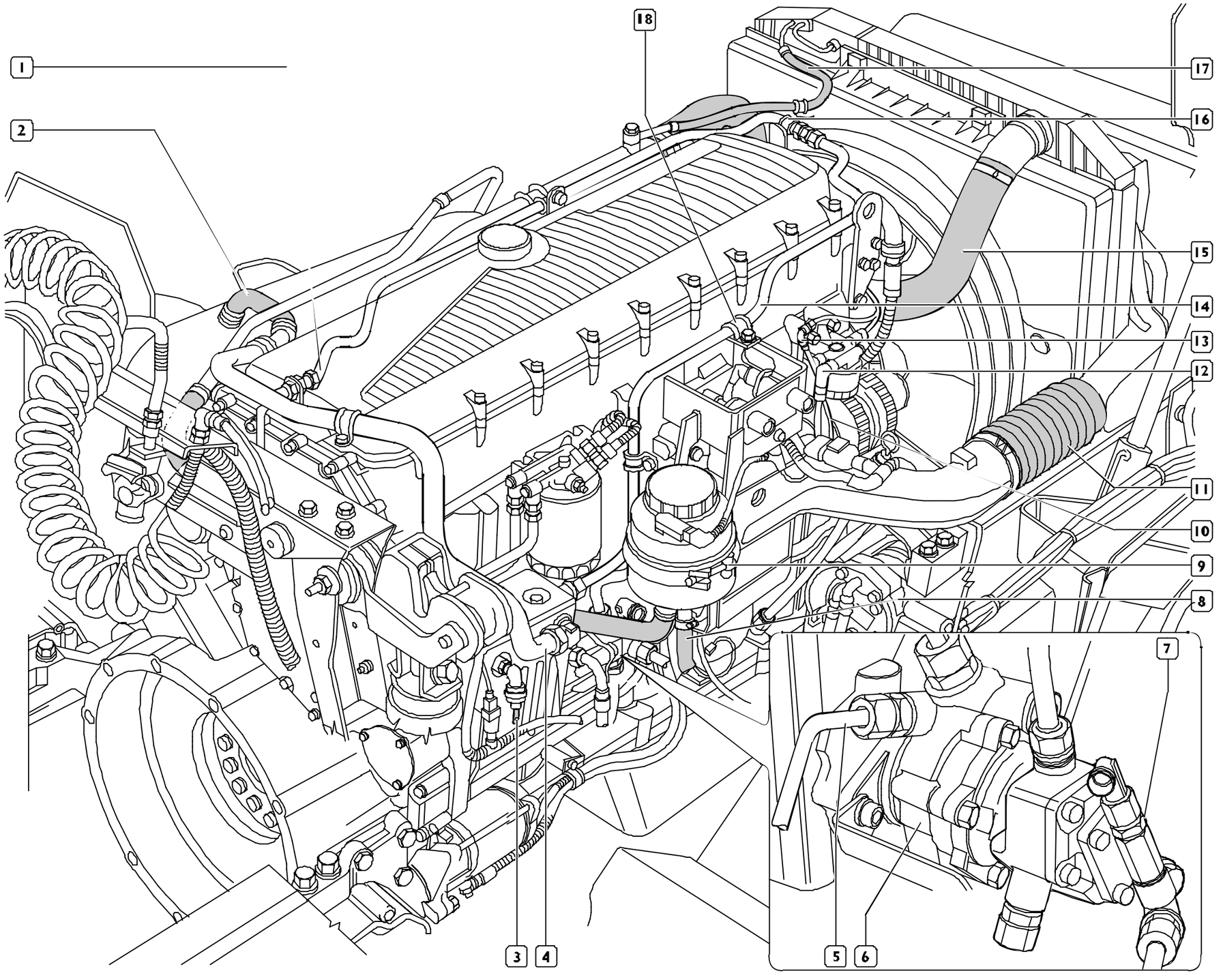
If washing the engine bay, adequately protect the electric/electronic components and their connections.

- Set the vehicle on the level over a pit. Lock the rear wheels and tilt up the cab.
- Break the electric circuit by disconnecting the positive cable of the battery.
- Lift the radiator cowling and tilt up the cab.
- Disconnect the gearbox as described under the relevant heading, "Disconnecting the Gearbox".
- Drain the hydraulic power steering and engine cooling systems.

Steps to perform on the engine intake side:

- Disconnect the pipe (8) from the power steering tank (9) and the pipe (5) from the power steering pump (6).
- Disconnect pipes from overpressure valve (7) for fuel return to tank;
- Disconnect the air pipe (12) from the turbocharger actuator air filter. Disengage the pipe (10) supplying air to the fan hub from the clamps and the fitting (13).
- Disconnect the tube (3) of the air compressor.
- Disconnect the pipes (4) and (14) from the air compressor, freeing them from the clamps (16) and (18) on the engine.
- With the hose (2), remove the pipe (4) from the seat on the intake manifold.
- With the fitting (1), remove the pipe (14).
- Disconnect the coolant piping (17) and (15) and remove it by freeing it from the clamps.
- Disconnect the engine air intake sleeve (11).

Figure 18




106241

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Figure 19

As a preliminary operation it is wise to disconnect the wiring (11) that will remain fastened to the chassis frame, proceeding as follows:

- Acting on the air intake side, disengage the wiring (11), disconnecting it from the engine cable with the connector (17).
- Disconnect the electrical connection (3) of the hydraulic power steering tank (4).
- Remove the entire mount of the engine starting and stopping buttons (2) together with the power steering tank (4), after disconnecting the pipe (5), by taking out the screws (1).

From the electronic control unit (8), disconnect the bottom connector (9), proceeding as follows:

- A Lift the safety lever.
- B Move the connector, disconnecting it from the control unit.
- C Lift the connector, unhooking the stop tooth.
- Disconnect the earth cable (10) from the crankcase and the electromagnetic clutch cable for the air-conditioning compressor, via the connector (12).
- Disconnect the electrical connections (7) on the starter motor (6).
- Disconnect the electrical connections (15) of the alternator (16).
- Disconnect the electrical connection from the valve on the control unit (8).
- Disconnect the diesel pipe (18) from the mount of the control unit (8).
- Then free the wiring (11) from the clamps (14) secured to the engine air intake duct (13) and carefully place it away to the side of the vehicle so it will not interfere with the removal of the engine.

109152

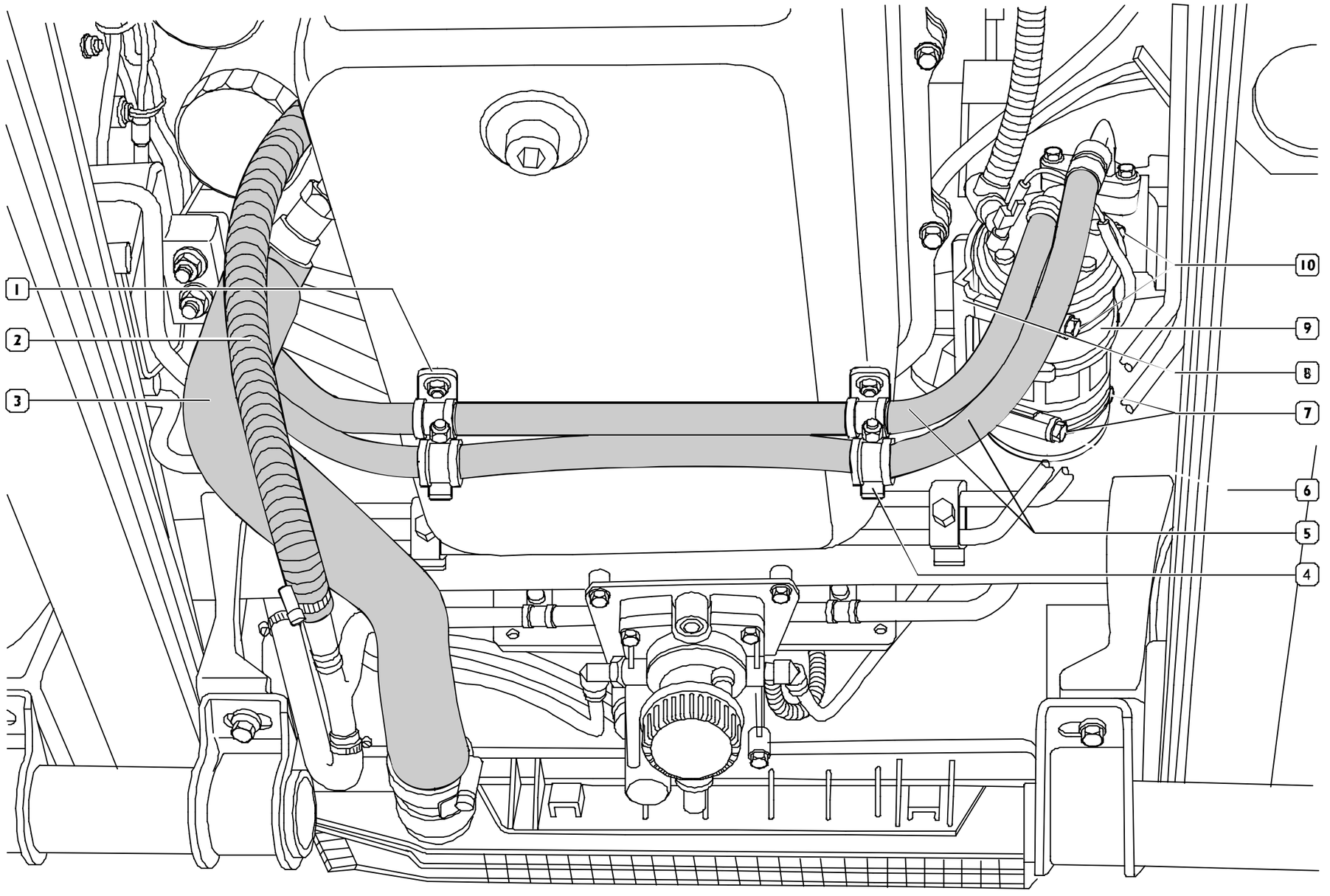
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From underneath the vehicle:

- Disconnect the coolant pipe (3) from the engine and from the radiator, then remove it.
- Disconnect the coolant pipe (2), loosen and remove the belt (6) from the pulley of the air-conditioning compressor by using the automatic tensioner.
- Disconnect the compressor (9) from the engine mount (8) by taking out the screws (7) and (10).
- Without disconnecting the pipes of the compressor and then without discharging the air-conditioning system, free the pipes (5) from the brackets (1 and 4), suitably tie the compressor to vehicle so it does not interfere with the operations of removing the engine.

Figure 20



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Working on the engine exhaust side (driver's side), proceed as follows:

- Disconnect the air sleeve (6).
- Free the air-conditioning pipes (5) from the clamp (4) secured onto the manifold (3).
- Disconnect the coolant pipes (9) and (11) from the engine.
- Remove the engine air intake manifold (12), disconnecting it from the sleeve (21), fastenings (8) and (13), flexible sleeve (14); disconnect the oil vapour recovery pipe (7) and disconnect the air intake pipe of the compressor (20).
- Disconnect the exhaust pipe (16) by acting on the collar (15) and remove the bracket (17) by undoing the fasteners.
- Anchor the engine to the beam 99360585 and keep the tool under tension before removing the engine mounts.
- Take out the front (10) and rear (18) and (19) screws fixing the engine mounts on both sides.
- Slowly take the engine out of its bay, drawing it slightly back so as to free the fan (2) from the bay of the air conveyor (1) on the radiator.
- Remove the fan from the hub by using the four screws. Take out the engine completely, taking care over any interference with the remaining parts secured to the chassis frame, especially the wiring interfering with the right-hand rear engine mount.
- Disconnect the air bleed pipe (22) from the Intarder coolant pipe.

**NOTE** If washing the engine, adequately protect the electric/electronic components and their connections.

## Refitting

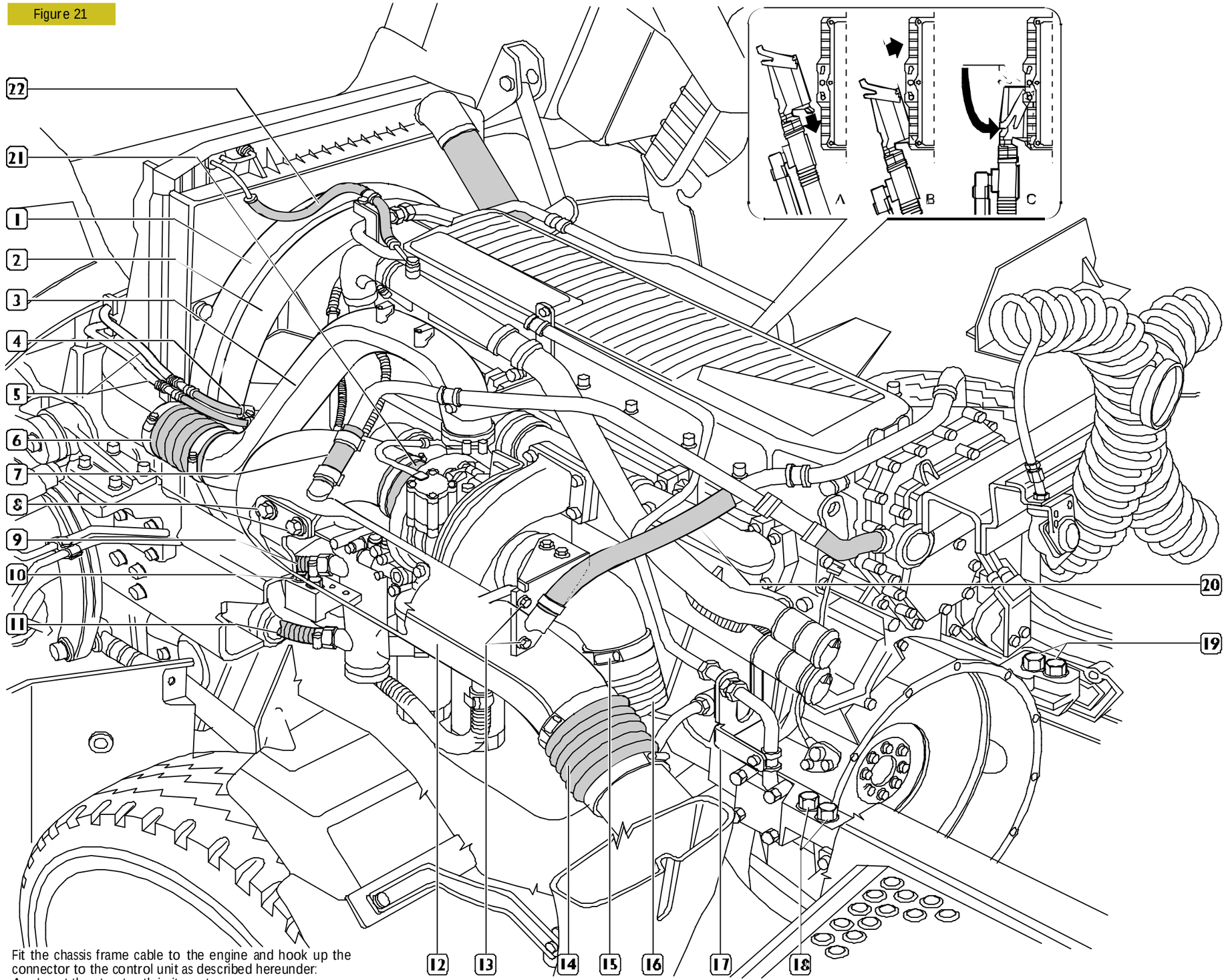
To refit the engine, carry out the steps described for removal in reverse order, taking special care over the steps required to install the assembly in the engine bay, and keep to the following instructions:

- Check the flexible mountings of the engine and gearbox assemblies; replace them if deteriorated.
- Check that the parts of the exhaust pipe have not deteriorated or are about to deteriorate, in which case they should be replaced.
- Tighten the screws and/or nuts to the required torque.
- Fill the cooling system with coolant as required under the relevant heading.
- Bleed the air from the supply system as described under the relevant heading (542011).

**NOTE** Before bleeding the supply system, connect tubes onto the bleed screws located on the pre-filter mount, filter and front of the cylinder head in order to recover the fuel in suitable containers during this operation. In particular, prevent the fuel, on coming out of the bleed screw on the cylinder head, from fouling the belts driving the fan, water pump, alternator and air-conditioner compressor, damaging them.

- Fill the hydraulic power steering circuit and bleed off the air as described under the relevant heading (501030).
- Check the engine oil level.

Figure 21




Fit the chassis frame cable to the engine and hook up the connector to the control unit as described hereunder:

A Insert the stop tooth in its seat.
B Hook up the connector.
C Push the safety lever as far as the stop.

73904

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## Filling the cooling system

### Preliminary operations

For vehicles equipped with just the standard cab heating system or manual air-conditioning:

- Fully open the coolant cock on the instrument panel.

For vehicles equipped with the automatic air-conditioning system:

- Set the temperature control in the cab on the HI position.

For vehicles equipped with an additional heater:

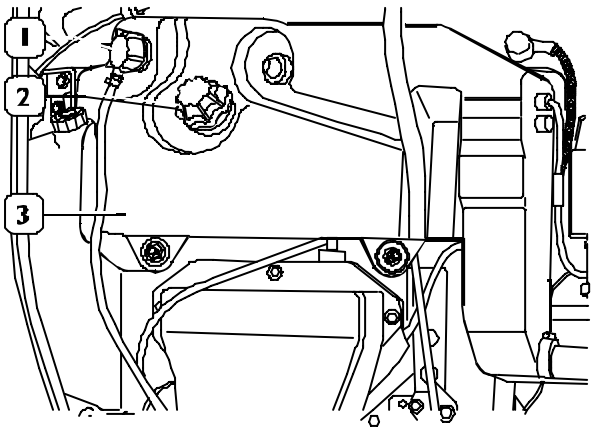
- The heater must not be turned on.

### Operations

Place a sheet of cardboard between the coolant radiator and the intercooler radiator in order to shorten the time it takes to reach the engine's working temperature (approx. 90°C).

### Filling the system

Figure 22




87198

**NOTE** Filling must be done with the engine cold.
The cap (1) must not be removed for any reasons whatsoever.
To prevent pockets of air forming in the system, the fluid has to be transferred slowly (approximate flow rate 8 litres/min).
For vehicles equipped with an additional heater: the percentage of glycols in the coolant must be no greater than 50%.

After conscientiously following the above warnings, proceed as follows:

- Remove the cap (2) from the expansion tub (3).
- Pour the coolant into the expansion tub (3) till it is quite full.



Bleeding air from the system

**NOTE** For vehicles equipped with an additional heater:
- Turn on the heater.

- Start the engine and keep the speed just above idling for 5 min.

**NOTE** If the tub empties completely during these first few minutes, stop and engine and top it up at a slower rate than before.
Restart the engine.

- after 5 min. running, top up the level of fluid in the expansion tub, if necessary.
- close the expansion tub filler with the cap (2).
Take the engine up to top speed so that the coolant quickly reaches the temperature of full thermostat opening (approx. 90°C) and keep it in this state until all the air is bled out of the system.
This is checked by seeing there is no foam or air bubbles in the tub.
The longest time it takes to bleed the air from the system completely is approximately 15 minutes from the moment when the thermostat opens (opening starts 85°±2°C).

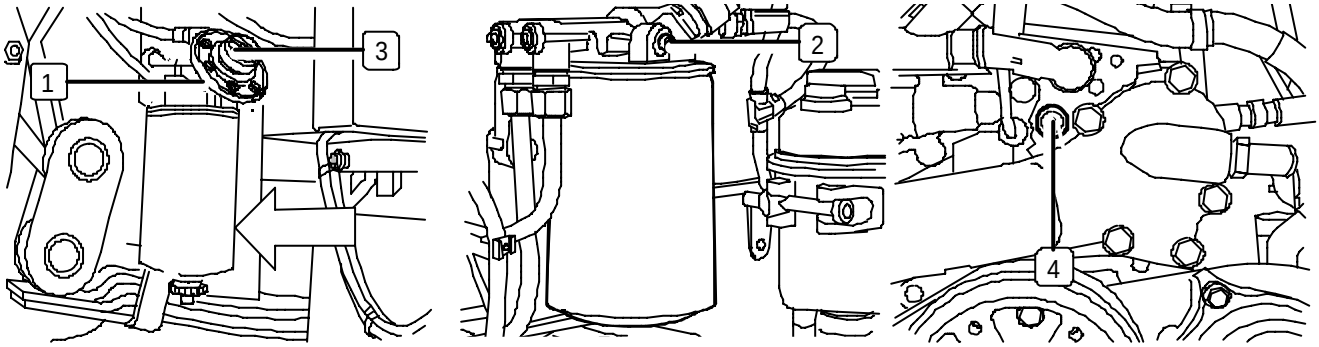
**NOTE** Do not take the filler cap off the expansion tub until the fluid in the system has cooled completely.
Any topping up must only be done with the engine cold.

This is to avoid:
1 - Operator burns.
2 - Damage to the engine since cooling system pressurization is only created with the fluid heating from the condition of the engine cold.

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## 542011 Bleeding air from the fuel system

Figure 23




Before starting the engine, bleed the air from the fuel system, applying special tubes to the bleed screws to run the bled fuel off into a specific container.

- Bleed screw (1) on the pre-filter mounting.
- Bleed screw (2) on the filter mounting.
- Bleed screw (4) on the front of the cylinder head.
- Work the pump (3) on the pre-filter mounting till fuel with no air bubbles in it comes out of the screw (1); close the screw (1).
- Repeat this step for screw (2).
- Repeat this step for screw (4).

**NOTE** Under no circumstances let fuel foul the water pump alternator drive belt, etc.

### Checks and tests

Start the engine, leave it running at just a little faster than idling speed and wait for the temperature of the coolant to reach the level to open the thermostat. Then, check that:

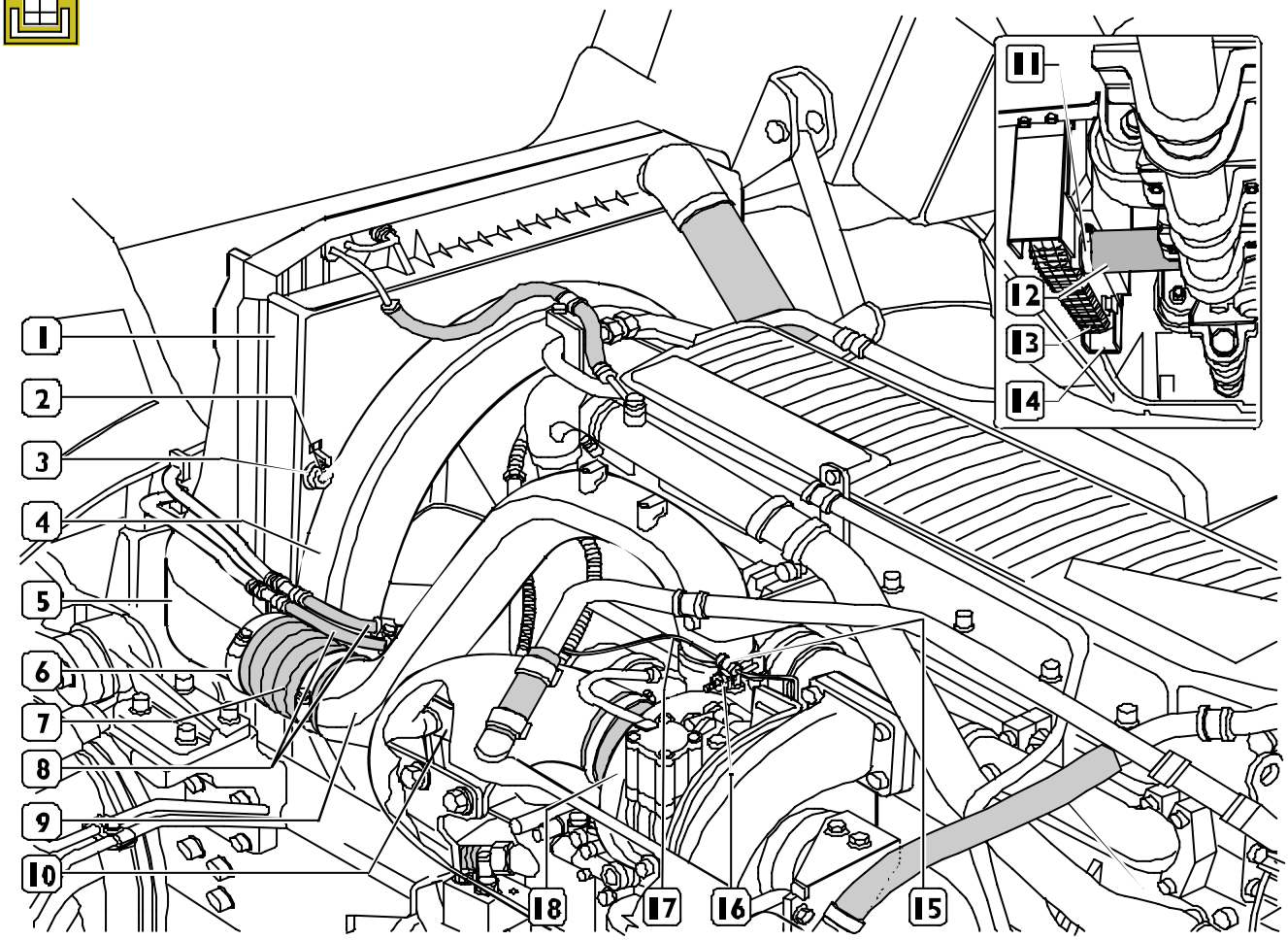
- no water leaks from the connecting sleeves of the pipes in the engine cooling and cab heating circuits, tightening the collars further if this is necessary.
- no oil leaks from between the cover and the cylinder head, between the oil sump and the crankcase, between the oil filter and its seat, between the heat exchanger and the crankcase, or between the various pipes in the lubrication circuit.
- no air leaks from the pipes connected to the pneumatic components involved in removal.
- the indicator lights on the instrument panel and the devices disconnected when removing the engine all work properly.

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## 543422 ELECTRO-MAGNETIC FAN DRIVE REPLACEMENT

### Removal

Figure 24




To cut off the batteries, remove the electric wires or open the main switch.

Lift the calender and tilt the cabin.

Go under the vehicle and remove the plug (13) from the radiator (14) and drain the coolant fluid in the appropriate container.

Remove the clip (11) and disconnect the radiator (12) sleeve (14).

Remove the climate control system pipe (8) fastening screw (if fitted) to the air conveyor (9).

Remove the air conveyor (9) fastening screws (10) from the support bracket.

Remove the two sleeve fastening screws to the intercooler radiator (5).

Remove nut (16), then disconnect electric cable (17). Slacken the clamp (15) and remove the air conveyor (9) from the turbocharger (18) and from the intercooler radiator (5).

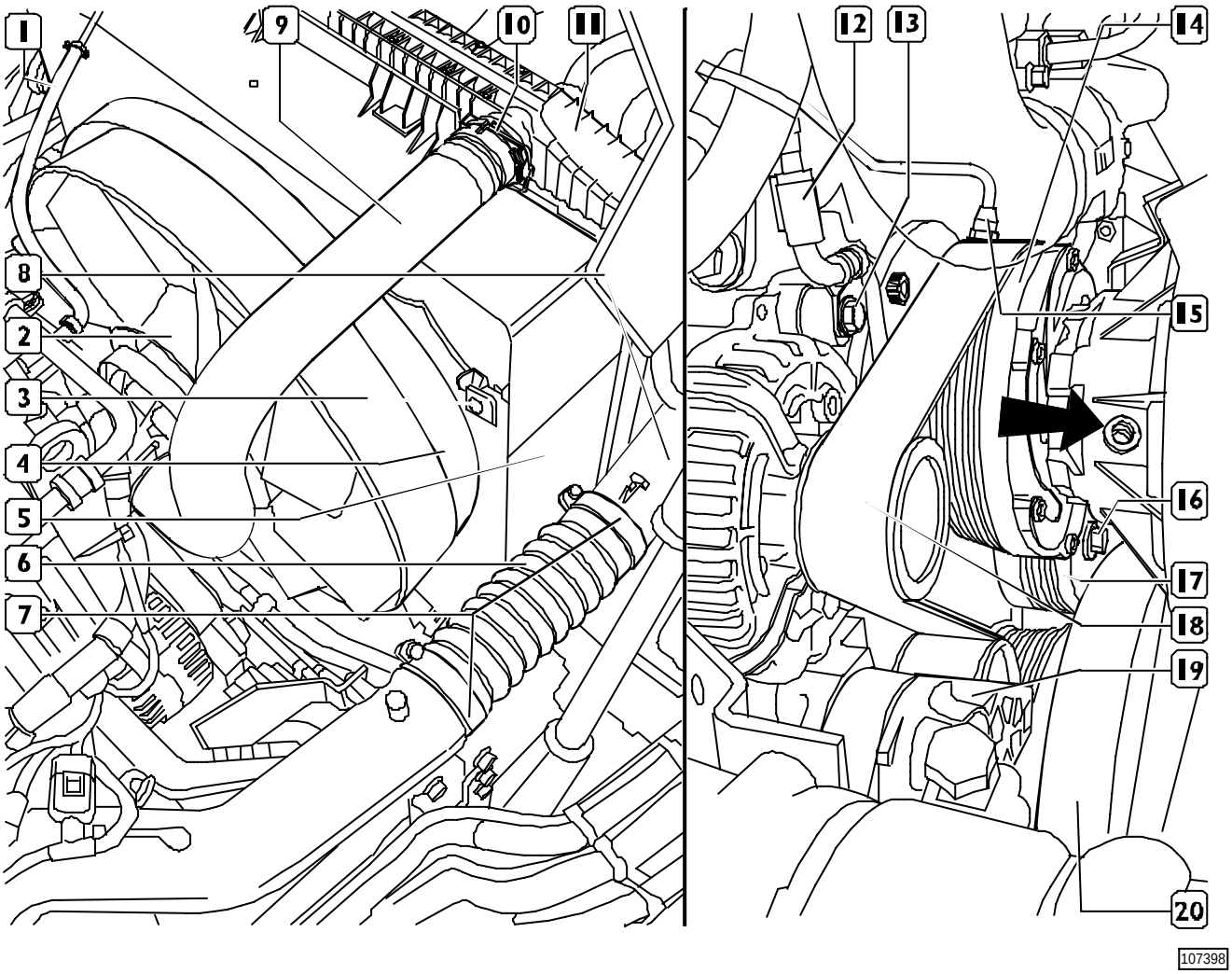
Slacken the sleeve (6) fastening clamp (7) from the intercooler (5) radiator.

Drive in the suitable self-threading screw in the pin hole (2) taking care to partially take off and finally remove with a screwdriver the upper clip (3) fastening the fan air (4) conveyor to the radiator guard (1).

Remove the lower clip in the same way.

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Figure 25




Disconnect the pipe (1) from the thermostat.
Remove the clip (10) and disconnect the sleeve (9) from the radiator (11).
Slacken the clamps (7) and remove the sleeve (6).
Remove the upper and lower clip (3) as described for the left-hand side.
Remove the radiator support fastening screws on the chassis and move the radiator unit forwards.
Lift air conveyor (4) and disconnect it from the vehicle.
Remove the radiator support fastening screws (2) on the chassis and move the radiator unit forwards (14).
Remove the fan fastening screws (2).
Loosen belt (18) tension by acting on automatic belt-stretcher (19), then remove the belt from the pulleys.
Disconnect the electric connection (12) from the electro-magnetic fan drive (14).
Lock engine shaft rotation.
Remove securing screws and dismount damper (20).
Unscrew screw (16) and dismount pulley (17).
Disconnect pneumatic piping (15) from electromagnetic fan drive (14).
Remove the fan fastening screws (13) to the electro-magnetic fan drive (14).

## Refitting

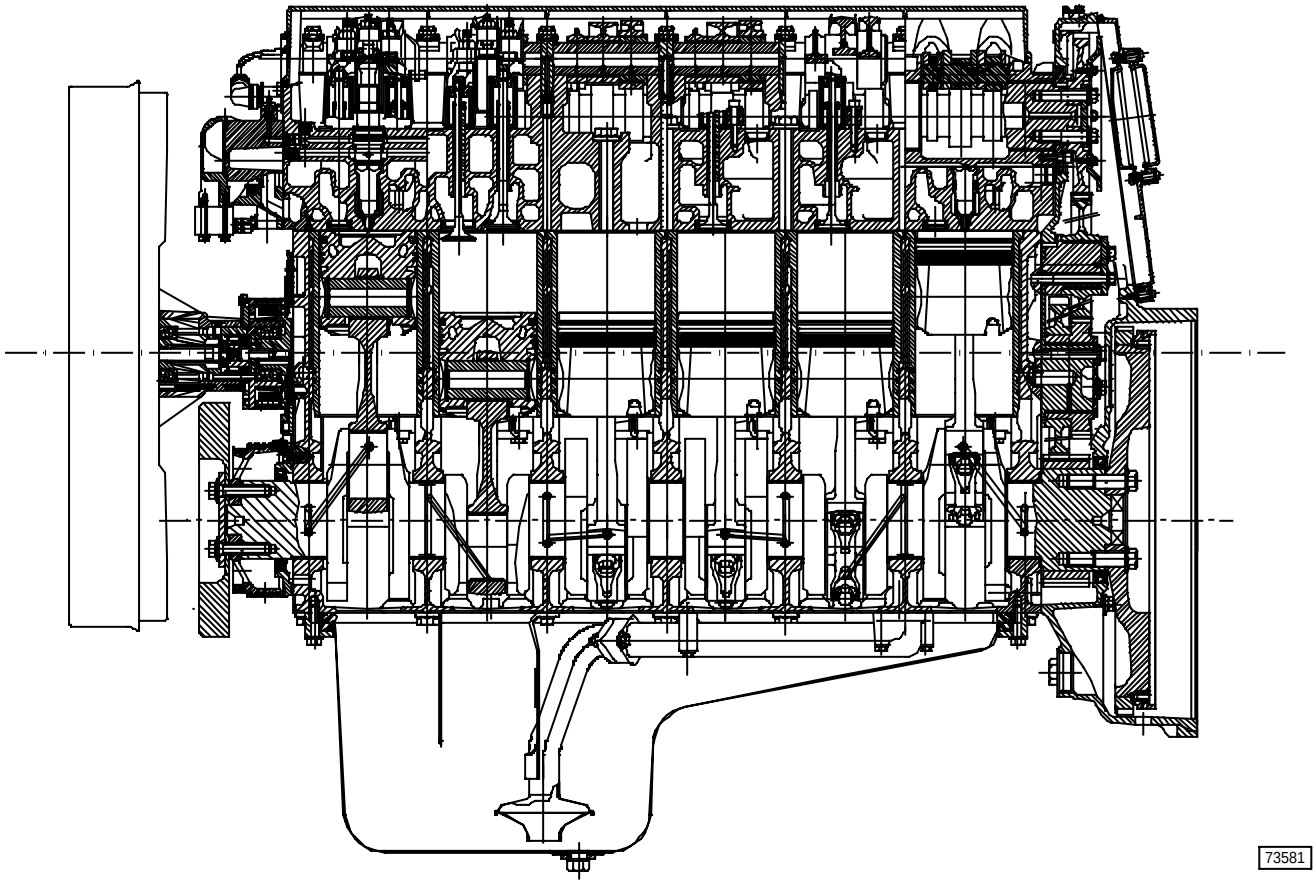
To refit the electro-magnetic fan drive, reverse the removal procedure and attain to the following rules:

- check the control belt (18) conditions; replace it if damaged or worn out;
- tighten the screws and/or nuts to the prescribed torque;
- fill the cooling system with the prescribed fluid, then blow air off the cooling system as described in the respective chapter;

**NOTE** The electro-magnetic fan drive is fitted with two threaded holes (→) at 180° one from the other. In the event of fault, lock the joint control driving in a M8x16 mm screw in these holes. In this way it is possible to take the vehicle to the closest dealership.

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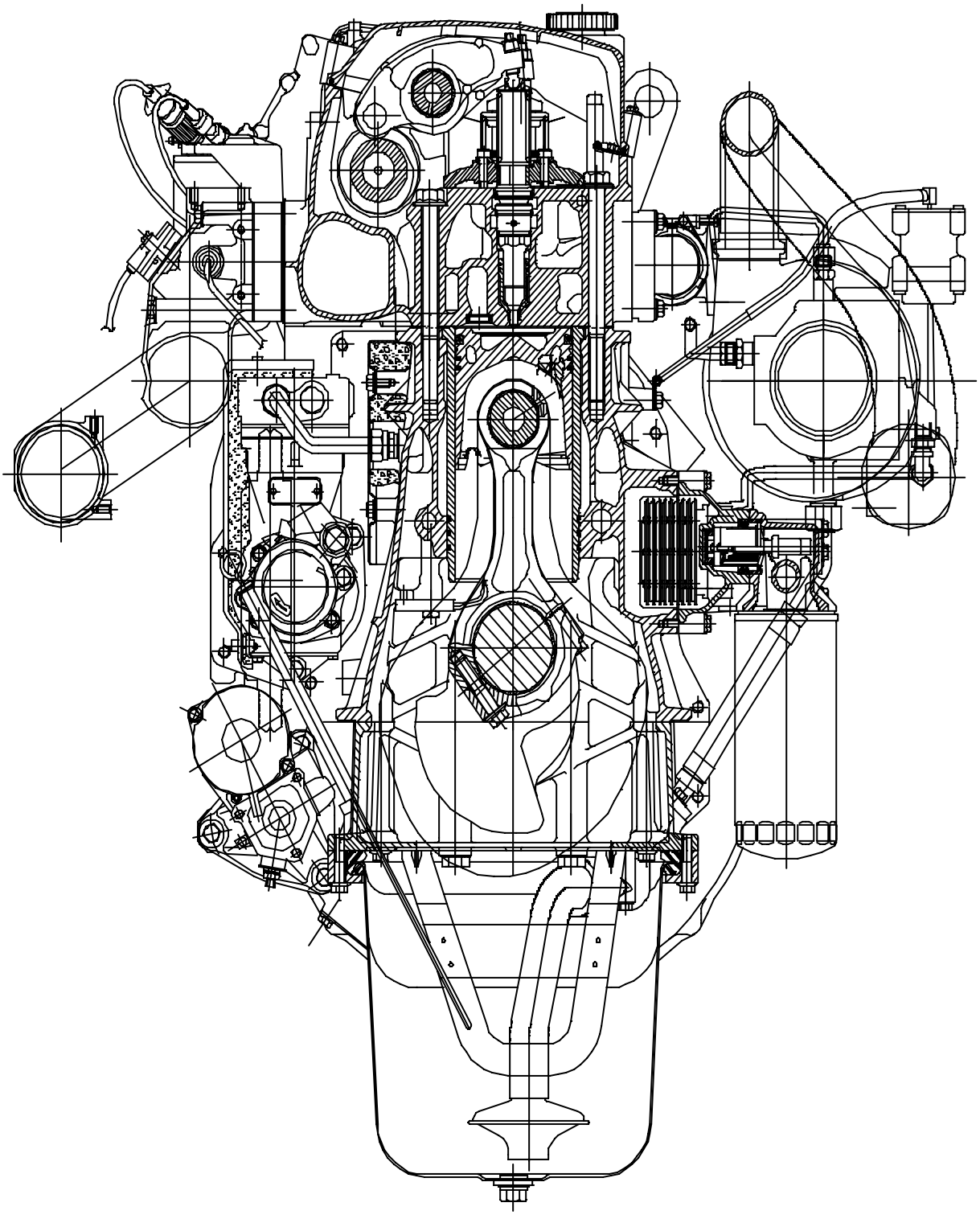
Figure 26




LONGITUDINAL SECTION OF THE ENGINE

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Figure 27



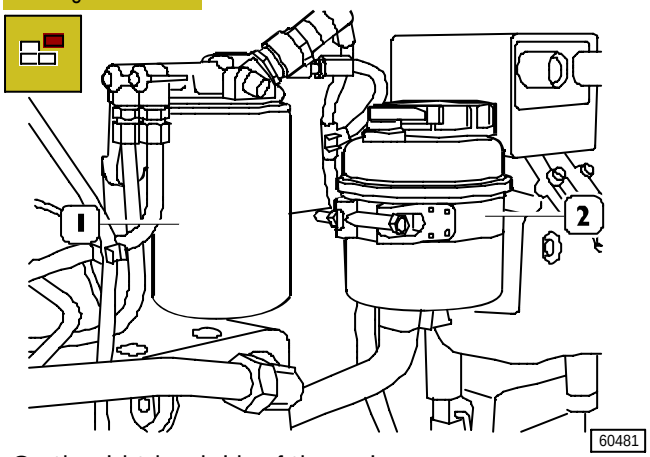

TRANSVERSE SECTION OF THE ENGINE

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## 540110 DISASSEMBLY OF THE ENGINE

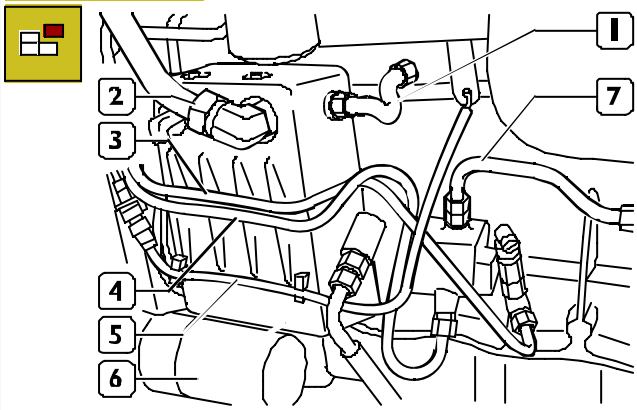
Before fastening the engine on rotary stand 99322230, dismount or disconnect following parts:

Figure 28



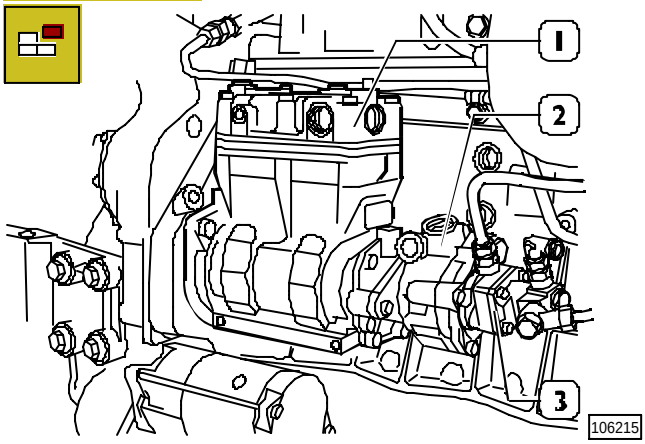

On the right-hand side of the engine
- the fuel cartridge filter (1).
- the hydraulic power steering tank (2).
- the electrical connections.

Figure 29



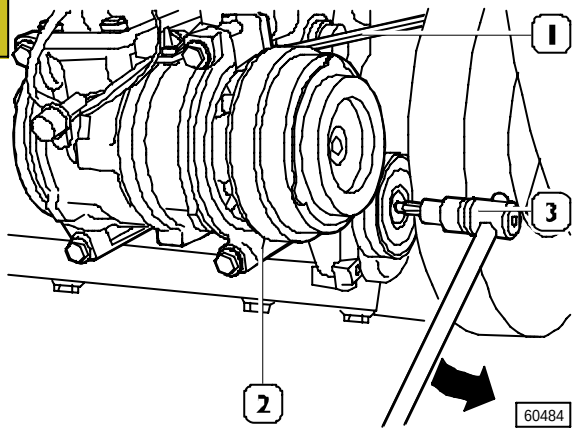

- pipes (3, 4 and 7);
- electrical cables (5);
- sound deadening guard (6);
- pipes (1 and 2).

Figure 30




- compressor (1) complete with oversteering pump (2) and feed pump (3).

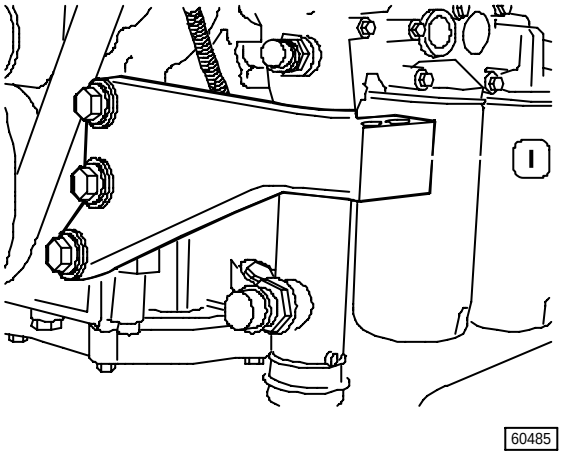
Figure 31




- Using the right tool (3), turn it in the direction shown by the arrow and remove the air-conditioner drive belt (1).
- Remove the air-conditioner (2) together with the engine mounting.

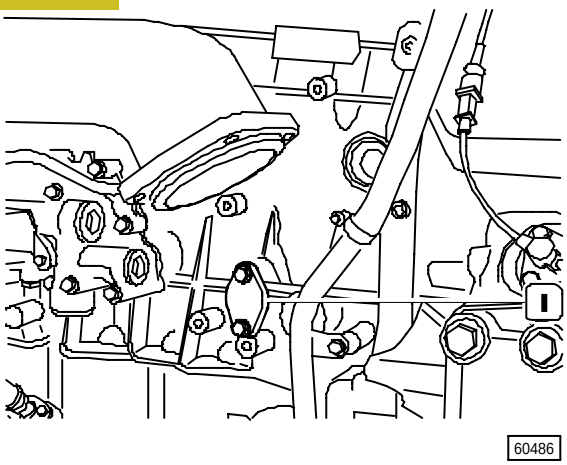
On the left-hand side of the engine

Figure 32




- the engine mounting (1).

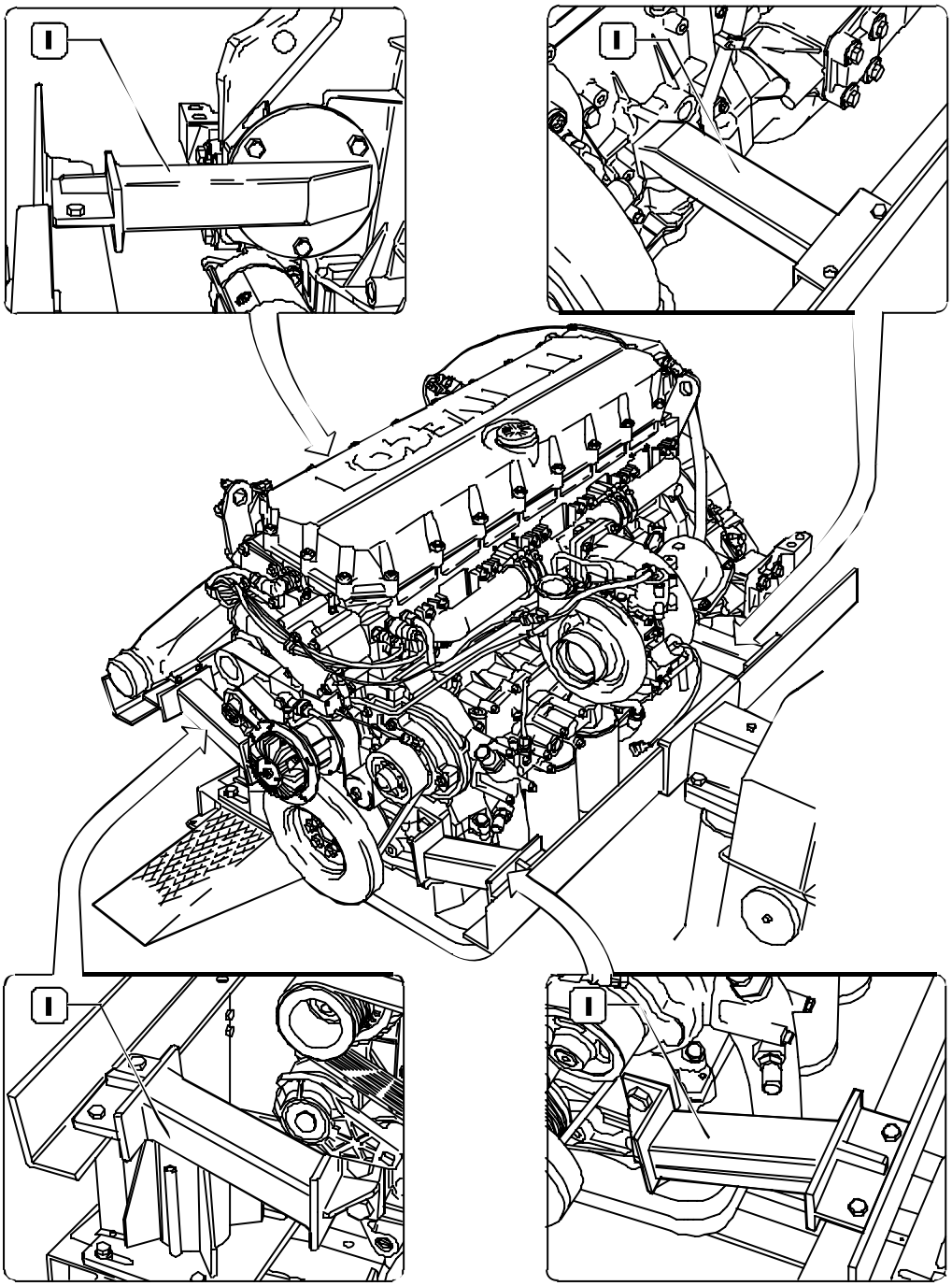
Figure 33




- the oil overpressure valve (1).

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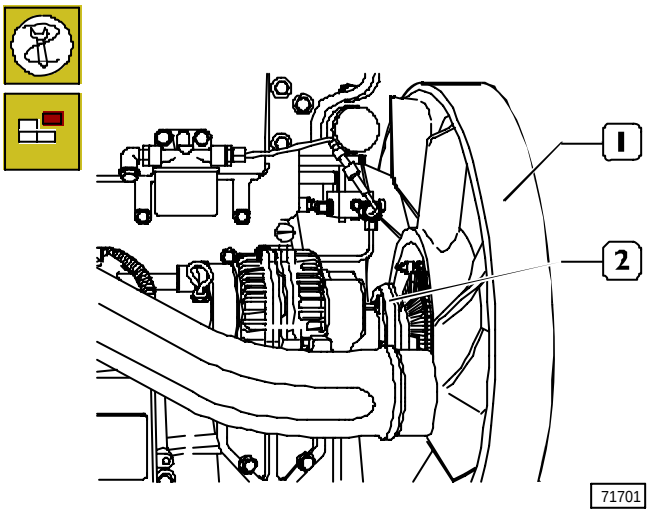
Figure 34




Secure the engine to the rotary stand 99322030 with the brackets 99361036 (1).

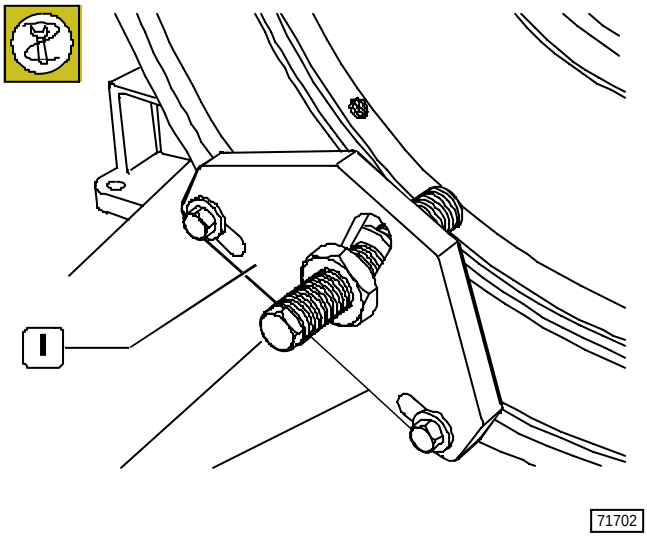
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Figure 35



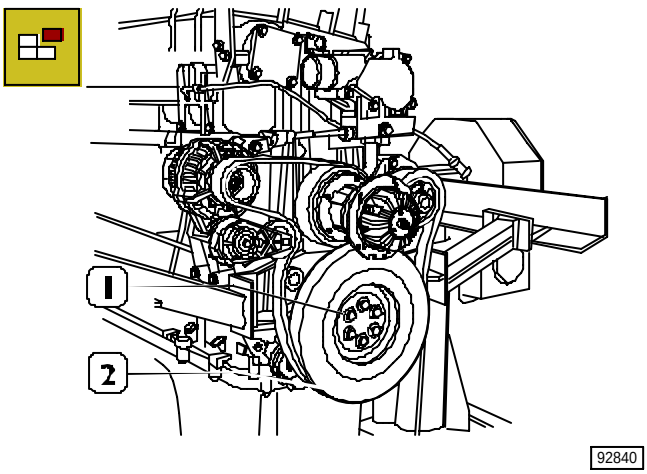

If present, dismount fan (1) from electromagnetic fan drive (2).

Figure 36



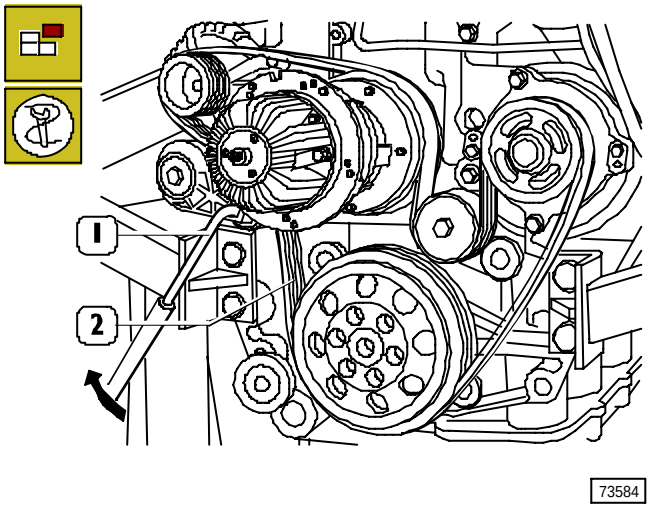

Use tool (1) 99360351 to lock the flywheel.

Figure 37




Operate the 6 Allen screws (1) to remove the damper (2).

Figure 38

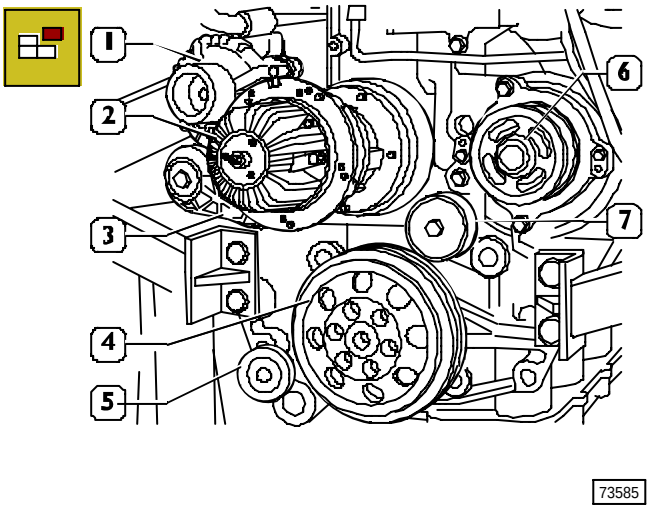



Using an appropriate tool (1), turn it in the direction shown by the arrow and remove the auxiliary member drive belt (2).

If present, dismount compressor for climate control system and relating driving spring belt.

**NOTE** Spring belt must be replaced by a new one after every dismounting operation.

Figure 39

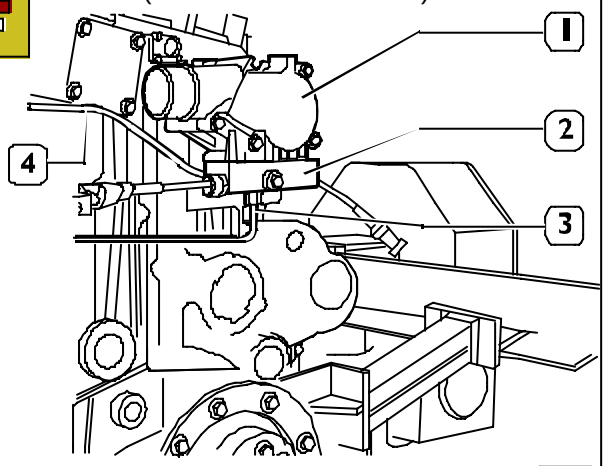



Remove the alternator (1), electric fan drive (2), automatic tensioners (3 and 5), pulley (4), water pump (6) and pulley (7).

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Figure 40

(Version without Intarder)

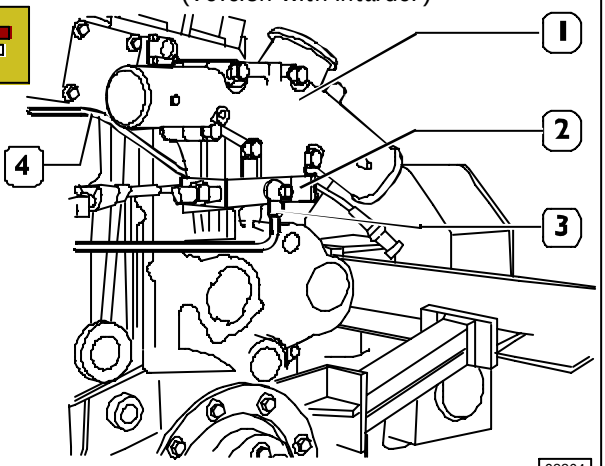



98863

Disconnect the pipes (3 and 4) from the V.G.T control solenoid valves.
Remove the thermostat assembly (1) together with the V.G.T. control solenoid valve (2).

Figure 41

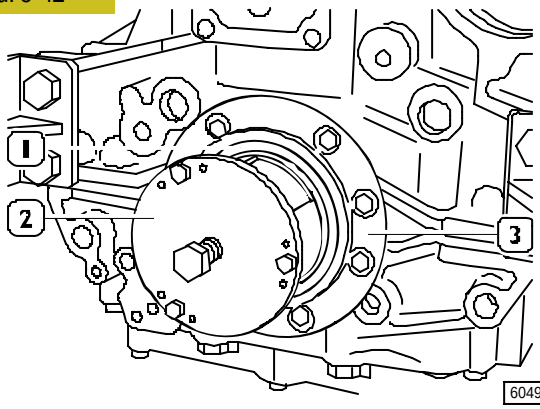
(Version with Intarder)




98864

Disconnect the pipes (3 and 6) from the V.G.T control solenoid valves. Remove the water inlet/outlet pipe assembly (1) together with the V.G.T. control solenoid valve (2).

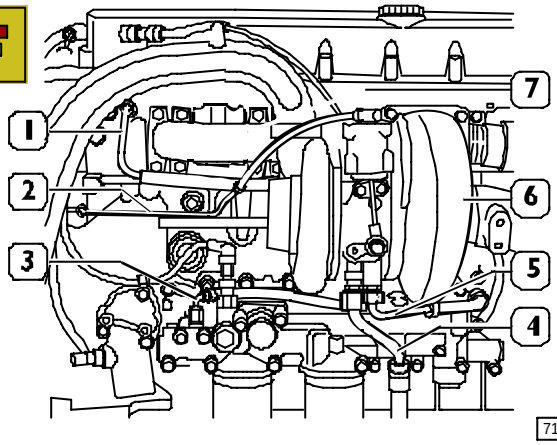
Figure 42




60490

Apply extractor 99340053 (2) and take out the crankshaft seal (1); now remove the flange (3).

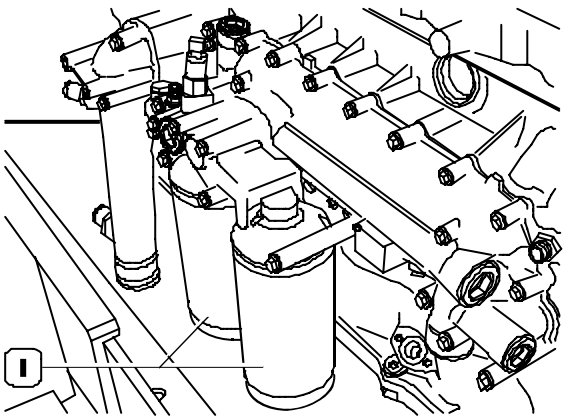
Figure 43




71707

Remove the following components: water delivery pipe (5); water outlet pipe (1); actuator control air pipe (2); oil delivery pipes (3); oil return pipes (4); turbo-compressor unit (6); exhaust manifold (7).

Figure 44

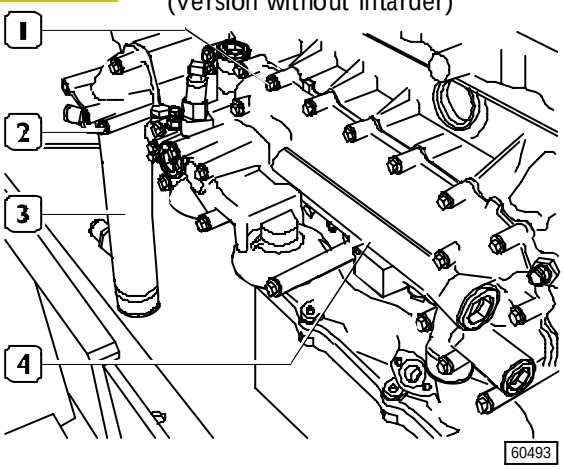



60492

Use tool 99360314 to slacken the oil filters (1).

Figure 45

(Version without Intarder)

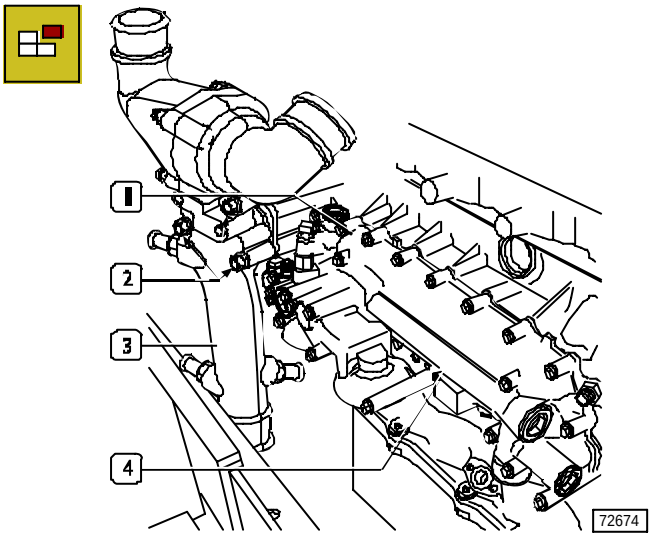



60493

- Slacken the screws (1) and remove the intercooler (4);
- Slacken the screws (2) and remove the water pipe (3).

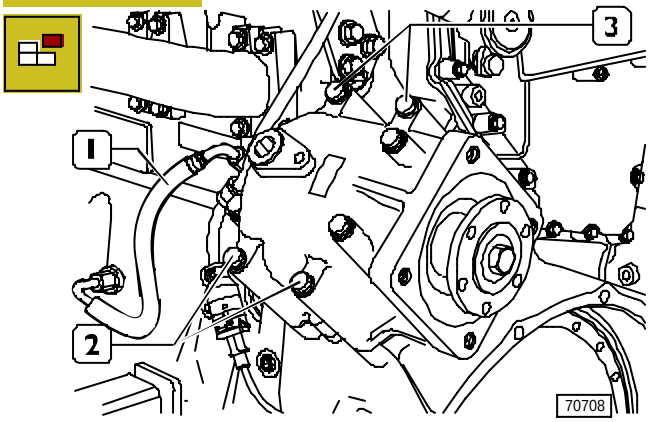
Aquila Trucks Centres

Figure 46 (Version with Intarder)



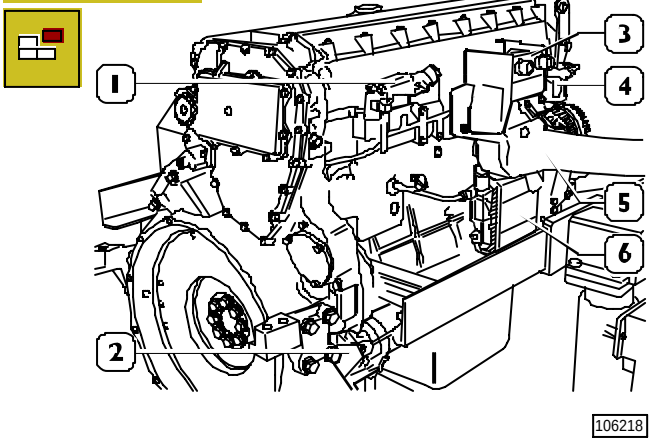

- Slacken the screws (1) and remove the intercooler (4);
- Slacken the screws (2) and remove the thermostat (3).

Figure 47



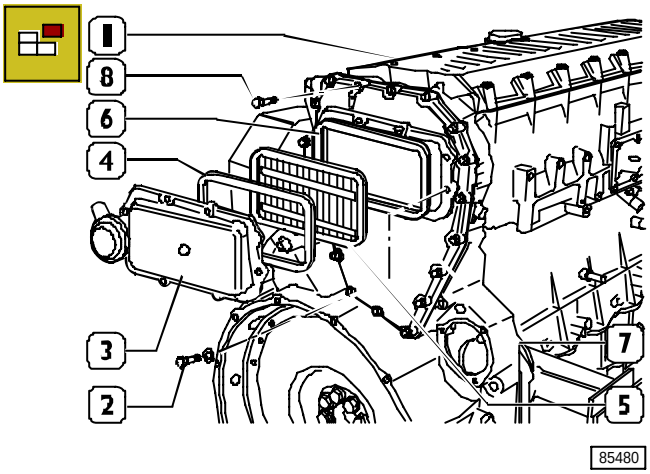

The remove the P.T.O. (if fitted):
- disconnect the oil pipe (1);
- slacken the 4 screws (2) and (3).

Figure 48



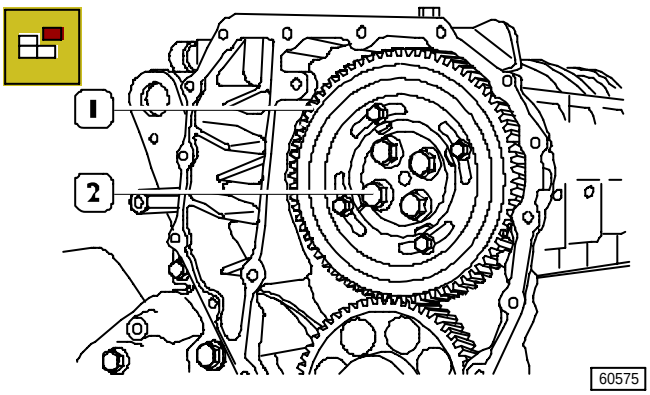

Dismount following parts: fuel filter support (1); relating pipes; starter (2); support for engine startup pushbuttons (3); air filter for PWM valve (4); intake manifold (5) complete with resistance for engine preheating; engine central unit (6);

Figure 49



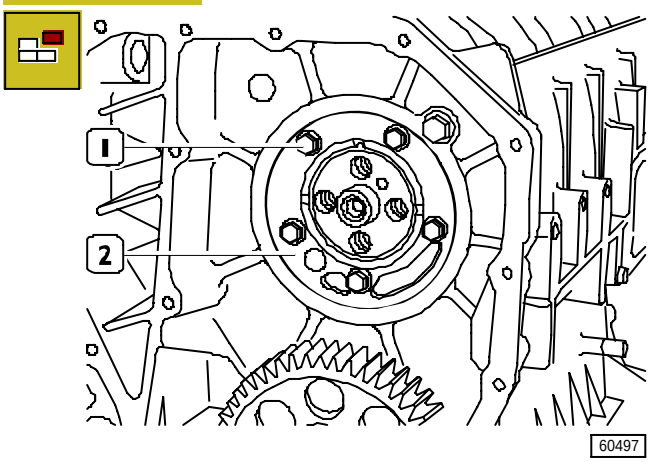

Remove the rocker arm cover (1), take off the screws (2) and extract the cover (3), the filter (5) and the gaskets (4 and 6). Remove the screws (8) and the blow-by case (7).

Figure 50




- Slacken the screws (2) and remove the gear (1) together with the phonic wheel.

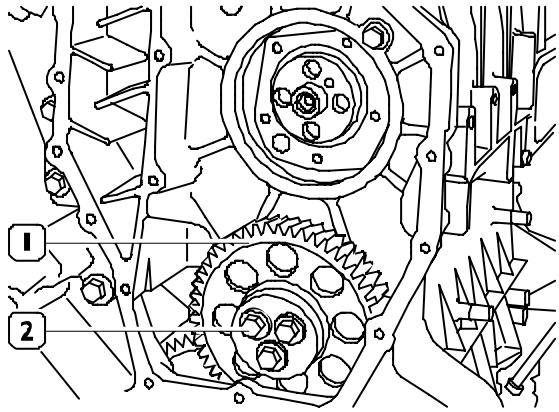
Figure 51




- Slacken the screws (1); drive one of them in a torque hole in order to remove the shoulder plate (2) and extract the metal sheet gasket.

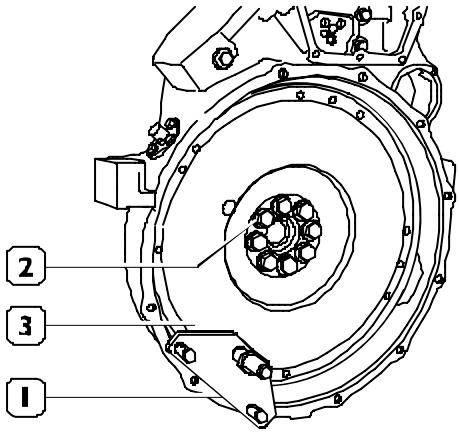
Aquila Trucks Centres

Figure 52



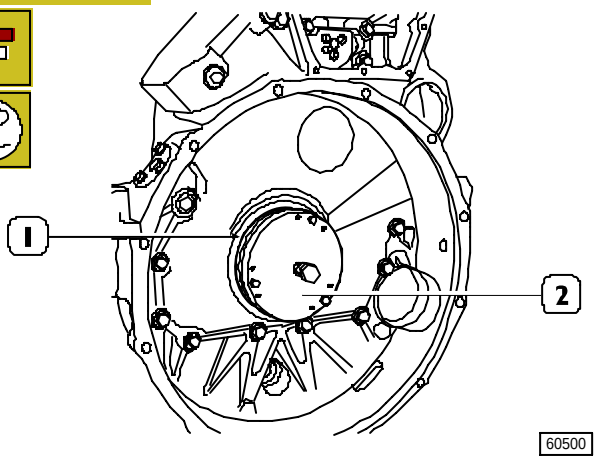

Unscrew the screws (2) and remove the idle gear (1).

Figure 53



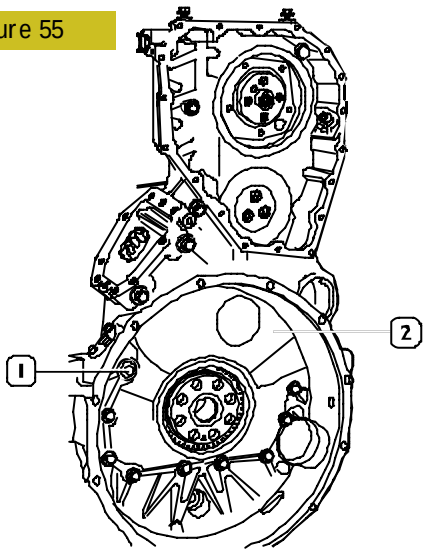

With the flywheel locking tool 99360351 (1) fitted, unscrew the fixing screws (2). Take off the tool (1) and extract the flywheel (3).

Figure 54



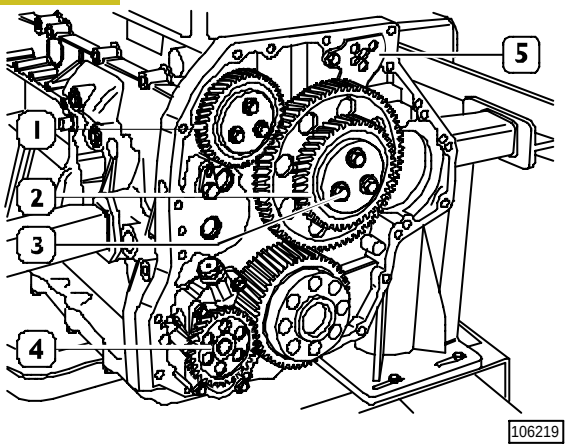

Fit on the extractor 99340054 (2) and extract the gasket (1).

Figure 55



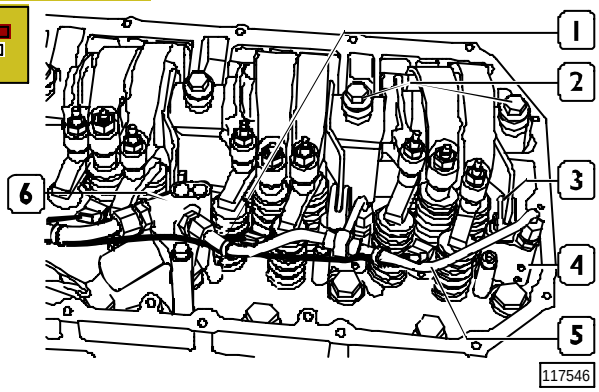

Unscrew the screws (1) and remove the gear housing (2).

Figure 56




If present, dismount P.T.O. driving gear (1).
Remove screws (3) and dismount double gear (2).
Remove securing screw and dismount articulated rod (5).
Dismount oil pump (4).

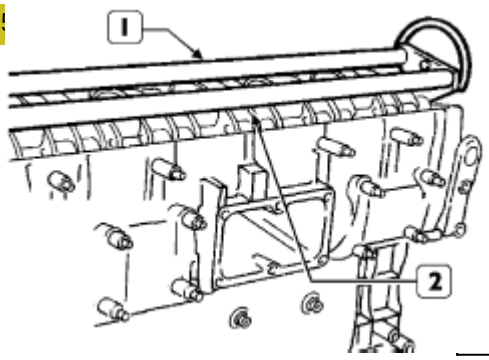
Figure 57




- Release the check springs (3) of the exhaust brake lever.
- Disconnect the electrical connections (1) from the injector.
- Remove exhaust brake pins (4) and slave cylinder (6) pipes (5).
- Remove the head injector wiring.
  The wiring has to be extracted from the front.

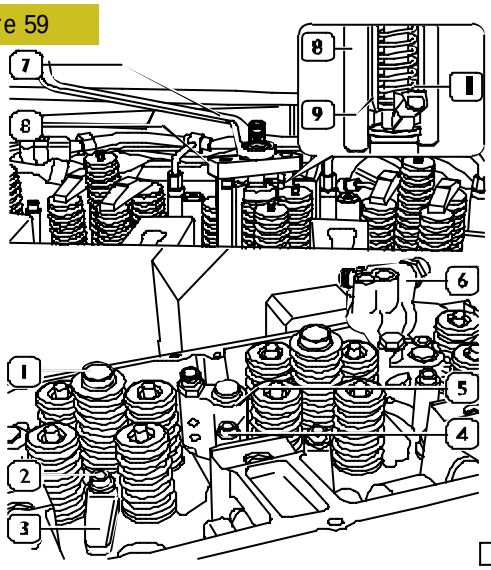
Aquila Trucks Centres

Figure 5



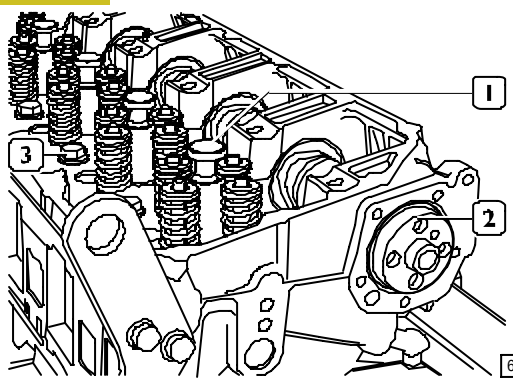

Apply tool 99360553 (1) to the rocker shaft (2) and remove the shaft (2) from the cylinder head.

Figure 59




- Unscrew the screws (2) fixing the brackets (3);
- hook tool 99342155 part (9) to pump injector (1);
- mount part (8) on part (9) resting part on cylinder head;
- screw nut (7) and extract pump injector (1) from cylinder head.
- unscrew the screws (4) and remove the exhaust brake pins (5).
- unscrew the screws and remove the slave cylinder (6).

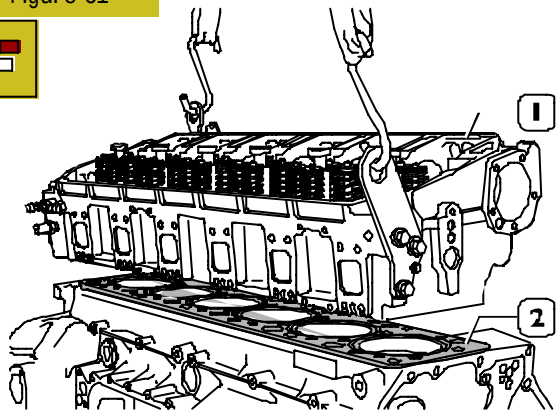
Figure 60




- Insert the plugs 99360180 (1) in place of the injectors.
- Extract the camshaft (2).
- Unscrew the screws fixing the cylinder head (3).

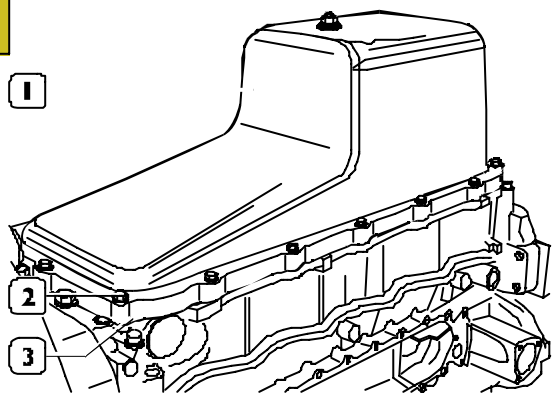
**NOTE** The cylinder head mount screws must be replaced at each removal operation.

Figure 61



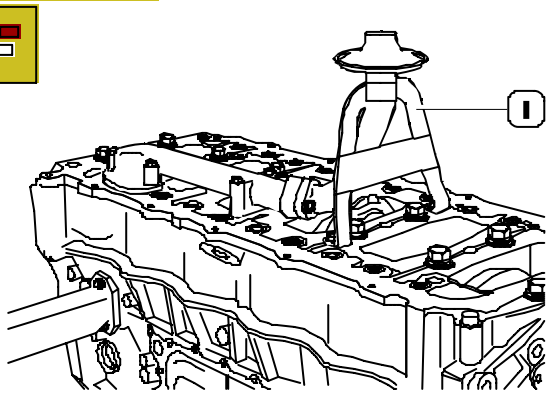

- Using metal ropes, lift the cylinder head (1).
- Take off the gasket (2).

Figure 62




Unscrew the screws (2) and take out the engine oil sump (1) together with the frame (3) and gasket.

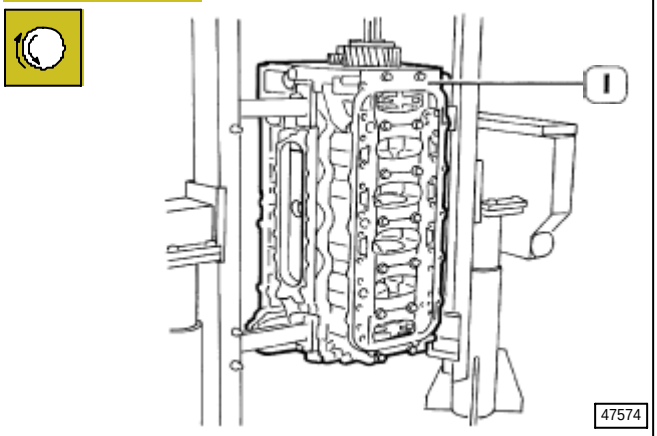
Figure 63




Unscrew the screws and take out the suction strainer (1).

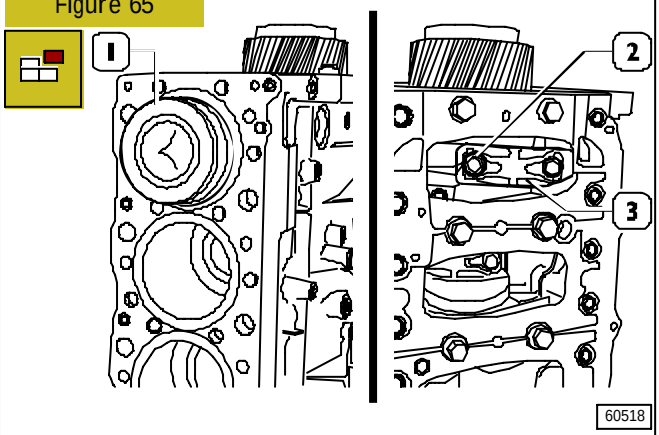
Aquila Trucks Centres

Figure 64




Turn the crankcase (1) upright.

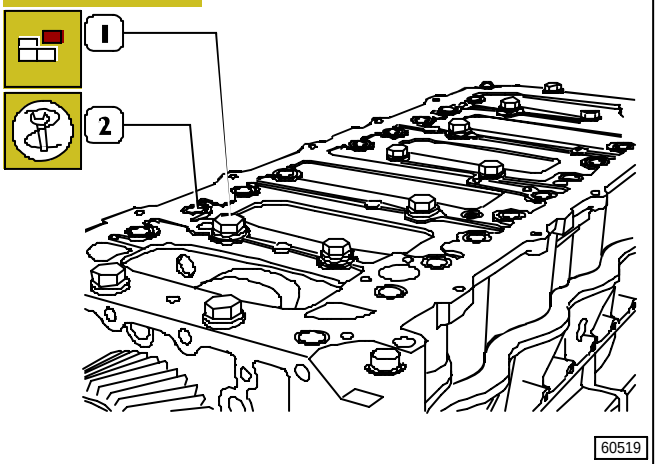
Figure 65




Untighten screws (2) fixing the connecting rod cap (3) and remove it. Remove the connecting rod-piston (1) assembly from the upper side. Repeat these operations for the other pistons.

**NOTE** Keep the big end bearing shells in their respective housings and/or note down their assembly position since, if reusing them, they will need to be fitted in the position found upon removal.

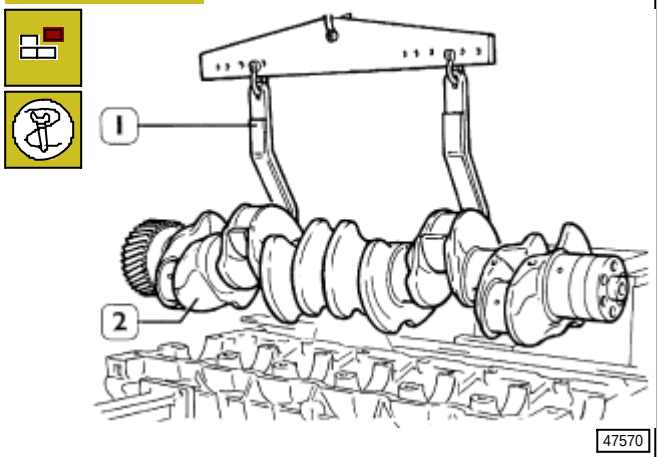
Figure 66




Using an appropriate wrench and the hex wrench unscrew the screws (1) and (2) and take off the crankcase base.

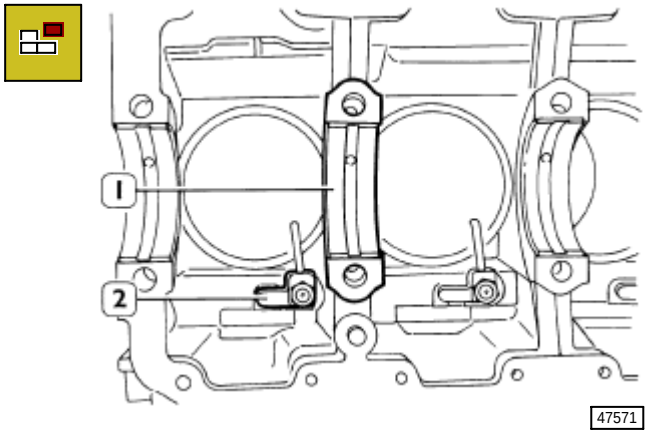
**NOTE** Note down the assembly position of the top and bottom main bearing shells since, if reusing them, they will need to be fitted in the position found upon removal.

Figure 67




Using tool 99360500 (1), remove the crankshaft (2).

Figure 68




Extract the main bearing shells (1), unscrew the screws and take out the oil nozzles (2).
Remove the cylinder liners as described under the relevant heading on page 179.

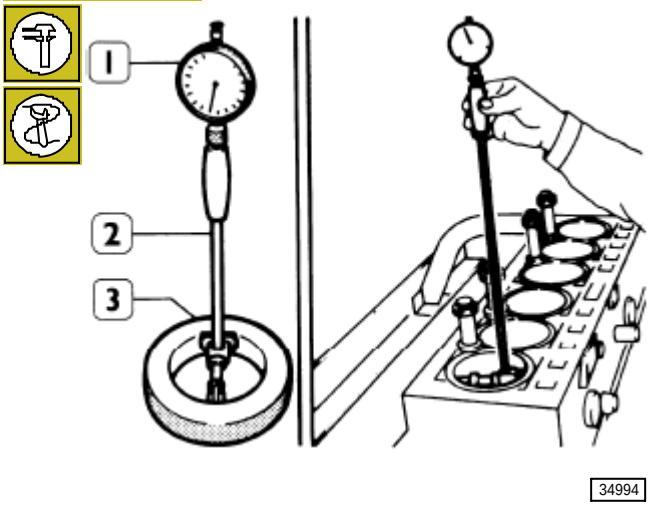
**NOTE** After removing the engine, you need to clean the removed parts thoroughly and check their integrity. The following pages give the instructions for making the checks and the main measurements to make to determine whether the parts can be reused.

Aquila Trucks Centres

## REPAIRS

### 540410 CYLINDER BLOCK
### 540420 Checks and measurements

Figure 69 (Demonstration)

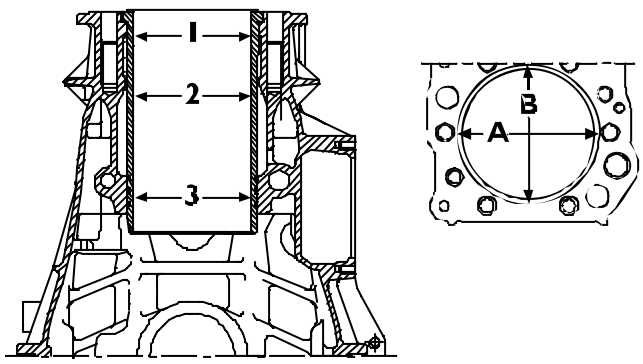



34994

The inside diameter of the cylinder liners is checked to ascertain the extent of ovalization, taper and wear using the gauge 99395687 (2) fitted with the dial gauge (1), zeroed beforehand on the ring gauge (3) of diameter 135 mm.

**NOTE** If you do not have a ring gauge of diameter 135 mm, use a micrometer for this purpose.

Figure 70

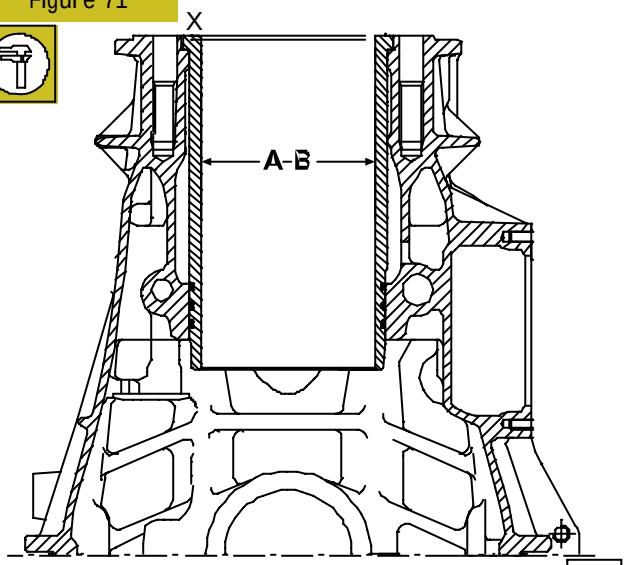



60596

1 = 1st measurement
2 = 2nd measurement
3 = 3rd measurement

The measurements have to be made on each single cylinder liner at three different heights and on two levels (A-B) at right angles to each other as shown in figure.

Figure 71



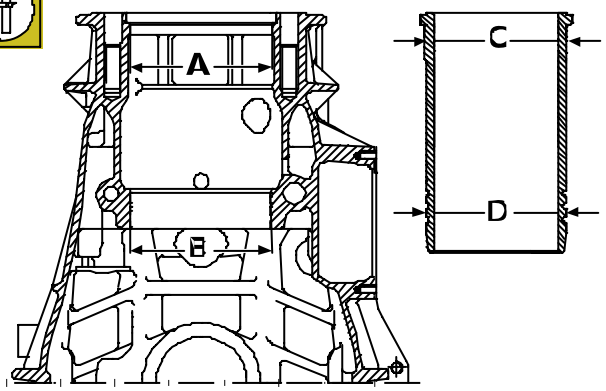

60595

A = Selection class Ø 135.000 to 135.013 mm
B = Selection class Ø 135.011 to 135.024 mm
X = Selection class marking area

On finding maximum wear greater than 0.150 mm or maximum ovalization of 0.100 mm compared to the values shown in the figure, you need to replace the cylinder liner as no grinding, facing or reconditioning is permitted.

**NOTE** The cylinder liners are supplied as spare parts with selection class "A".

Figure 72




60597

A = Ø 153.500 to 153.525 mm
B = Ø 152.000 to 152.025 mm
C = Ø 153.461 to 153.486 mm
D = Ø 151.890 to 151.915 mm

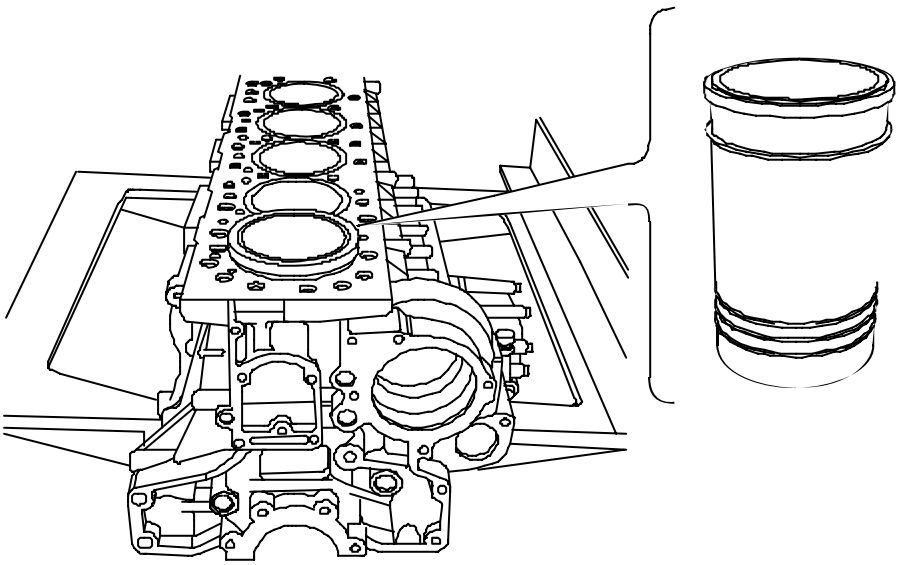
The diagram shown in the figure gives the outside diameter of the cylinder liner and inside diameter of its seat.

The cylinder liners can, if necessary, be extracted and fitted several times in different seats.

Aquila Trucks Centres

## Cylinder liners

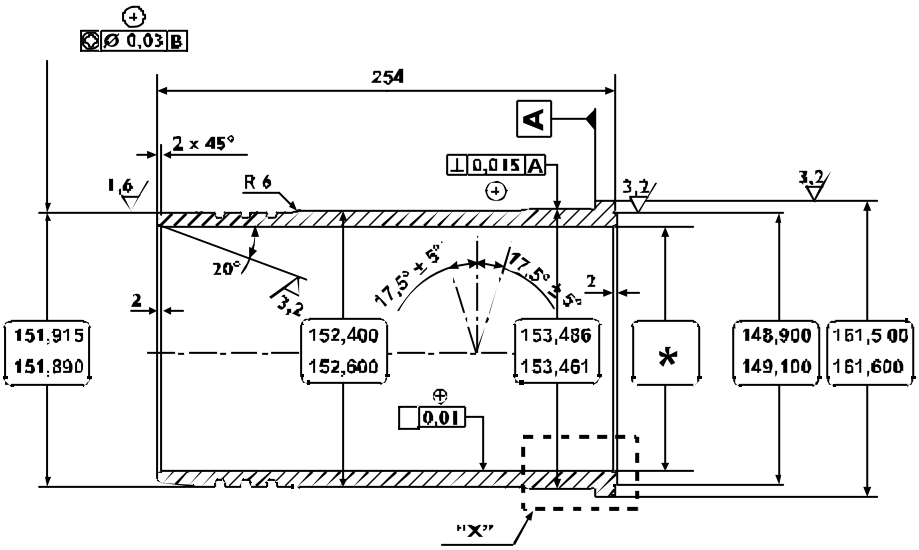
Figure 73



60598

CRANKCASE ASSEMBLY WITH CYLINDER LINERS

Figure 74

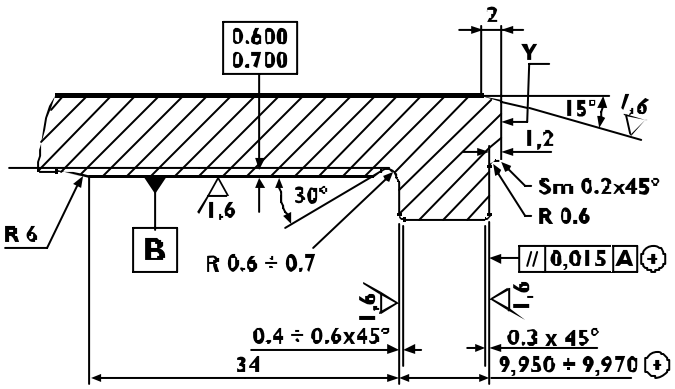



108832

* Selection class { A mm 135.000 to 135.013
B mm 135.011 to 135.024

MAIN CYLINDER LINER DATA

Figure 75




108833

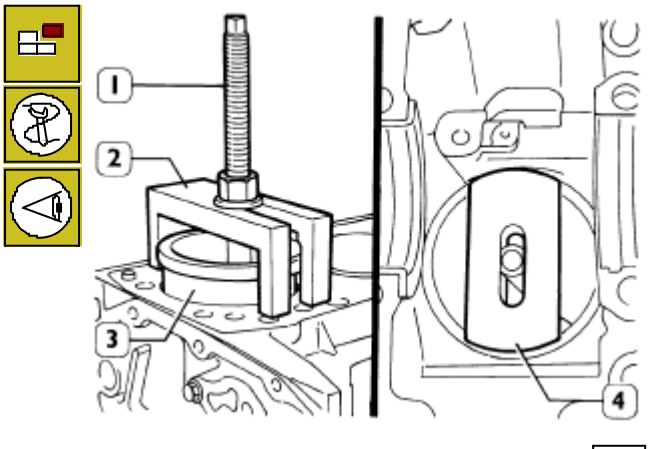
DETAIL "X"
"Y" - Selection class marking area

Aquila Trucks Centres

## 540420 Replacing the cylinder liners

Removal

Figure 76

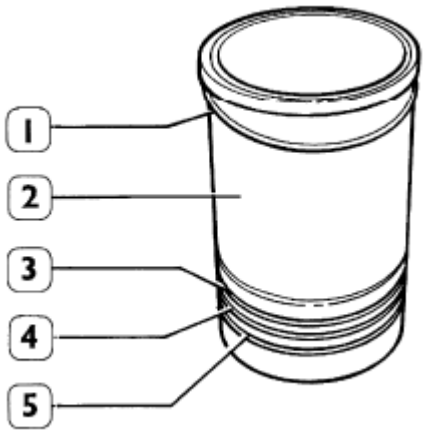



47577

Position the parts 99360706 (2) and the plate 99360728 (4) as shown in the figure, checking that the plate (4) rests on the cylinder liner correctly.
Screw down the nut of screw (1) and extract the cylinder liner (3) from the crankcase.

Assembly and checking protrusion

Figure 77

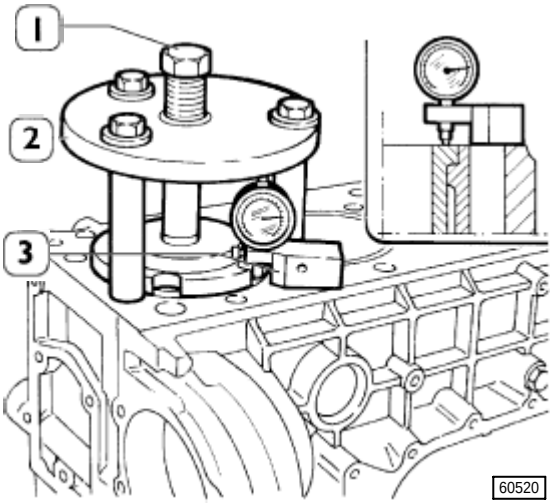



16798

Always replace the water seals (3, 4 and 5).
Fit the adjustment ring (1) on the cylinder liner (2). Lubricate the bottom of it and mount it in the cylinder assembly using the appropriate tool.

**NOTE** The adjustment ring (1) is supplied as a spare part with the following thicknesses: 0.08 mm - 0.10 mm - 0.12 mm - 0.14 mm.

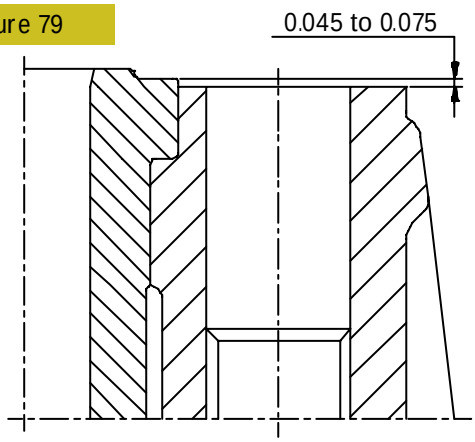
Figure 78




60520

Check the protrusion of the cylinder liners with tool 99360334 (2) and tightening the screw (1) to a torque of 225 Nm.
Using the dial gauge 99395603 supplied as standard with the dial gauge base 99370415 (3), check that the protrusion of the cylinder liner over the supporting face of the cylinder head is 0.045 - 0.075 mm (Figure 79); if this is not so, replace the adjustment ring (1, Figure 77), supplied as a spare part with several thicknesses.

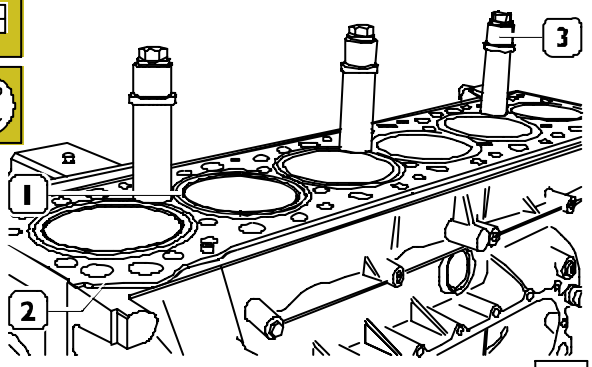
Figure 79




49017

CYLINDER LINER PROTRUSION

Figure 80




60521

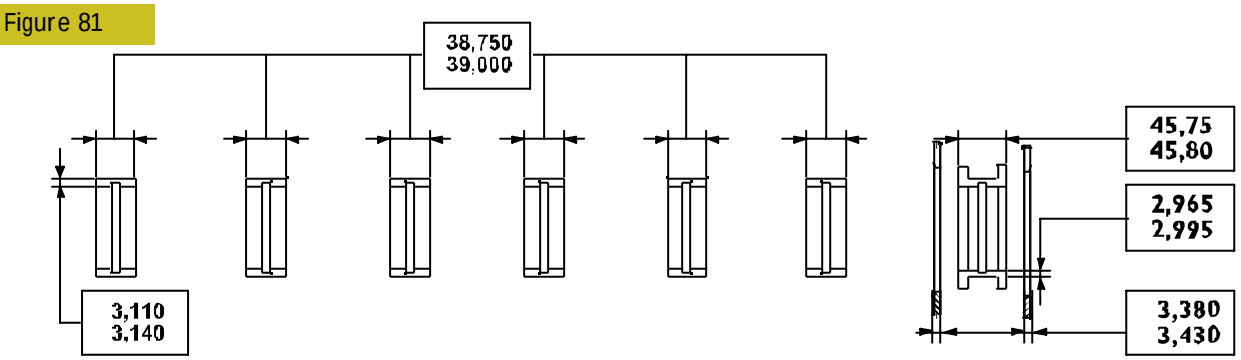
On completing assembly, lock the cylinder liners (1) to the crankcase (2) with the pins 99360703 (3).

https://truckmanualshub.com/

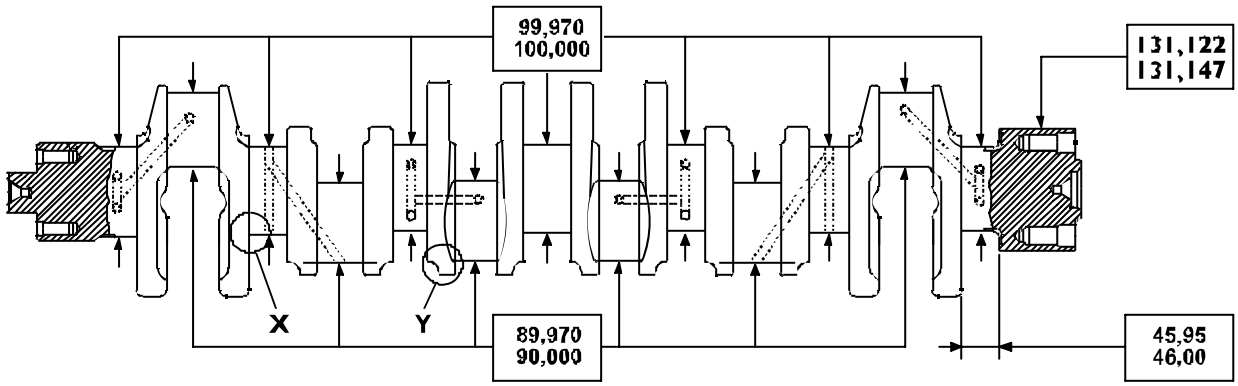

Aquila Trucks Centres

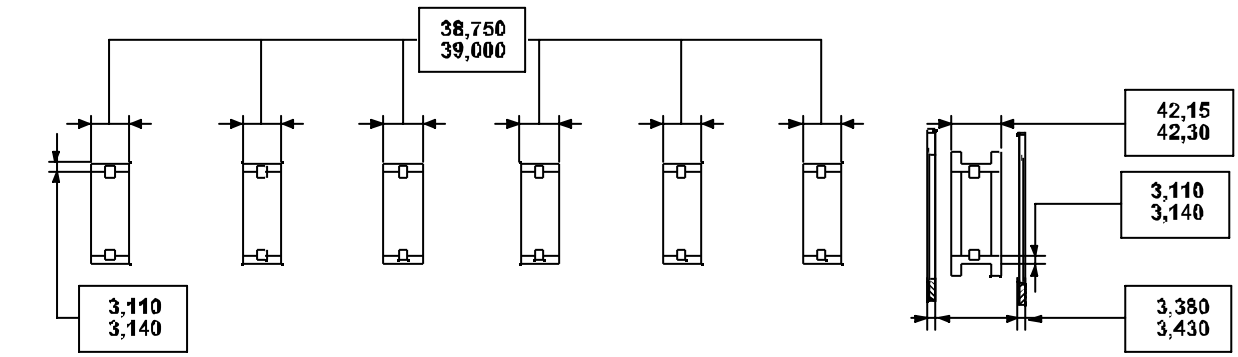
## 5408 Crankshaft

Figure 81




Top main bearing shells



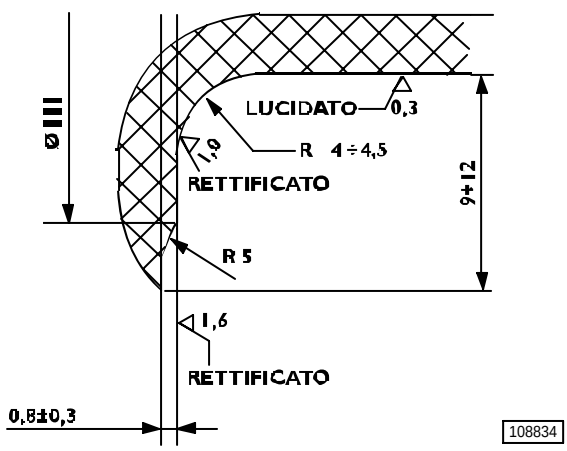

Bottom main bearing shells

117547

MAIN DATA OF CRANKSHAFT AND MAIN BEARING SHELLS

Check the state of the main journals and crankpins of the crankshaft. They must not be scored or be too ovalized or worn. The data given refer to the normal diameter of the journals.

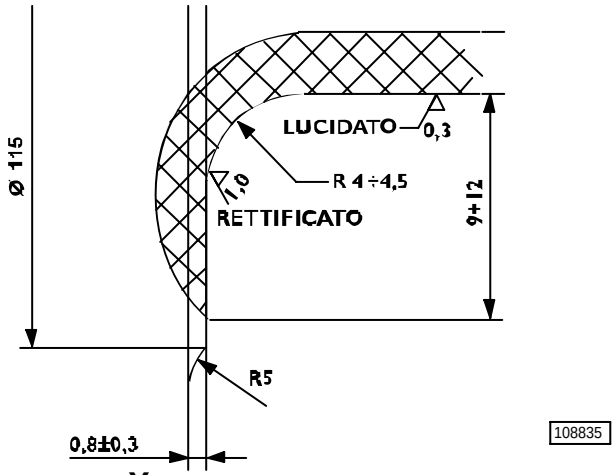
Figure 82




108834

**X.** Detail of the main journal unions

Figure 83




108835

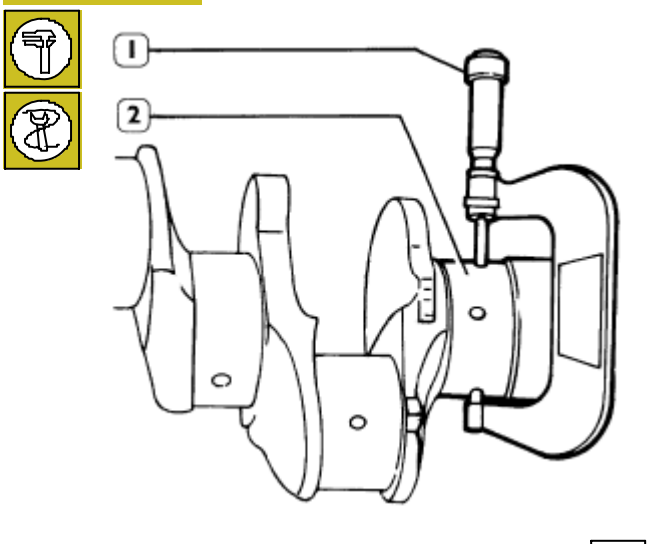
**Y.** Detail of the crankpin unions

Aquila Trucks Centres

## 540812 Measuring the main journals and crankpins

Before grinding the journals, use a micrometric gauge (1) to measure the journals of the shaft (2) and establish, on the basis of the undersizing of the spare bearing shells, to what diameter it is necessary to reduce the journals.

Figure 84

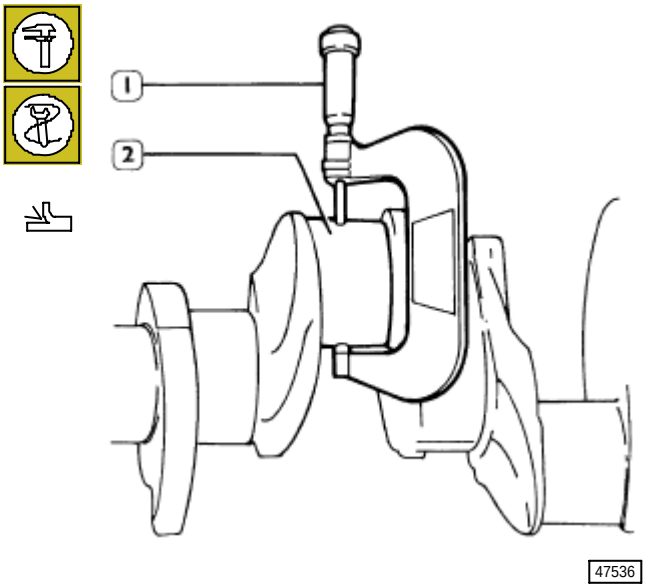



47535

MEASURING THE MAIN JOURNALS

**NOTE** It is advisable to note the measurements in a table (Figure 85).

Figure 86




47536

MEASURING THE CRANKPINS

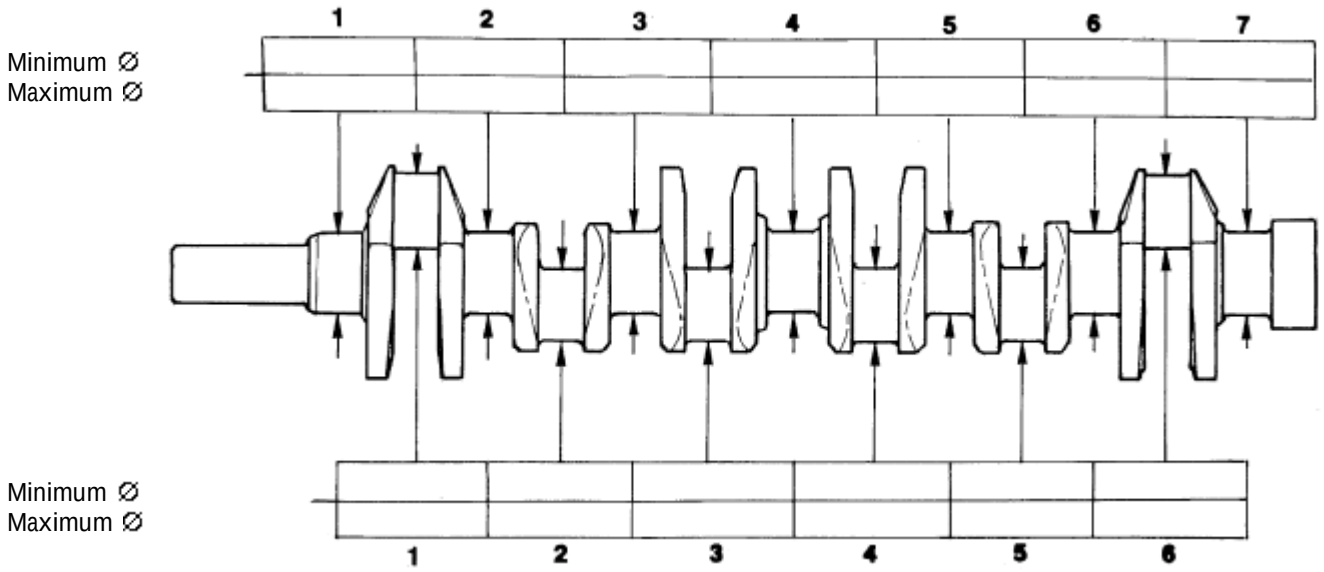
When grinding, pay the utmost attention to the values of the unions of the main journals and of the crankpins given in Figure 82 and Figure 83.

**NOTE** All the main journals and crankpins should always be ground to the same undersizing class so as not to alter the balance of the shaft.

Figure 85

Table for noting down the measurements of the main journals and crankpins of the crankshaft.

MAIN JOURNALS




CRANKPINS

36061

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## Preliminary measurement of data to select main bearing and big end bearing shells

For each of the journals of the crankshaft, it is necessary to carry out the following operations:

MAIN JOURNALS:

- Determine the class of diameter of the seat in the crankcase.
- Determine the class of diameter of the main journal.
- Select the class of the bearing shells to mount.

CRANKPINS:

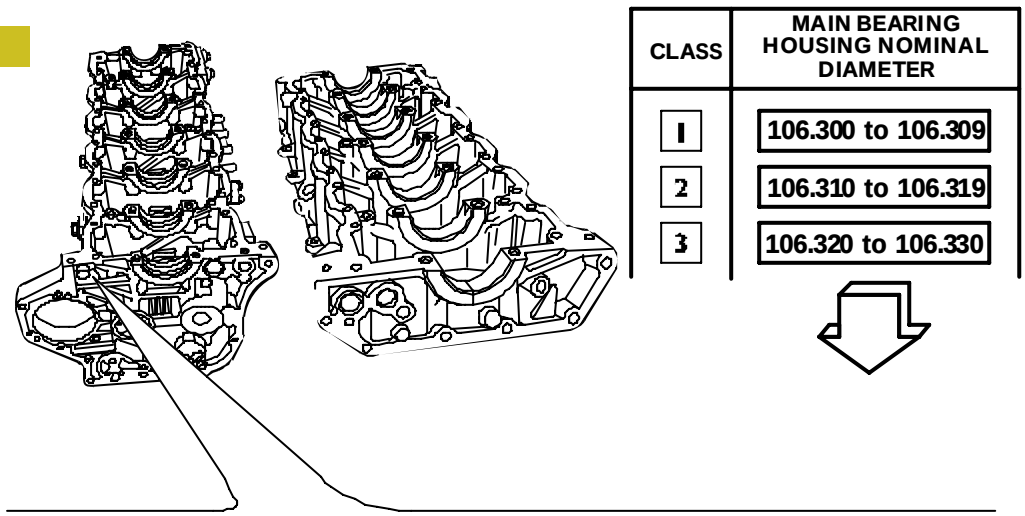
- Determine the class of diameter of the seat in the connecting rod.
- Determine the class of diameter of the crankpin.
- Select the class of the bearing shells to mount.

DEFINING THE CLASS OF DIAMETER OF THE SEATS FOR BEARING SHELLS ON THE CRANKCASE

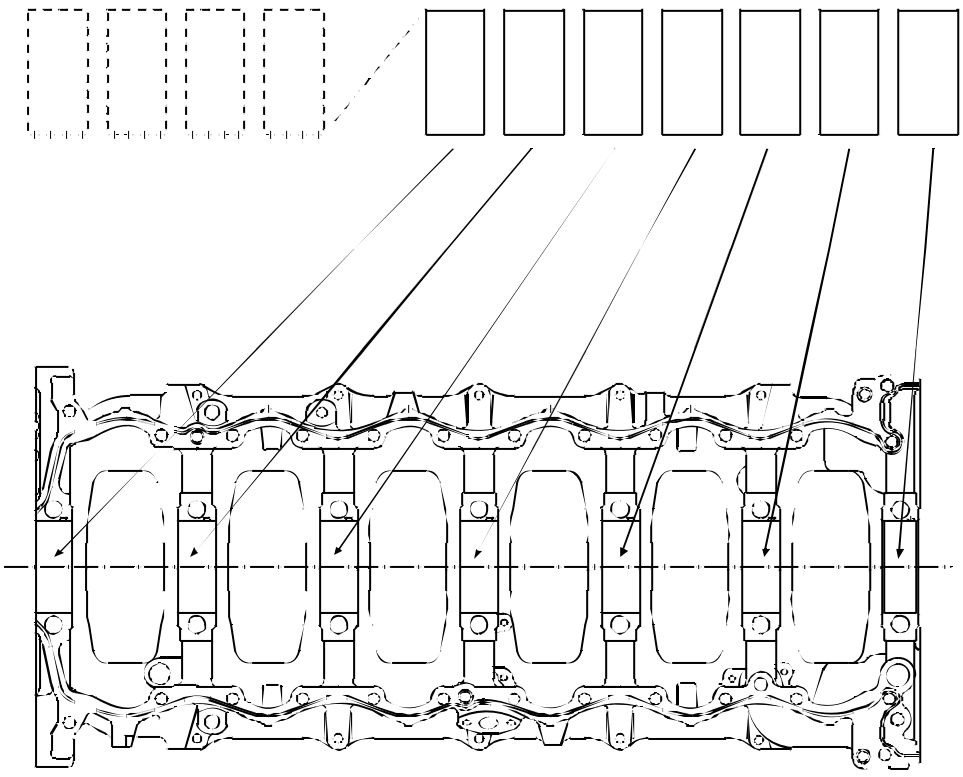
On the front of the crankcase two sets of numbers are marked in the position shown.

- The first set of digits (four) is the coupling number of the crankcase with its base.
- The second set of digits (seven) is the class of diameter of each of the seats referred to.
- Each of these digits may be **1**, **2** or **3**.

Figure 87



| CLASS | MAIN BEARING HOUSING NOMINAL DIAMETER |
|---|---|
| 1 | 106.300 to 106.309 |
| 2 | 106.310 to 106.319 |
| 3 | 106.320 to 106.330 |



47535

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## Selecting the main bearing and big end bearing shells

**NOTE** To obtain the required assembly clearances, the main bearing and big end bearing shells have to be selected as described hereunder.

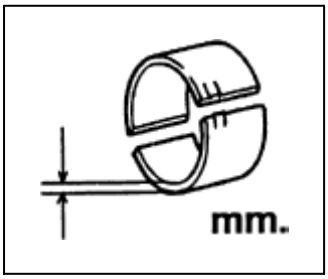
This operation makes it possible to identify the most suited bearing shells for each of the journals of the shaft (the bearing shells may even have different classes for different pins).

Depending on the thickness, the bearing shells are selected in classes of tolerance marked by a colour (red-green - red/black - green/black).

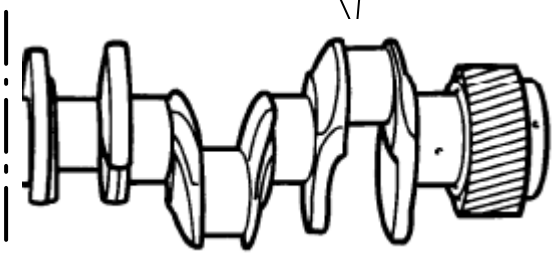
Figure 88 gives the specifications of the main bearing and big end bearing shells available as spare parts in the standard sizes (STD) and in the permissible oversizes (+0.127, +0.254, +0.508).

Figure 88

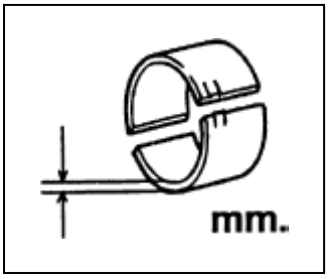
Big end bearing shells




| | STD | +0.127 | +0.254 | +0.508 |
|---|---|---|---|---|
| red | 1.965 to 1.975 | | 2.092 to 2.102 | 2.219 to 2.229 |
| red/black | | 2.028 to 2.038 | | |
| green | 1.976 to 1.985 | | 2.103 to 2.112 | 2.230 to 2.239 |
| green/black | | 2.039 to 2.048 | | |



Main bearing shells




| | STD | +0.127 | +0.254 | +0.508 |
|---|---|---|---|---|
| red | 3.110 to 3.120 | | 3.237 to 3.247 | 3.364 to 3.374 |
| red/black | | 3.173 to 3.183 | | |
| green | 3.121 to 3.130 | | | |
| green/black | | 3.184 to 3.193 | | |

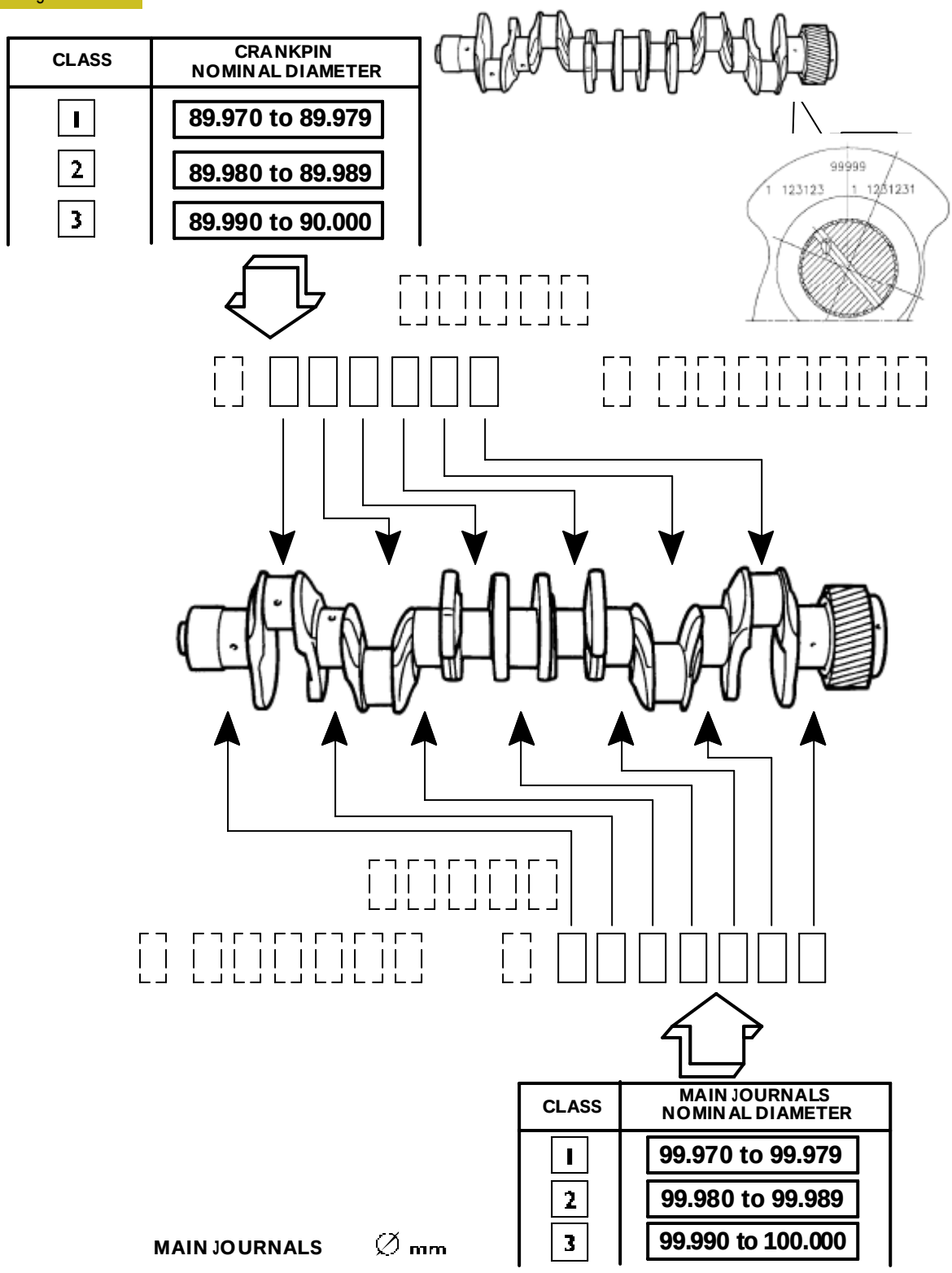
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DEFINING THE CLASS OF DIAMETER OF THE MAIN JOURNALS AND CRANKPINS (journals with nominal diameter)

Three sets of numbers are marked on the crankshaft in the position shown by the arrow (Figure 89 at top):

- The first number, of five digits, is the part number of the shaft.
- Under this number, on the left, a set of six digits refers to the crankpins and is preceded by a single digit showing the status of the journals (1 = STD, 2 = -0.127), the other six digits, taken singly, give the class of diameter of each of the crankpins they refer to (Figure 89 at top).
- The set of seven digits, on the right, refers to the main journals and is preceded by a single digit: the single digit shows the status of the journals (1 = STD, 2 = -0.127), the other seven digits, taken singly, give the class of diameter of each of the main journals they refer to (Figure 89 at bottom).

Figure 89



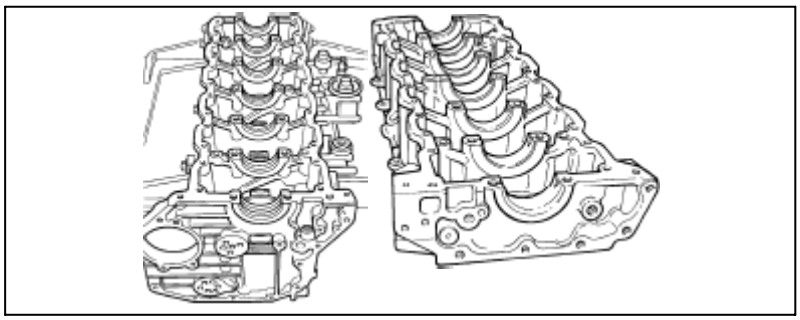
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SELECTING THE MAIN BEARING SHELLS

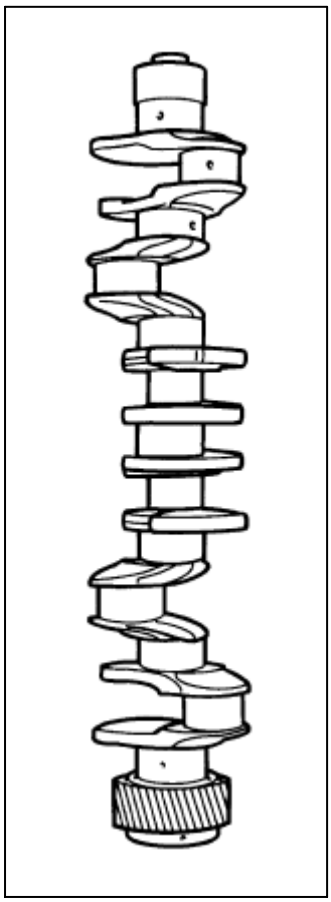
After reading off the data, for each of the main journals, on the crankcase and crankshaft, you choose the type of bearing shells to use according to the following table:

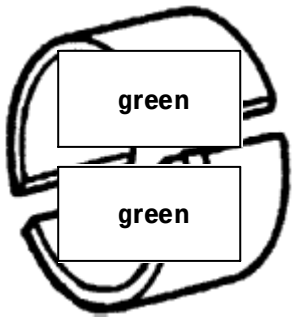
Figure 90

**STD.**



| CLASS | 1 | 2 | 3 |
|---|---|---|---|
| 1 | green<br>green | green<br>green | green<br>green |
| 2 | red<br>red | green<br>green | green<br>green |
| 3 | red<br>red | red<br>red | green<br>green |



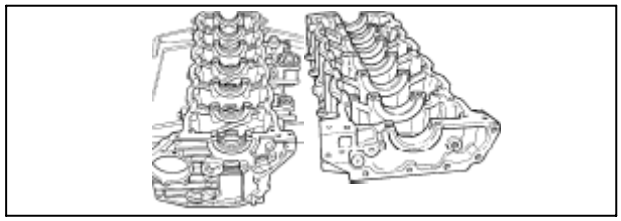


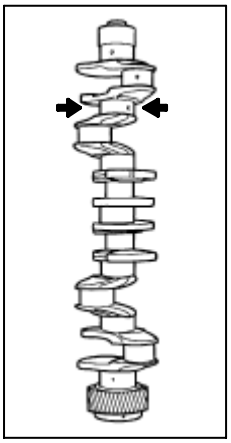
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## SELECTING THE MAIN BEARING SHELLS (GROUND JOURNALS)

If the journals have been ground, the procedure described so far cannot be applied.
In this case, it is necessary to check that the new diameter of the journals is as shown in the table and to mount the only type of bearing shell envisaged for the relevant undersizing.

Figure 91



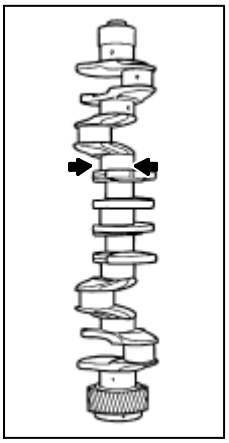


**-0.127**

red/black = mm 3.173 to 3183

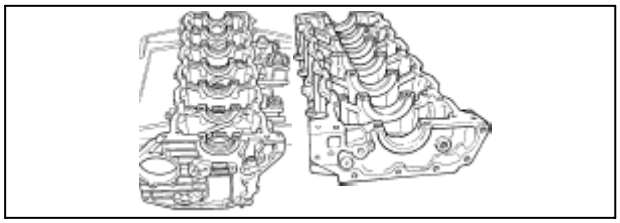
green/black = mm 3.184 to 3.193

| CLASS | | 1 | 2 | 3 |
|---|---|---|---|---|
| 99.843 99.852 | 1 | green/black | green/black | green/black |
| | | green/black | green/black | green/black |
| 99.853 99.862 | 2 | red/black | green/black | green /black |
| | | red/black | green/black | green/black |
| 99.863 99.873 | 3 | red/black | red/black | green/black |
| | | red/black | red/black | green/black |

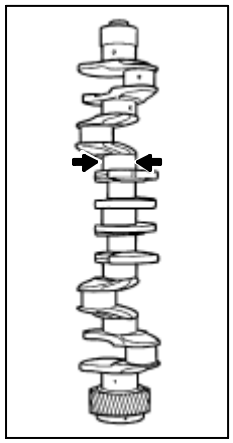


**-0.254**

red = mm 3.237 to 3.247

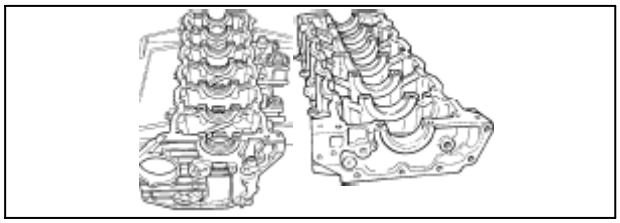


| | 1 | 2 | 3 |
|---|---|---|---|
| 99.726 99.746 | red | red | red |
| | red | red | red |



**-0.508**

red = mm 3.364 to 3.374



| | 1 | 2 | 3 |
|---|---|---|---|
| 99.472 99.492 | red | red | red |
| | red | red | red |

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SELECTING THE BIG END BEARING SHELLS (JOURNALS WITH NOMINAL DIAMETER)

There are three markings on the body of the connecting rod in the position indicated as "A":

1 Letter indicating the class of weight:

A = 4741 to 4780 g.
B = 4781 to 4820 g.
C = 4821 to 4860 g.

2 Number indicating the selection of the diameter of the big end bearing seat:

1 = 94.000 to 94.010 mm
2 = 94.011 to 94.020 mm
3 = 94.021 to 94.030 mm

3 Numbers identifying the cap-connecting rod coupling.

The number, indicating the class of diameter of the bearing shell seat may be **1**, **2** o **3**.

Determine the type of big end bearing to fit on each journal by following the indications in the table (Figure 93).

Figure 92

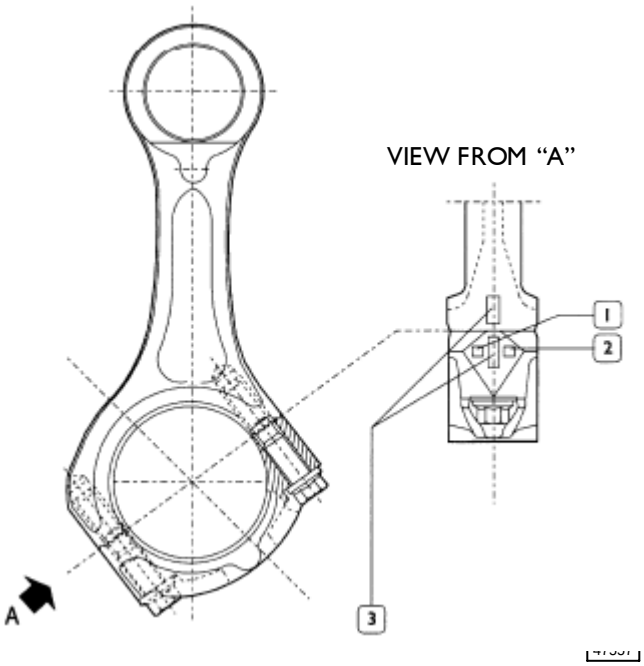
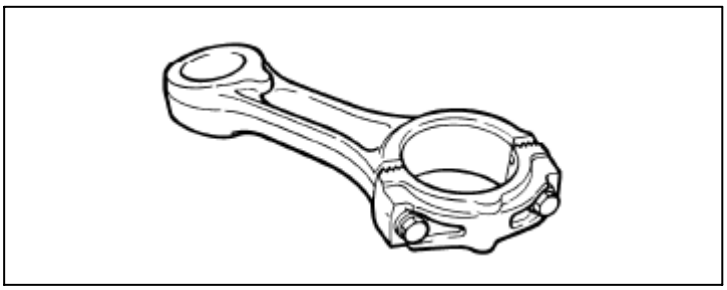
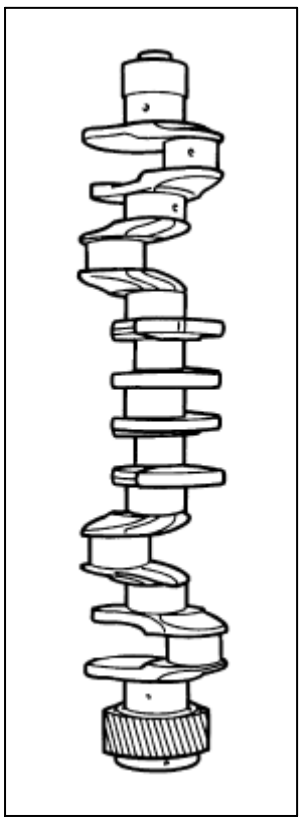



Figure 93

**STD.**





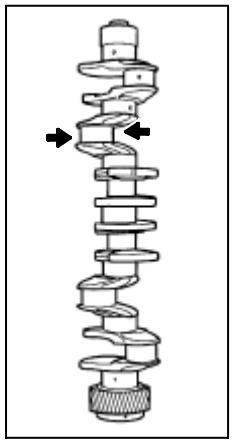
| CLASS | 1 | 2 | 3 |
|---|---|---|---|
| 1 | green | green | green |
| | green | green | green |
| 2 | red | green | green |
| | red | green | green |
| 3 | red | red | green |
| | red | red | green |

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## SELECTING BIG END BEARING SHELLS (GROUND JOURNALS)

If the journals have been ground, the procedure described so far cannot be applied.
In this case, it is necessary to check (for each of the undersizings) which field of tolerance includes the new diameter of the crankpins and to mount the bearing shells identified with the relevant table.

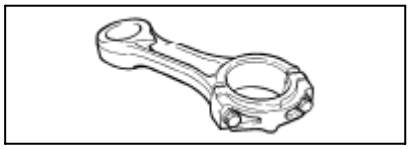
Figure 94



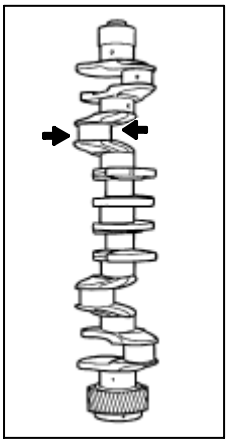
### -0.127

red/black = mm 2.028 to 2.038

green/black = mm 2.039 to 2.048

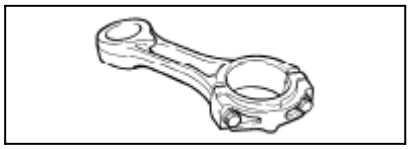


| CLASS | | 1 | 2 | 3 |
|---|---|---|---|---|
| 89.843 | 1 | green/black | green/black | green/black |
| 89.852 | | green/black | green/black | green/black |
| 89.853 | 2 | red/black | green/black | green /black |
| 89.862 | | red/black | green/black | green/black |
| 89.863 | 3 | red/black | red/black | green/black |
| 89.873 | | red/black | red/black | green/black |

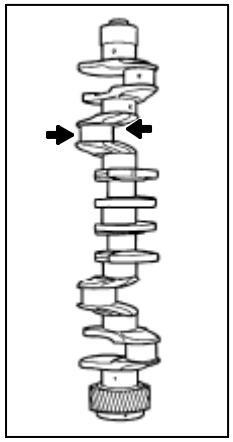


### -0.254

red = mm 2.092 to 2.102
green = mm 2.103 to 2.112

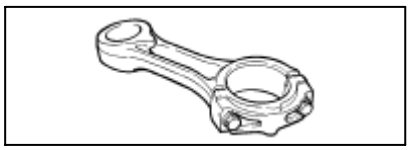


| | 1 | 2 | 3 |
|---|---|---|---|
| 89.726 | red | green | green |
| 89.735 | red | green | green |
| 89.736 | red | red | green |
| 89.746 | red | red | green |



### -0.508

red = mm 2.219 to 2.229
green = mm 2.230 to 2.239



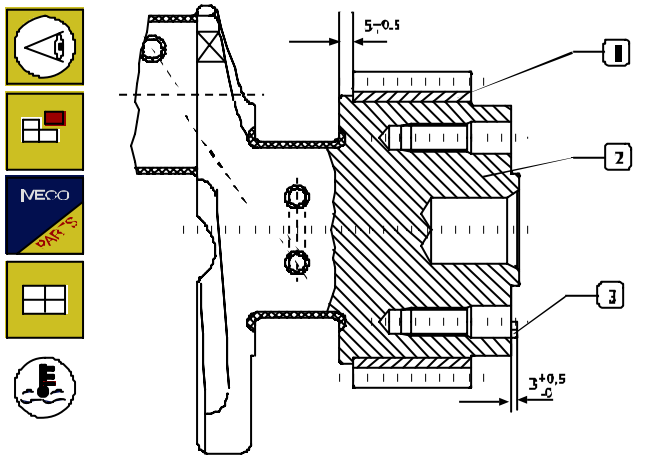
| | 1 | 2 | 3 |
|---|---|---|---|
| 89.472 | red | green | green |
| 89.481 | red | green | green |
| 89.482 | red | red | green |
| 89.492 | red | red | green |

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## 540815 Replacing the timing gear and oil pump drive

Check that the toothing of the gear is neither damaged nor worn; if it is, take it out with an appropriate extractor and replace it.

Figure 95



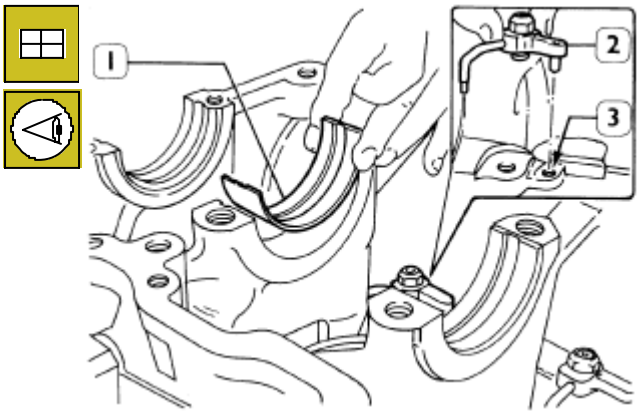

108836

When fitting the gear (1) on the crankshaft (2), heat it for no longer than 2 hours in an oven at a temperature of 180°C. After driving it in, leave it to cool.

If changing the pin (3), after fitting it on, check it protrudes from the crankshaft as shown in the figure.

## 540811 Checking main journal assembly clearance

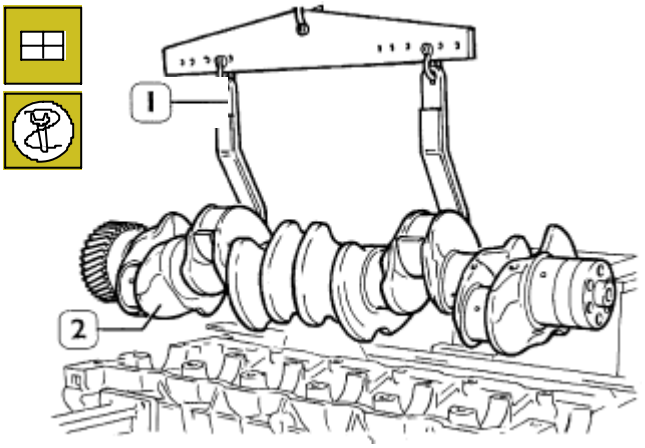
Figure 96




47579

Mount the oil nozzles (2), making the grub screw match the hole (3) on the crankcase.
Arrange the bearing shells (1) on the main bearing housings.

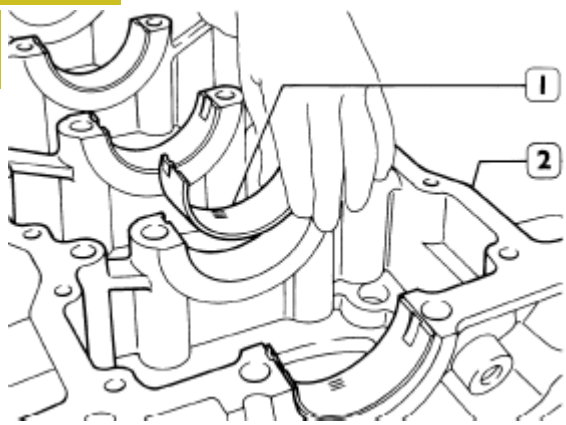
Figure 97




47578

Using the tackle and hook 99360500 (1), mount the crankshaft (2).

Figure 98

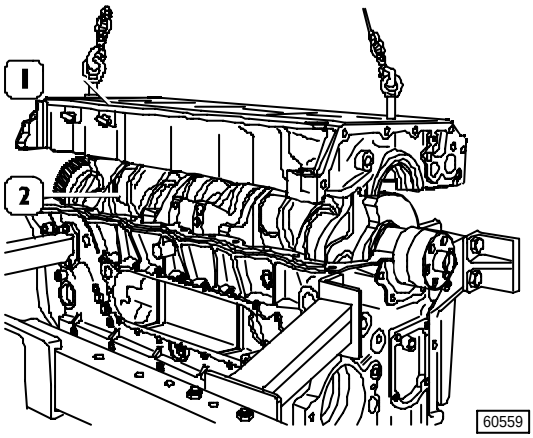



49021

Arrange the bearing shells (1) on the main bearing housings in the crankcase base (2).
Check the assembly clearance between the main journals of the crankshaft and their bearings, proceeding as illustrated on the following pages.

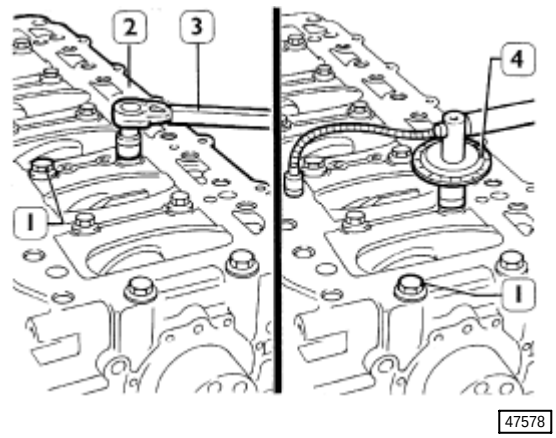
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Figure 99




Set two journals of the crankshaft (2) parallel to the longitudinal axis, a section of calibrated wire. Using appropriate hooks and tackle, mount the lower crankcase (1).

Figure 100




- Lubricate the internal screws (1) with UTDM oil and tighten them with a torque wrench (3) to a torque of 120 Nm, using tool 99395216 (4), to an angle of 60°, following the diagram of Figure 101.

Figure 101

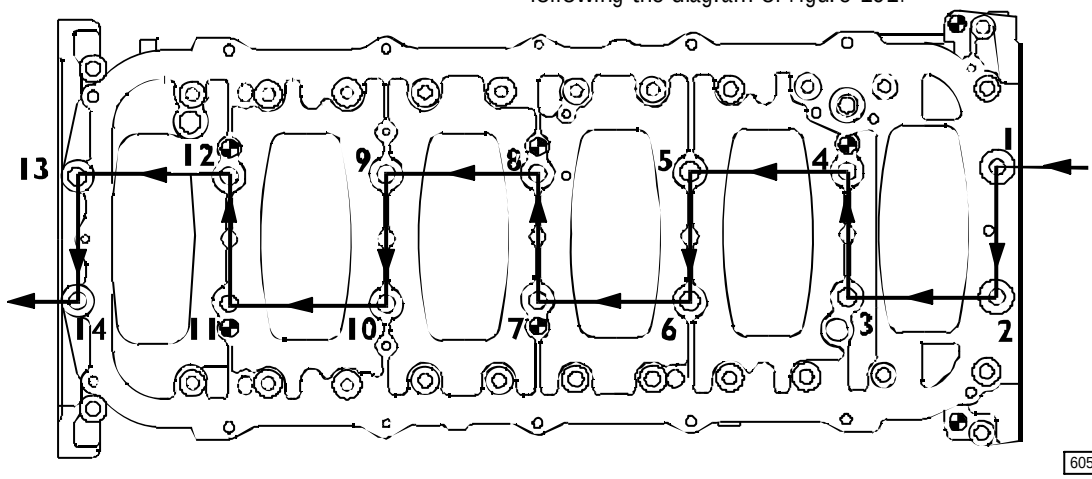
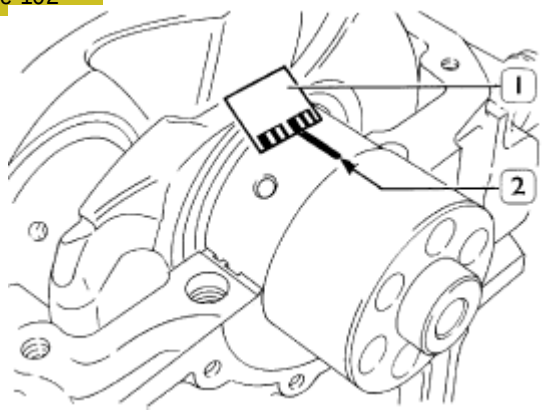



DIAGRAM OF SEQUENCE FOR TIGHTENING THE SCREWS FIXING THE BOTTOM CRANKCASE TO THE CRANKCASE

Figure 102

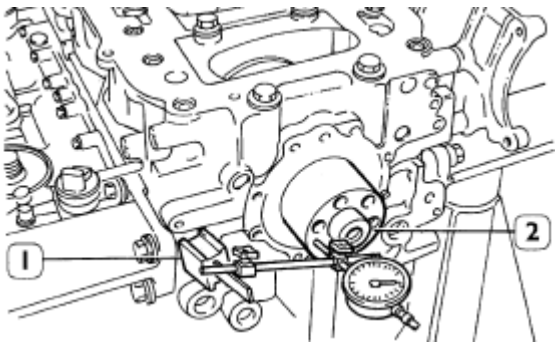



- Remove the lower crankcase.

The clearance between the main bearings and their journals is measured by comparing the width taken on by the calibrated wire (2) at the point of greatest crushing with the graduated scale on the case (1) containing the calibrated wire.
The numbers on the scale give the clearance of the coupling in millimetres. If you find the clearance is not as required, replace the bearing shells and repeat the check.

## Checking crankshaft end float

Figure 103

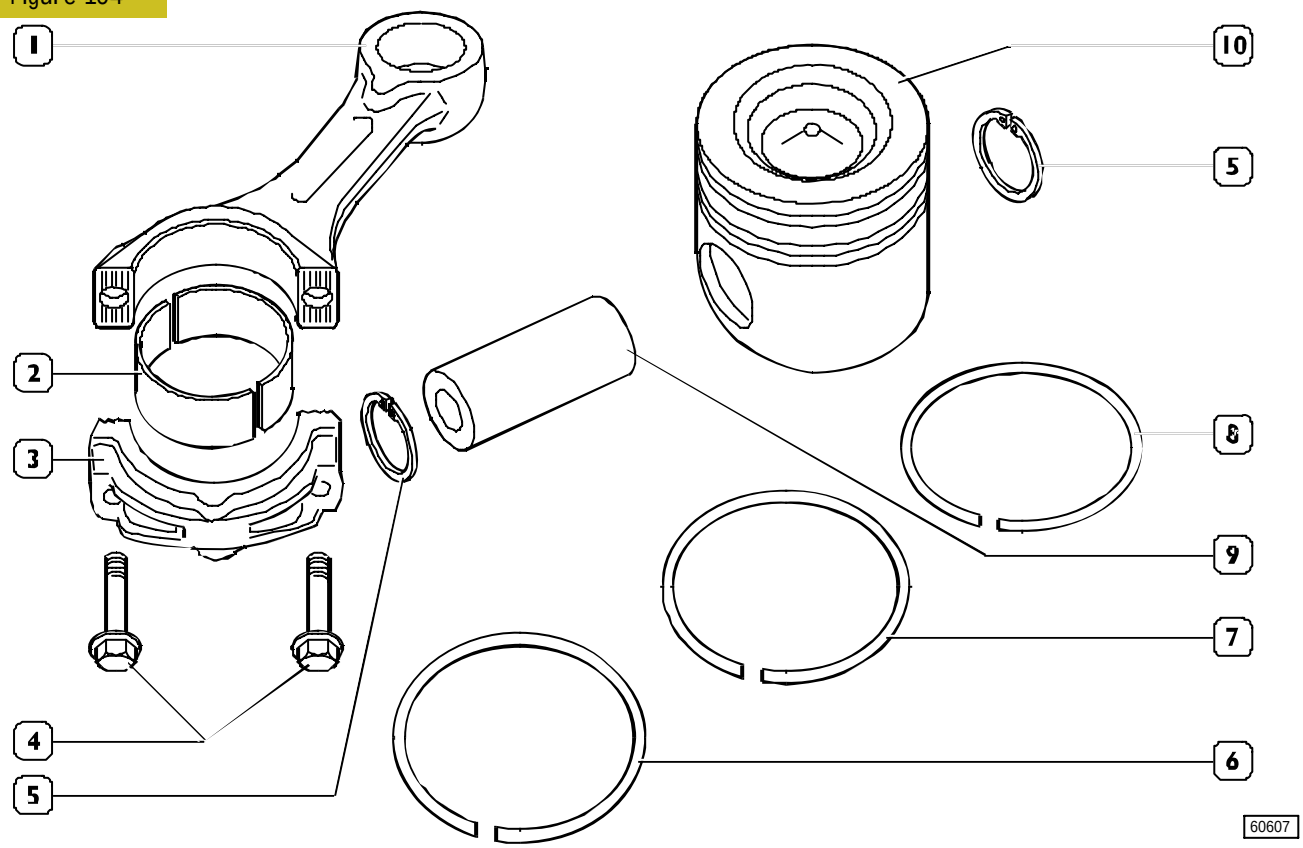



The end float is checked by setting a dial gauge (1) 99395603 with a magnetic base on the crankshaft (2) as shown in the figure. If you find the clearance to be greater than as required, replace the rear main bearing shells carrying the thrust bearings and repeat the clearance check.

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## 5408 Connecting rod piston assembly

Figure 104



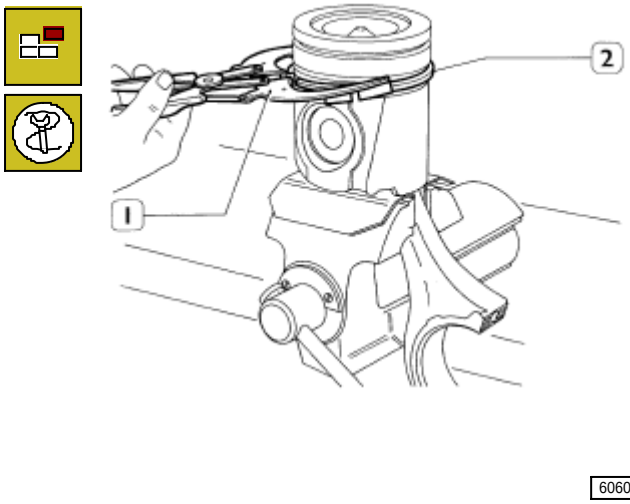

PISTON - CONNECTING ROD ASSEMBLY

1. Connecting rod body - 2. Bearing shells - 3. Connecting rod cap - 4. Cap fixing screws - 5. Seeger ring - 6. Slotted scraper ring - 7. Scraper ring - 8. Compression ring - 9. Piston gudgeon pin - 10. Piston

Check the pistons. They must show no signs of seizure, scoring, cracking or excessive wear; replace them if they do.

Removal

Figure 105

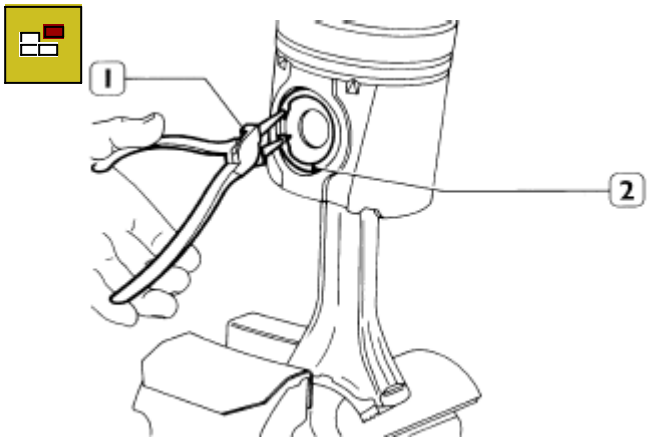



Removing the piston rings from the piston (2) using pliers 99360184 (1).

The pistons are fitted with three rings: the first one is a V-seal, the second one a bevelled seal and the third one a scraper ring.

The pistons are selected in two classes, A and B, according to diameter.

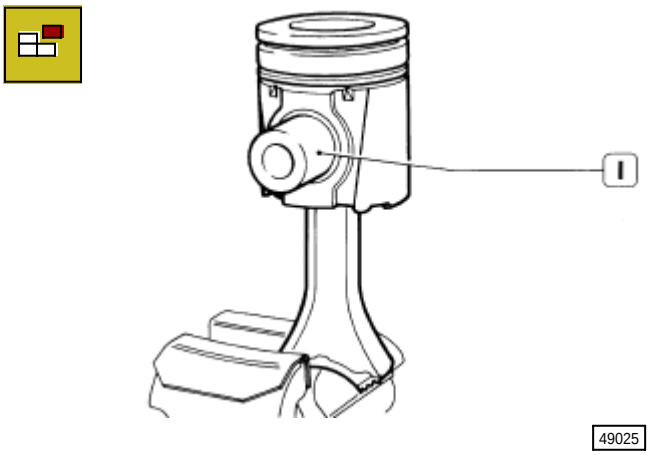
Figure 106




Removing the rings (2) retaining the piston gudgeon pin using round-nose pliers (1).

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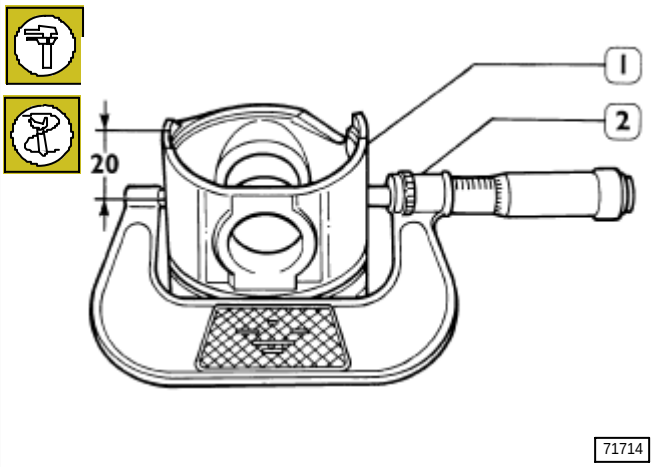
Figure 107




Removing the piston gudgeon pin (1).
If removal is difficult, use an appropriate drift.

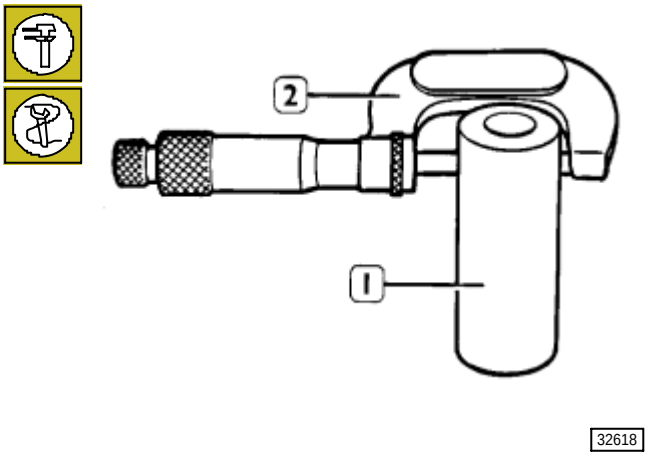
Measuring piston diameter

Figure 108




Using a micrometer (2), measure the diameter of the piston (1) to determine the assembly clearance. The diameter has to be measured at the value shown.

Figure 109




Measuring the diameter of the pin (1) using a micrometer (2).

Conditions for correct pin-piston coupling

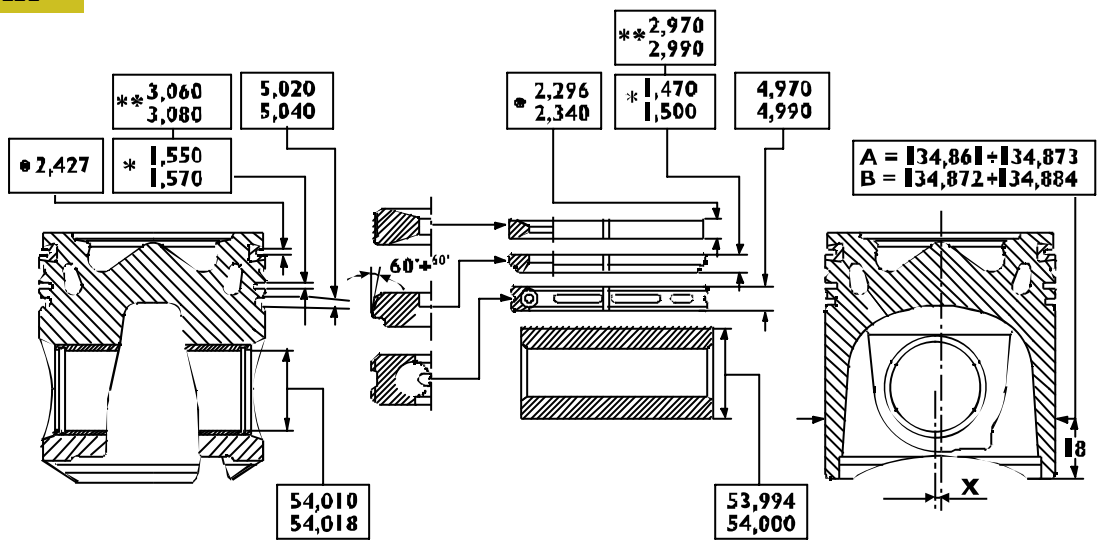
Figure 110




Lubricate the pin (1) and its seats on the hubs inside the piston with engine oil. The pin has to go into the piston by lightly pressing it with the fingers and must not drop out.

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Figure 111

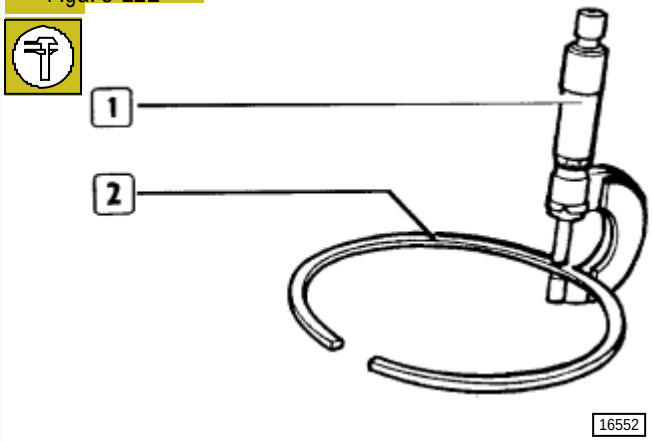



MAIN DATA OF THE PISTON, PISTON RINGS AND PIN

F Dimension detected on 130 mm ∅. - J measured at 2.5 mm from outer ∅ - X = 0,8±0,1
* Old part number - ** New part number

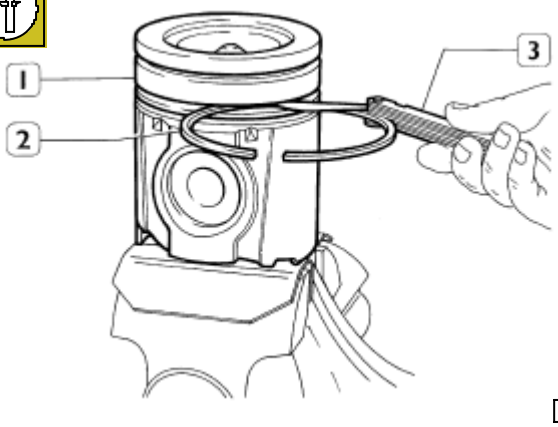
## 540842 Piston rings

Figure 112



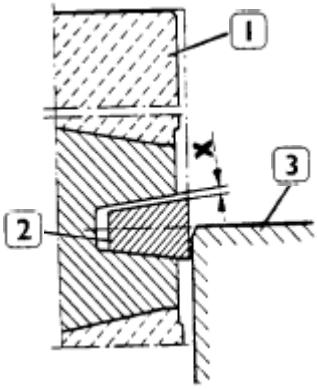

Check the thickness of the piston ring (2) with a micrometer (1).

Figure 113



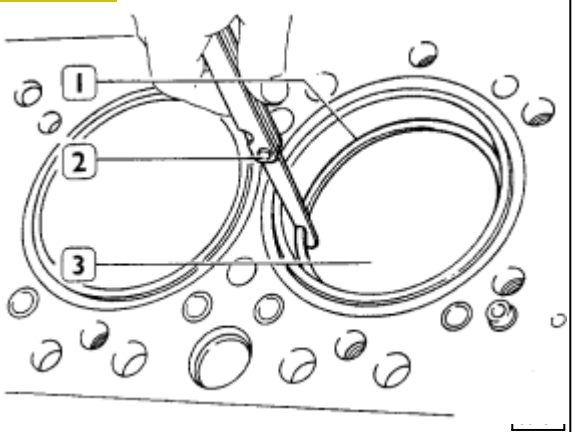

Check the clearance between the seals (2) and their seats on the piston (1) with a feeler gauge (3).

Figure 114




The seal (2) of the 1st slot has a V shape. The clearance "X" between the seal and its seat is measured by setting the piston (1) with the ring in the cylinder liner (3) so that the seal comes half out of the cylinder liner.

Figure 115




Using a feeler gauge (2), check the opening between the ends of the seals (1) inserted in the cylinder liner (3).
If you find the distance between the ends is less than or greater than as required, replace the piston rings.

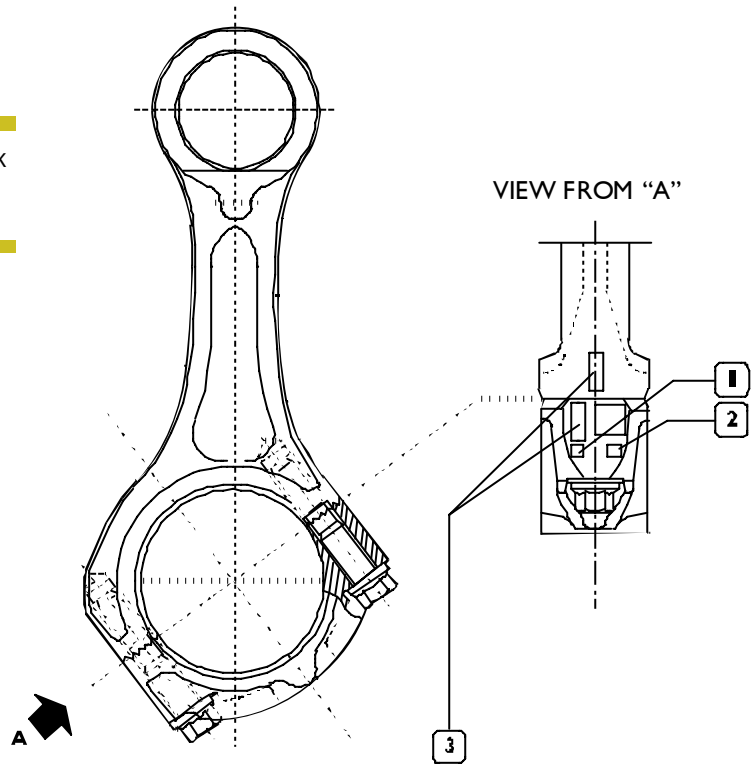
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## 540830 Connecting rod

Figure 116

Punched on the big end of the connecting rod are the data relating to the section in classes relating to the connecting rod seats and the weights.

**NOTE** On assembling the connecting rods, check they are all of the same class of weight.




117180

Connecting rod punch markings

1 Letter indicating the class of weight:

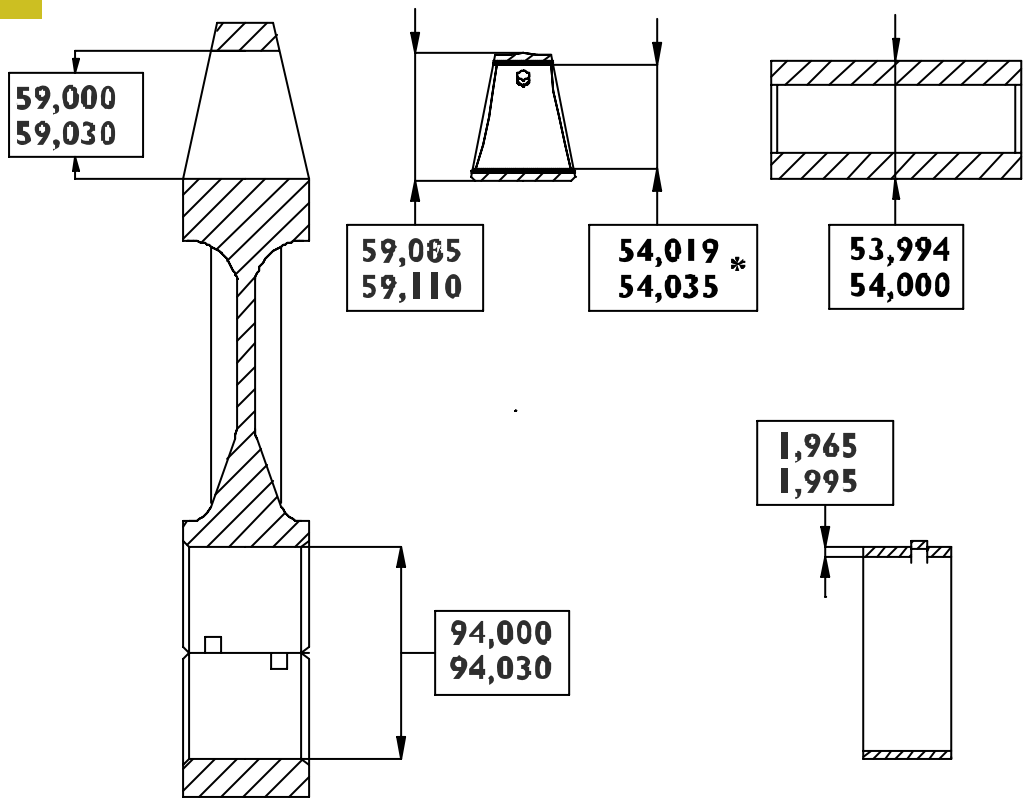
A = 4741 to 4780 g.
B = 4781 to 4820 g.
C = 4821 to 4860 g.

2 Number indicating the selection of the diameter of the big end bearing seat:

1 = 94.000 to 94.010 mm
2 = 94.011 to 94.020 mm
3 = 94.021 to 94.030 mm

3 Number indicating the selection of diameter for the big end bearing housing:

Figure 117




71716

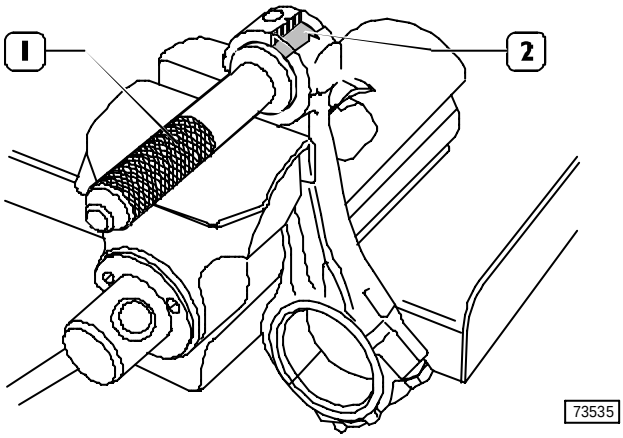
MAIN DATA OF THE BUSHING, CONNECTING ROD, PIN AND BEARING SHELLS

* Measurement to be made after driving in the bushing.

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## 540834 Bushings

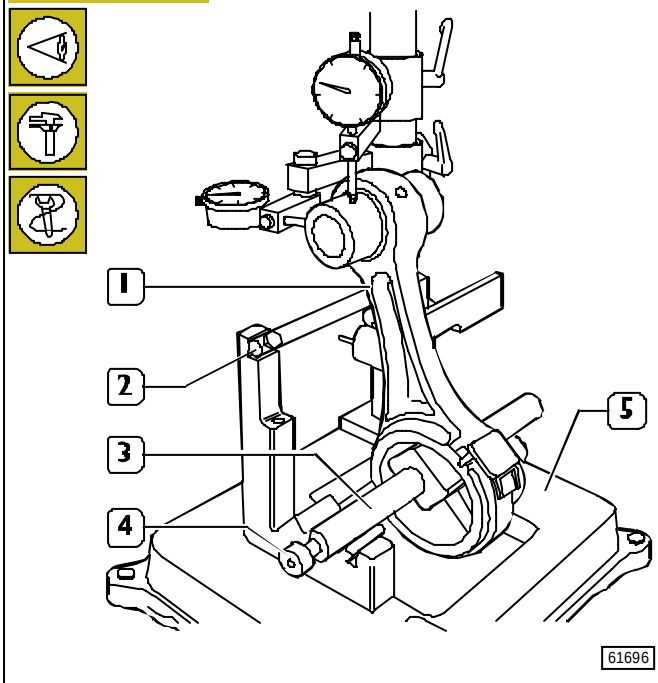
Figure 118




Check the bushing in the small end has not come loose and shows no sign of scoring or seizure; replace it if it does.
The bushing (2) is removed and fitted with a suitable drift (1).
When driving it in, make absolutely sure that the holes for the oil to pass through in the bushing and small end coincide.
Using a boring machine, rebore the bushing so as to obtain a diameter of 54.019 – 54.035.

## Checking connecting rods squareness

Figure 119 (Demonstration)




Checking axis alignment

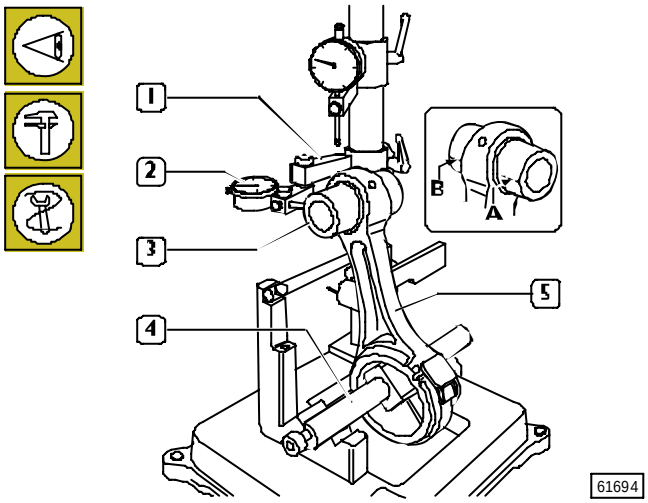
Check the alignment of the axes of the connecting rods (1) with a suitable device (5), proceeding as follows:

Fit the connecting rod (1) on the spindle of the tool (5) and lock it with the screw (4).

Set the spindle (3) on the V-prisms, resting the connecting rod (1) on the stop bar (2).

Checking torsion

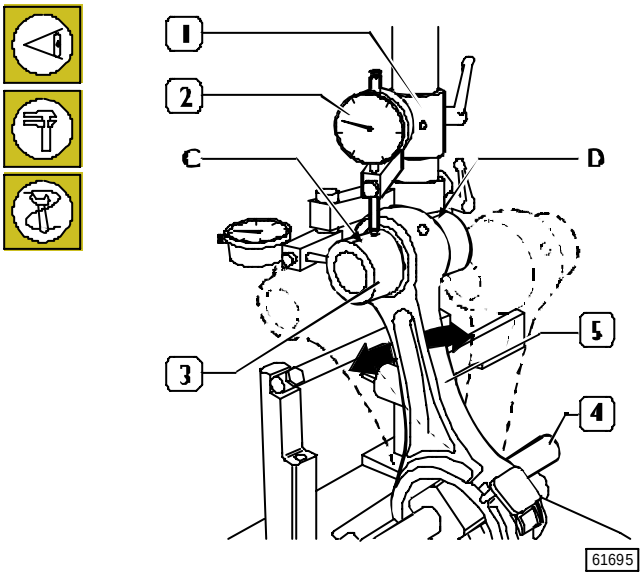
Figure 120 (Demonstration)




Check the torsion of the connecting rod (5) by comparing two points (A and B) of the pin (3) on the horizontal plane of the axis of the connecting rod.
Position the mount (1) of the dial gauge (2) so that this pre-loads by approx. 0.5 mm on the pin (3) at point A and zero the dial gauge (2). Shift the spindle (4) with the connecting rod (5) and compare any deviation on the opposite side B of the pin (3): the difference between A and B must be no greater than 0.08 mm.

Checking bending

Figure 121 (Demonstration)

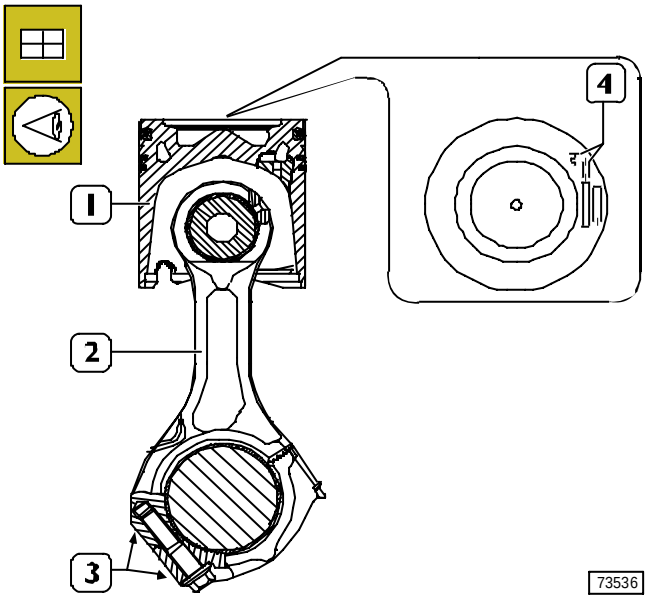



Check the bending of the connecting rod (5) by comparing two points C and D of the pin (3) on the vertical plane of the axis of the connecting rod.
Position the vertical mount (1) of the dial gauge (2) so that this rests on the pin (3) at point C.
Swing the connecting rod backwards and forwards seeking the highest position of the pin and in this condition zero the dial gauge (2). Shift the spindle (4) with the connecting rod (5) and repeat the check on the highest point on the opposite side D of the pin (3). The difference between point C and point D must be no greater than 0.08 mm.

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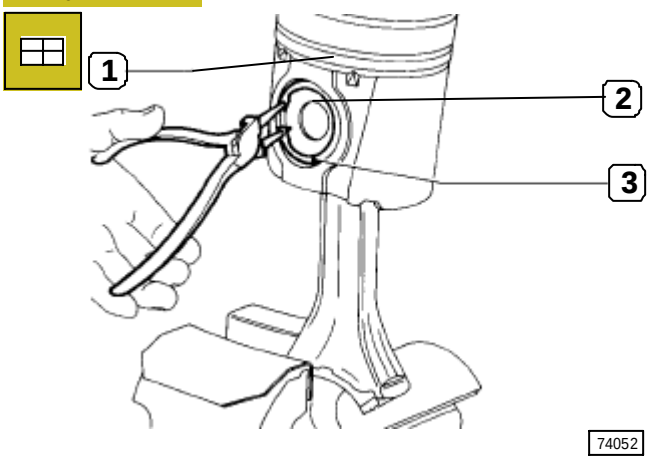
## Mounting the connecting rod – piston assembly

Figure 122




The piston (1) has to be fitted on the connecting rod (2) so that the graphic symbol (4), showing the assembly position in the cylinder liner, and the punch marks (3) on the connecting rod are observed as shown in the figure.

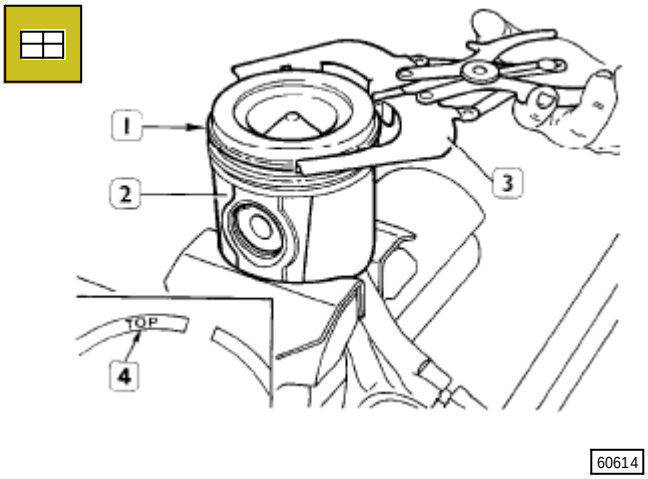
Figure 123




Fit the pin (2) and fasten it on the piston (1) with the seeger rings (3).

## Mounting the piston ring

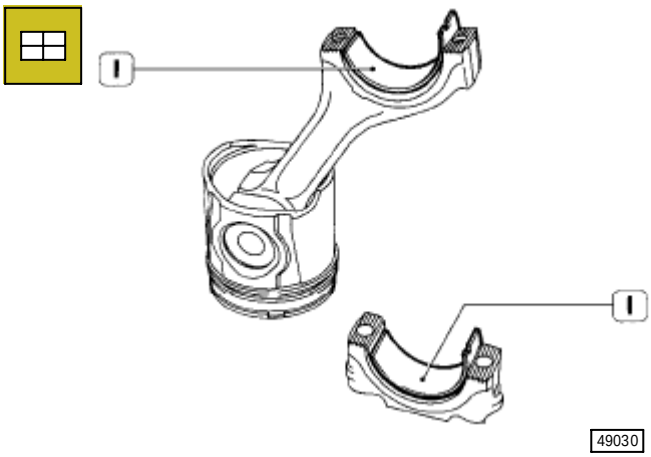
Figure 124




To fit the piston rings (1) on the piston (2) use the pliers 99360184 (3).
The rings need to be mounted with the word "TOP" (4) facing upwards. Direct the ring openings so they are staggered 120° apart.

## Fitting the big end bearing shells

Figure 125




Fit the bearing shells (1), selected as described under the heading "Selecting the main and big end bearing shells", on both the connecting rod and the cap.
If reusing bearing shells that have been removed, fit them back into their respective seats in the positions marked during removal.

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## Fitting connecting rod - piston assemblies in the cylinder liners

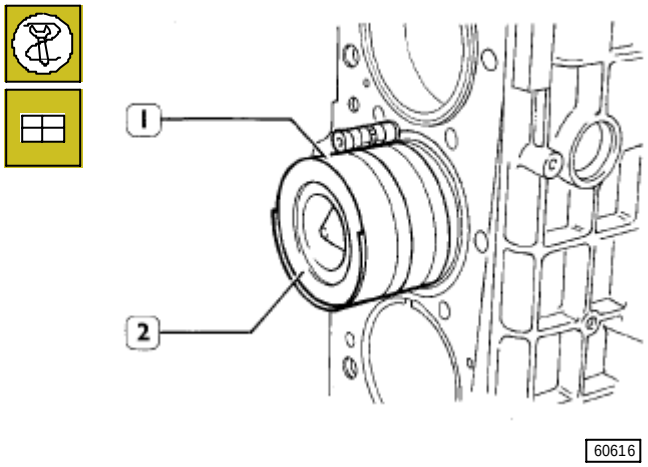
With the aid of the clamp 99360605 (1, Figure 126), fit the connecting rod – piston assembly (2) in the cylinder liners, according to the diagram of Figure 127, checking that:

- The openings of the piston rings are staggered 120° apart.
- The pistons are all of the same class, A or B.
- The symbol punched on the top of the pistons faces the engine flywheel, or the recess in the skirt of the pistons tallies with the oil nozzles.

Be very careful that the connecting rod does not strike the cylinder walls.

**NOTE** The pistons are supplied as spares in class A and can be fitted in class B cylinder liners.

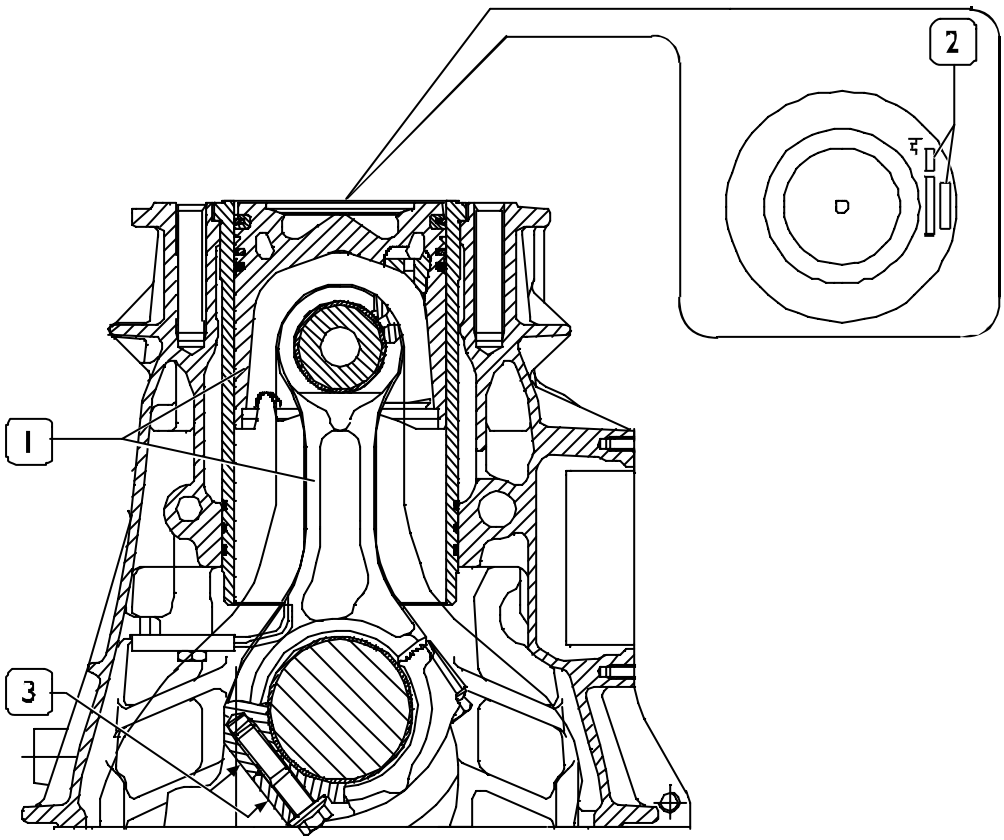
Figure 126




## Checking piston protrusion

On completing assembly, check the protrusion of the pistons from the cylinder liners; it must be 0.12 – 0.42 mm.

Figure 127



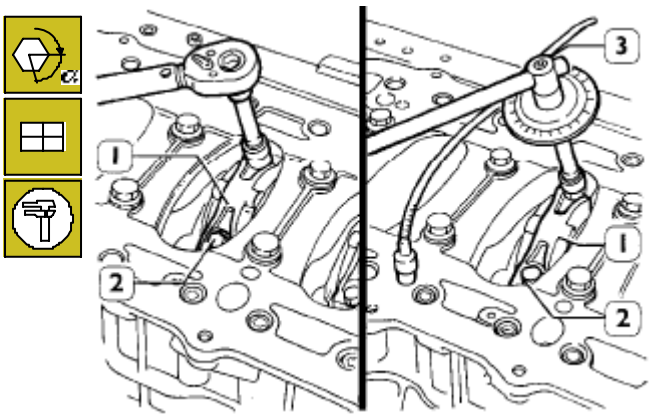

ASSEMBLY DIAGRAM OF CONNECTING ROD – PISTON ASSEMBLY IN CYLINDER LINER
1. Connecting rod – piston assembly – 2. Area of punch marking on the top of the piston, symbol showing assembly position and selection class – 3. Connecting rod punch mark area

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## 540831 Checking crankpin assembly clearance

To measure the clearance, carry out the following operations.
Connect the connecting rods to the relevant journals of the crankshaft, placing a length of calibrated wire on the journals.

Figure 128




47594

Mount the connecting rod caps (1) together with the bearing shells. Tighten the screws (2) fixing the connecting rod caps to a torque of 60 Nm (6 kgm). Using tool 99395216 (3), further tighten the screws with an angle of 60°.

**NOTE** The thread of the screws (2), before assembly, has to be lubricated with engine oil.

Remove the caps and determine the clearance by comparing the width of the calibrated wire with the graduated scale on the case containing the calibrated wire.
Upon final assembly: check the diameter of the thread of the screws (2), it must be no less than 13.4 mm; if it is, change the screw. Lubricate the crankpins and connecting rod bearings. Tighten the screws (2) as described above.

## 540610 CYLINDER HEAD

Before dismounting cylinder head, check cylinder head for hydraulic seal by proper tooling; in case of leaks not caused by cup plugs or threaded plugs, replace cylinder head.

When replacing, the cylinder head is supplied as a spare part with a threaded plug, which must be removed during assembly.

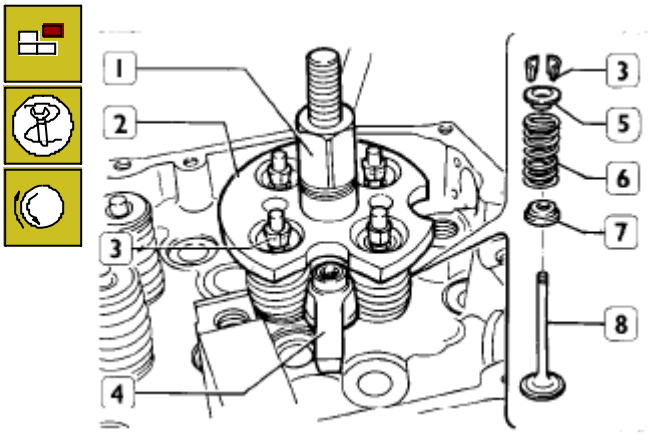
**NOTE** In case of plugs dismounting/replacement, on mounting, apply sealant Loctite 270 on plugs.

### Disassembly the valves

**NOTE** Before dismounting cylinder head valves, number them in view of their remounting in the position observed on dismounting should they not have to be overhauled or replaced.

Intake valves are different form exhaust valves in that they have a notch placed at valve head centre.

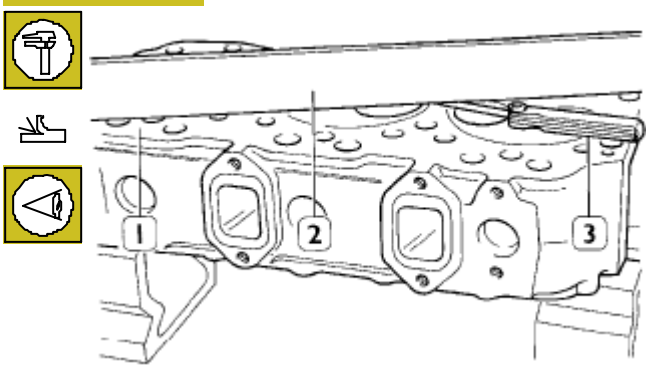
Figure 129




Mount and secure the tool 99360263 (2) with the bracket (4). Screw down with the device 99360261 (1) to be able to remove the cotters (3). Take out the tool (2) and extract the top plate (5), spring (6) and bottom plate (7).
Repeat this process on all the valves.
Turn over the cylinder head and take out the valves (8).

### Checking head bearing surface on cylinder block

Figure 130 **(Demonstration)**




36159

Check the supporting surface (1) of the head on the cylinder block with a rule (2) and a feeler gauge (3). If you find any deformation, level the head on a surface grinder; maximum amount of material that can be removed 0.2 mm.

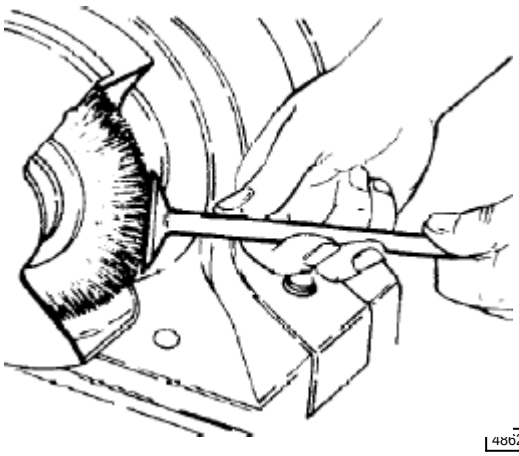
**NOTE** After this process, you need to check the valve recessing and injector protrusion.

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## 540622 Valves

Decarbonizing and checking valves

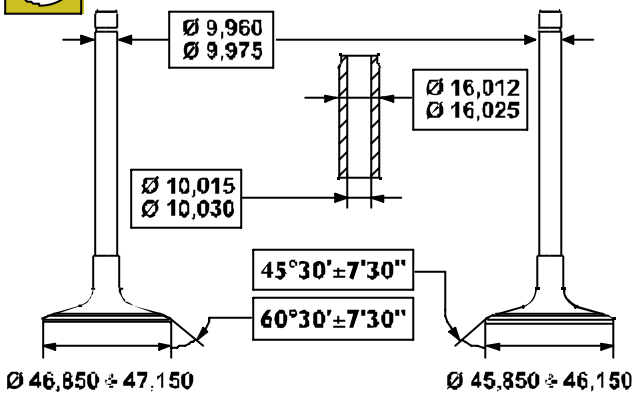
Figure 131



48625

Remove the carbon deposits on the valves with a wire brush. Check that the valves show no signs of seizure or cracking and check with a micrometer that the valve stem diameter comes within the required values (see Figure 132); replace the valves if it does not.

Figure 132




71718

MAIN DATA OF VALVES AND VALVE GUIDES

* Measurement to be made after driving in the valve guides

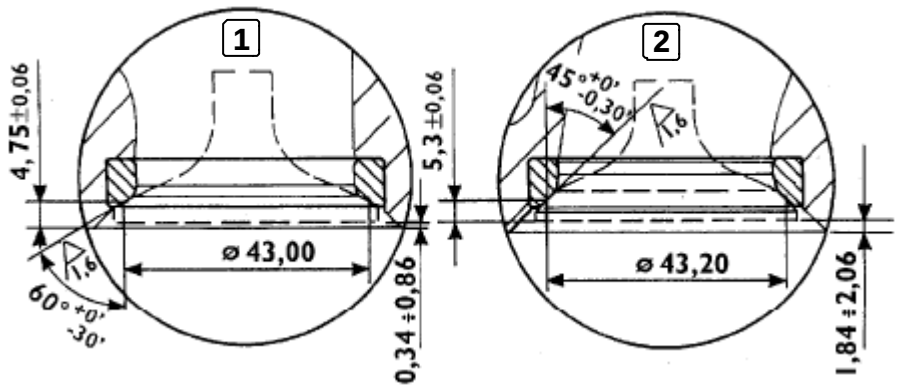
Check with a micrometer that the diameter of the valve stems is as indicated. If necessary, grind the valve seats with a grinding machine, removing as little material as possible.

## 540661 Valve seats

Regrinding – replacing valve seats

**NOTE** The valve seats are reground whenever the valves or valve guides are ground and replaced.

Figure 133



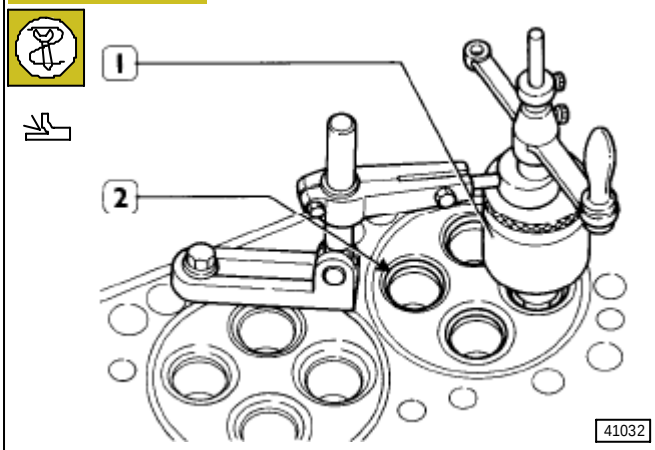

73555

MAIN DATA OF VALVE SEATS

1. Intake valve seat – 2. Exhaust valve seat

Aquila Trucks Centres

Figure 134 (Demonstration)




Check the valve seats (2). If you find any slight scoring or burns, regrind them with a suitable tool (1) according to the angles shown in Figure 133. If it is necessary to replace them, using the same tool and taking care not to affect the cylinder head, remove as much material as possible from the valve seats so that, with a punch, it is possible to extract them from the cylinder head.

Heat the cylinder head to 80 ÷ 100°C and, using a drift, fit in the new valve seats (2), chilled beforehand in liquid nitrogen. Using tool 99305019 (1), regrind the valve seats according to the angles shown in Figure 133.

After regrinding the valve seats, using tool 99370415 and dial gauge 99395603, check that the position of the valves in relation to the plane of the cylinder head is:

- -0.45 ÷ -0.75 mm (recessing) intake valves
- -1.65 ÷ -1.95 mm (recessing) exhaust valves.

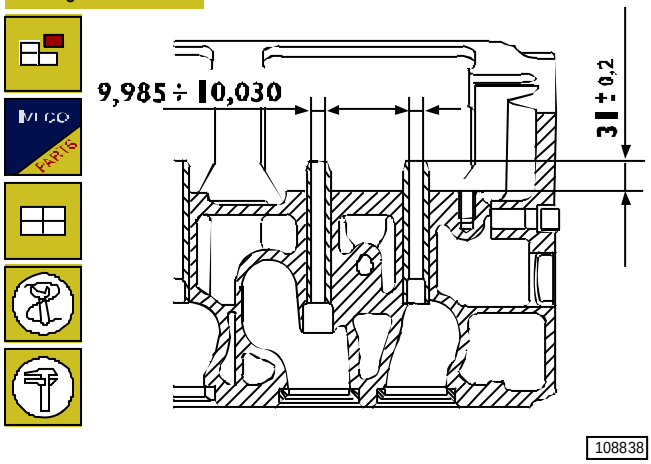
## Checking clearance between valve-stem and associated valve guide

Using a dial gauge with a magnetic base, check the clearance between the valve stem and the associated guide. If the clearance is too great, change the valve and, if necessary, the valve guide.

## 540667 Valve guides

Replacing valve guides

Figure 135



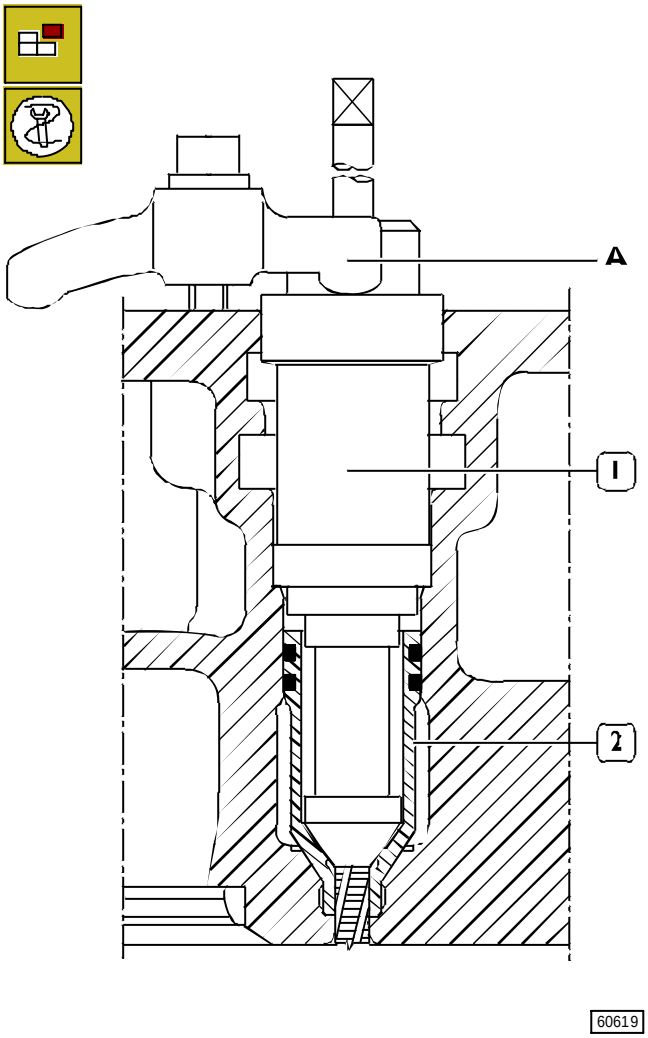

The valve guides are removed with the drift 99360143.
They are fitted with the drift 99360143 equipped with part 99360296.

Part 99360296 determines the exact position of assembly of the valve guides in the cylinder head. If they are not available, you need to drive the valve guides in to the cylinder head so they protrude by 30.8÷31.2 mm.
After driving in the valve guides, rebore their holes with the smoother 99390330.

## 540613 Replacing injector holders

Removal

Figure 136



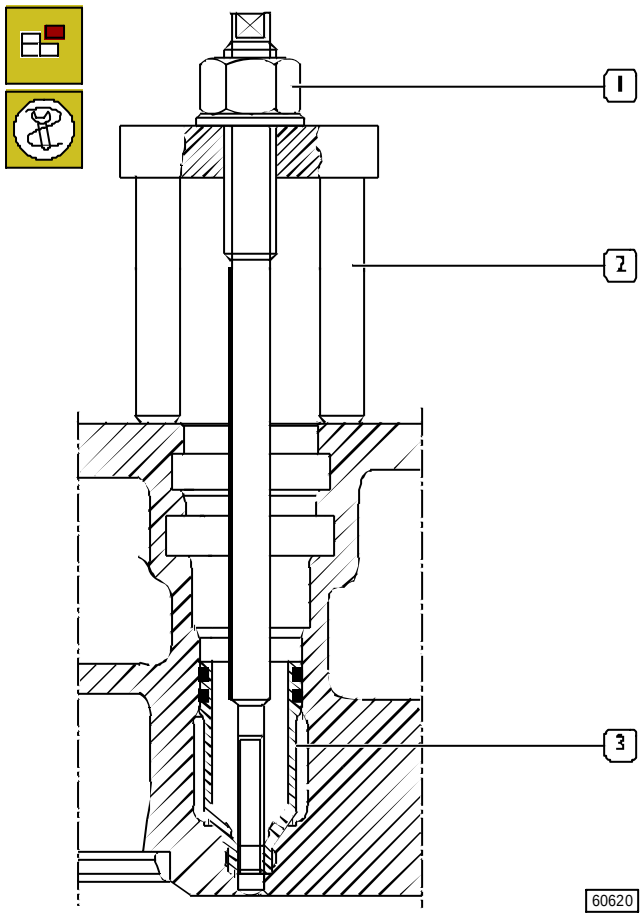

To replace the injector holder (2), proceed as follows:

- Thread the holder (2) with tool 99390804 (1).

The steps described in Figs. 137 - 139 - 140 - 141 need to be carried out by fixing the tools, with the bracket A, to the cylinder head.

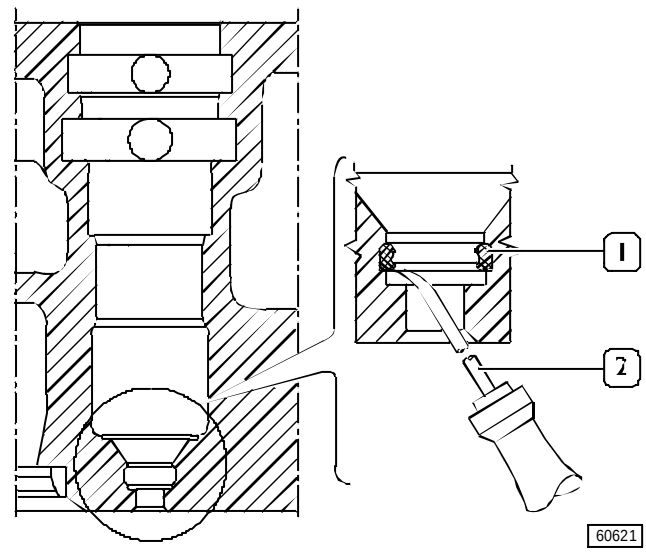
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Figure 137




- Screw the extractor 99342149 (2) into the holder (3). Screw down the nut (1) and take the holder out of the cylinder head.

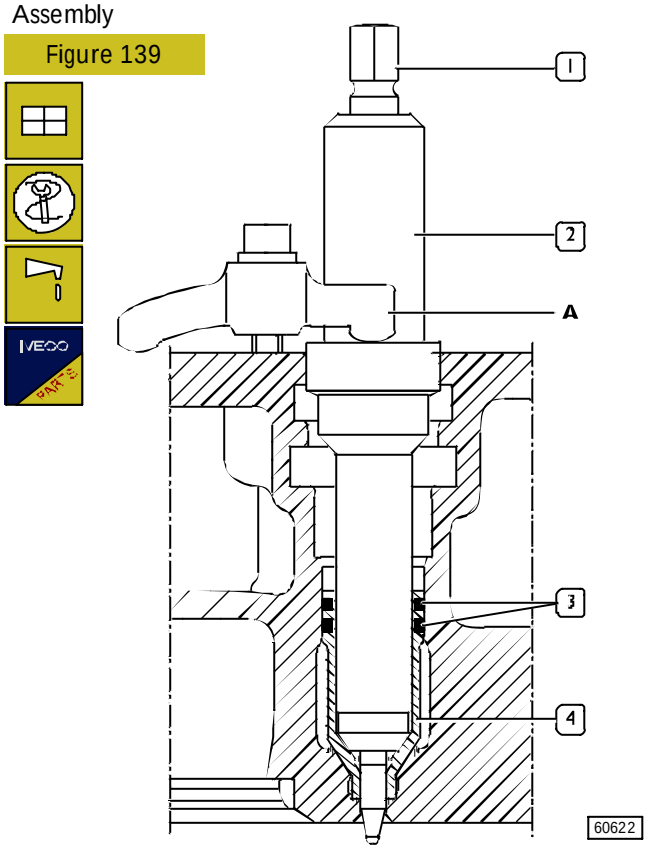
Figure 138




- Using the tool 99390772 (2) remove any residues (1) left in the groove of the cylinder head.

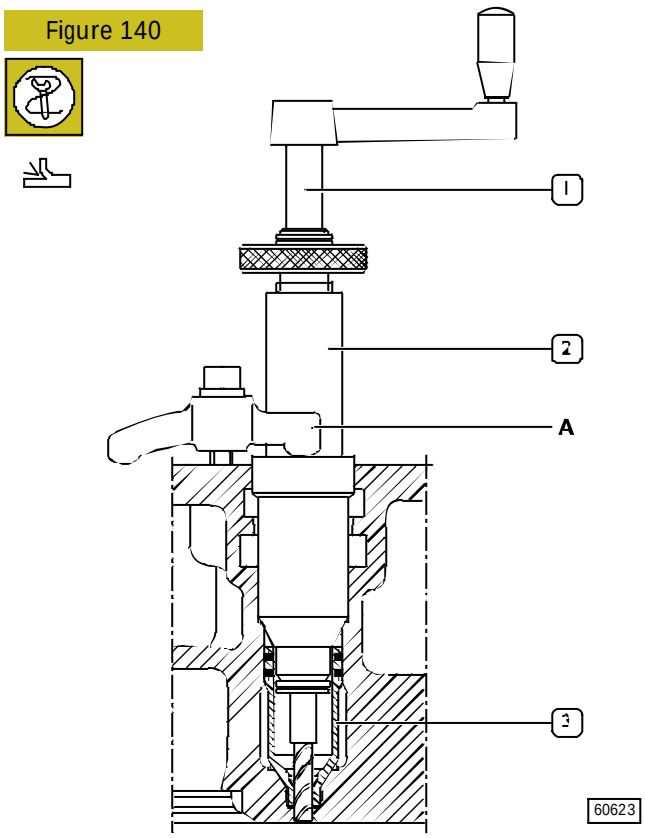
Assembly

Figure 139




- Lubricate the seals (3) and fit them on the case (4). Using tool 99365056 (2) secured to the cylinder head with bracket A, drive in the new holder, screwing down the screw (1) upsetting the bottom portion of the holder.

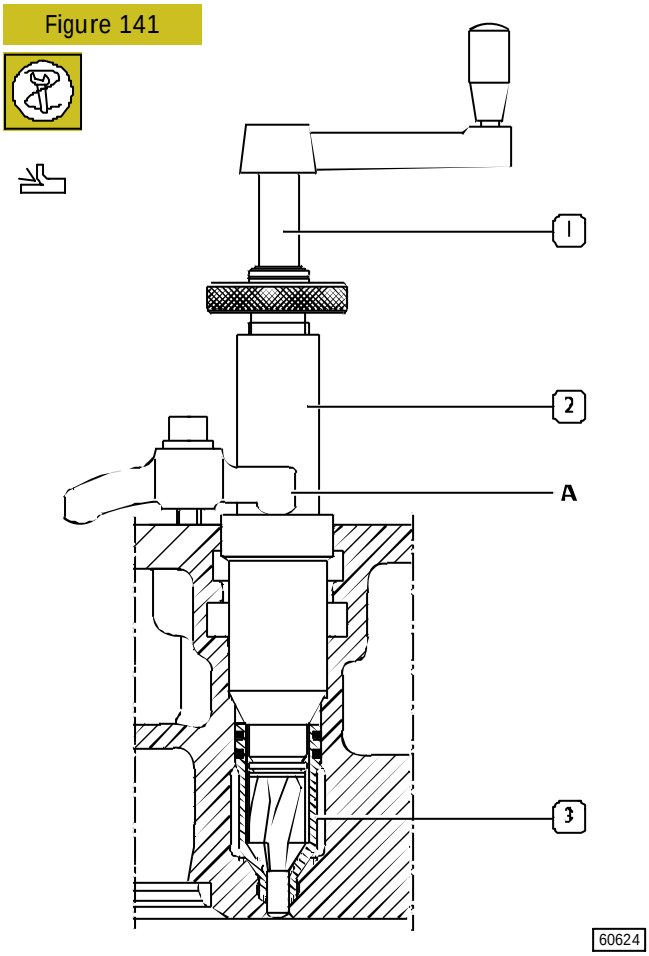
Figure 140




- Using the reamer 99394041 (1-2), rebore the hole in the holder (3).

Aquila Trucks Centres

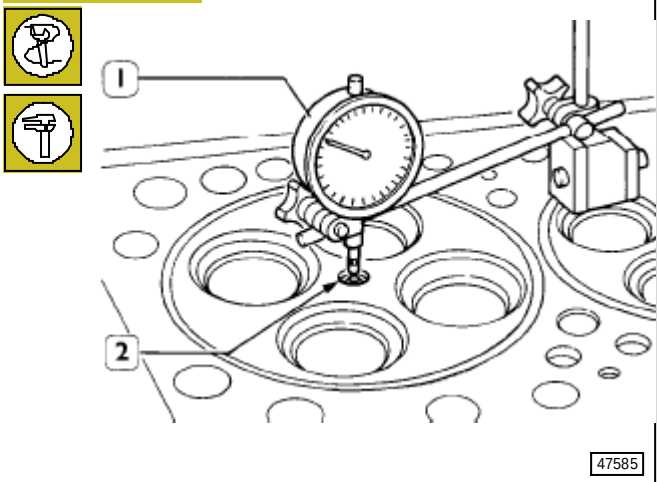
Figure 141




- Using the milling cutter 99394043 (1-2), regrind the injector seat in the injector holder (3).

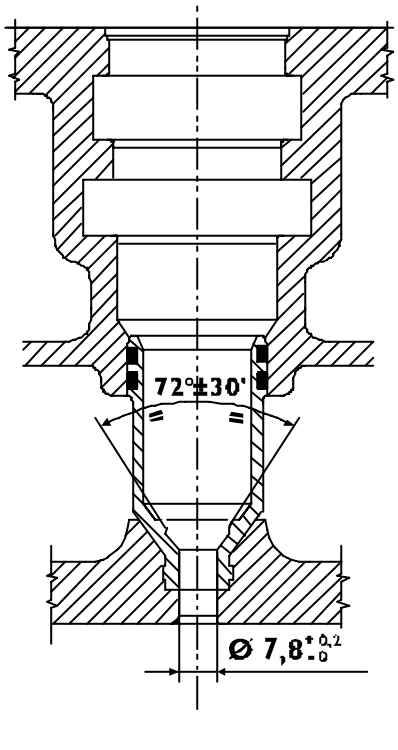
## Checking injector protrusion

Figure 142




Check injector protrusion (2) with the dial gauge (1).
The protrusion must be 0.52 - 1.34 mm.

Figure 143



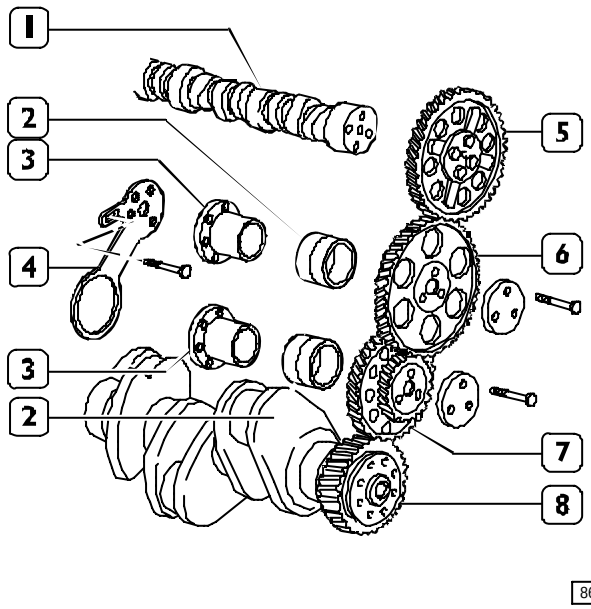

INJECTOR HOLDER ASSEMBLY DIAGRAM

Aquila Trucks Centres

## 5412 TIMING GEAR

### Camshaft drive

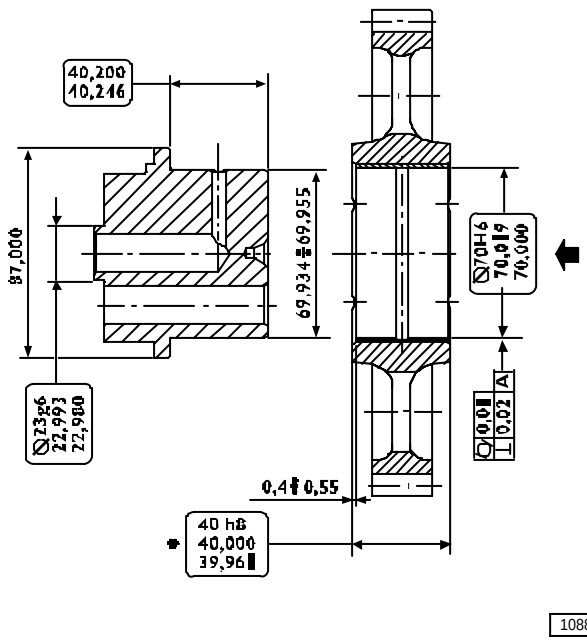
Figure 144




TIMING CONTROL COMPONENT PARTS
1. Camshaft - 2. Bushing - 3. Pin - 4. Articulated rod - 5. Camshaft control gear - 6. Idler gear - 7. Twin idler gear - 8. Drive shaft driving gear.

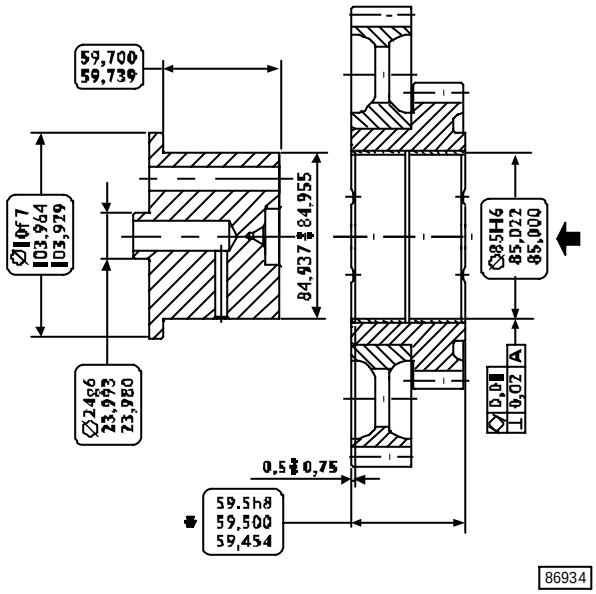
### 541253 Idler gear pin
### 541252 Idler gear

Figure 145




### 541253 Twin intermediate gear pin
### 541252 Twin idler gear

Figure 146




### 541254 Replacing the bushings

Bushings (2, Figure 143), can be replaced when they are worn. Put up the bushing, then bore it to obtain the diameter shown on Figure 145 or .Figure 146

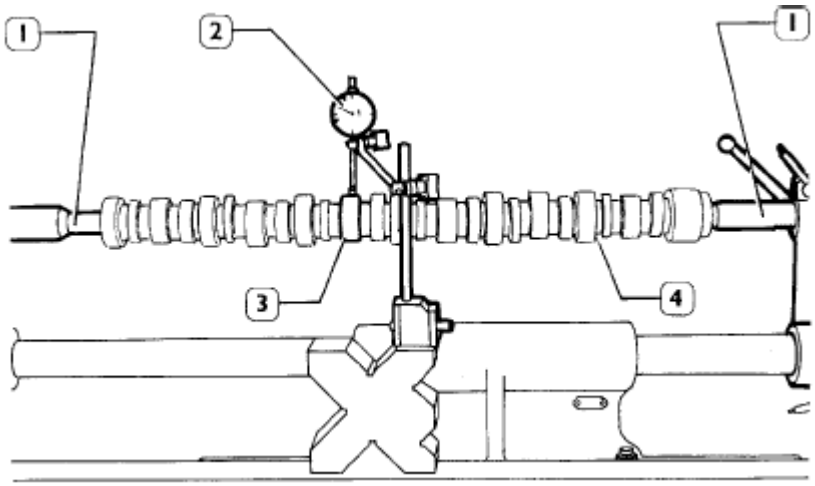
**NOTE** The bushing must be driven into the gear by following the direction of the arrow and setting the latter to the dimension shown on Figure 145 or .Figure 146

Rated assembling play between gear bushings and pins:
Figure 145 – 0.045 ÷ 0.085 mm
Figure 146 – 0.045 ÷ 0.085 mm.

Aquila Trucks Centres

## 541210 Timing system
## 541211 Checking cam lift and pin alignment

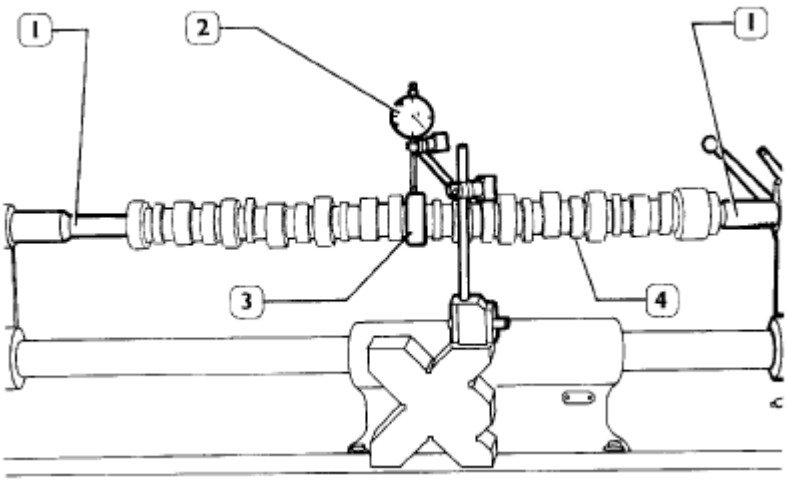
Figure 147




47506

Set the camshaft (4) on the tailstocks (1) and check the lift of the cams (3) with the dial gauge (2); the values are given in the table on page 139.

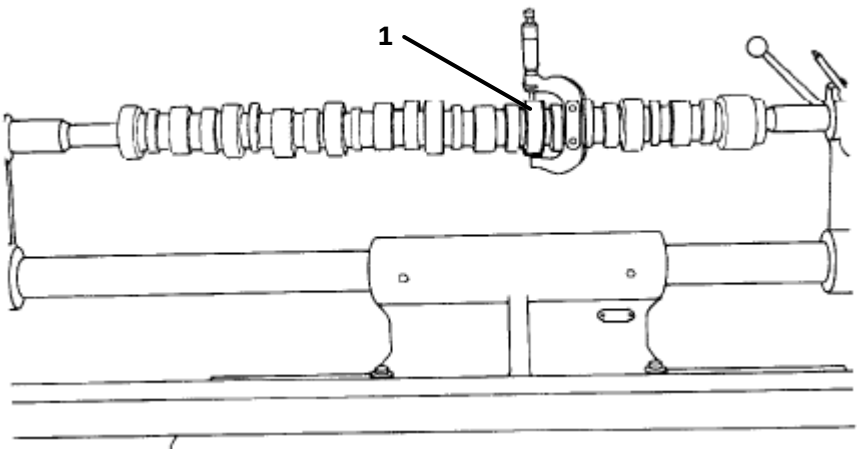
Figure 148




47507

Still with the camshaft (4) set on the tailstocks (1), check the alignment of the supporting pins (3) with the dial gauge (2); it must be no greater than 0.030 mm. If you find a greater misalignment, replace the shaft.

Figure 149

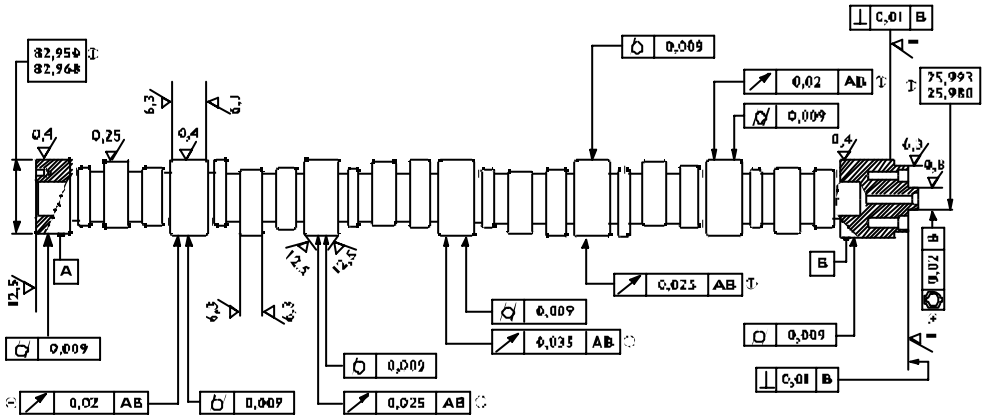



47505

To check the assembly clearance, measure the inside diameter of the bushings and the diameter of the pins (1) of the camshaft: the difference will give the actual clearance.
If you find any clearances over 0.135 mm, replace the bushings and, if necessary, the camshaft as well.

Aquila Trucks Centres

Figure 150

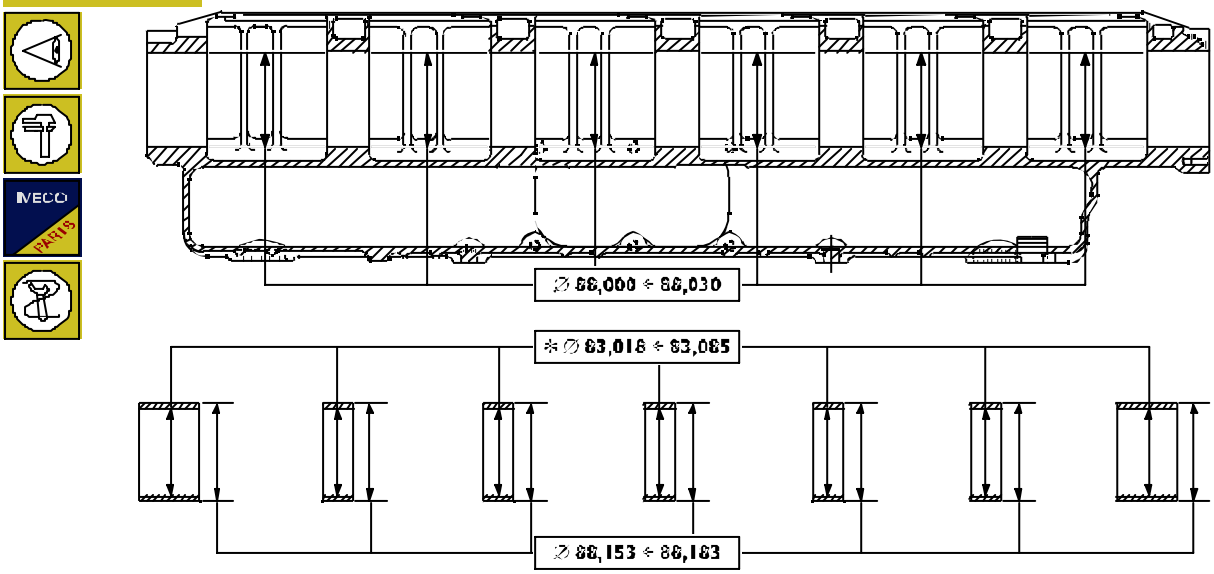



MAIN DATA OF THE CAMSHAFT AND TOLERANCES
The surfaces of the supporting pins of the shaft and those of the cams need to be extra smooth.
Whereas, if they show any signs of seizing or scoring, you should replace the shaft and the relevant bushings.

| TOLERANCES | FEATURE SUBJECT OF TOLERANCE | SYMBOL |
|---|---|---|
| DIRECTION | Perpendicularity | ⊥ |
| POSITION | Concentricity or coaxiality | ◎ |
| SWING | Circular oscillation | ↗ |
| CLASS OF IMPORTANT ASCRIBED TO PRODUCT CHARACTERISTICS | | SYMBOL |
| CRUCIAL | | Ⓒ |
| IMPORTANT | | ⊕ |
| SECONDARY | | ⊖ |

## 541213 Bushings

Figure 151




MAIN DATA OF THE BUSHINGS FOR THE CAMSHAFT AND SEATS ON THE CYLINDER HEAD
* Bushing inside diameter after driving in

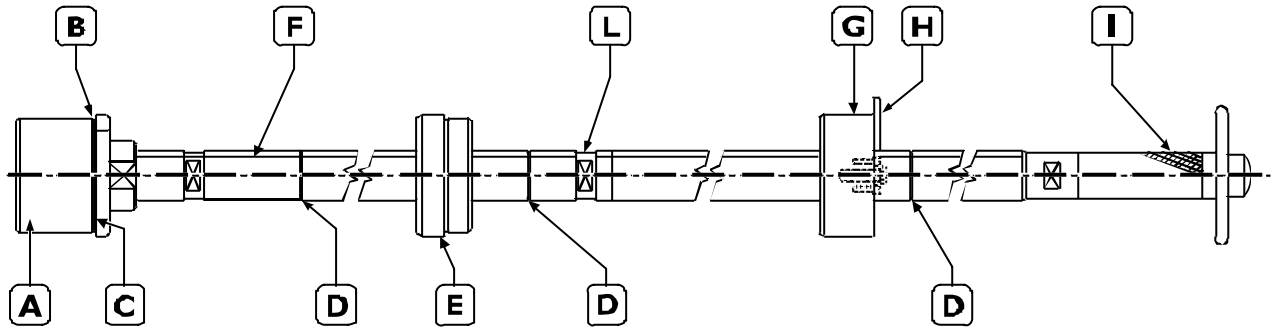
The surface of the bushings must show no sign of seizing or scoring; replace them if they do.
Measure the inside diameter of the bushings with a bore gauge.

If you find a higher value than the tolerance, replace them.
To remove and fit the bushings, use the appropriate drift 99360499.

Aquila Trucks Centres

Replacing camshaft bushings with drift 99360499
Drift

Figure 152

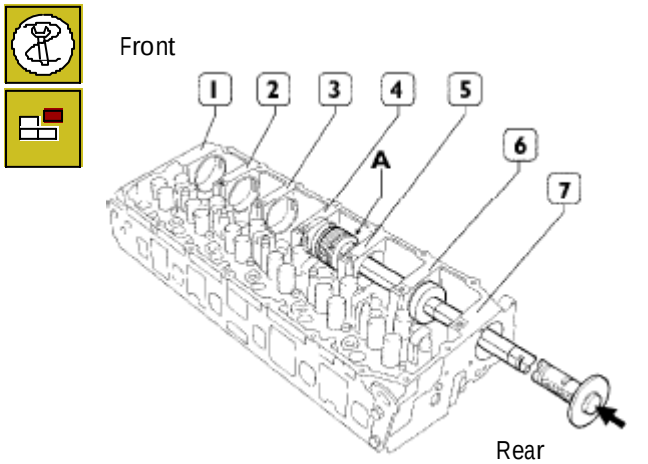



107217

A = Drift with seat for bushings to insert/extract.
B = Grub screw for positioning bushings.
C = Reference mark to insert seventh bushing correctly.
D = Reference mark to insert bushings 1, 2, 3, 4, 5, 6 correctly (yellow marks).
E = Guide bushing.
F = Guide line.
G = Guide bushing to secure to the seventh bushing mount.
H = Plate fixing bushing G to cylinder head.
I = Grip.
L = Extension coupling.

Removal

Figure 153

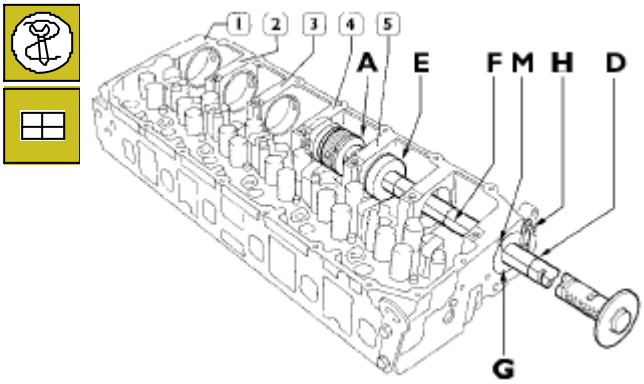



71725

The sequence for removing the bushings is 7, 6, 5, 4, 3, 2, 1.
The bushings are extracted from the front of the single seats.
Removal does not require the drift extension for bushings 5, 6 and 7 and it is not necessary to use the guide bushing.
For bushings 1, 2, 3 and 4 it is necessary to use the extension and the guide bushings.
Position the drift accurately during the phase of removal.

Assembly

Figure 154



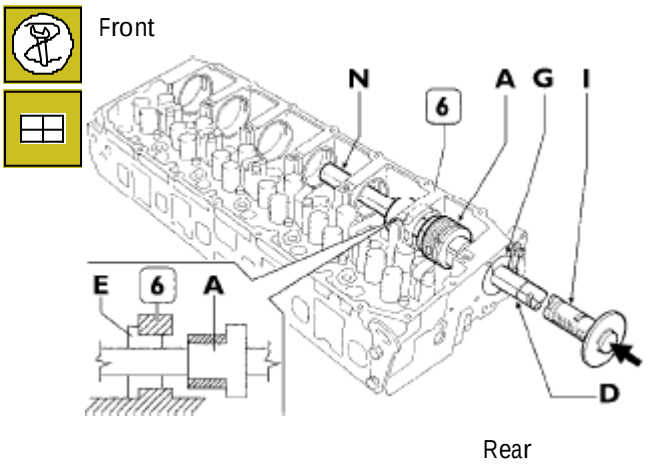

77795

Assemble the drift together with the extension.
To insert bushings 1, 2, 3, 4 and 5, proceed as follows:

1 position the bushing to insert on the drift (A) making the grub screw on it coincide with the seat (B) (Figure 152) on the bushing;
2 position the guide bushing (E) and secure the guide bushing (G) (Figure 152) on the seat of the 7th bushing with the plate (H);
3 while driving in the bushing, make the reference mark (F) match the mark (M). In this way, when it is driven home, the lubrication hole on the bushing will coincide with the oil pipe in its seat.
The bushing is driven home when the 1st yellow reference mark (D) is flush with the guide bushing (G).

Aquila Trucks Centres

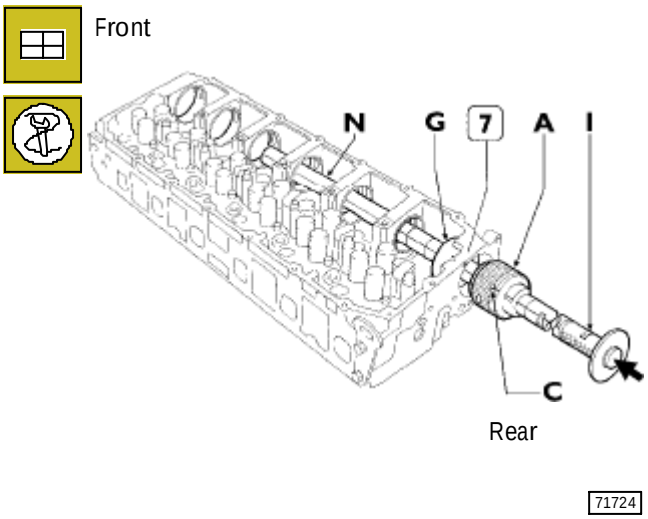
Figure 155




To insert the bushing (6), proceed as follows:

- Unscrew the grip (I) and the extension (N).
- Position the extension (N) and the guide bushing E as shown in the figure.
- Repeat steps 1, 2, 3.

Figure 156

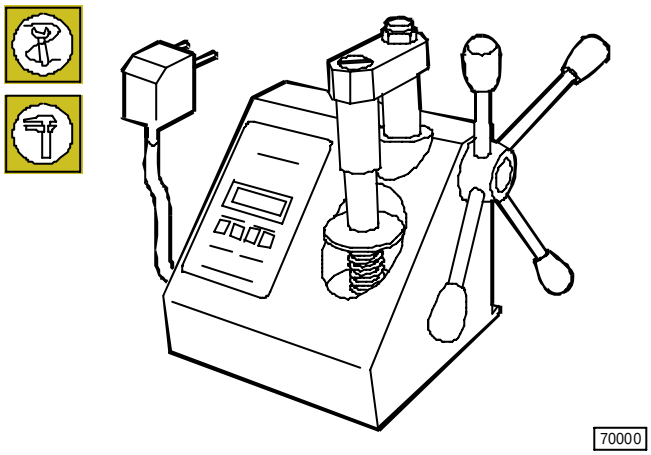



To insert bushing (7), proceed as follows:

- Unscrew the grip (I) and the extension (N).
- Refit the guide (G) from the inside as shown in the figure.
- Position the bushing on the drift (A) and bring it close up to the seat, making the bushing hole match the lubrication hole in the head. Drive it home.
  The 7th bushing is driven in when the reference mark (C) is flush with the bushing seat.

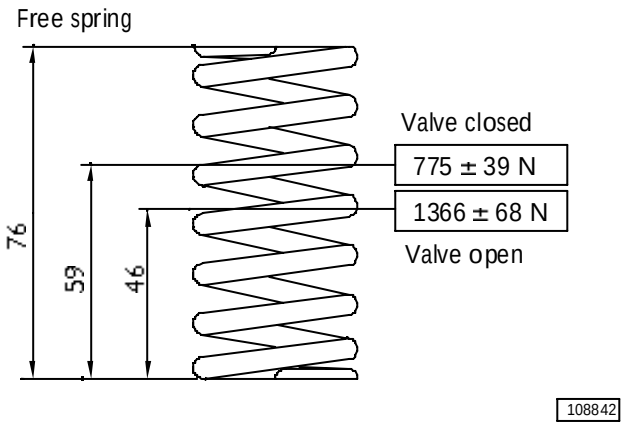
## 540665 Valve springs

Figure 157 (Demonstration)




Before assembly, the flexibility of the valve springs has to be checked with a suitable tool.
Compare the load and elastic deformation data with those of the new springs given in the following figure.

Figure 158

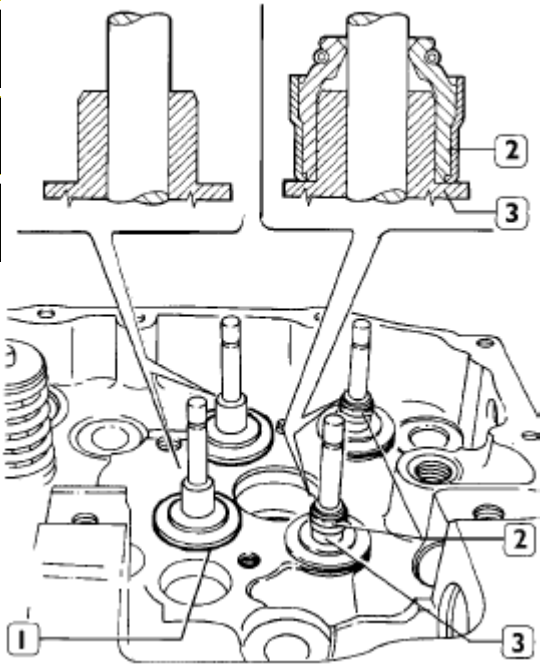



MAIN DATA TO CHECK THE SPRING FOR INTAKE AND EXHAUST VALVES

Aquila Trucks Centres

Fitting valves and oil seal

Figu



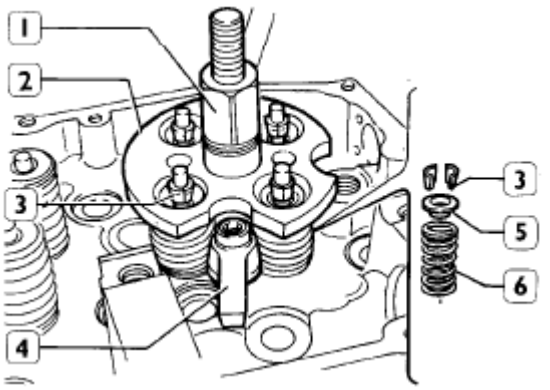

87051

Lubricate the valve stem and insert the valves in the respective valve guides; fit the lower caps (1). Use tool 99360329 to fit the oil seal (2) on the valve guides (3) of the exhaust valves; then, to fit the valves, proceed as follows.

**NOTE** Should valves not have been overhauled or replaced, remount them according to numbering performed on dismounting.

Intake valves are different form exhaust valves in that they have a notch placed at valve head centre.

Figure 160

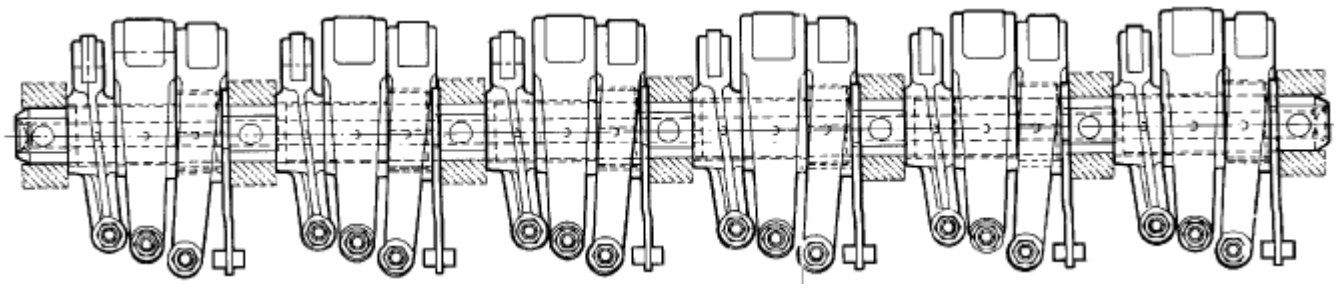



86290

- Mount the springs (6) and the top plate (5).
- Fit the tool 99360263 (2) and secure it with the bracket (4). Screw down the lever (1) to be able to fit on the cotters (3). Take off the tool (2).

## 5412 ROCKER SHAFT

Figure 161



44925

The cams of the camshaft control the rocker arms directly: 6 for the injectors and 12 for the valves.

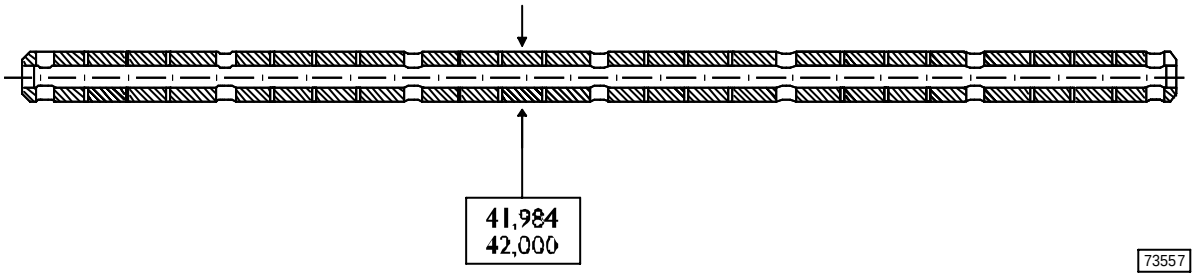
Injectors and intake valves control rocker arms are keyed on rocker arms shaft directly. Exhaust intake valves control rocker arms are keyed on rocker arms shaft putting in between the levers with engine brake control eccentric pin.

The rocker arms run directly on the profiles of the cams by means of rollers.
The other end acts on a crosspiece that rests on the stem of the two valves.
There is a pad between the rocker arm adjustment screw and the crosspiece.
There are two lubrication ducts inside the rocker arms.
The length of the rocker arm shaft is basically the same as that of the cylinder head. It has to be detached to be able to reach all the parts beneath.

Aquila Trucks Centres

## Shaft

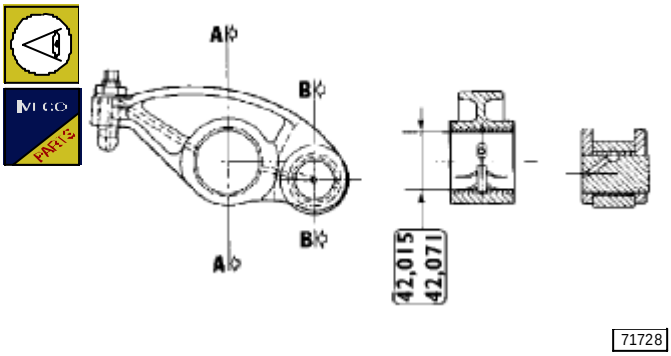
Figure 162




MAIN DATA OF THE ROCKER ARM SHAFT
Check that the surface of the shaft shows no scoring or signs of seizure; if it does, replace it.

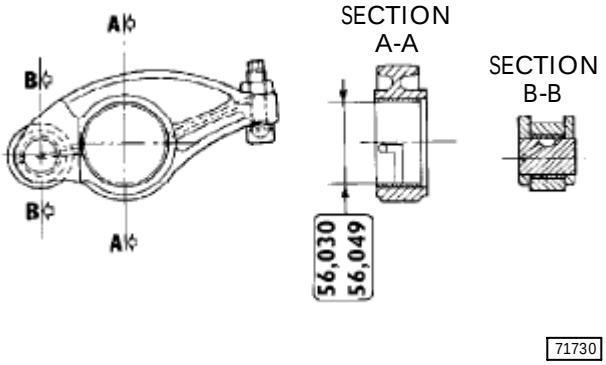
## Rocker arms

Figure 163



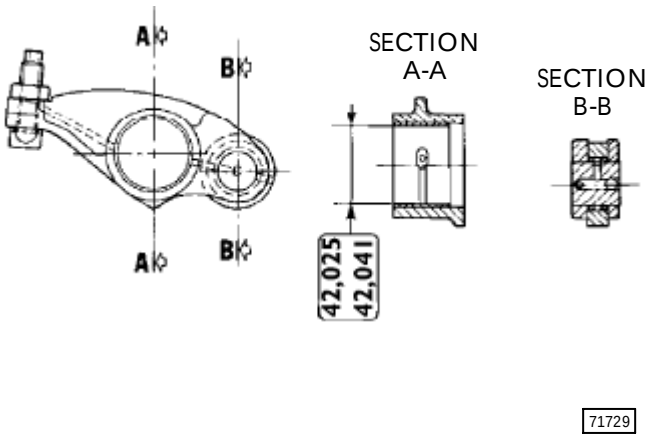

PUMP INJECTOR ROCKER ARMS

Figure 165



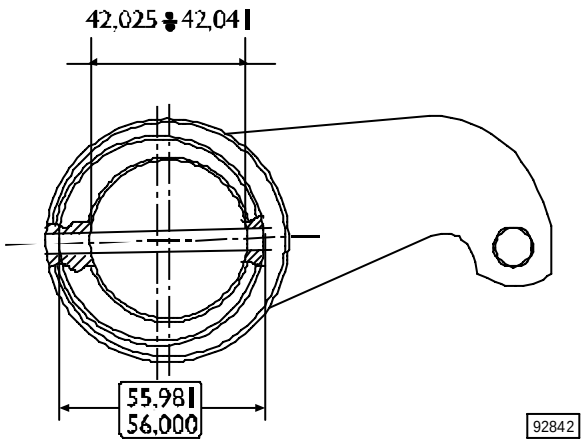

EXHAUST VALVE ROCKER ARM

Figure 164




INTAKE VALVE ROCKER ARMS

Figure 166




LEVER WITH ENGINE BRAKE CONTROL ECCENTRIC PIN

Check the surfaces of the bushings, which must show no signs of scoring or excessive wear; if they do, replace the rocker arm assembly.

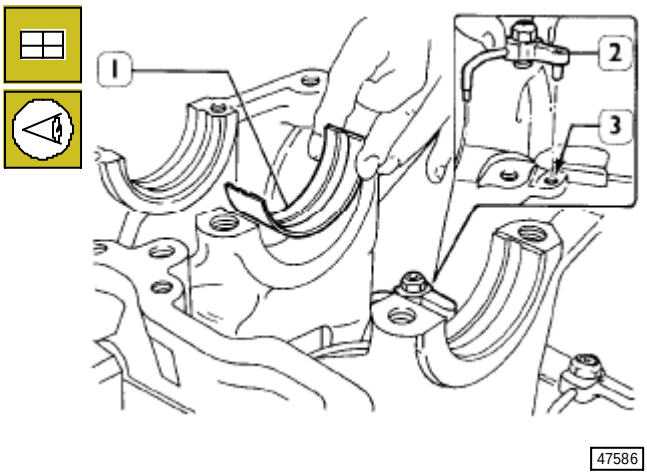
https://truckmanualshub.com/

Aquila Trucks Centres

## ENGINE ASSEMBLY

Using the brackets 99361036, secure the crankcase to the stand 99322230.
Mount the cylinder liners as described on page 179.

Figure 167



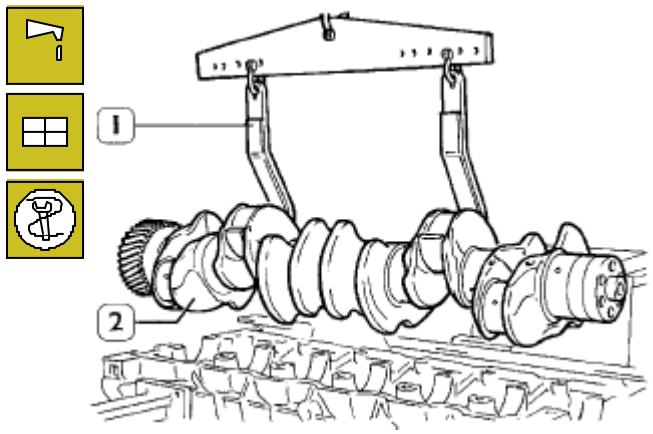

47586

Mount the oil nozzles (2), making the grub screw coincide with the hole (3) in the crankcase.

Arrange the bearing shells (1) on the main bearing housings.

**NOTE** Not finding it necessary to replace the main bearings, you need to fit them back in exactly the same sequence and position as in removal.
Choose main bearings, if they are to be replaced, based on selection described in chapter "Selecting main and big end bearings".

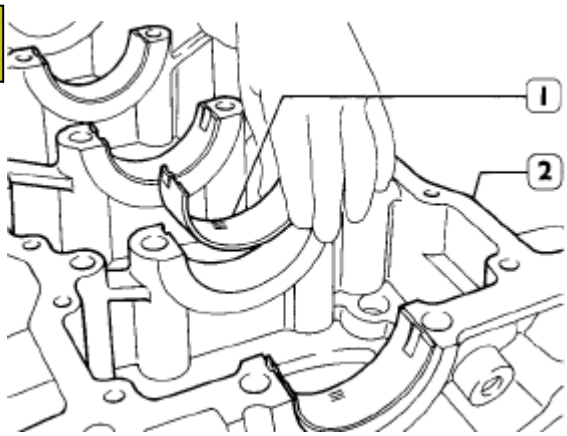
Figure 168




47570

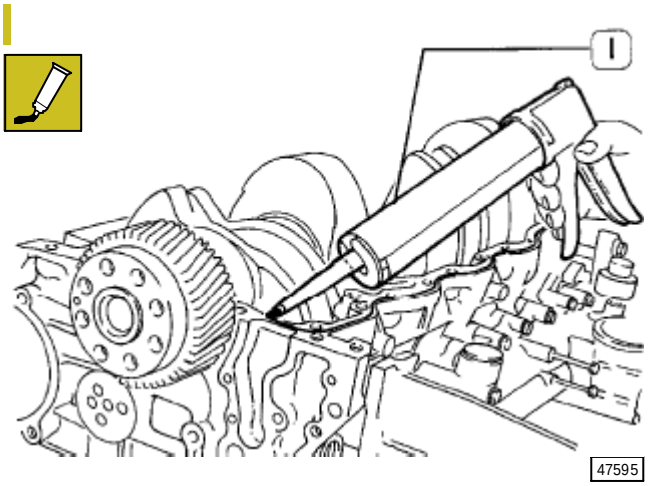
Lubricate the bearing shells then mount the crankshaft (2) using the tackle and hook 99360500 (1).

Figure 169




49021

Arrange the bearing shells (1) on the main bearing housings in the crankcase base (2).

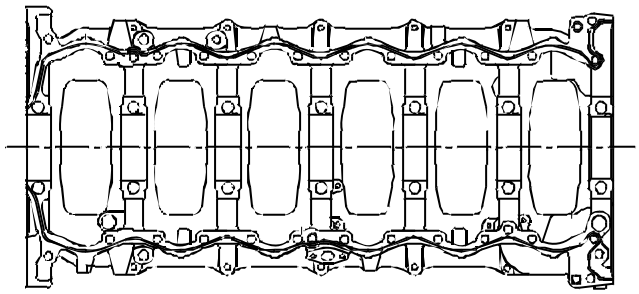



47595

Apply LOCTITE 5970 IVECO No. 2995644 silicone on the crankcase using the appropriate tools (1) as shown in Figure 171.

Aquila Trucks Centres

Figure 171

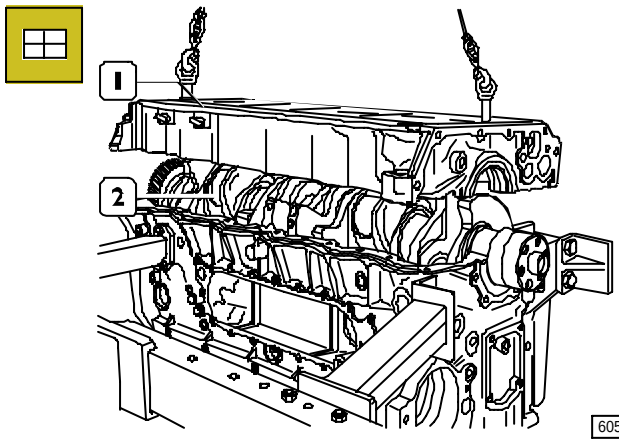


60632

Sealant application diagram.

**NOTE** Mount the lower crankcase within 10 min. of applying the sealant.

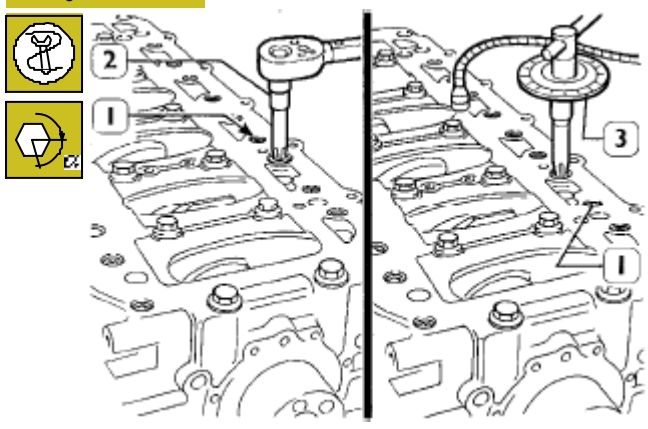
Figure 172




60559

Mount the lower crankcase (1) using appropriate tackle and hooks.

Figure 173

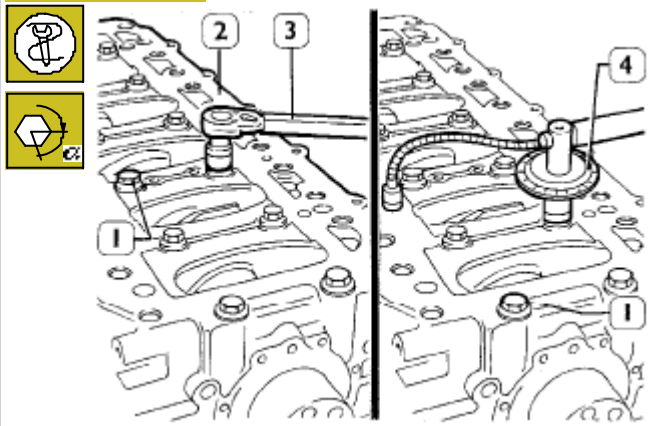



47581

**NOTE** Use new screws whenever removing the bed-plate.

By torque wrench (2), tighten (1) outer Hex splined screws at 30 Nm torque observing the schemes at next page.

Figure 174



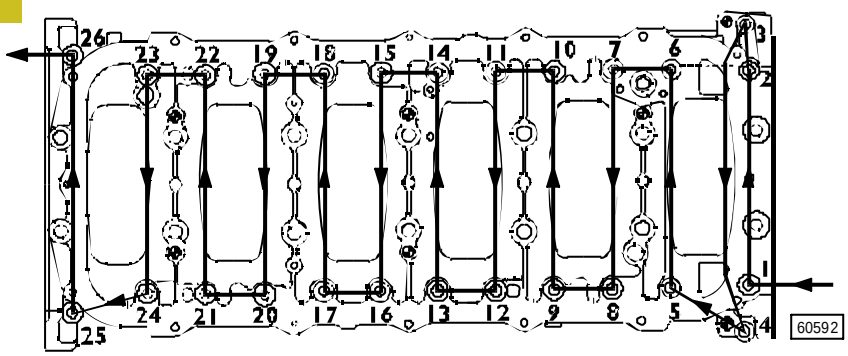

47579

Using a torque wrench (3), tighten the inside screws (1) to a torque of 120 Nm. Then tighten them to an angle of 60° and 55° with tool 99395216 (4) with another two phases. Regrind the outside screws (1, Figure 173) with closure to an angle of 60° using tool 99395216 (4).

Aquila Trucks Centres

Figure 175

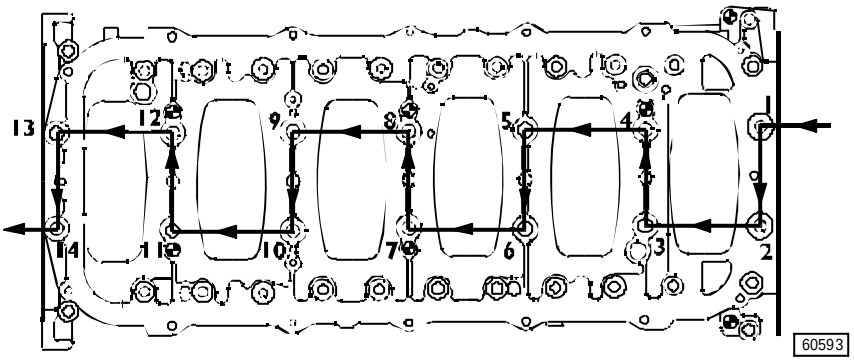
FRONT SIDE




First phase: pre-tightening outside screws

30 Nm

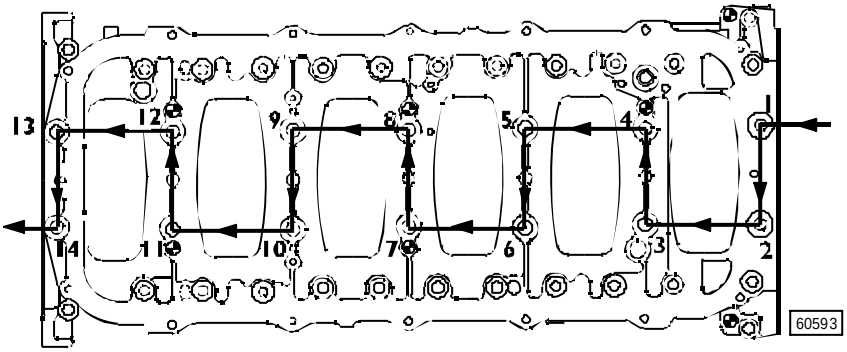
FRONT SIDE




Second phase: pre-tightening inside screws

120 Nm

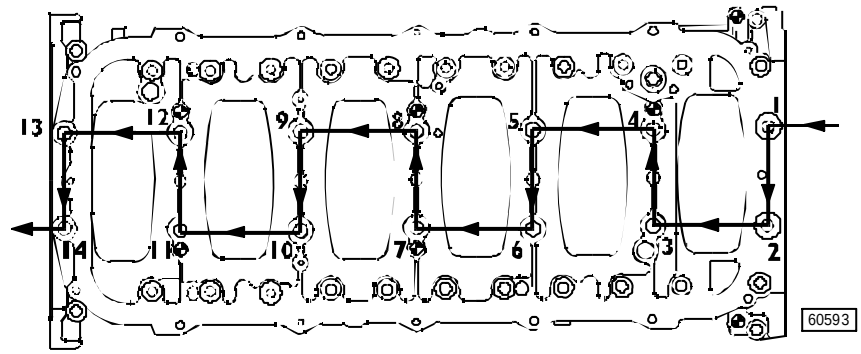
FRONT SIDE




Third phase: closing inside screws to angle

60°

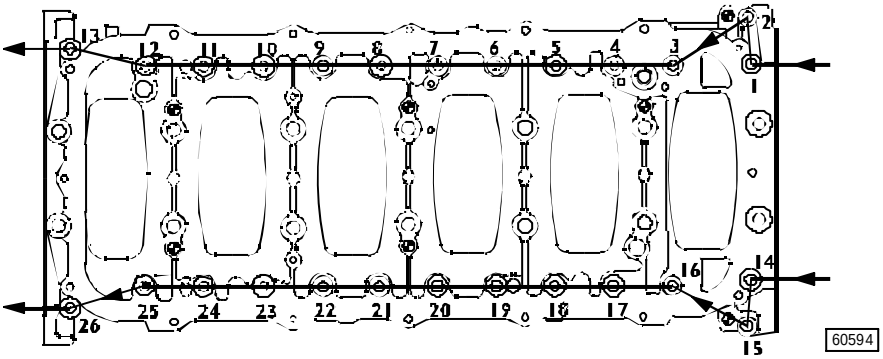
FRONT SIDE




Fourth phase: closing inside ìscrews to angle

55°

FRONT SIDE




Fifth phase: closing outside screws to angle

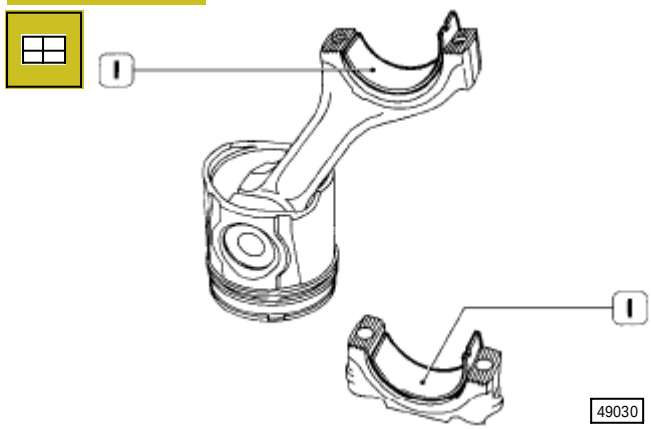
60°

DIAGRAM OF TIGHTENING SEQUENCE OF LOWER CRANKCASE FIXING SCREWS

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## Fitting connecting rod - piston assemblies in cylinder liners

Figure 176

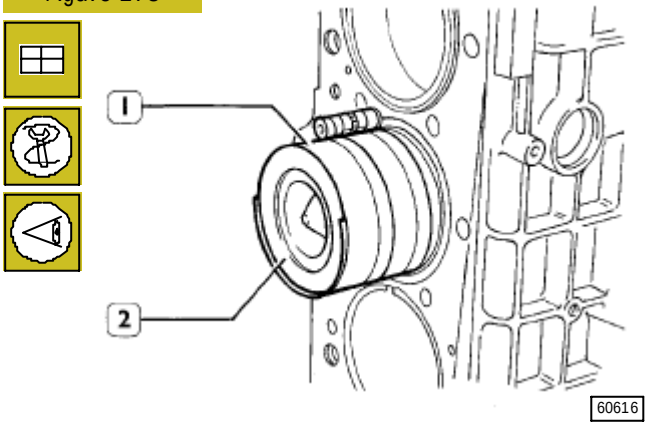



**NOTE** Not finding it necessary to replace the connecting rod bearings, you need to fit them back in exactly the same sequence and position as in removal.
Choose main bearings, if they are to be replaced, based on selection described in chapter "Selecting main and big end bearings".

Lubricate the bearing shells (1 and 3) and fit them on the connecting rod (2) and on the cap (4).

**NOTE** Do not make any adjustment on the bearing shells.

Figure 178

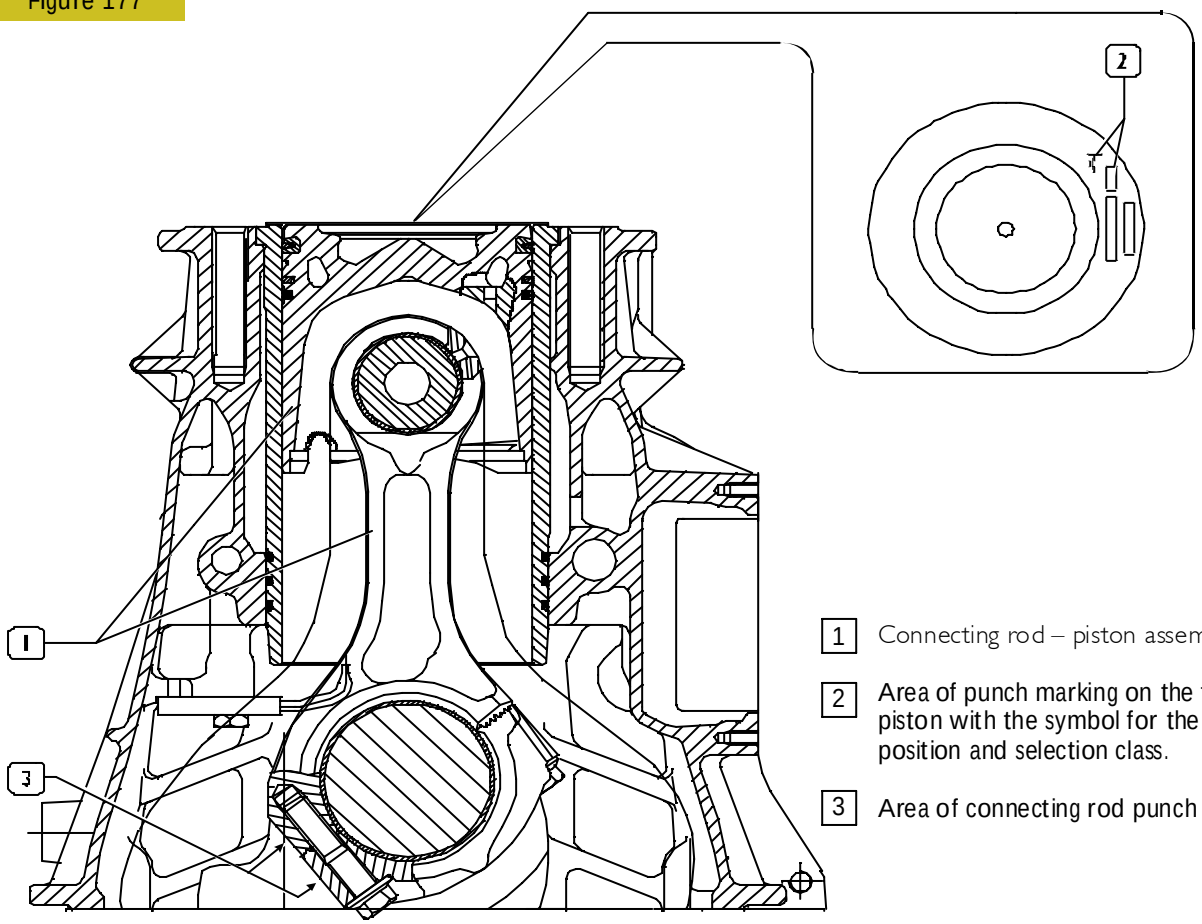



Turn the cylinder block, setting it upright.
Lubricate the pistons, piston rings and inside the cylinder liners. With the aid of the clamp 99360605 (1) mount the connecting rod – piston assemblies (2) in the cylinder liners according to Figure 177. Check that:

- The number of each connecting rod corresponds to the cap coupling number.
- The symbol (2, Figure 177) punched on the top of the pistons faces the engine flywheel or the recess in the piston skirt tallies with the position of the oil nozzles.

**NOTE** The pistons are supplied as spares in class A and can also be fitted in class B cylinder liners.

Figure 177




1 Connecting rod – piston assembly

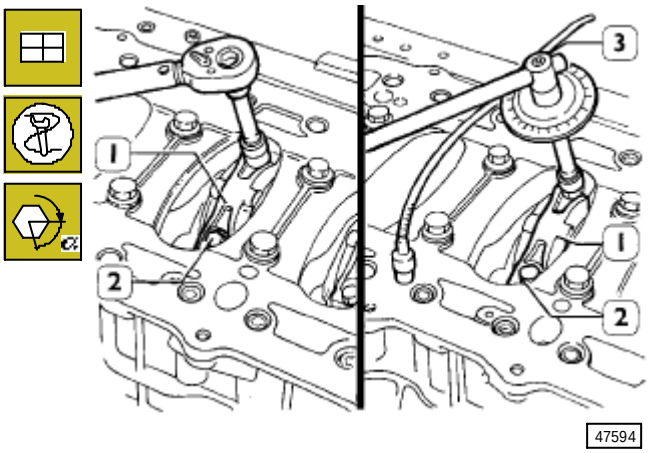
2 Area of punch marking on the top of the piston with the symbol for the mounting position and selection class.

3 Area of connecting rod punch marking

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## Fitting the cylinder head

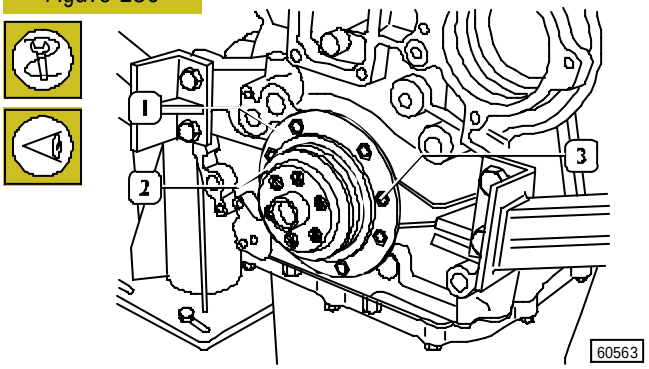
Figure 179




**NOTE** Before reusing the screws (2), measure the diameter of the thread; it must be no less than 13.4 mm; if it is, change the screw.
Lubricate the thread of the screws with engine oil before assembly.

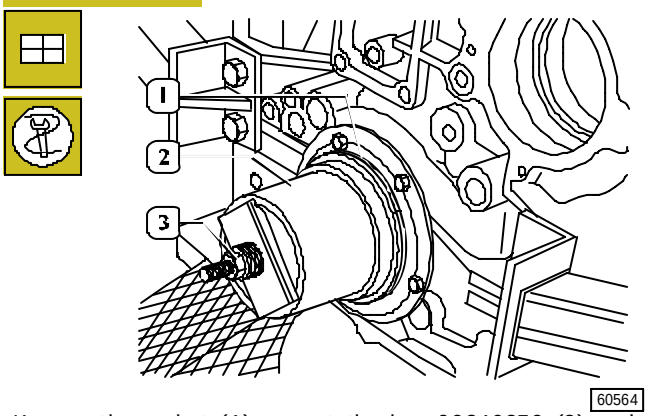
Connect the connecting rods to the relevant pins of the crankshaft, mount the connecting rod caps (1) together with the bearing shells. Tighten the screws (2) fixing the connecting rod caps to a torque of 60 Nm (6 kgm). Using tool 99395216 (3), tighten the screws further with an angle of 60°.

Figure 180



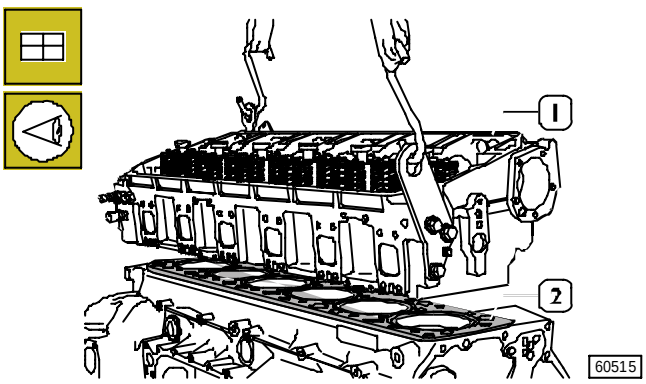

Using the centring ring 99396035 (2), check the exact position of the cover (1). If it is wrong, proceed accordingly and lock the screws (3).

Figure 181




Key on the gasket (1), mount the key 99346250 (2) and, screwing down the nut (3), drive in the gasket (1).

Figure 182




Check that the pistons 1-6 are exactly at the T.D.C.
Put the gasket (2) on the crankcase.

**NOTE** Use new screws whenever removing the cylinder head.

Mount the cylinder head (1) and tighten the screws as shown in Figs. 183, 184 and 185.

**NOTE** Lubricate the thread of the screws with engine oil before assembly.

Figure 183

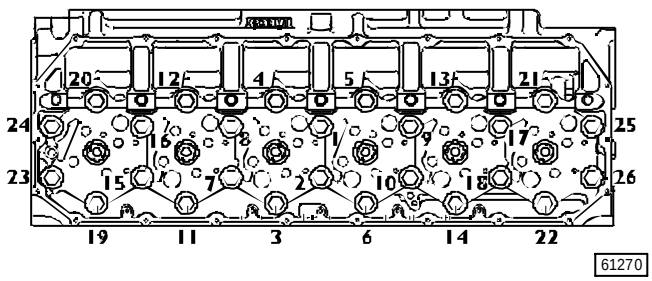
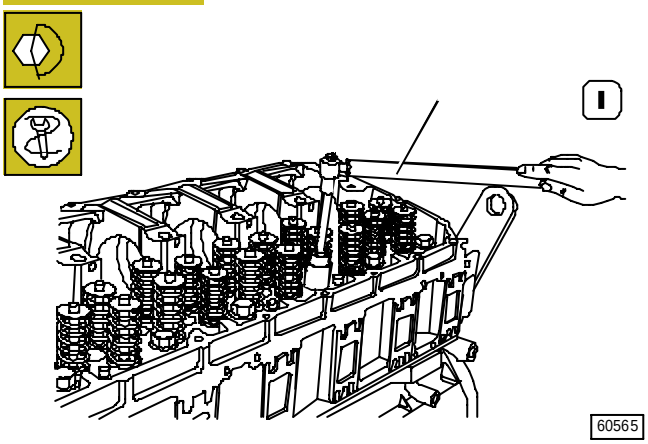



Diagram of the tightening sequence of the screws fixing the cylinder head.

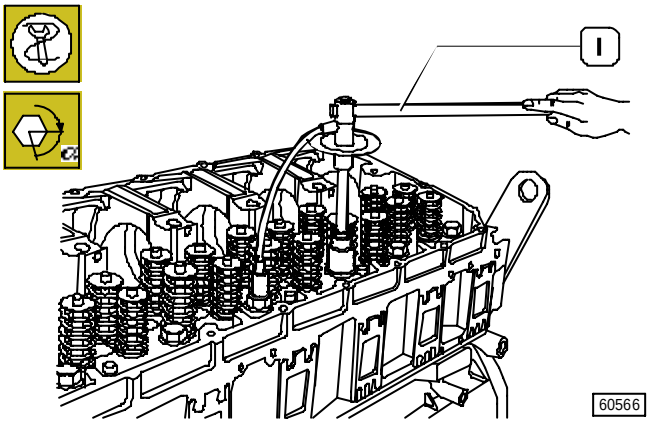
Figure 184




- Pre-tightening with the torque wrench (1):
  1st phase: 60 Nm (6 kgm).
  2nd phase: 120 Nm (12 kgm).

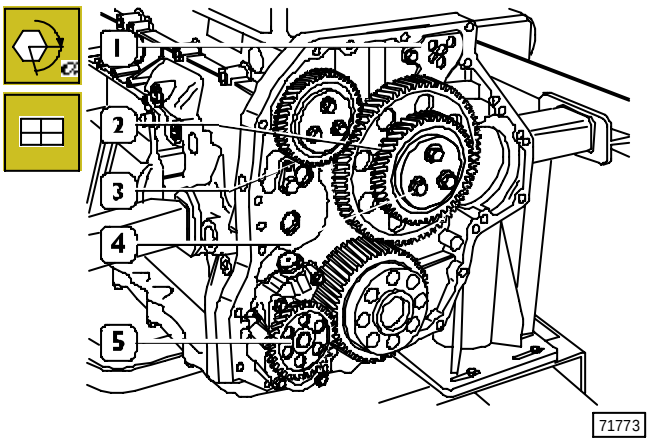
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Figure 185




- Closing to angle with tool 99395216 (1):
  3rd phase: angle of 90°
  4th phase: angle of 65°.

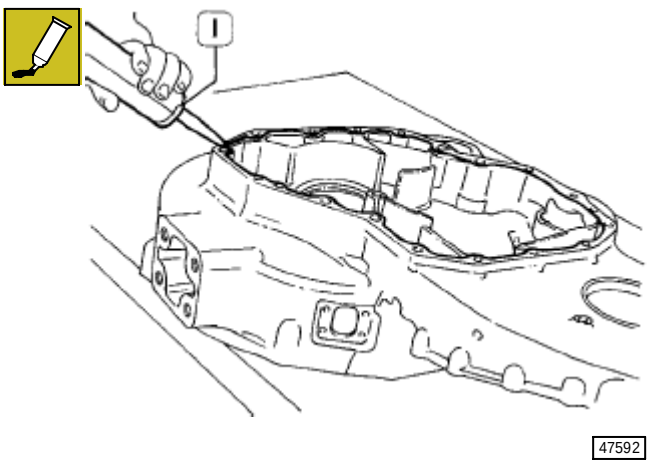
Figure 186




Mount the oil pump (5), the middle gears (2) together with the link rod (1) and the PTO driving gear (3).
Tighten the screws (4) to the required torque.

## Fitting flywheel housing

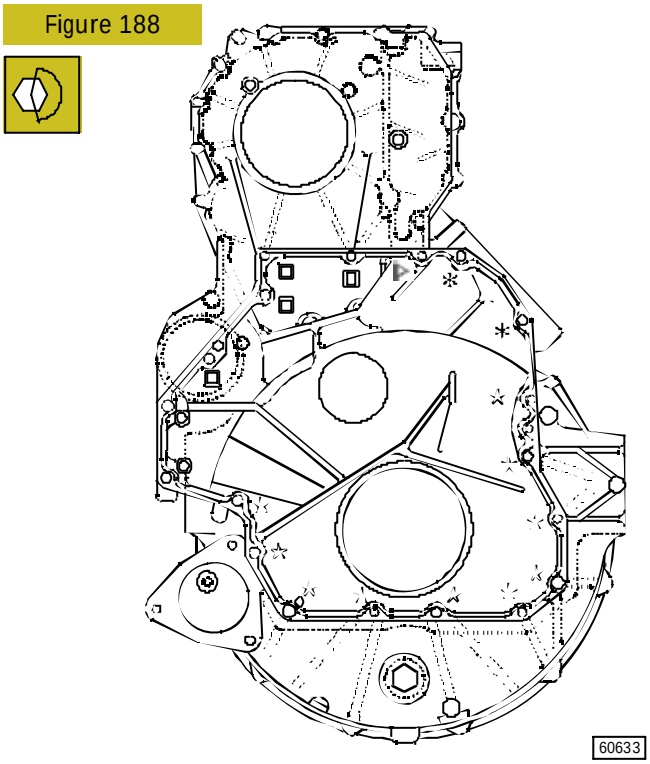
Figure 187




Apply LOCTITE 5970 IVECO No. 2995644 silicone on the flywheel using appropriate tools (1) as shown in the figure.

**NOTE** Mount the gear housing within 10 min. of applying the sealant.

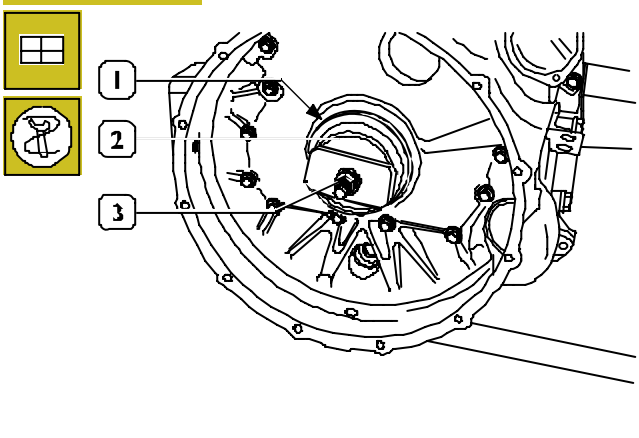
Figure 188




Using a torque wrench, tighten the highlighted screws with the following sequence and torque:

| | | |
|---|---|---|
| ✲ | 10 screws M12 x 1.75 x 100 | 56 to 70 Nm |
| ○ | 2 screws M12 x 1.75 x 70 | 56 to 70 Nm |
| □ | 4 screws M12 x 1.75 x 35 | 56 to 70 Nm |
| △ | 1 screw M12 x 1.75 x 120 | 56 to 70 Nm |
| : | 2 screws M12 x 1.75 x 193 | 56 to 70 Nm |

Figure 189




Key on the gasket (1), fit the key 99346251 (2) and, screwing down the nut (3), drive in the gasket.

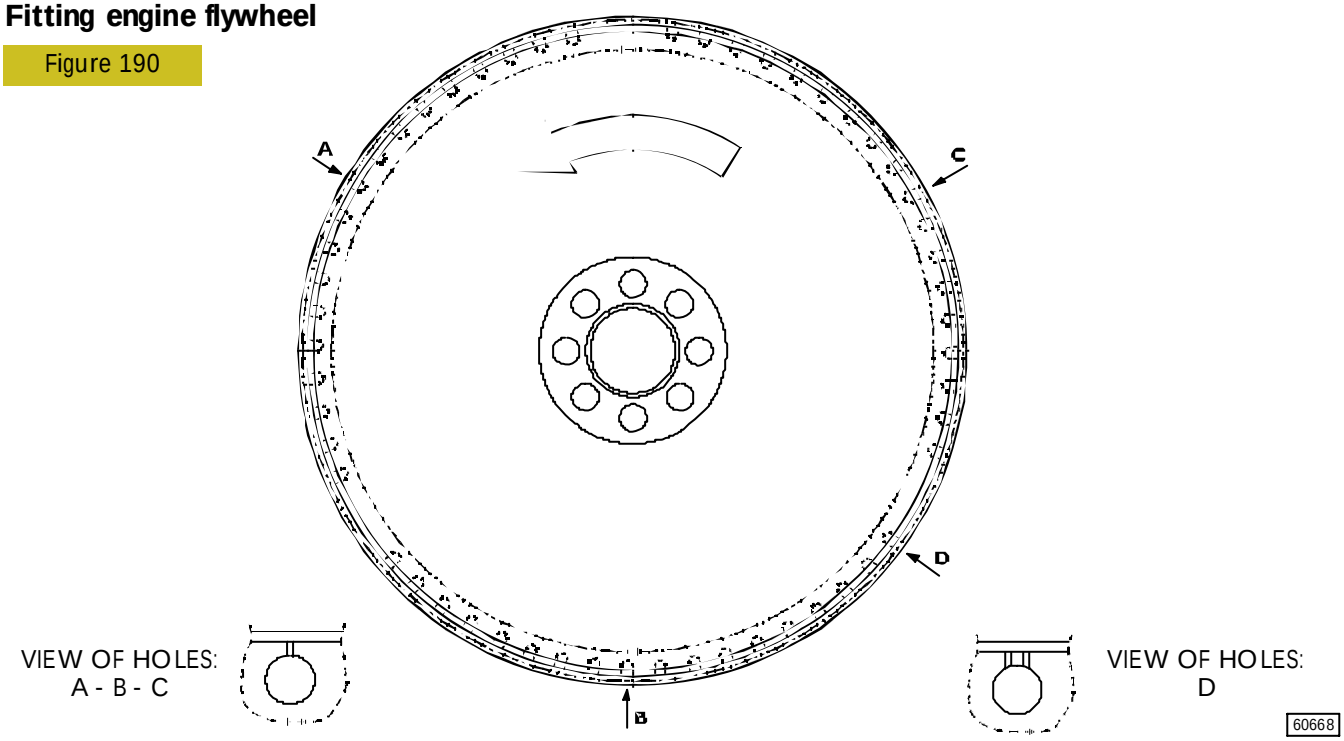
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## 540850 ENGINE FLYWHEEL

### Fitting engine flywheel

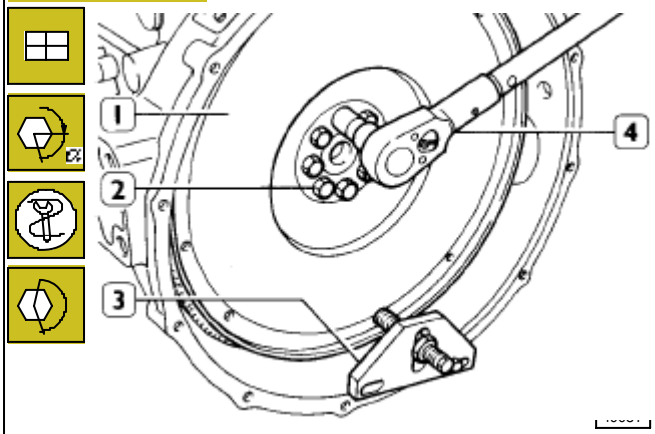
Figure 190




DETAIL OF PUNCH MARKS ON ENGINE FLYWHEEL FOR PISTON POSITIONS
A. Hole on flywheel with one reference mark, corresponding to the TDC of pistons 3-4. - B. Hole on flywheel with one reference mark, corresponding to the TDC of pistons 1-6. - C. Hole on flywheel with one reference mark, corresponding to the TDC of pistons 2-5. - D. Hole on flywheel with two reference marks, position corresponding to 54°.

**NOTE** If the teeth of the ring gear mounted on the engine flywheel, for starting the engine, are very damaged, replace the ring gear. It must be fitted after heating the ring gear to a temperature of approx. 200°C.

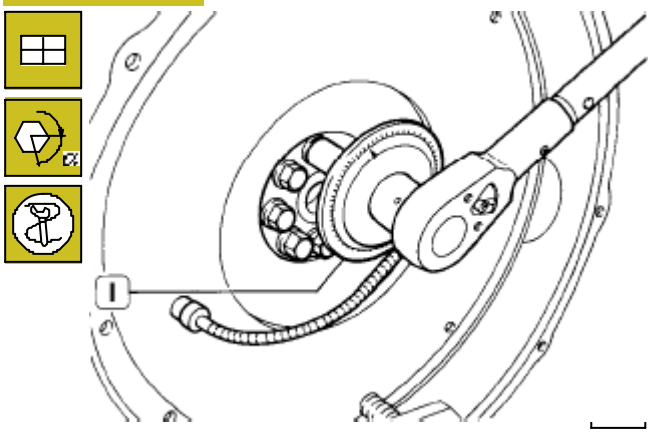
Figure 191




**NOTE** The crankshaft has a locating peg that has to couple with the relevant seat on the engine flywheel.

Position the flywheel (1) on the crankshaft, lubricate the thread of the screws (2) with engine oil and screw them down. Lock rotation with tool 99360351 (3). Lock the screws (2) in three phases.
First phase: pre-tightening with torque wrench (4) to a torque of 120 Nm (12 kgm).

Figure 192

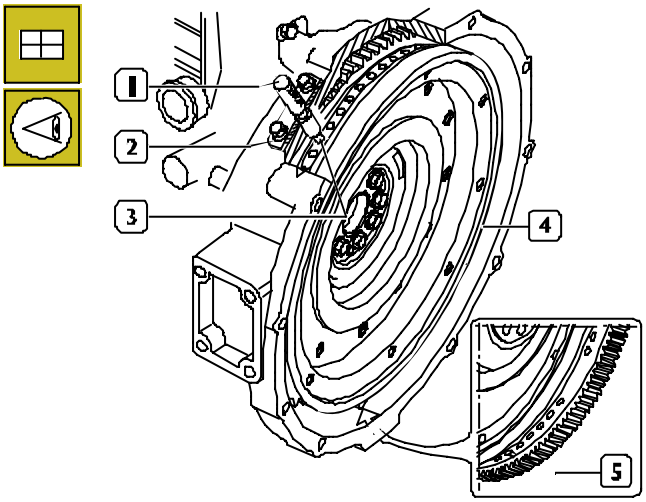



Second phase: closing to angle of 90° with tool 99395216 (1).

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## Fitting camshaft

Figure 193



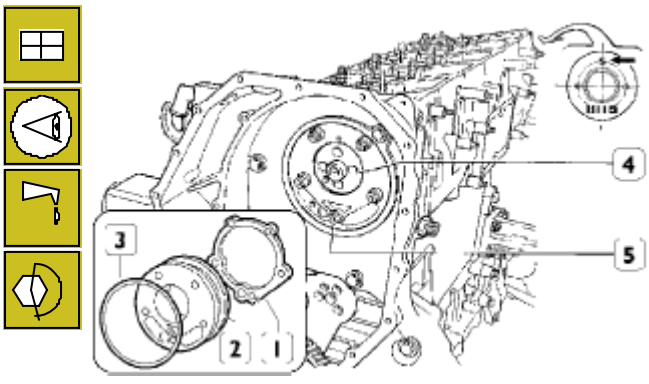

72436

Position the crankshaft with the pistons 1 and 6 at the top dead centre (T.D.C.).
This situation occurs when:

1. The hole with reference mark (5) of the engine flywheel (4) can be seen through the inspection window.
2. The tool 99360612 (1), through the seat (2) of the engine speed sensor, enters the hole (3) in the engine flywheel (4).

If this condition does not occur, turn the engine flywheel (4) appropriately.
Remove the tool 99360612 (1).

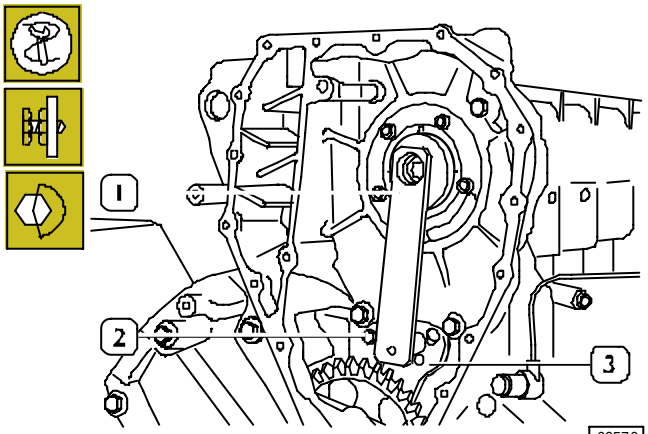
Figure 194




73843

Fit the camshaft (4), positioning it observing the reference marks (→) as shown in the figure.
Lubricate the seal (3) and fit it on the shoulder plate (2).
Mount the shoulder plate (2) with the sheet metal gasket (1) and tighten the screws (5) to the required torque.

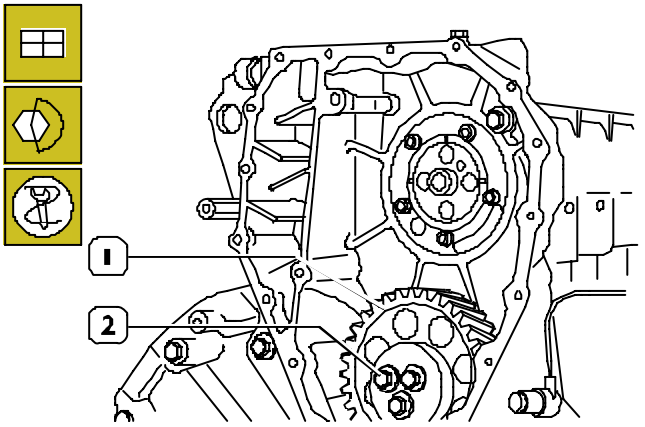
Figure 195




60570

- Apply the gauge 99395219 (1). Check and adjust the position of the link rod (3) for the idle gear. Lock the screw (2) to the required torque.

Figure 196

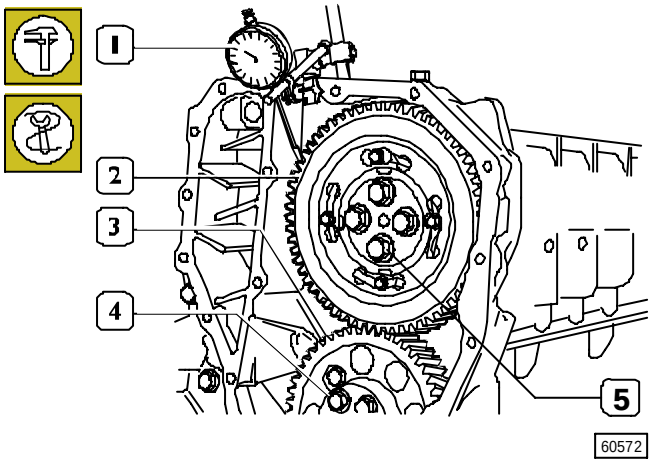



60571

- Fit the idle gear (1) back on and lock the screws (2) to the required torque.

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Figure 197

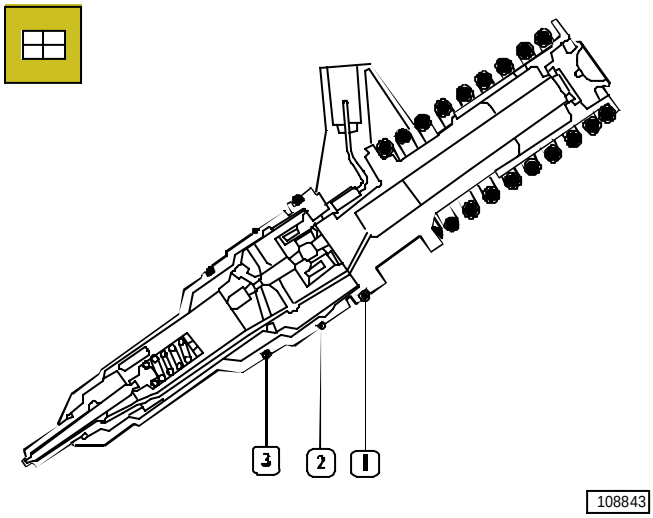



Position the gear (2) on the camshaft so that the 4 slots are centred with the holes for fixing the camshaft, without fully locking the screws (5).
Using the dial gauge with a magnetic base (1), check that the clearance between the gears (2 and 3) is 0.074 – 0.195 mm; if this is not so, adjust the clearance as follows:

- Loosen the screws (4) fixing the idle gear (3).
- Loosen the screw (2, Figure 195) fixing the link rod. Shift the link rod (3, Figure 195) to obtain the required clearance.
- Lock the screw (2, Figure 195) fixing the link rod and screws (4, Figure 197) fixing the idle gear to the required torque.

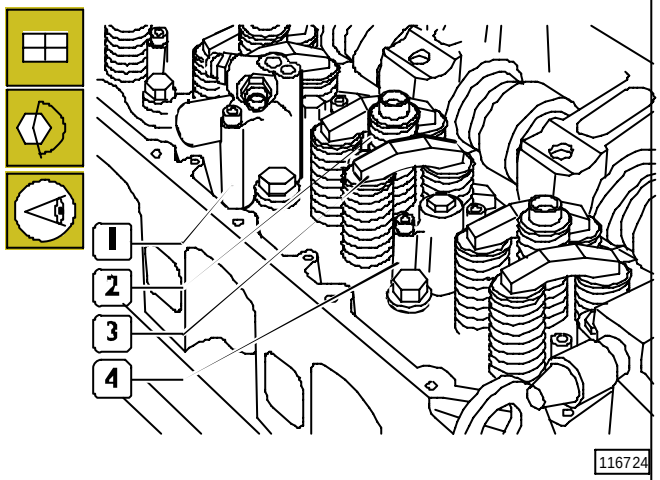
## Fitting pump-injectors

Figure 198




Fit the seals (1) (2) (3) on the injectors.

Figure 199



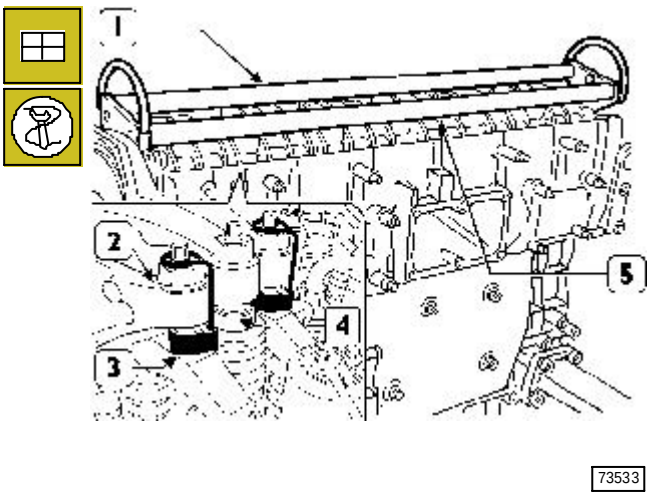

Mount:

- The injectors (2) and, using a torque wrench, lock the bracket fixing screws to a torque of 30 ÷ 35 Nm.
- The exhaust brake cylinders (1) and (4) and, using a torque wrench, fix them to a torque of 19 Nm.
- The crosspieces (3) on the valve stem, all with the largest hole on the same side.

## Fitting rocker-arm shaft assembly

**NOTE** Before refitting the rocker-arm shaft assembly, make sure that all the adjustment screws have been fully unscrewed.

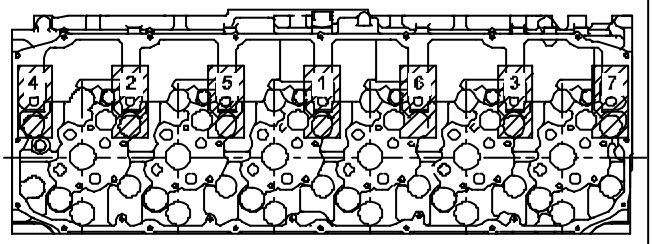
Figure 200




Using tool 99360144 (3), fasten the blocks (4) to the rocker arms (2).
Apply the tool 99360553 (1) to the rocker arm shaft (5) and mount the shaft on the cylinder head.

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Figure 201

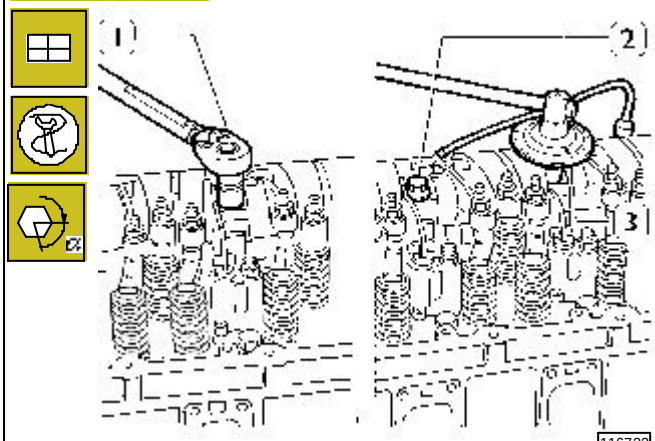



70567A

SCHEME OF SCREW TIGHTENING SEQUENCE SECURING ROCKER ARMS

Screw screws (1 - 2 - 3) until rocker arms are brought to contact relating seats on cylinder head, tighten the screws according to sequence indicated in figure operating in two steps as indicated in successive figure.

Figure 202

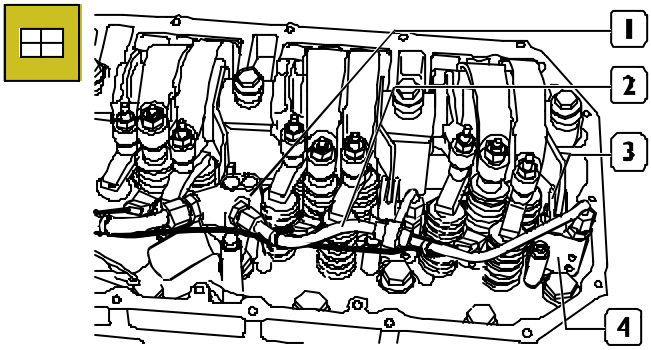



116722

Lock the screws (2) fixing the rocker-arm shaft as follows:

- 1st phase: tightening to a torque of 80 Nm (8 kgm) with the torque wrench (1).
- 2nd phase: closing with an angle of 60° using the tool 99395216 (3).

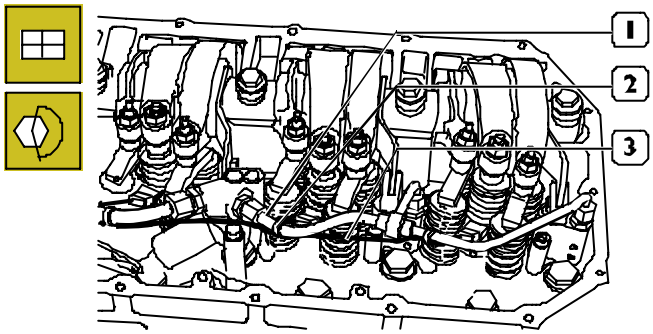
Figure 203




117548

- Mount the engine brake lever retaining springs (3).
- Connect the pipe (2) to the engine brake cylinders (4) and to the cylinder with the engine brake solenoid valve (1).

Figure 204

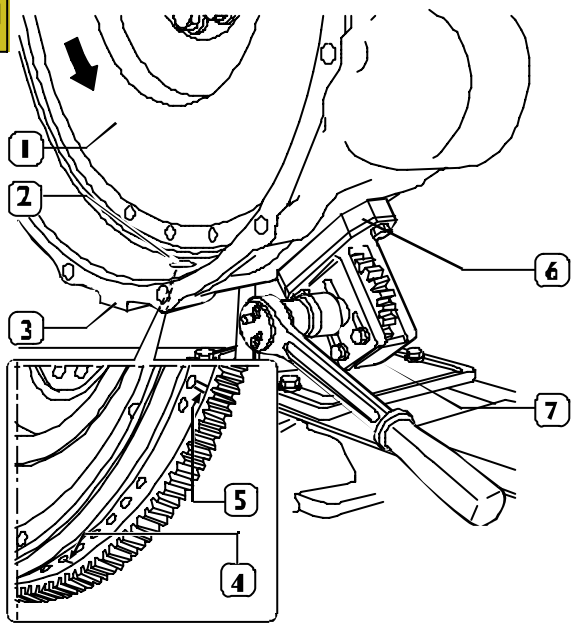



117543

Use strips (2) to fix cable (3) to pipe (1) corresponding to white color notches machined both on cable and on pipe.

**Camshaft timing**

Figure 205




71776

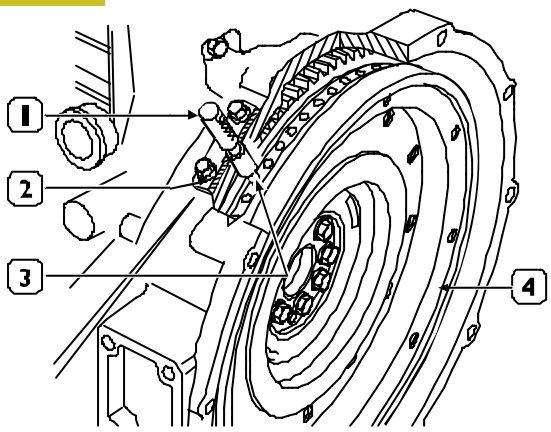
Apply tool 99360321 (7) and spacer (6) to gears housing (3).

**NOTE** The arrow shows the direction of rotation of the engine when running.
Using the above-mentioned tool, turn the flywheel (1) in the direction of rotation of the engine so as to take the piston of cylinder no.1 to approximately the T.D.C. in the phase of combustion.
This condition occurs when the hole with one reference mark (4), after the hole with two reference marks (5) on the engine flywheel (1), can be seen through the inspection window (2).

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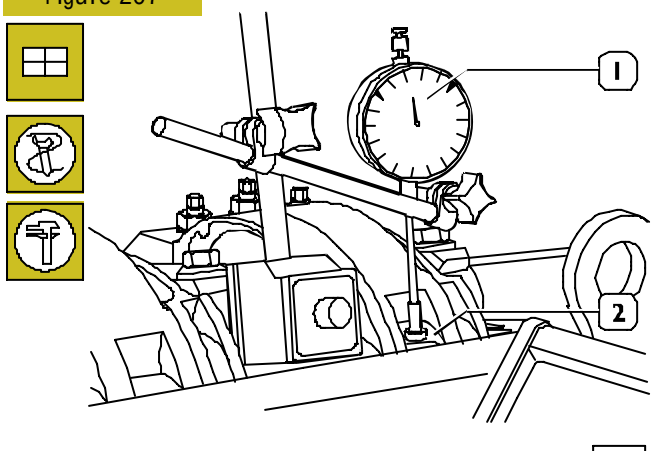
Figure 206




71774

The exact position of piston no.1 at the T.D.C. is obtained when in the above-described conditions the tool 99360612 (1) goes through the seat (2) of the engine speed sensor into the hole (3) in the flywheel (4).
If this is not the case, turn and adjust the flywheel (4) appropriately.
Remove the tool 99360612 (1).

Figure 207




106535

Set the dial gauge with the magnetic stand (1) with the rod (flat based) on the roller (2) of the rocker arm that governs the injector of cylinder no.1 and pre-load it by 6 mm.

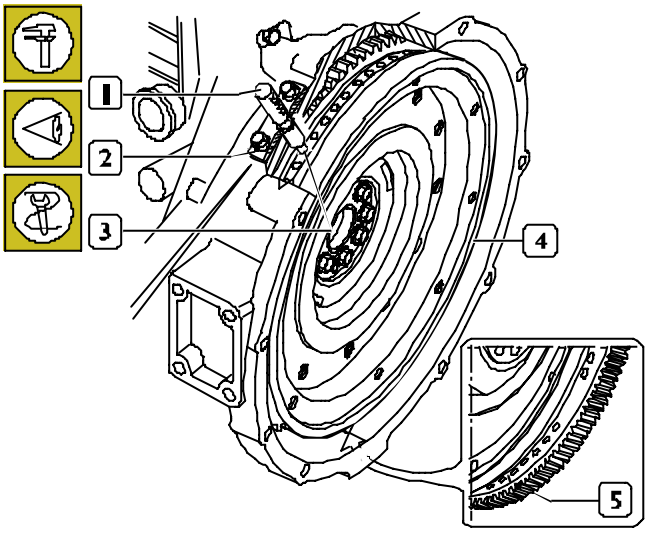
**NOTE** During the measurement, the dial gauge rod must always be at right angles to the engine centre line and NOT to the head surface.

With tool 99360321 (6, Figure 205), turn the crankshaft clockwise until the pointer of the dial gauge reaches the minimum value beyond which it can no longer fall.

Reset the dial gauge.

Turn the flywheel anticlockwise until the dial gauge gives a reading for the lift of the cam of the camshaft of 5.33±0.05 mm.

Figure 208

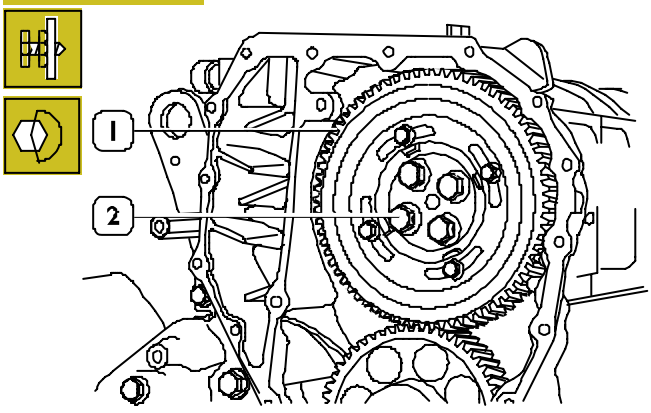



77259

The camshaft is in step if at the cam lift values of 5.33±0,05 mm there are the following conditions:

1) a notch (5) can be seen through the inspection window;
2) the tool 99360612 (1) through the seat (2) of the engine speed sensor goes into the hole (3) in the engine flywheel (4).

Figure 209



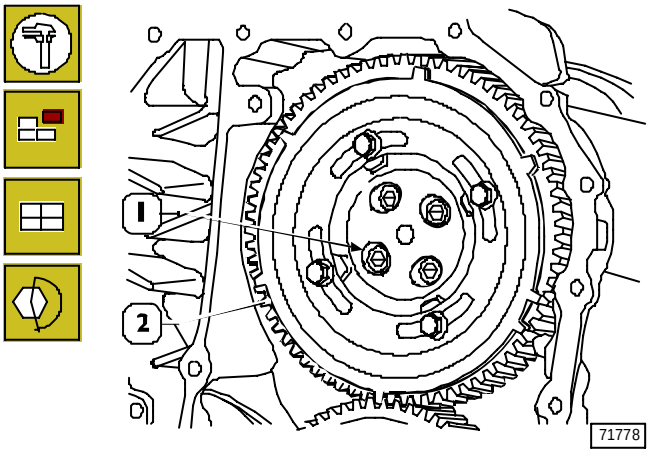

60575

If you do not obtain the conditions illustrated in Figure 208 and described in points 1 and 2, proceed as follows:

1) loosen the screws (2) securing the gear (1) to the camshaft and utilize the slots (1) on the gear (2, Figure 210);
2) turn the flywheel appropriately so as to bring about the conditions described in points 1 and 2 Figure 208, it being understood that the cam lift must not change at all;
3) lock the screws (2) and repeat the check as described above;
4) tighten the screws (2) to the required torque.

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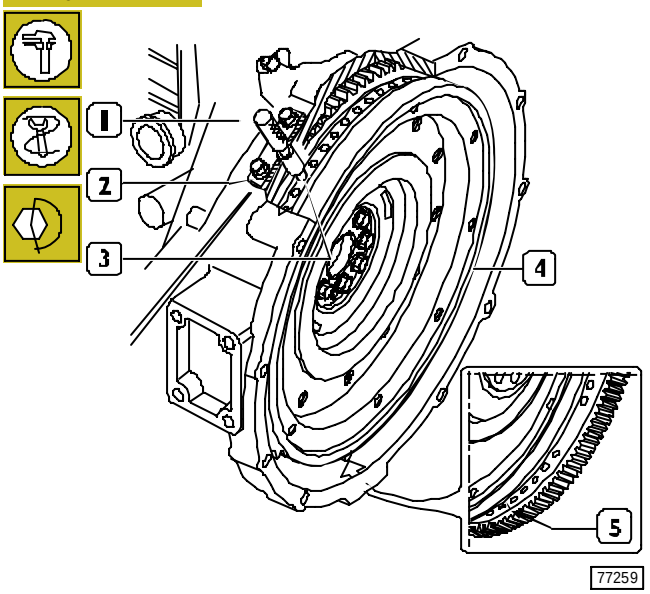
Figure 210




When the adjustment with the slots (1) is not enough to make up the phase difference and the camshaft turns because it becomes integral with the gear (2); as a result, the reference value of the cam lift varies, in this situation it is necessary to proceed as follows:

1) lock the screws (2, Figure 209) and turn the engine flywheel clockwise by approx. 1/2 turn;
2) turn the flywheel anticlockwise until the dial gauge gives a reading of the lift of the cam of the camshaft of 5.33 ±0.05 mm;
3) take out the screws (2, Figure 209) and remove the gear (2) from the camshaft.

Figure 211



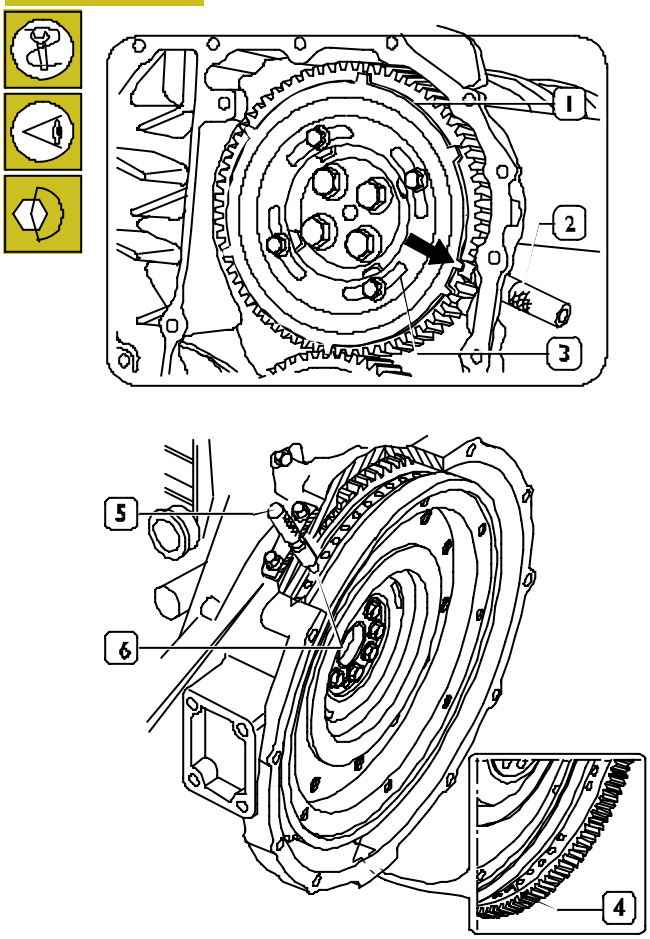

Turn the flywheel (4) again to bring about the following conditions:

- a notch (5) can be seen through the inspection window;
- the tool 99360612 (1) inserted in the hole (3) in the flywheel (4) through the seat (2) of the engine speed sensor.

Mount the gear (2, Figure 210) with the 4 slots (1, Figure 210) centred with the fixing holes of the camshaft, locking the relevant screws to the required tightening torque. Check the timing of the shaft by first turning the flywheel clockwise to discharge the cam completely and then turn the flywheel anticlockwise until the dial gauge gives a reading of 5.33 ±0.05 mm.
Check the timing conditions described in Figure 208.

## Phonic wheel timing

Figure 212




Turn the crankshaft by taking the piston of cylinder no. 1 into the compression phase at T.D.C.; turn the flywheel in the opposite direction to the normal direction of rotation by approximately 1/4 of a turn.

Again turn the flywheel in its normal direction of rotation until you see the hole marked with the double notch (4) through the inspection hole under the flywheel housing. Insert tool 99360612 (5) into the seat of the flywheel sensor (6).

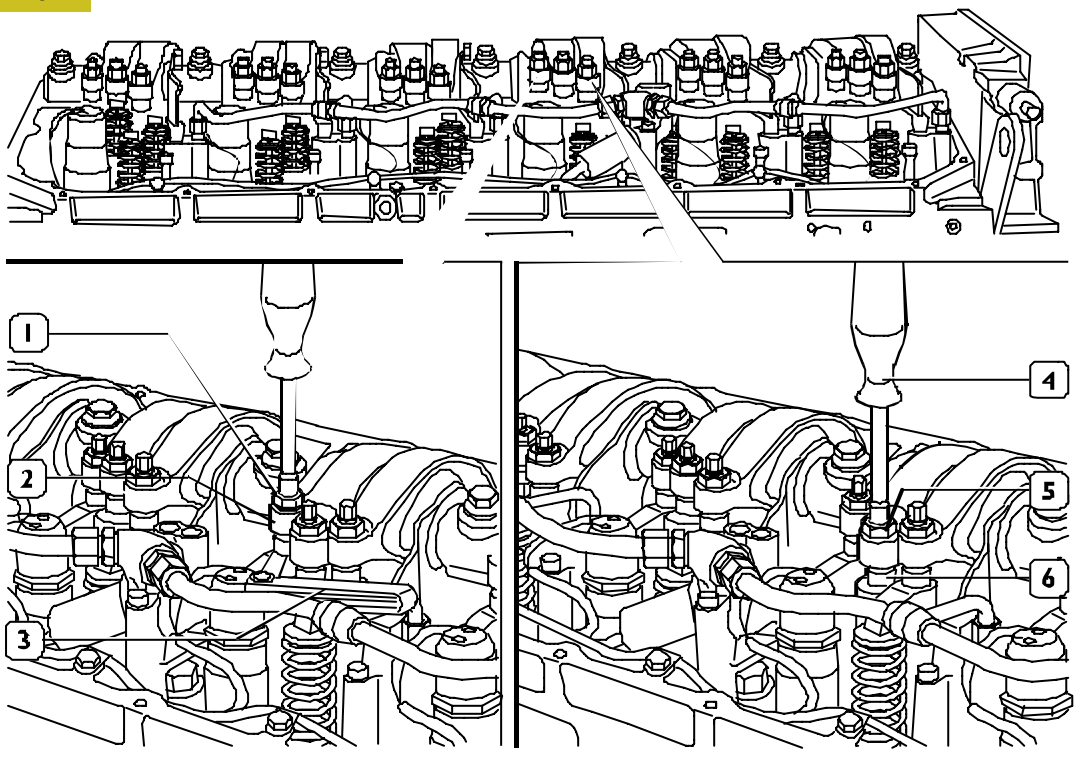
Insert the tool 99360613 (2), via the seat of the phase sensor, onto the tooth (↑) obtained on the phonic wheel.

Should inserting the tool (2) prove difficult, loosen the screws (3) and adjust the phonic wheel (1) appropriately so that the tool (2) gets positioned on the tooth correctly. Go ahead and tighten the screws (3).

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## Adjust intake and exhaust rocker arm clearance, and pump injector preload

Figure 213




ADJUSTING INTAKE, EXHAUST AND INJECTION ROCKER ARMS

The adjustment of the clearance between the rocker arms and the crosspieces governing the intake and exhaust valves and the adjustment of the pre-load of the pump injector governing rocker arms has to be done very conscientiously.

Take the cylinder whose clearance you want to adjust into the combustion phase. The valves of this cylinder are closed while they balance those of the symmetric cylinder.
The symmetric correspondence of the cylinders is 1 - 6, 2 - 5 and 3 - 4.
To perform these operations correctly, proceed as described below and as illustrated in the table.

Adjusting clearance between rocker arms and crosspieces governing the intake and exhaust valves

- Using a box wrench, loosen the nut (1) locking the adjustment screw.
- Insert the strip of feeler gauge (3) corresponding to the working clearance (page 133);
- Use a suitable wrench to screw or unscrew rocker arm (2) adjusting screw.
- Check that the blade of the feeler gauge (3) can slide with a light amount of friction.
- Lock the nut (1) holding the adjustment screw still.

Pre-load of pump injector governing rocker arms

- Using a box wrench, loosen the nut locking the adjustment screw of the rocker arms (5) governing the pump injector (6).
- With a suitable wrench (4), screw down the adjustment screw to take the pumping element to its limit.
- Tighten the adjustment screw with a torque wrench to a torque of 5 Nm (0.5 kgm).
- Unscrew the adjustment screw by 1/2 ÷ 3/4 of a turn.
- Tighten the locking nut to a torque of 39 Nm (3.9 kgm).

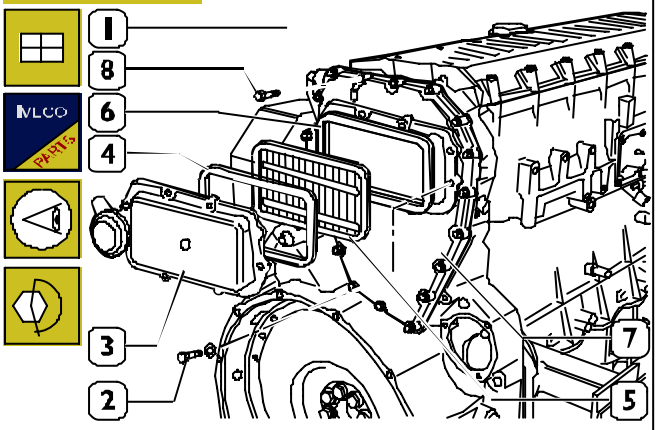
FIRING SEQUENCE 1 - 4 - 2 - 6 - 3 - 5

| Starting and clockwise rotation | Balance valves of cylinder no. | Adjust clearance of valves of cylinder no. | Adjust pre-load of injectors of cylinder no. |
|---|---|---|---|
| 1 and 6 at TDC | 6 | 1 | 5 |
| 120° | 3 | 4 | 1 |
| 120° | 5 | 2 | 4 |
| 120° | 1 | 6 | 2 |
| 120° | 4 | 3 | 6 |
| 120° | 2 | 5 | 3 |

**NOTE** To perform the above adjustments correctly, it is mandatory to follow the sequence given in the table, checking the position at each phase of rotation with the pin 99360612 to be inserted in hole identified by a notch on flywheel, corresponding to TPD (see detail figure 190).

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Figure 214



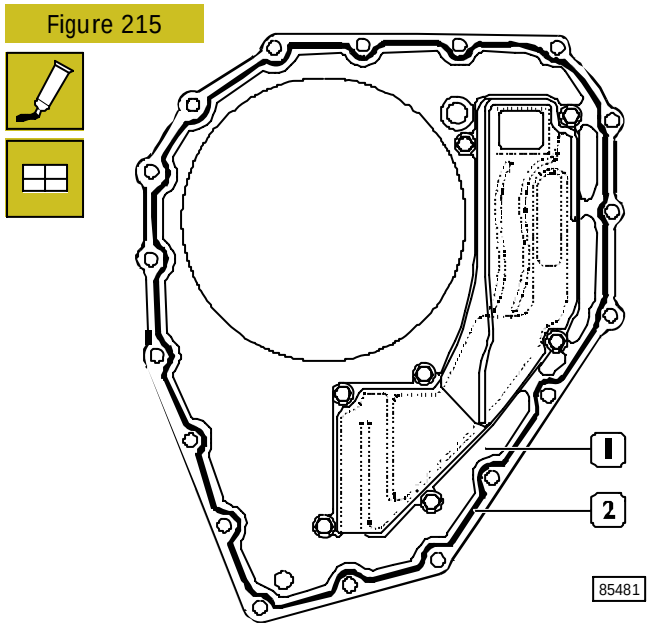

Fit the rocker cover (1).
Fit the blow-by case (7) and its gasket and then tighten the screws (8) to the prescribed torque.
Install the filter (5) and the gaskets (4 and 6).

**NOTE** The filter (5) operation is unidirectional, therefore it must be assembled with the two sight supports as illustrated in the figure.

Fit the cover (3) and tighten the fastening screws (2) to the prescribed torque.

**NOTE** Apply silicone LOCTITE 5970 (IVECO No. 2995644) on the blow-by case (7) surface of engines fitted with P.T.O. according to the procedure described in the following figure.

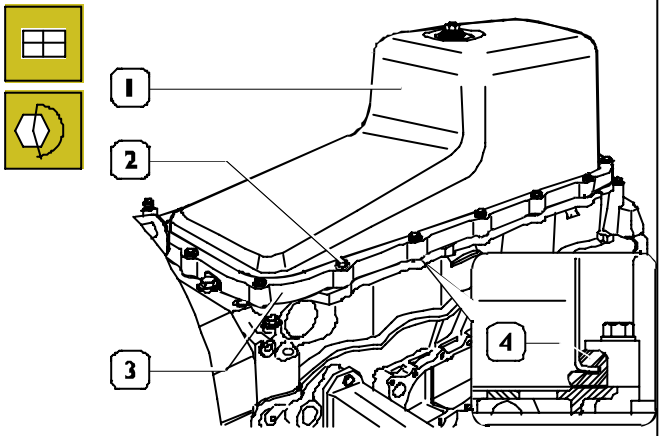
Figure 215




Apply silicone LOCTITE 5970 (IVECO No. 2995644) on the blow-by case and form a string (2) of ∅ 1,5 $^{0.5}_{0.2}$ as shown in the figure.

**NOTE** Fit the blow-by case (1) within 10' from sealer application.

Figure 216




Turn engine and mount oil rose pipe.
Arrange gasket (4) on oil sump (1), position frame (3) and mount the sump on engine block screwing up screws (2) at prescribed torque:

## Completing Engine Assembly

Complete the engine by fitting or hooking up the following parts:

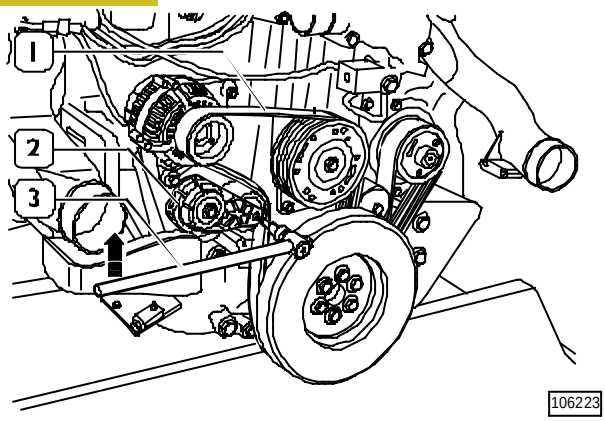
- power take-off (P.T.O., if present) and relating pipes;
- fuel pump;
- support complete with fuel filter and pipes;
- EDC central unit;
- intake manifold;
- preheating resistance;
- heat exchanger;
- oil filters, lubricating the gasket;
- exhaust manifold;
- turbocompressor and relating water and oil pipes;
- pulley and damping flywheel;
- thermostat assembly;
- belt tensioner, water pump, alternator;
- electromagnetic joint;
- belt tensioner, if present, air-conditioner compressor;
- starter;
- oil level rod;
- electrical connections and sensors.

**NOTE** The fittings of the cooling water and lubricating oil pipes of the turbocharger have to be tightened to a torque of:

- 35 ±5 Nm, water pipe fittings;
- 55 ±5 Nm, oil pipe female fitting;
- 20-25 Nm, oil pipe male fitting.

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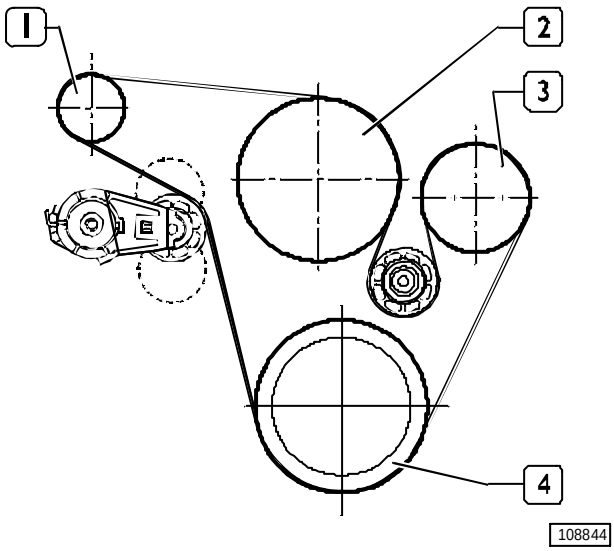
Figure 217




- driving belt.

To mount belt (1), belt tensioner (2) has to be operated by proper tooling (3) according to the direction indicated by the arrow in Figure.

Figure 218




ASSEMBLY DIAGRAM OF FAN – WATER PUMP – ALTERNATOR DRIVE BELT

1. Alternator – 2. Electromagnetic coupling – 3. Water pump – 4. Crankshaft

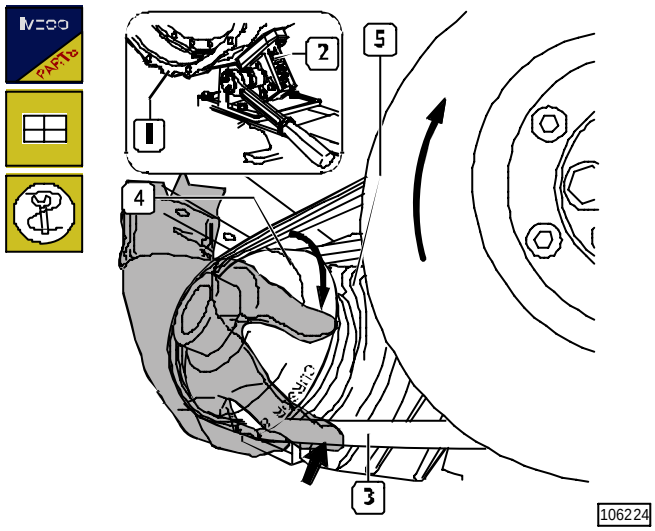
**NOTE** Belt tensioner is of automatic type; therefore, further adjusting is not provided after mounting.

- refuel engine with provided oil quantity;
- dismount engine from rotary stand and take off brackets (99361036) securing the engine.

Mount:

- oil pressure regulation valve;
- engine left support;
- air compressor complete with hydraulic guide pump;
- sound deadening guard;
- pipes.
- if present, climate control system compressor driving belt similarly to belt (1, Figure 217);

Figure 219




**NOTE** In the case of engines with climate control system compressor spring driving belt, for mounting the belt, tool 99360192 (4) must be used. Different methods may cause tensions impairing spring belt.

Apply tool 99360321 (2) provided with spacer 99360325 to gears box (1).
Mount spring belt (3) on driving shaft pulley, mount chock 99360192 (4) on compressor pulley (5) for climate control system. Position spring belt (3) in the opening of tool 99360192 marked with "cursor 10/13".
By tool 99360321 (2), rotate driving shaft according to the direction of the arrow (→) until spring belt (3) is correctly positioned on compressor pulley (5).

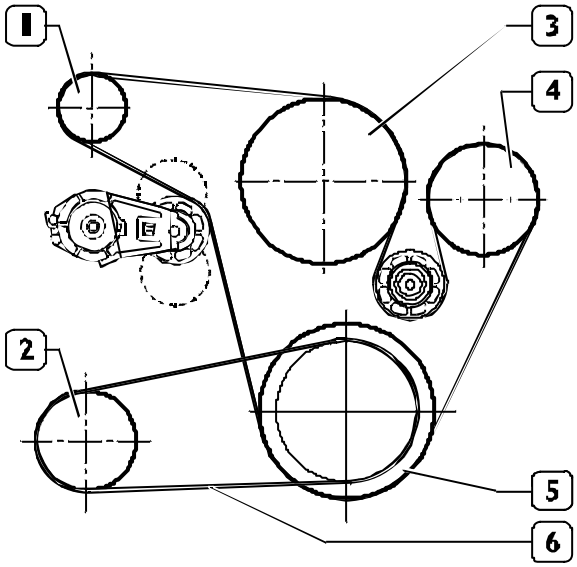
**NOTE** While operating, keep tool 99360192 (4) in contact to pulley and at the same time guide spring belt (3) in order to prevent it from twisting.

**NOTE** Spring belt must be replaced by a new one after every dismounting operation.

**NOTE** Replacing spring belt with engine on the vehicle is from engine opening after tilting the cab.

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Figure 220




COMPRESSOR CONTROL BELT ASSEMBLY DIAGRAM
1. Crankshaft - 2. Air conditioner compressor - 3. Electromagnetic coupling - 4. Water pump - 5. Crankshaft - 6. Spring belt.

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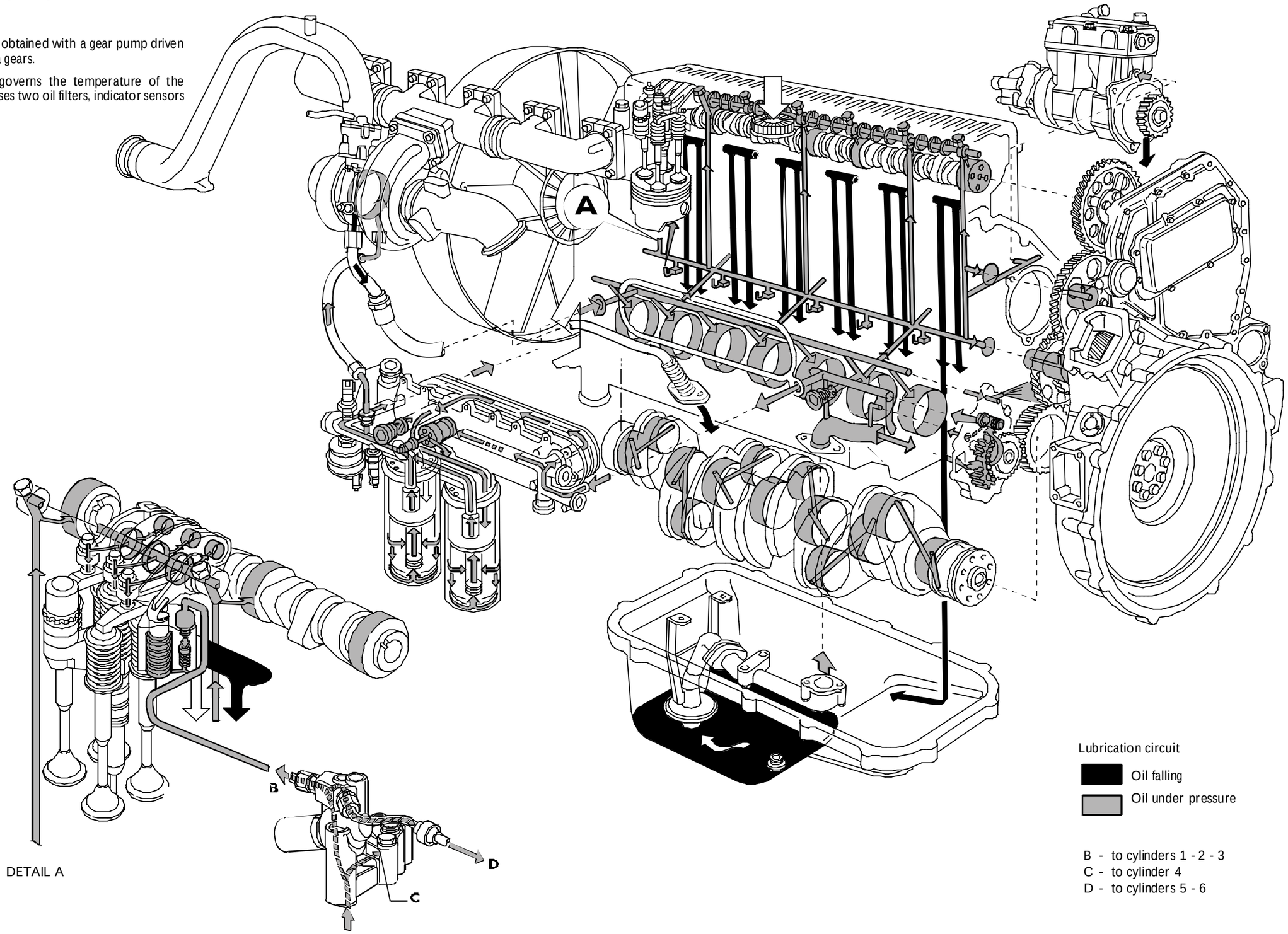
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## 5430 LUBRICATION

Figure 221

Engine lubrication is obtained with a gear pump driven by the crankshaft via gears.

A heat exchanger governs the temperature of the lubricating oil. It houses two oil filters, indicator sensors and safety valves.




Exhaust brake solenoid valve with piston driving the exhaust brake of the 4th cylinder.

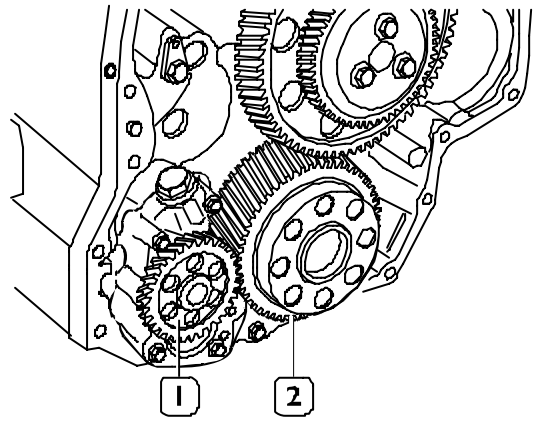
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## 543010 Oil pump

Figure 222



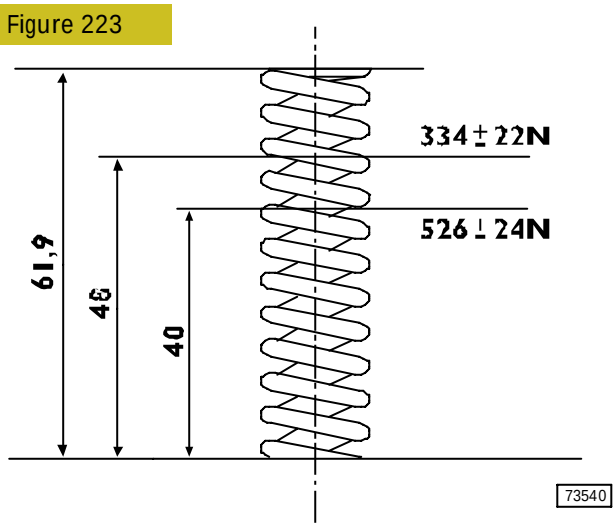

60560

The oil pump (1) cannot be overhauled. On finding any damage, replace the oil pump assembly.

See under the relevant heading for replacing the gear (2) of the crankshaft.

### Safety relief valve

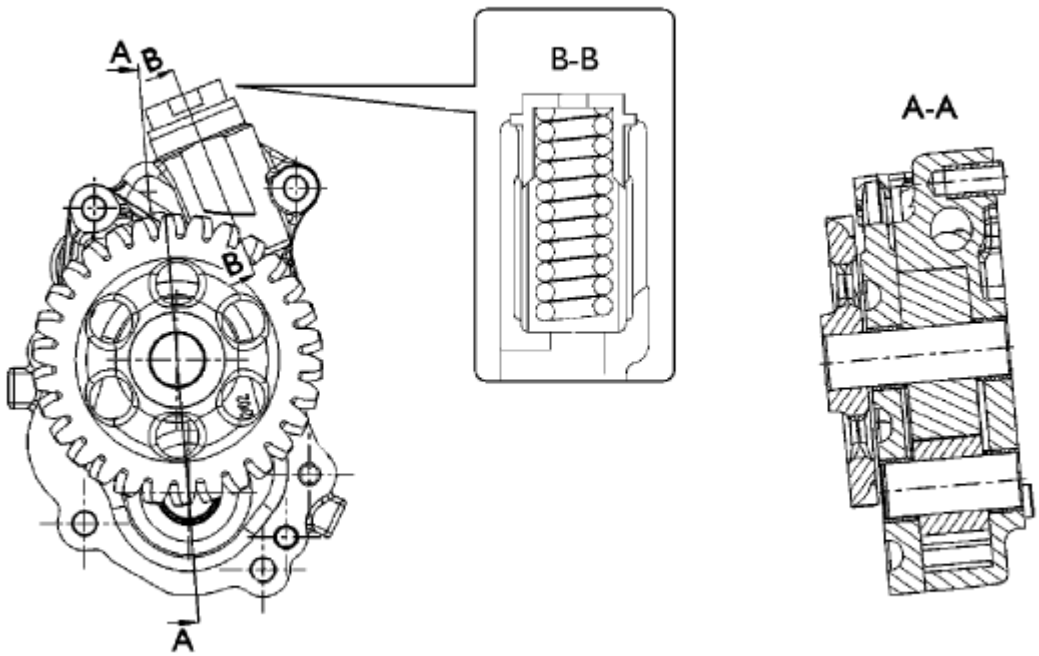
Figure 223




73540

MAIN DATA TO CHECK THE OVERPRESSURE VALVE SPRING

Figure 224



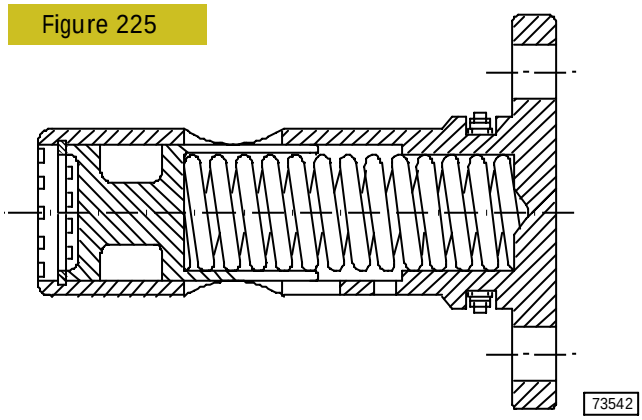

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OIL PUMP CROSS-SECTION
1. Safety relief valve – 2. Start of opening pressure 10 ± 1 bars.

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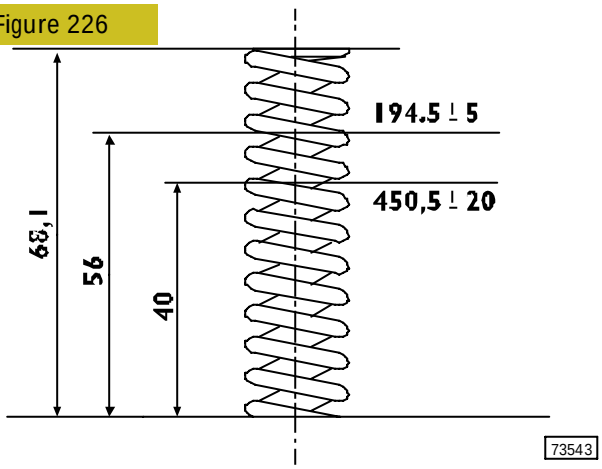
## Oil overpressure valve

Figure 225




The oil overpressure valve is located on the left-hand side of the crankcase.
Start of opening pressure 5 bars.

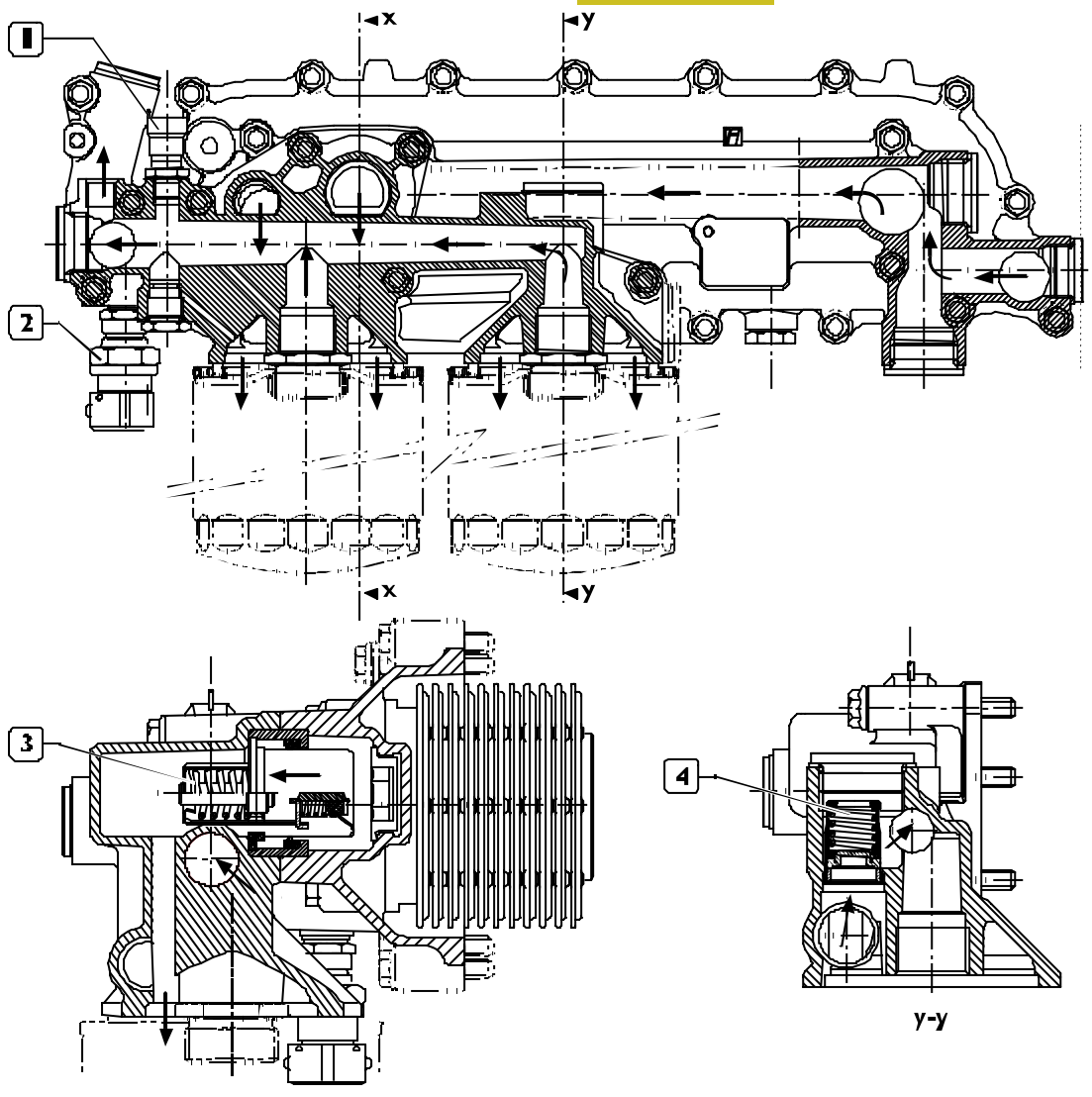
Figure 226




MAIN DATA TO CHECK THE OIL OVERPRESSURE VALVE SPRING

## 543110 Heat exchanger

Figure 227

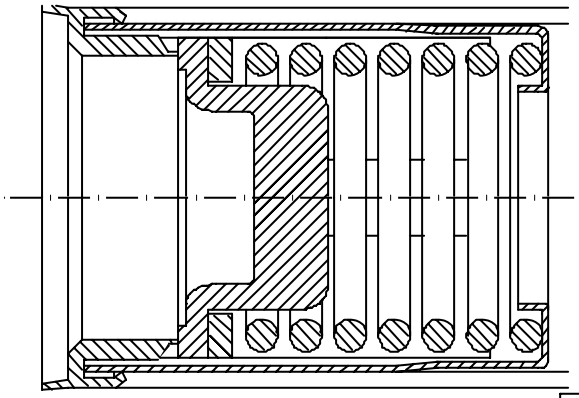



HEAT EXCHANGER
The heat exchanger is fitted with: 1. Oil temperature transmitter – 2. Oil pressure transmitter – 3. Filter bypass valve – 4. Thermostat
Number of heat exchanger elements: 11.

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## By-pass valve

Figure 228

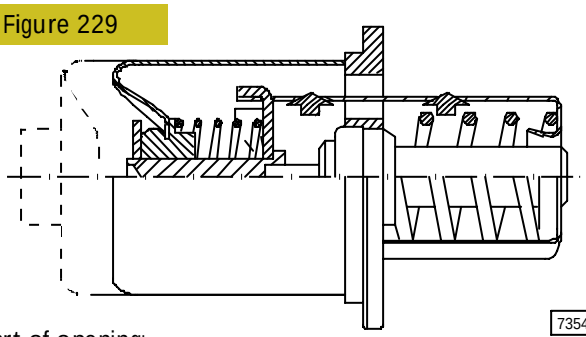


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The valve quickly opens at a pressure of: 3 bars.

## Thermostatic valve

Figure 229



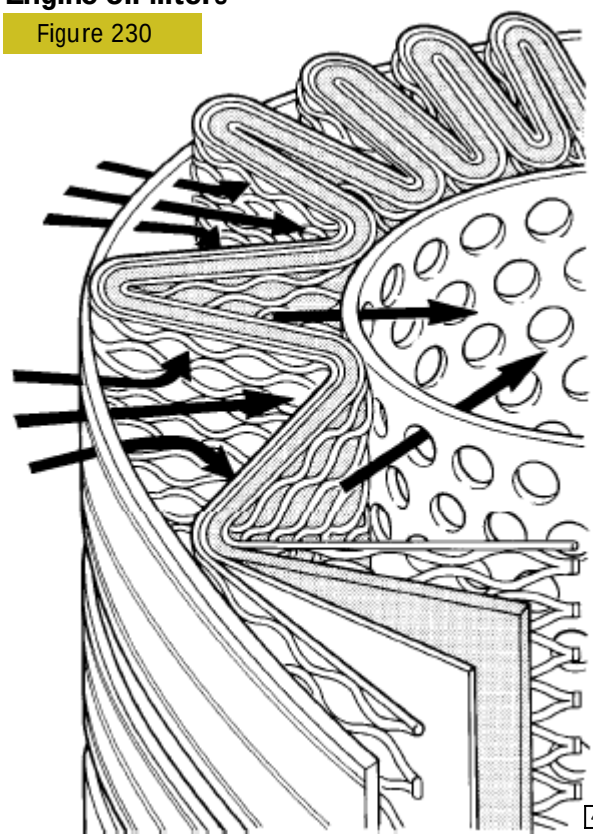
73546

Start of opening:
- travel 0.1 mm at a temperature of 82 ±2°C.

End of opening:
- - travel 8 mm at a temperature of 97°C.

## Engine oil filters

Figure 230



47447

This is a new generation of filters that permit much more thorough filtration as they are able to holder back a greater amount of particles of smaller dimensions than those held back by conventional filters with a paper filtering element.

These high-filtration devices, to date used only in industrial processes, make it possible to:

- reduce the wear of engine components over time;
- maintain the performance/specifications of the oil and thereby lengthen the time intervals between changes.

### External spiral winding

The filtering elements are closely wound by a spiral so that each fold is firmly anchored to the spiral with respect to the others. This produces a uniform use of the element even in the worst conditions such as cold starting with fluids with a high viscosity and peaks of flow. In addition, it ensures uniform distribution of the flow over the entire length of the filtering element, with consequent optimization of the loss of load and of its working life.

### Mount upstream

To optimize flow distribution and the rigidity of the filtering element, this has an exclusive mount composed of a strong mesh made of nylon and an extremely strong synthetic material.

### Filtering element

Composed of inert inorganic fibres bound with an exclusive resin to a structure with graded holes, the element is manufactured exclusively to precise procedures and strict quality control.

### Mount downstream

A mount for the filtering element and a strong nylon mesh make it even stronger, which is especially helpful during cold starts and long periods of use. The performance of the filter remains constant and reliable throughout its working life and from one element to another, irrespective of the changes in working conditions.

### Structural parts

The o-rings equipping the filtering element ensure a perfect seal between it and the container, eliminating by-pass risks and keeping filter performance constant. Strong corrosion-proof bottoms and a sturdy internal metal core complete the structure of the filtering element.

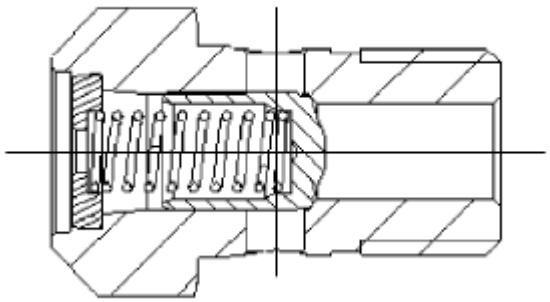
When mounting the filters, keep to the following rules

- Oil and fit new seals.
- Screw down the filters to bring the seals into contact with the supporting bases.
- Tighten the filter to a torque of 35-40 Nm.

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## Valve integrated in piston cooling nozzle

Figure 231



109080

The valve allows oil to enter only above the threshold pressure of 1.7 ± 0.2 bar. This permits filling the circuit and therefore lubricating the most stressed parts even when working at lower pressures.

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## 5432 COOLING

### Description

The engine cooling system works with forced circulation inside closed circuit and can be connected to an additional heater (if any) and to the intarder intercooler.
It consists mainly of the following components:

- an expansion reservoir whose plug (1) incorporates two valves – discharge and charge – controlling the system pressure.
- a coolant level sensor placed at the bottom of the expansion reservoir with two coupling points:

  right drive vehicles:

  D coupling point for sensor S1 6.2 litres
  D coupling point for sensor S2 4.7 litres

  left drive vehicles:

  D coupling point for sensor S1 6 litres
  D coupling point for sensor S2 3.7 litres
- an engine cooling unit to dissipate the heat taken by the coolant from the engine through the intercooler.
- a heat exchanger to cool down lubrication oil;
- a water pump with centrifugal system incorporated in the cylinder block;
- an electric fan consisting of a 2-speed electro-magnetic joint equipped with a neutral wheel shaft hub fitted with a metal plate moving along the axis and where the fan is installed. It is controlled electronically by the vehicle Multiplex system.
- a 3-way thermostat controlling the coolant circulation.

### Operation

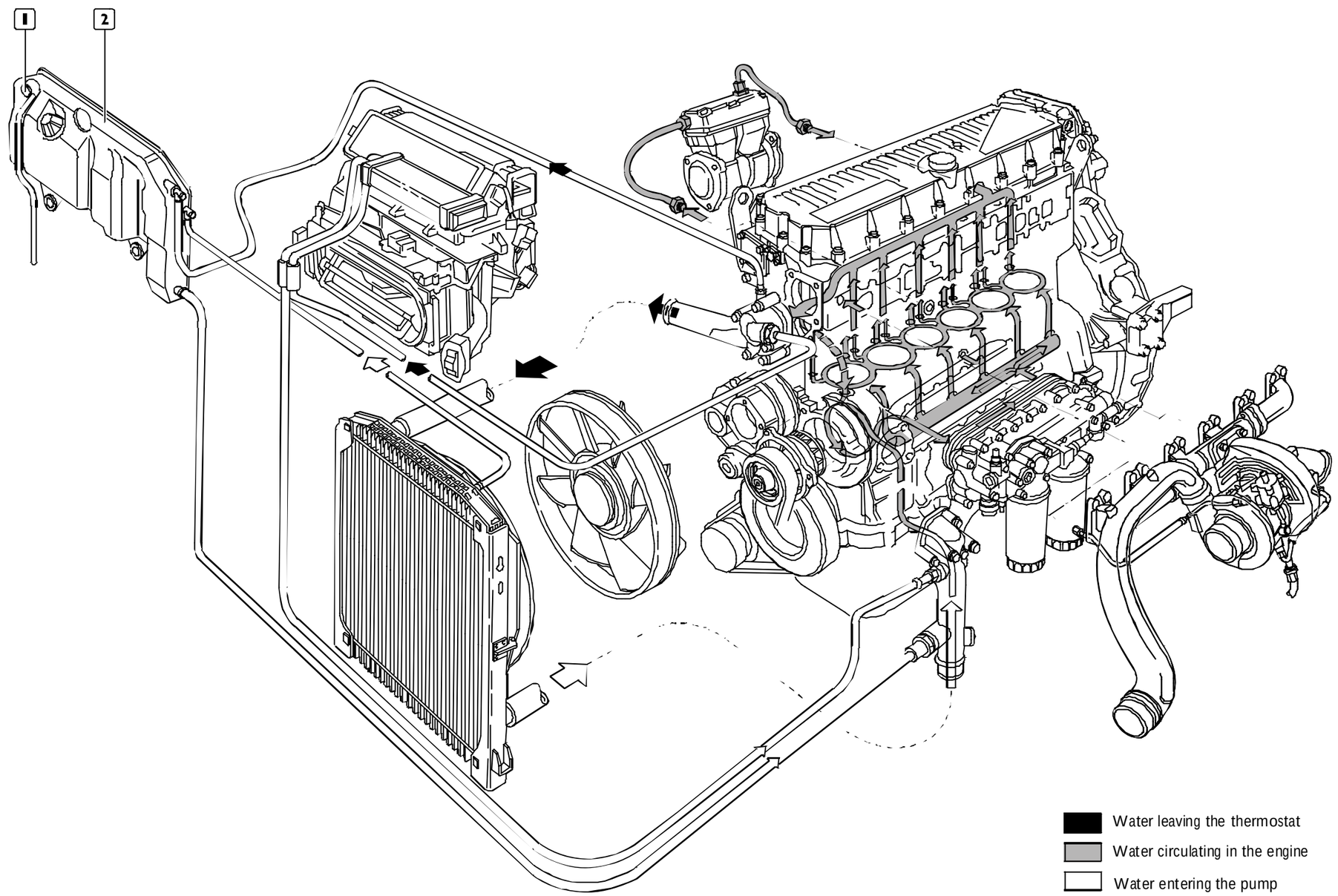
The water pump is actuated by the crankshaft through a poli-V belt and sends coolant to the cylinder block, especially to the cylinder head (bigger quantity). When the coolant temperature reaches and overcomes the operating temperature, the thermostat is opened and from here the coolant flows into the radiator and is cooled down by the fan.
The pressure inside the system depending on the temperature variation is controlled by the discharge and charge valves incorporated in the expansion reservoir filling plug (1).
The discharge valve has a double function:

- keep the system under light pressure in order to raise the coolant boiling point;
- discharge the pressure surplus in the atmosphere as a result of the coolant high temperature.

The charge valve makes it possible to transfer the coolant from the expansion reservoir to the radiator when a depression is generated inside the system as a result of the coolant volume reduction depending on the fall in the coolant temperature.
Discharge valve opening:

| | | | |
|---|---|---|---|
| D 1st breather | 0.9 | $^{+0.2}_{-0.1}$ | bar |
| D 2nd breather | 1.2 | $^{+0.2}_{-0.1}$ | bar |
| Charge valve opening | -0.03 | $^{+0}_{-0.02}$ | bar |
| Plug tightening torque (1): | | 8 ± 1 | Nm |

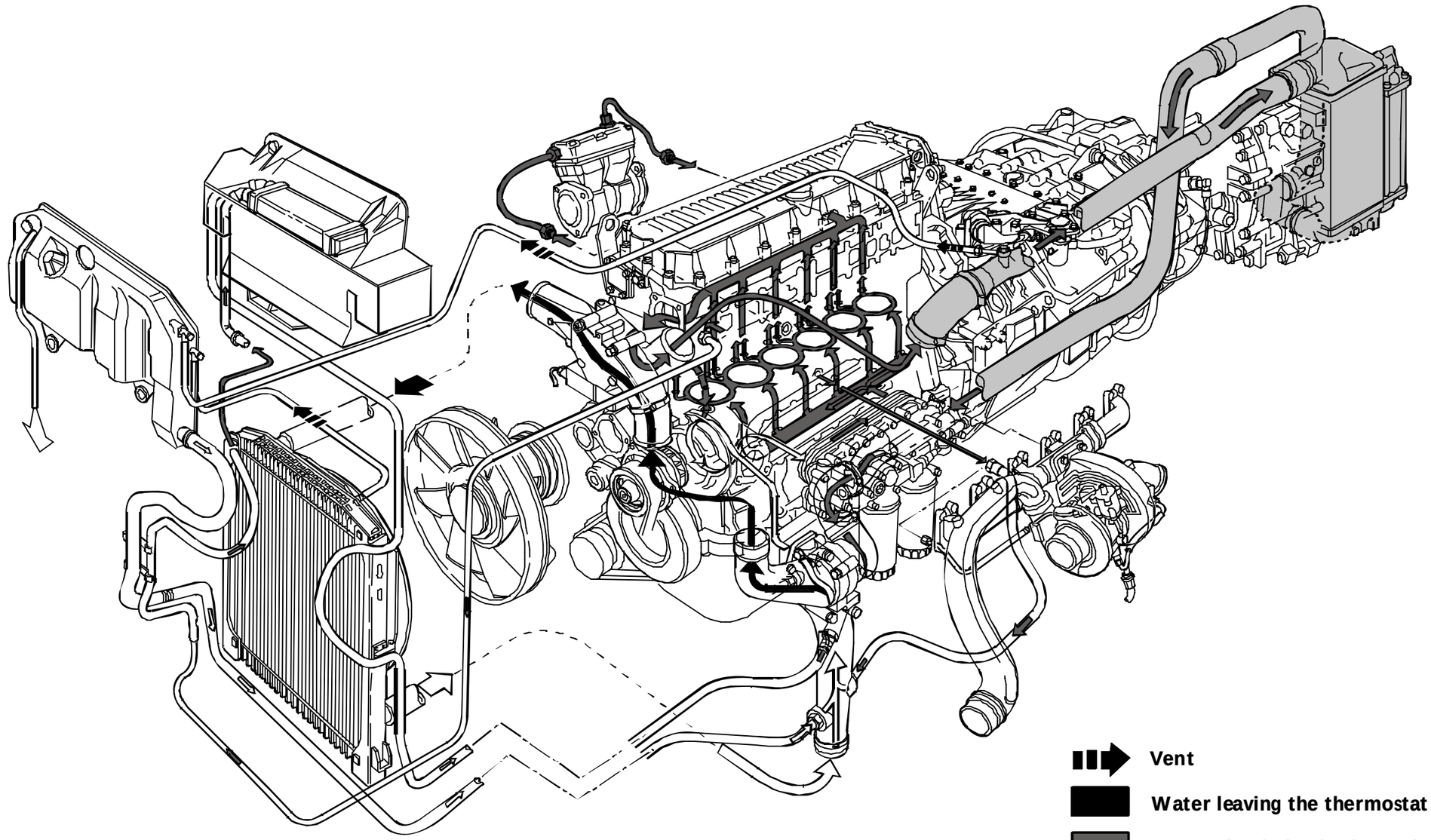
Figure 232




COOLING CIRCUIT VERSION WITHOUT INTARDER

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Figure 233

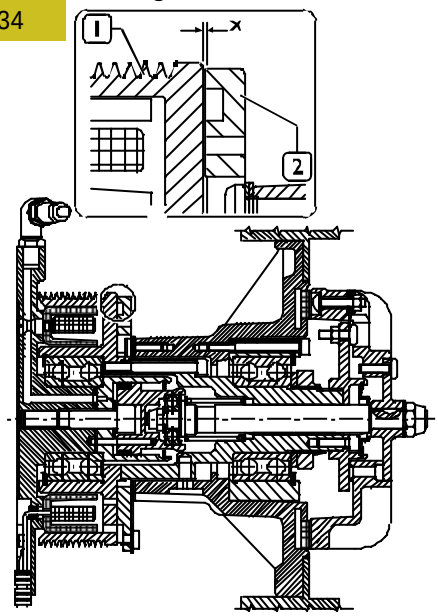



COOLING CIRCUIT VERSION WITH INTARDER

Aquila Trucks Centres

## 543210 Electromagnetic fan drive

Figure 234




ELECTROMAGNETIC FAN DRIVE SECTION

Using a feeler gauge, check the gap between the anchor assembly (2) and the pulley (1), it must be no greater than 2.5 mm.

The electro-magnetic fan drive action depends on:
- the coolant temperature;
- the climate control system fluid pressure (if any);
- the slowing down action of the intarder on (if any).

Idling condition:
- water temperature is less than 93_C and both the Intarder and the air-conditioning unit (where available) are OFF;
- coolant temperature is less than 85_C and the air-conditioning system is ON (pressure inside the circuit is less than 18 bar);
- coolant temperature is less than 85_C, and the Intarder is ON, with its braking power less than 41% of its maximum power.

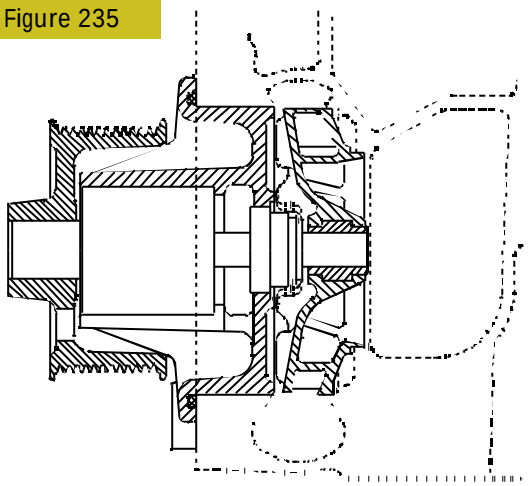
The first speed is actuated when:
- coolant temperature reaches 85_C, and the Intarder is ON, with its braking power greater than 41% of its maximum power;
- coolant temperature reaches 85_C and the air-conditioning system is ON (pressure inside the circuit in higher than 18 bar);

The second speed is actuated when:
- coolant temperature reaches 93_C, and the Intarder is either OFF or ON with its braking power less than 41% (speed is deactuated when temperature falls down to 88_C);
- coolant temperature reaches 85%, the Intarder is ON (with its braking power greater than 41% of its maximum power), or the air-conditioning system is ON and the pressure inside the circuit is 22 bar.

When second speed actuation is required, the system will drive the fan for 5 seconds at the first speed and then engages the second speed. This will increase belt and fan component wear in time. When the fan first speed is actuated for more than 1 minute, the system actuates the second speed until the control parameters fall under the operation levels.
As to the description of the electro-magnetic fan drive operation and servicing, see the "Manual for electric/electronic system repairing" - Volume 3

## 543210 Water pump

Figure 235




CROSS-SECTION OF THE WATER PUMP

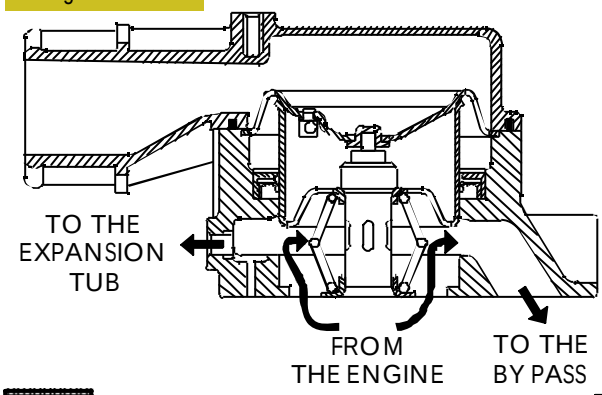
The water pump is composed of: impeller, bearing, seal and driving pulley.

**NOTE** Check that the pump body has no cracks or water leakage; if it does, replace the entire water pump.

## 543250 Thermostat

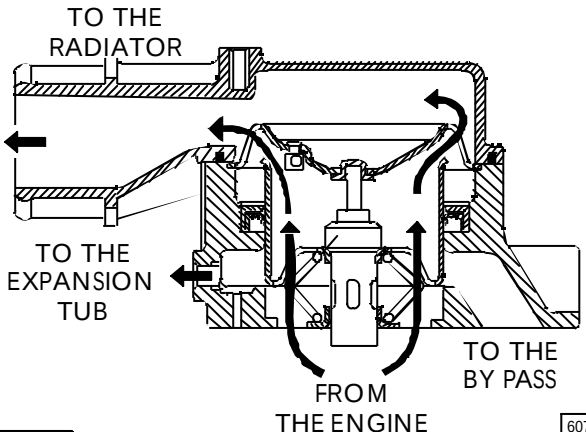
View of thermostat operation

Figure 236




Water circulating in the engine

Figure 237




Water leaving the thermostat

Check the thermostat works properly; replace it if in doubt.

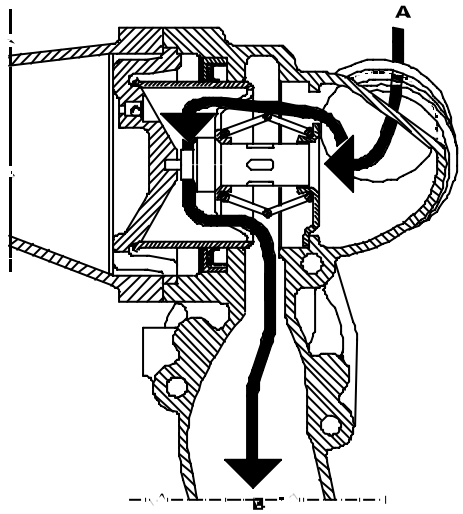
Temperature of start of travel 84°C ±2°C.
Minimum travel 15 mm at 94°C ±2°C.

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## View of thermostat operation for versions with Intarder

Figure 238

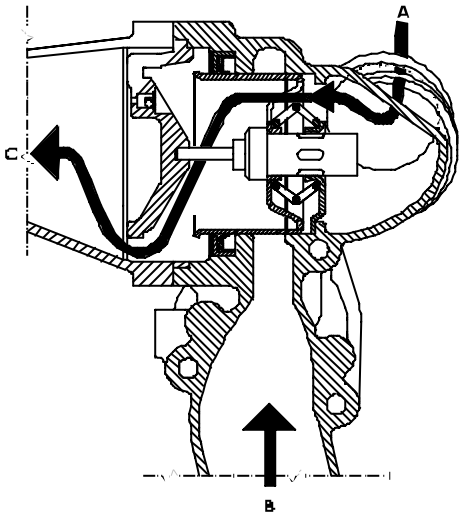



COLD OPERATION WITH CLOSED THERMOSTAT

A - Water circulating in the engine and the intarder.

B - To water pump.

Figure 239




HOT OPERATION WITH OPEN THERMOSTAT

A - Water circulating in the engine and the intarder.

B - From the radiator to the water pump.

C - To radiator.

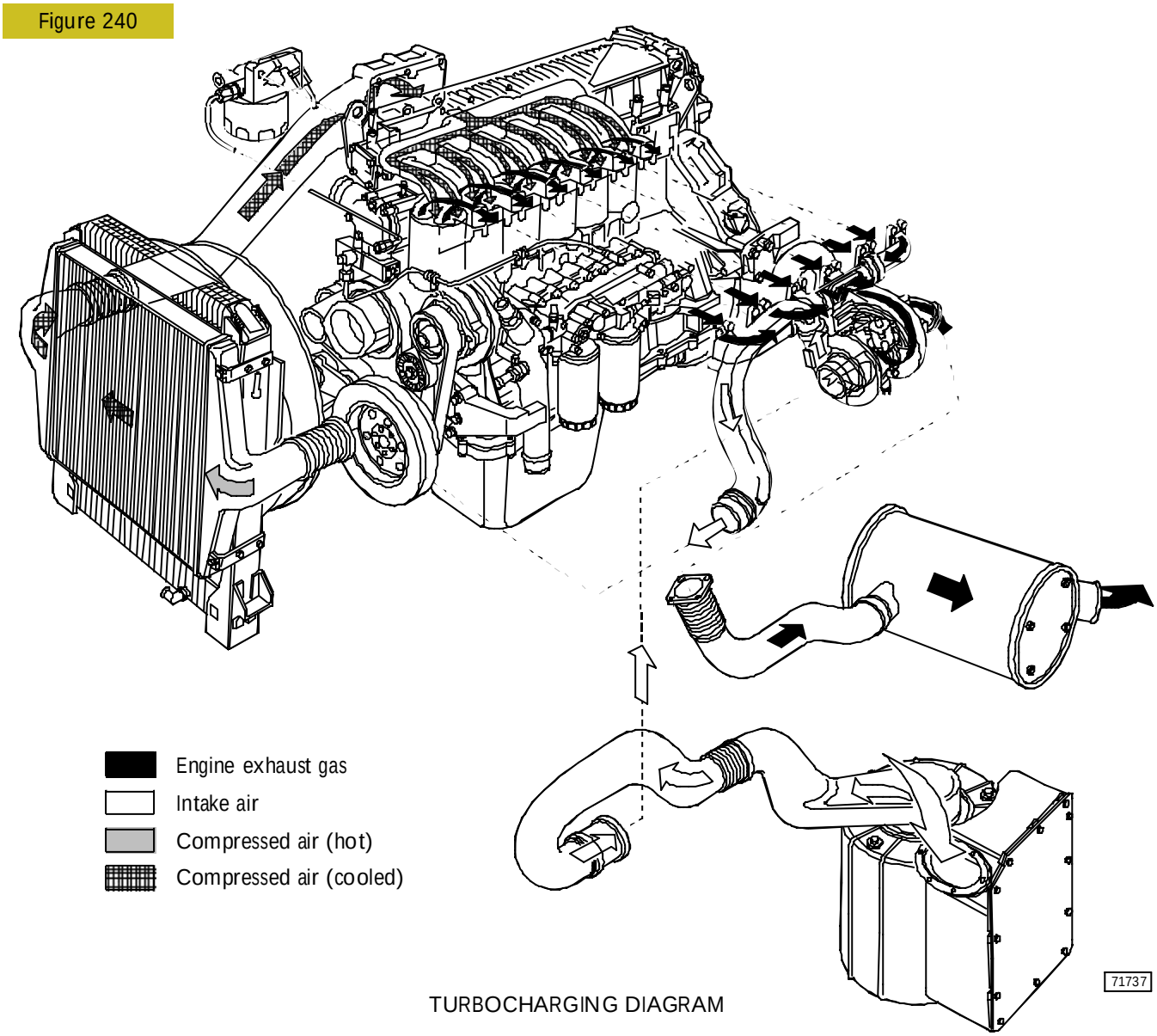
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## 5424 TURBOCHARGING

The turbocharging system is composed of:

- an air filter;
- A turbocharger with fixed geometry and WASTEGATE (410 HP engines) or with variable geometry for 450 HP/500 HP engines;
- an "intercooler" radiator.

Figure 240




TURBOCHARGING DIAGRAM

### Turbocharger HOLSET HE 551 V

Working principle

The variable geometry turbocharger (VGT) is composed of a centrifugal compressor and a turbine equipped with a mobile device that, by changing the area of cross-section of the passage of the exhaust gases going to the turbine, governs the speed.

Thanks to this solution, it is possible to keep the speed of the gases and turbine high even when the engine is running at low speed.

By making the gases pass through small cross-sections, they flow faster, so that the turbine turns faster as well.

The movement of the device changing the cross-section of the flow of exhaust gases is accomplished with a mechanism operated by a pneumatic actuator.

This actuator is controlled directly by the electronic control unit via a proportional solenoid valve.

This device is most closed at low speed.

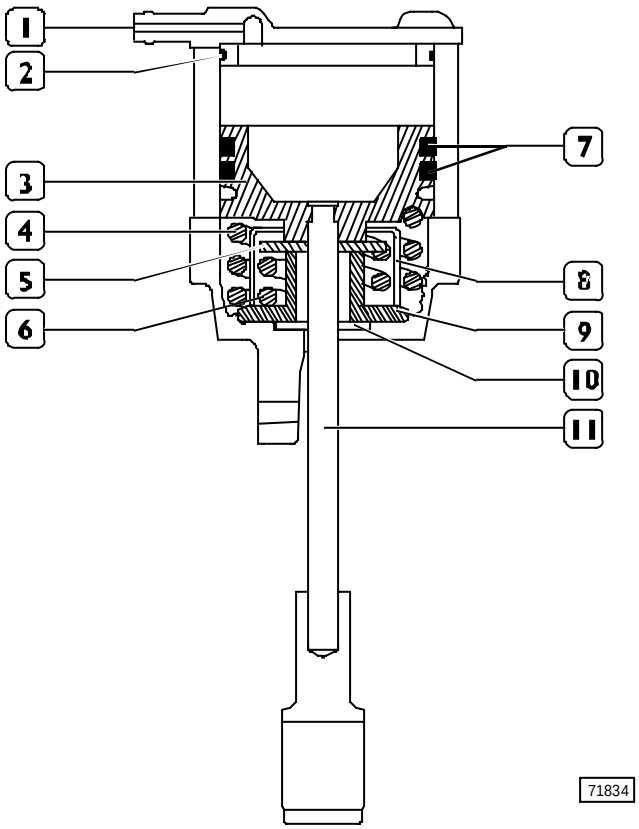
At high engine speeds, the electronic control system increases the cross-section of the passage to permit the incoming gases to flow without increasing their speed too much.

Cast in the central body there is a toroidal chamber for the coolant to pass through.

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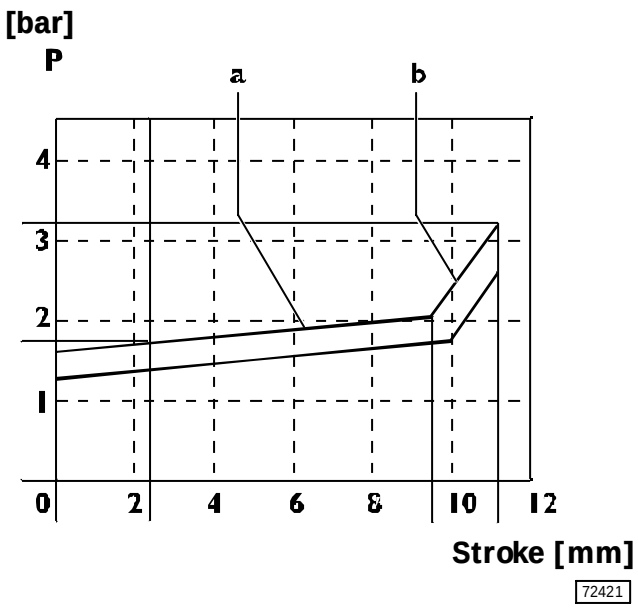
## Actuator

Figure 241




1. Air inlet - 2. Gasket - 3. Piston - 4. External spring - 5. Internal spring control disc - 6. Internal spring - 7. O-ring - 8. Spring holder - 9. Limit stop - 10. Dust seal - 11. Control rod

Figure 242




a Gradient characterized by the effect of the external spring (4, Figure 241).

b Gradient characterized by the effect of the external (4, Figure 241) and internal (6, Figure 241) springs.

Working principle (See Figure 241)

The actuator piston, connected to the drive rod, is controlled with the compressed air introduced through the air inlet (1) on the top of the actuator.

Modulating the air pressure varies the movement of the piston and turbine control rod. As the piston moves, it progressively compresses the external spring (4) until the base of the piston reaches the disc (5) controlling the internal spring (6).

On further increasing the pressure, the piston, via the disc (5), interferes with the bottom limit stop (10).

Using two springs makes it possible to vary the ratio between the piston stroke and the pressure. Approximately 85% of the stroke of the rod is opposed by the external spring and 15% by the internal one.

## Solenoid valve for VGT control

This N.C. proportional solenoid valve is located on the left-hand side of the crankcase under the turbine.

The electronic control unit, via a PWM signal, controls the solenoid valve, governing the supply pressure of the turbine actuator, which, on changing its position, modifies the cross-section of the flow of exhaust gases onto the blades of the impeller and therefore its speed.

The VGT solenoid valve is connected to the electronic control unit between pins C1/C3.

The resistance of the coil is approx. 20-30 Ohms.

## REPAIR

**NOTE** If anomalous engine operation is found, which is due to the boosting system, it is advisable that you check the efficiency of seal gaskets and the fastening of connecting sleeves prior to carrying out the checks on the turboblower. Also check for obstructions in the sucking sleeves, air filter. If the turbocharger damage is due to a lack of lubrication, check that the oil circulation pipes are not damaged. If so, change them or eliminate the cause.

After carrying out the above mentioned checks, check the turbocharger operation with an Engine Test by using IVECO diagnosis equipment (Modus - IT 2000 - E.A.SY.) according to the relevant procedure.

**NOTE** The test must be performed in following conditions:

- engine coolant temperature >50 °C;
- battery up (voltage >22V) for compression test;
- efficient recharging system.

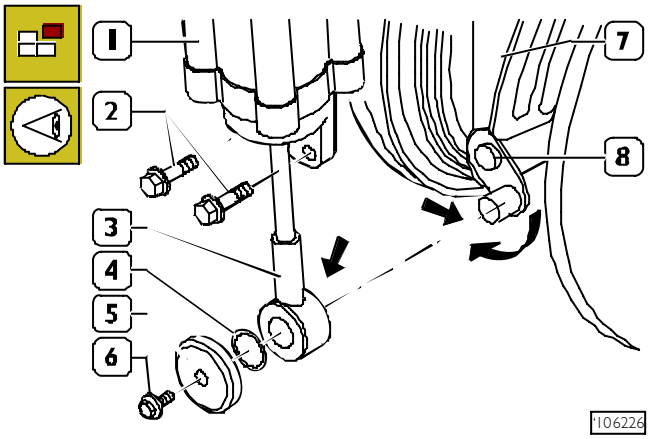
If values beyond tolerance are detected, check the efficiency of:

- shut-off valve;
- pressure sensor;
- engine cable pressure sensor connection (if oxidised, clean with a specific product);
- lack of electrical defects in solenoid valve VGT (continuity connection);
- actuator moved by active diagnosis as described in relating chapter, in case of locking, grease bushing with lubricant Kernite (for high temperatures); if the trouble persists, replace the actuator;
- sliding sleeve: it must slide freely when operated manually. If locked and if the bush check is not sufficient or effective, or no faults are detected in the other points, upon authorization of the "Help Desk" market operator, change the turbocharger according to the standard procedures.

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## Variable geometry movement control

Figure 243




Remove screws (2) and take actuator (1) off turbocompressor (7).
Remove screw (6), underlying disk (5), ring (4) and disconnect tie rod (3) of actuator (1) from the pin of variable geometry driving lever (8).
Accurately clean pin (→) of lever (8) and bushing (→) of tie rod (3) using a cloth made of non abrasive micro fibre.

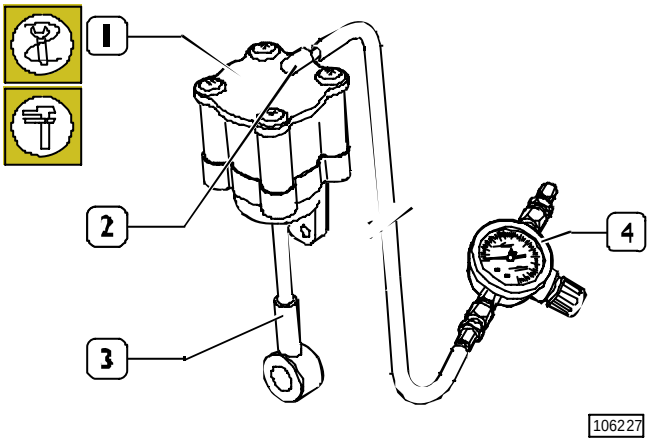
**NOTE** Do not use abrasive paper of any kind.

Visually check the conditions of bushing (→) of tie rod (3) and pin (→) of lever (8); where they are found to be worn out, replace actuator (1) or turbocompressor (7).

Check variable geometry inner driving mechanism movement by operating on lever (8); jamming must not occur; otherwise, clean turbine body, as described in relating chapter.

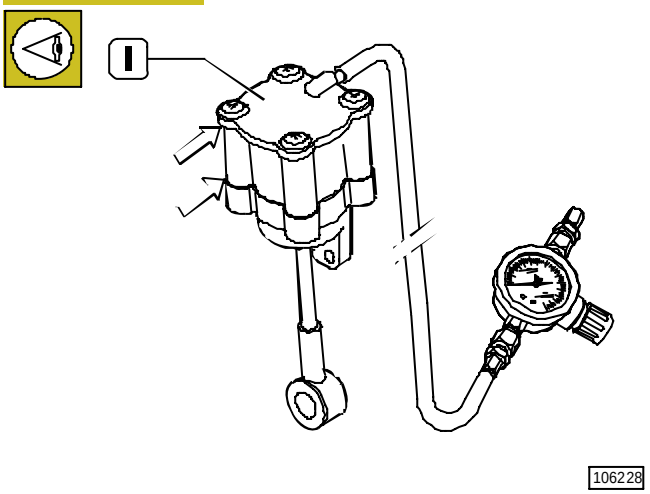
## Checking the actuator

Figure 244




Check actuator efficiency (1) operating as follows.
Apply, to fitting (2) of actuator (1), compressed air feed piping provided with pressure regulator (4). By using the pressure regulator, introduce, into the actuator, compressed air slowly modulating it, from 0÷3.5 bar; tie rod (3) of actuator (1) must move without jamming; otherwise, replace actuator (1).

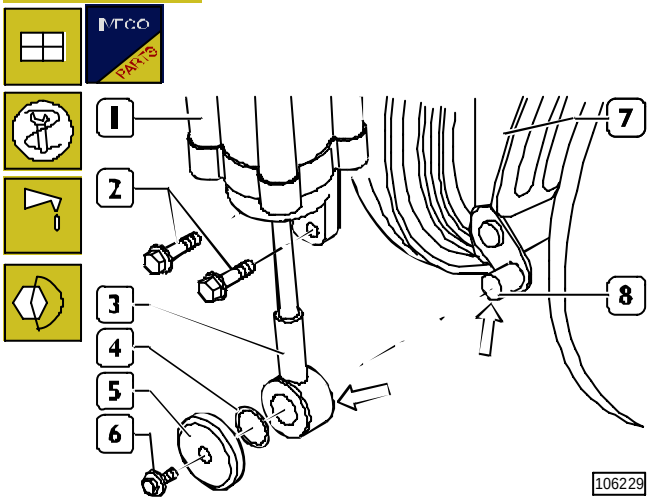
Figure 245




Check for any actuator leaks at indicated points (→) applying, on these points, a solution of suds.
When actuator (1) is fed with compressed air, no bubbles must be found at indicated points (→); otherwise, replace actuator (1).

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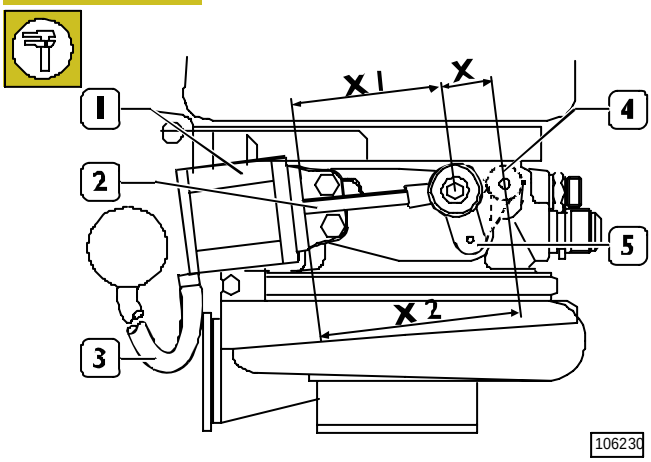
Figure 246




Lubricate bushing (→) of tie rod (3) and pin (→) of lever (8) with lithium-based Castrol LM GREASE type and reconnect actuator (1) to turbocompressor (7) operating as follows.
Connect tie rod (3) to lever (8).
Mount new ring (4), mount disk (5) and screw up screw (6).
Screw up screws (2) securing actuator (1) to turbocompressor (7).
Tighten screws (2 and 6) at 25 Nm torque.

## Checking actuator travel

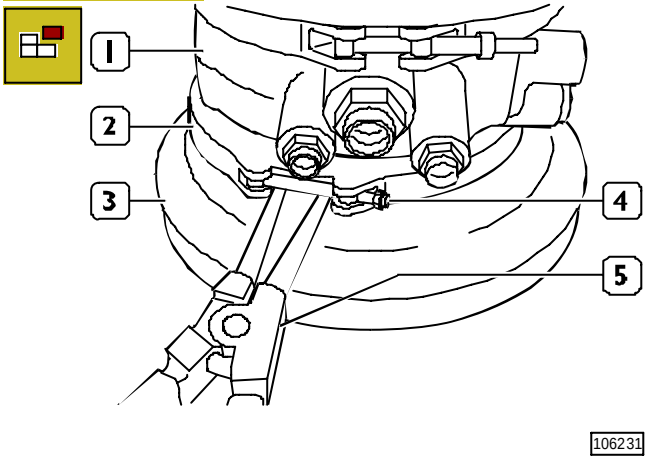
Figure 247




Check travel X of tie rod (2) of actuator (1) operating as follows.
Measure distance X1 between actuator (1) and cross-axis of eyelet (4).
Apply, to fitting of actuator (1), piping (3) for compressed air feed provided with pressure regulator. By using the pressure regulator, introduce, into actuator (1) compressed air slowly modulating it, from 0÷3,5 bar, until lever (5) is taken to its end of travel.
Measure again the distance between actuator (1) and cross-axis of eyelet (4) dimension X2.
Travel X of tie rod (2) of actuator (1) is given by following subtraction X = X2-X1 and must result to be equal to 11.5±0.5 mm.

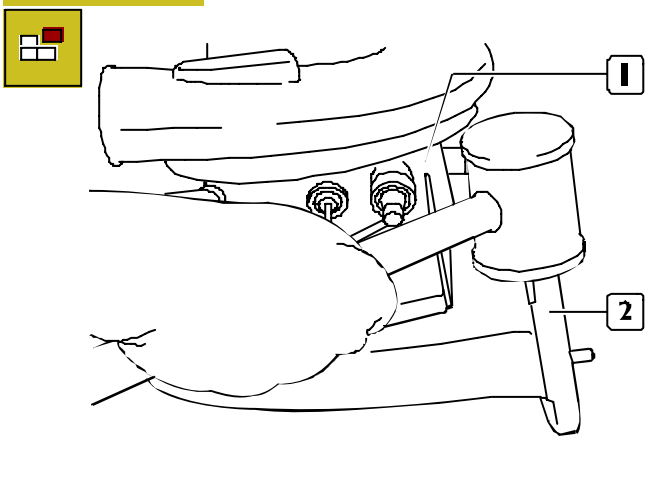
## Cleaning turbine body

Figure 248




Mark mounting position of clamp (2) on central body (1).
On threading and nut (4), apply antioxidant spray lubricant and, operating on nut (4), loosen clamp (2).
Slightly rotate clamp (2) using pliers (5).
Mark mounting position of turbine body (3) on central body (1).

Figure 249



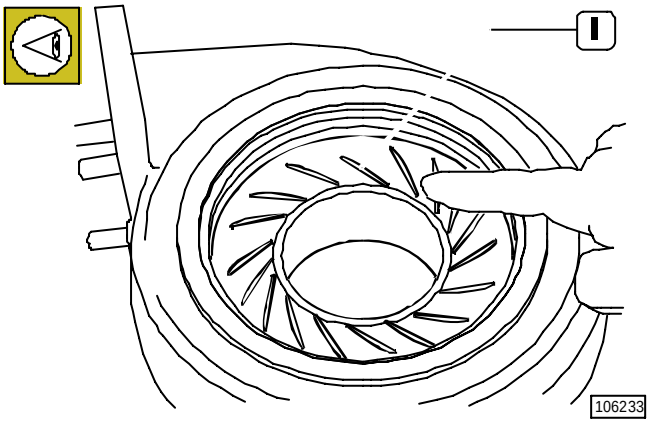

By a copper hammer, beat on two opposite points (~180°) on turbine body (2) to separate turbine body from central body (1).

**NOTE** In operation, take particular care to avoid damaging turbine rotor.

After dismounting turbine body, check variable geometry movement as described in relating chapter; where improvement in movement is not found with respect to previous check, replace turbocompressor.

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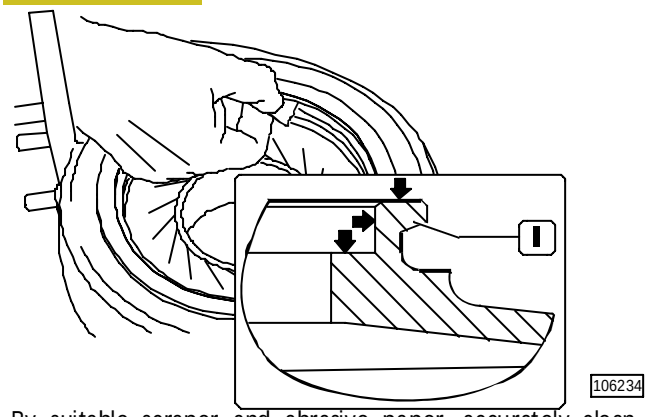
Figure 250




Accurately clean slot ring (1) and area around turbine body from carbonaceous deposits and check that the ring moves freely, otherwise, replace turbocompressor.

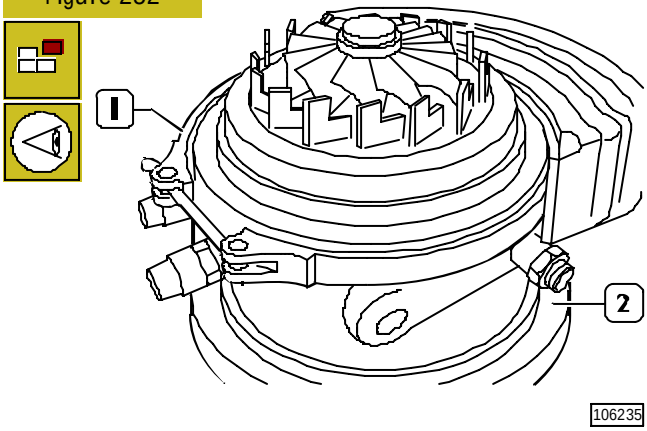
**NOTE** Any small cracks between slots and ring can be accepted, because they do not impair turbocompressor operation conditions.

Figure 251



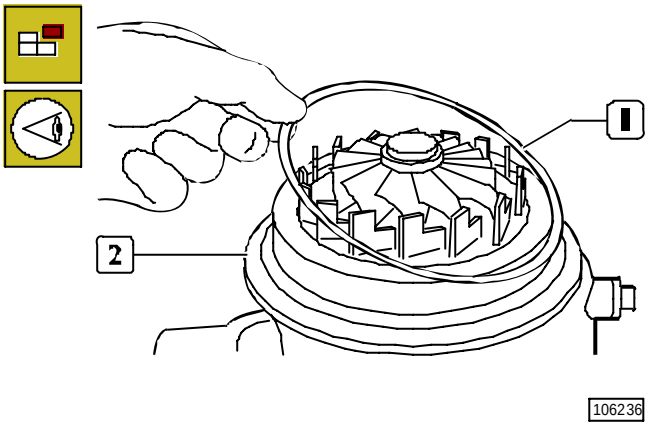

By suitable scraper and abrasive paper, accurately clean surfaces (→) of turbine body (1) from carbonaceous deposits, taking care to avoid damaging the surfaces.

Figure 252



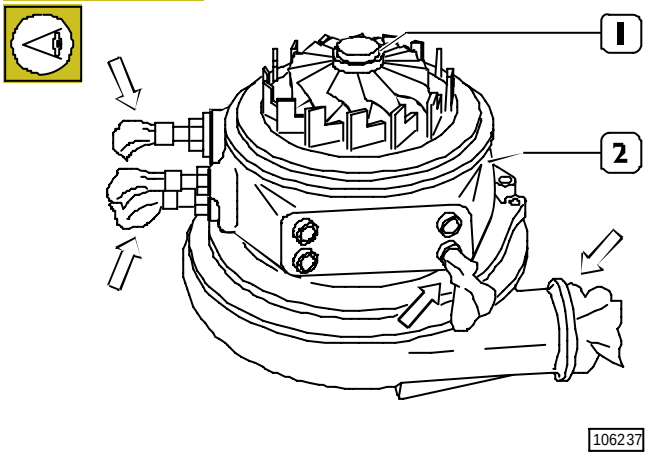

Dismount clamp (1) from central body (2) and check that the clamp does not result to be damaged; otherwise replace the clamp.

Figure 253




Dismount seal ring (1), external with respect to central body (2).
Accurately clean seal ring (1) and check that the ring does not result to be damaged; otherwise replace the ring.

Figure 254



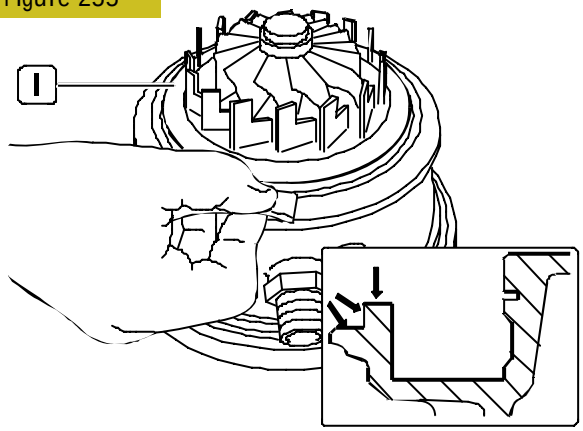

Check turbine rotor (1); there must not be found: carbonaceous deposits, deformation, cracks, blade scoring; also, turbine must turn freely.
By comparator, check clearance of turbine rotor stem (1); clearance must result to be:
- axial clearance: 0.051÷0.152 mm
- radial clearance: 0.381÷0.533 mm.

Where either clearance values over above ones or any one of above mentioned faults are found, replace turbocompressor.

**NOTE** Before cleaning turbine side central body, properly protect oil, water and air inlets and outlets (→) in order to prevent dirt or foreign bodies from entering turbocompressor.

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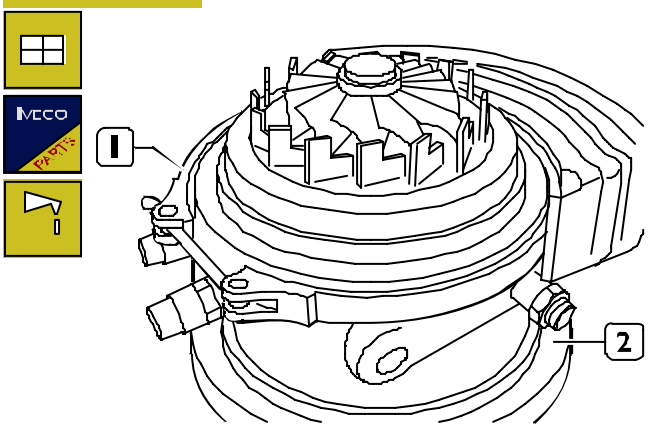
Figure 255




106238

By suitable scraper and abrasive paper, accurately clean surfaces (→) of central body (1) from carbonaceous deposits, taking care to avoid damaging the surfaces and variable geometry ring.
Then, with compressed air, clean variable geometry surfaces and ring from removed residues.
Check again, as described in relating chapters:
- variable geometry movement;
- actuator;
- actuator travel.

Figure 256



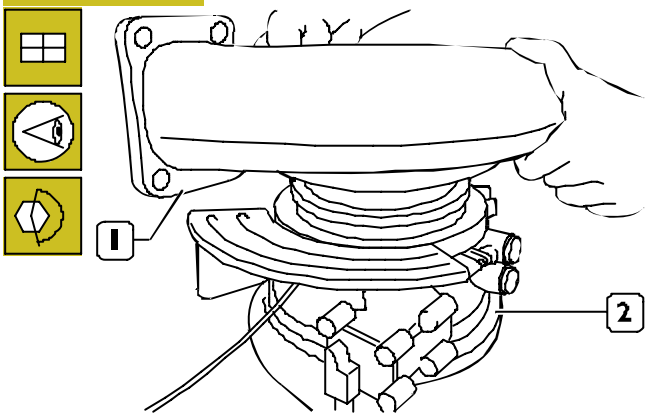

106239

Position clamp (1) on central body (2)

**NOTE** Should clamp (1) be replaced with an integrated heat guard, a new actuator has to be mounted with an integrated heat guard at the place of existing one.

Position accurately cleaned seal ring on central body.
Apply a thin layer of antiscuff paste on cleaned matching surfaces: central body / turbine body.

Figure 257



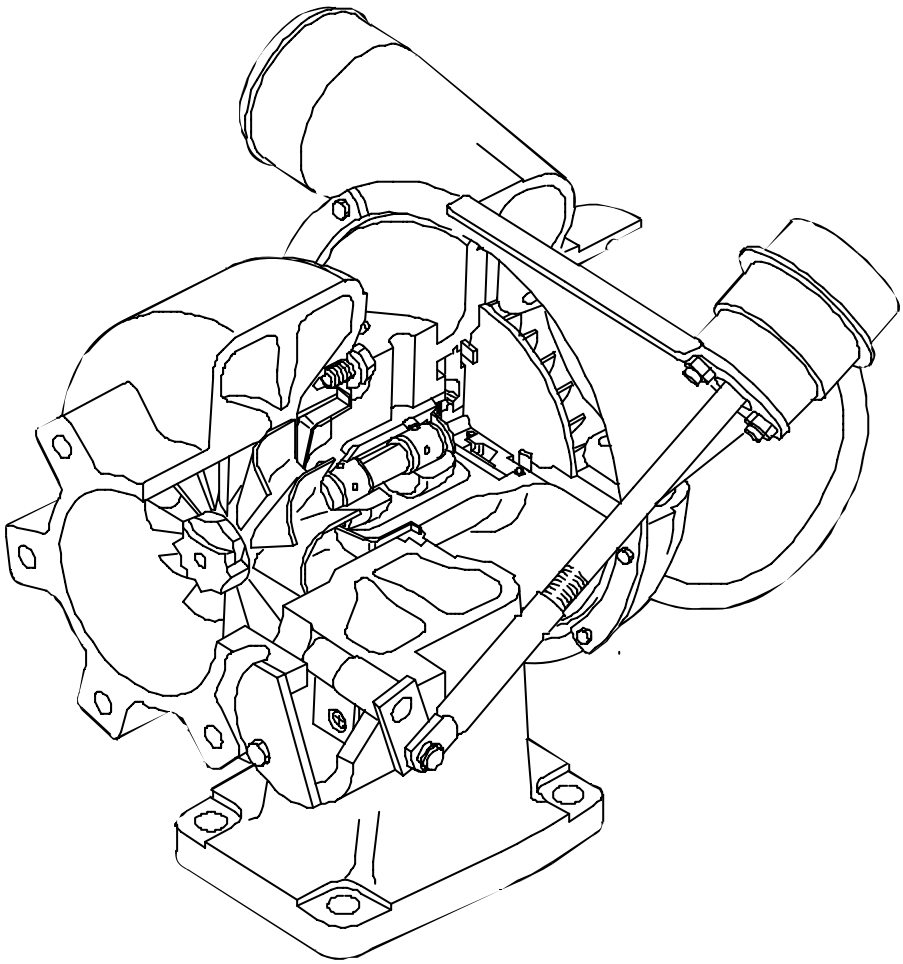

106240

Mount turbine body (1) on central body (2) taking care to avoid damaging turbine rotor and align turbine body variable geometry slot ring. Do not force mounting operation: in case of jamming, it might damage variable geometry with consequent regulation system faulty operation.
Once mounting has been completed, make sure that turbine body results to be matched correctly on central body.
Position turbine body on central body and clamp on central body in such a way that marks, made on dismounting, are matching.
Tighten nut clamping the clamp at 11.3 Nm torque.
Check again, as described in relating chapters:
- actuator;
- actuator travel.

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## 542410 Turbocharger HOLSET HX 50W

Figure 258




The turboblower is of the type equipped with pressure relief valve.
It is essentially made up of:

- a central body which incorporates a shaft supported by bushings at the opposite ends of which the turbine impeller and the compressor rotor are fitted;
- a turbine body and a compressor body, both of which mounted on the central body end;
- an overpressure relief valve fitted to the turbine body. The function of this valve is to choke the exhaust gas outlet, by conveying part of the gas directly into the exhaust pipe, when the boosting pressure downstream the compressor reaches the calibration value.

### REPAIRS

**NOTE** If anomalous engine operation is found, which is due to the boosting system, it is advisable that you check the efficiency of seal gaskets and the fastening of connecting sleeves prior to carrying out the checks on the turboblower. Also check for obstructions in the sucking sleeves, air filter and radiators. If the turboblower damage is due to lacking lubrication, check that the oil circulation pipes are not broken or clogged; if so, replace them or eliminate the trouble.

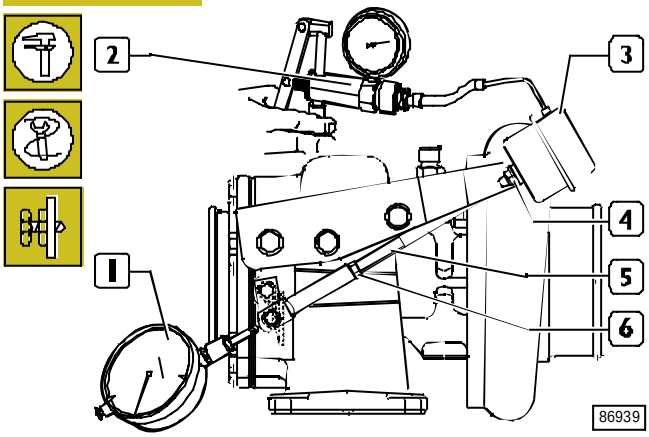
### 54249 WASTEGATE

**Wastegate check and calibration**

Cover the air, exhaust gas and lubricating oil inlets and outlets. Make a thorough cleaning of the turboblower outside by using an anti-oxidant and corrosion-proof fluid.

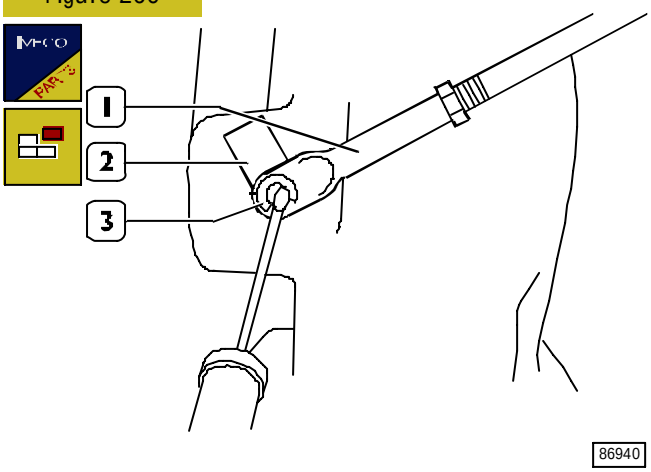
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Figure 259



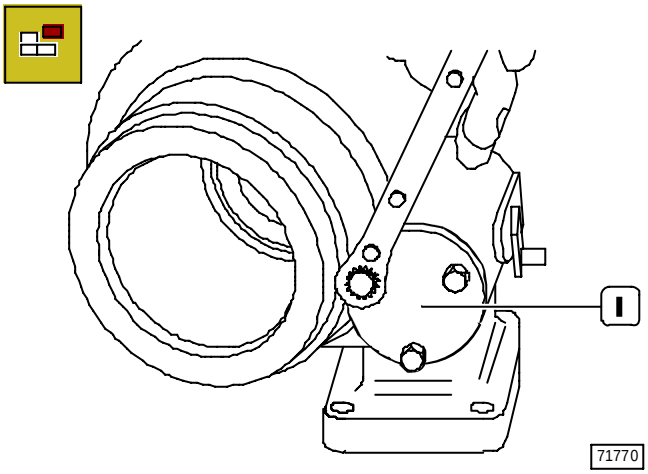

Disconnect the pipe from wastegate valve (3) union, then fit device 99367121 (2) pipe to the union.
Place the magnetic-stand comparator (1) tip onto tie rod (4) end, then reset the comparator.
Use device 99367121 (2) to let compressed air (pressure: 1.75 ± 0.01 bar) into the valve body (3), then make sure that such value remains unchanged over the entire duration of the check. Otherwise, replace the valve, as described in the relevant chapter.
Under the above conditions, the tie rod will have to make a travel of 0.43 ÷ 1.95 mm.
If a different value is found, loosen nut (6) and properly rotate tie rod (5) such that tie rod travel at above indicated pressure results to be 0.86 to 1.40.

Figure 260



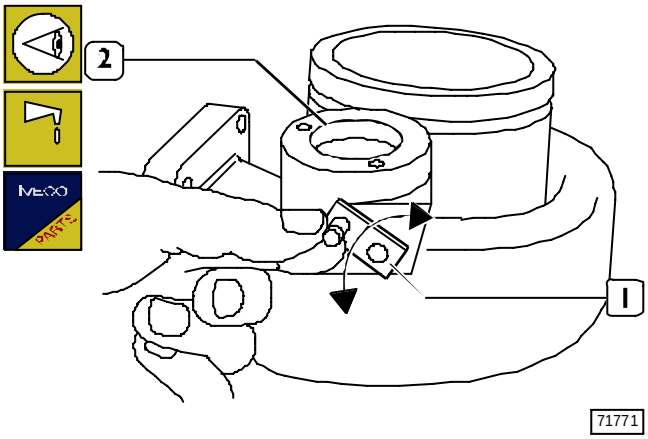

If the wastegate valve (3, Figure 259) turns out to be stuck, disconnect tie rod (1) from lever (2), by removing snap ring (3).
Use device 99367121 (2, Figure 259) to convey weak pressure into the valve body (3) again, to check whether the valve is stuck. If so, replace valve (3, Figure 259) as described in the relevant chapter.
Otherwise, check of the efficiency of the mechanism as follows.

Figure 261




Take off the cover (1) to be able to inspect the turbine mechanism governed by the actuator.

Figure 262




Check through the inspection hole (2) that the internal linkage control (1) is not stiff or seized; if it is, then lubricate it. And if the defect is not eliminated, replace the turbine.

## Replacing the wastegate valve (see Figure 260)

Take off clip (3) securing tie rod (4) to lever (2), then remove valve (4, Figure 259) from the turboblower by taking off fastening nuts (4, Figure 259).
Fit the new valve by reversing the order of disassembling operations, then adjust the tie rod stroke as described in the relevant chapter.

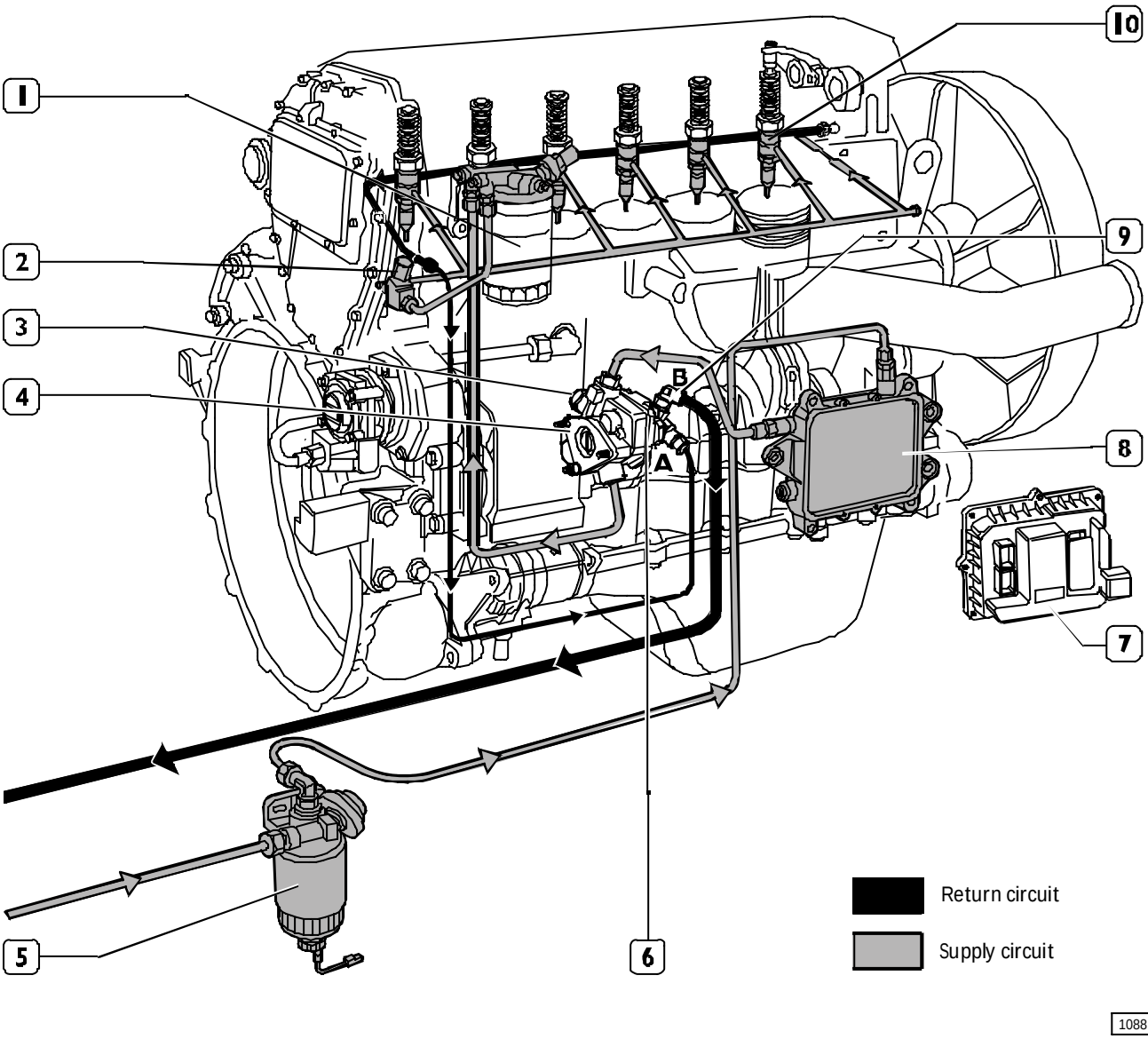
**NOTE** Before fitting the turbocharger to the engine, it is necessary to fill the main body with lubricating oil.

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## FUEL SYSTEM

Fuel is supplied via a fuel pump, filter and pre-filter, 6 pump-injectors governed by the camshaft via rocker arms and by the electronic control unit.

Figure 263




ENGINE FEED SCHEME

1. Fuel filter - 2. Pressure damper - 3. Pressure control valve (start of opening at 5 bar) - 4. Feed pump - 5. Fuel pre-filter with priming pump - 6. Valve, to recirculate fuel from injectors, integrated in feed pump (start of opening at 3.5 bar) - 7. Central unit - 8. Heat exchanger - 9. Overpressure valve to return fuel to tank (start of opening at 0.2 bar) - 10. Pump injectors

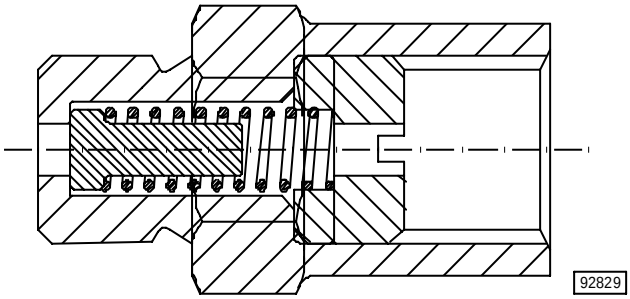
A. Fuel arriving at injectors - B. Fuel returning to tank

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## Overpressure valve

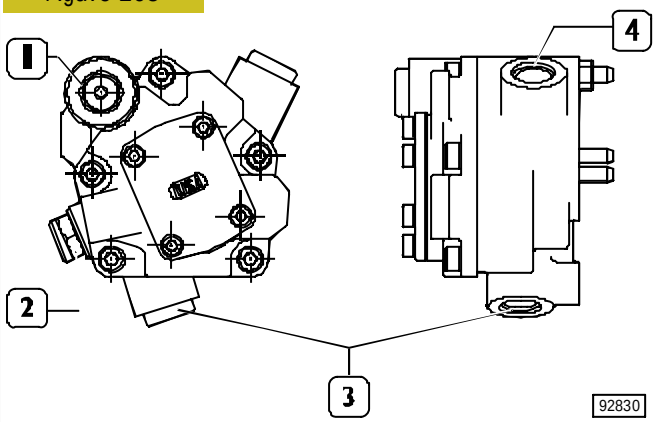
Figure 264




An overpressure valve is a single-acting valve, calibrated to 0.2 ÷ 0.3 bar, placed on the piping that returns fuel to tank. The overpressure valve prevents fuel duct in cylinder head from emptying with engine stopped.

## Feed pump

Figure 265




Engine feed pump for vehicles 4x2 - 4x4 - 6x4
1. Overpressure valve - 2. Delivering fuel to injectors - 3. Sucking in fuel - 4. Pressure control valve

| Pump performances | | | | | |
|---|---|---|---|---|---|
| Pump rotation speed (rpm) | | 2600 | 600 | 170 | 100 |
| Minimum flow rate (l/h) | | 310 | 45 | 12 | |
| Test conditions | Negative pressure on aspiration (bar) | 0.5 | 0.3 | 0.3 | 0.3 |
| | Pressure on delivery (bar) | 5 | 3 | 0,3 | 0.3 |
| | Test liquid temperature (°C) | 30 | 30 | 30 | 30 |
| | Test liquid | ISO 4113 | | | |

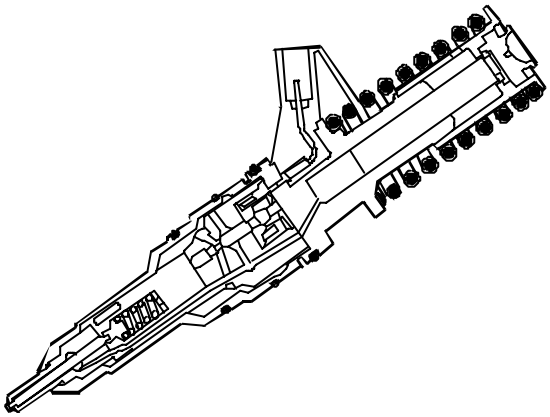
| Field of use | |
|---|---|
| Pump rotation speed (rpm) | 2600 |
| Overrunning rotation speed (max 5 min) (rpm) | 4100 max |
| Diesel oil temperature (°C) | -25/+80 |
| Filtering rate on aspiration (micron) | 30 |
| Negative pressure on aspiration (bar) | 0.5 max |

| Pressure control valve | |
|---|---|
| Valve calibration | 5 ÷ 5.8 |

| Injectors return valve | |
|---|---|
| Valve calibration | 3.4 ÷ 3.8 |

## Injector-pump

Figure 266

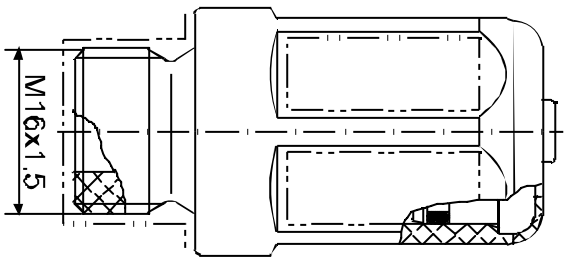



INJECTOR SECTION

The new pump injectors are capable, thanks to the higher injection pressure, of atomizing the fuel in the combustion chamber to a greater extent, thus improving combustion and therefore reducing the polluting exhaust emissions.

## Pressure damper

Figure 267




FUEL PRESSURE DAMPER

The fuel pressure damper located on the delivery pipe between the fuel filter and the cylinder head is designed to damp counter-pressure increases in the delivery pipe and filter due to injection pressure surges.

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# Hydrocar power take-off on timing system

Page

HYDROCAR POWER TAKE-OFF ON TIMING SYSTEM - (P.T.O. OPTIONAL) . 249

- Description . . . . . 249

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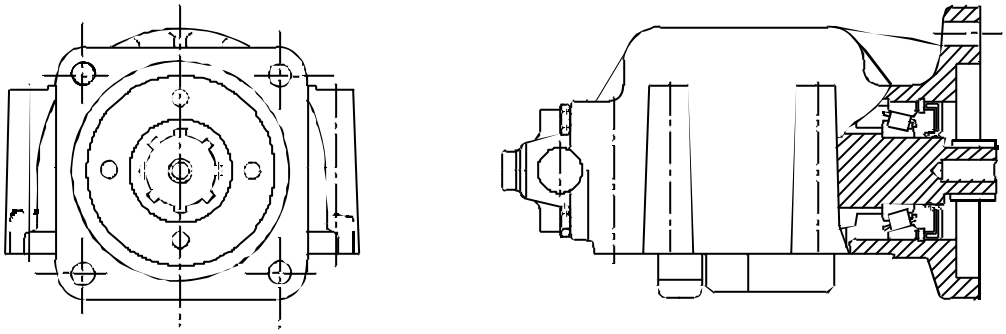
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# HYDROCAR POWER TAKE-OFF ON TIMING SYSTEM - (P.T.O. OPTIONAL)

## Description

It is a power takeoff based on one axle, with gear movement and clutch engagement which is set in motion by the timing gears regardless of the vehicle clutch. It can be used with the vehicle stationary or travelling and continuously; it can be engaged/disengaged with the engine on.
The power takeoff can be fitted for the direct pump coupling, or with a flange for the universal shaft.

Figure 1



108621

| | |
|---|---|
| Output rev number/engine rev number ratio | 1.14 |
| Output nominal torque (Nm) | 600 |
| Foreseen duration with nominal torque (hours) | 500 (with 1500 rpm) |
| Rotation direction (compared to the engine) | Opposite |
| Mounting side (vehicle travelling direction) | Top |
| Control system | Air |

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## Denox System 2


| | Page |
|---|---|
| DENOX2 SYSTEM | 253 |
| - General remarks | 253 |
| - Tank | 255 |
| - AdBlue fluid level gauge control | 255 |
| - Switch valve | 255 |
| - Pump module | 256 |
| - Dosing module | 256 |
| - Catalyst | 256 |
| - Exhaust gas temperature sensor | 257 |
| - Humidity detecting sensor | 258 |

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# DeNO$_x$2 SYSTEM

## General remarks

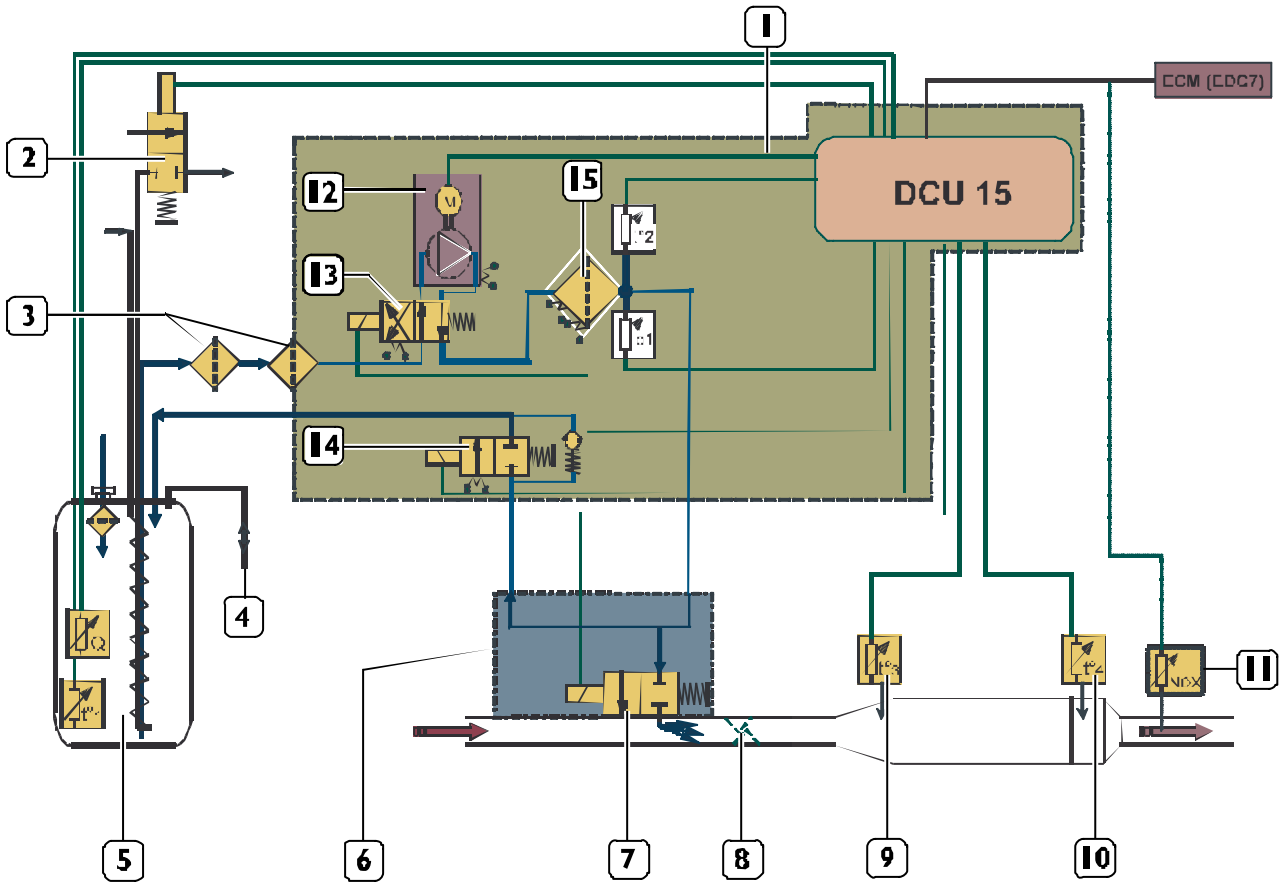
In order to keep the exhaust emission values of nitric oxides ($NO_X$) within the limits prescribed by the Euro 4 standard, with low fuel consumption, a system for post-processing of the above substances found in exhaust gas has been fitted to the vehicles.

This system essentially consists of an electronic-control oxidizing catalyst.

The system converts, through the SCR (Selective Catalytic Reduction) process, nitric oxides ($NO_X$) into inert compounds: free nitrogen ($N_2$) and water vapour ($H_2O$).

The SCR process is based on a series of chemical reactions, which leads, due to ammonia reacting with exhaust gas oxygen, to a reduction of nitric oxides ($NO_X$) found in exhaust gas.

Figure 1




1. Pump module - 2. Tank heating valve - 3. Pre-filters - 4. Tank vent pipe - 5. Ad Blue tank - 6. Dosing module - 7. Dosing valve - 8. Mixer - 9/10. Exhaust gases temperature sensors - 11. $NO_X$ detection sensors (*) - 12. Diaphragm pump - 13. Multi-ways magnetic valve - 14. Cooling valve - 15. Main filter

* Future application

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The system is essentially made up of:

- a tank (10) for reagent solution (water - urea: AdBlue), equipped with level gauge (9);
- an $H_2O$ switch valve (1);
- pump module (8);
- a mixing and injection module (2);
- catalyst (5);
- two exhaust gas temperature sensors (3, 4) on catalyst (5);
- a moisture detection sensor (7) fitted on the engine air intake pipe downstream from the air cleaner.

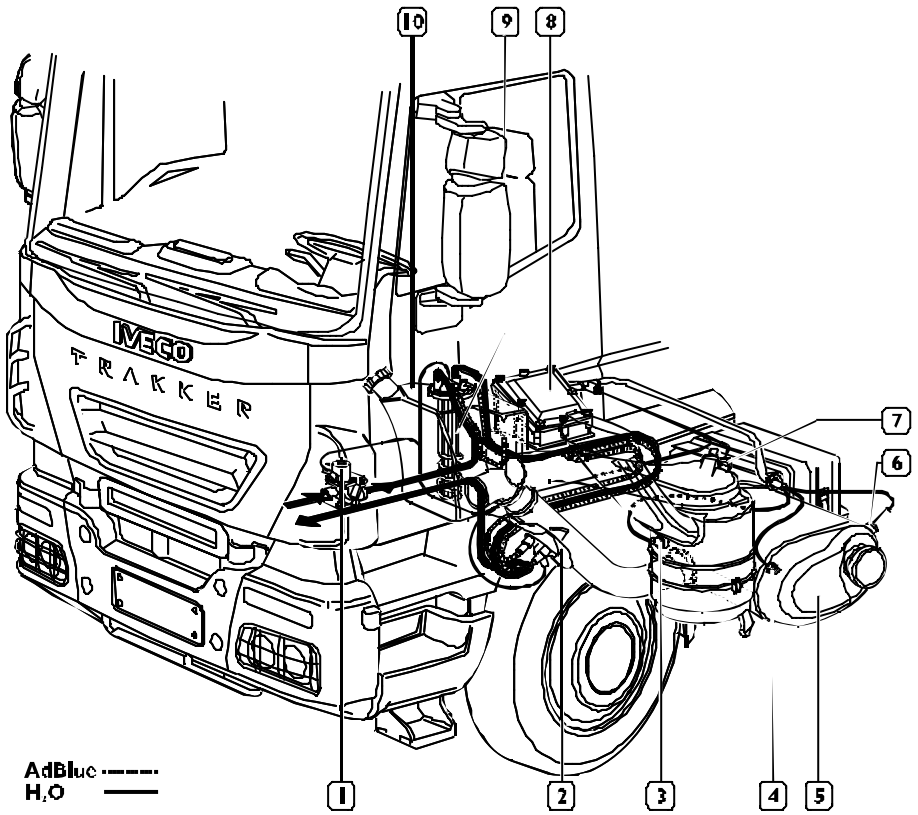
SCR system is electronically managed by DCU (Dosing Control Unit) incorporated into pump module (10); depending on engine rpm, supplied torque, exhaust gas temperature, quantity of nitrogen oxides and humidity of air sucked in, the control unit regulates the flow rate of AdBlue solution to be let into the system.

Pump module (8) takes reagent solution out of tank (10), then sends it under pressure into measuring out module (2); finally, the reagent solution is injected into the exhaust pipe upstream of catalyst (5).

The first stage of the process takes place in the first part of the catalytic converter: due to the effect of the exhaust gas temperature, the reagent solution evaporates instantly and is hydrolysed to ammonia ($2NH_3$) and carbon dioxide ($CO_2$). At the same time, the solution evaporates to bring down the exhaust gas temperature to levels close to the optimum temperature required for the process.

Exhaust gases containing ammonia at the temperature required for the reaction enter the catalytic converter, where the second stage of the process takes place: the ammonia reacts with the oxygen in the exhaust gases and is converted to free nitrogen ($N_2$) and steam ($H_2O$).

Figure 2




POSITION OF SCR SYSTEM COMPONENTS ON THE VEHICLE

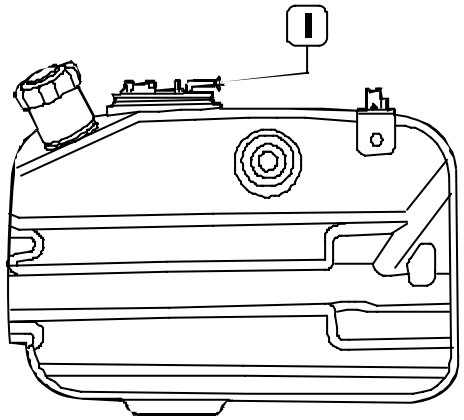
1. $H_2O$ valve - 2. By-pass valve - 3. Inflow exhaust gas temperature sensor - 4. Output exhaust gas temperature sensor - 7. Sucked air humidity and temperature sensor - 5. Catalyst - 6. Nitric oxide detecting sensor (*) - 8. Pump module - 9. Level gauge - 10. Water-urea solution (AdBlue) tank

* Future application

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## Tank

Figure 3

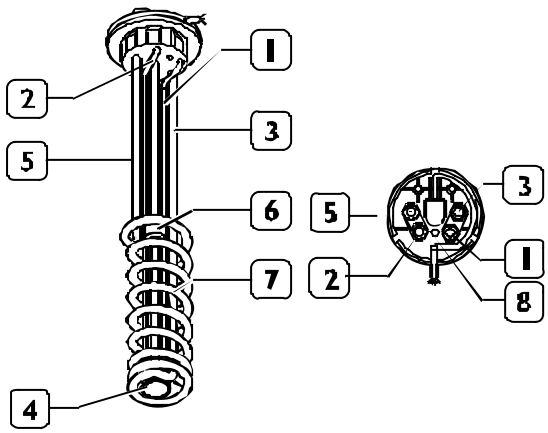



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The tank equipped with level gauge control (1) contains the reducing substance required for the SCR process, which consists of a 35%-urea and water solution called AdBlue.

## AdBlue fluid level gauge control

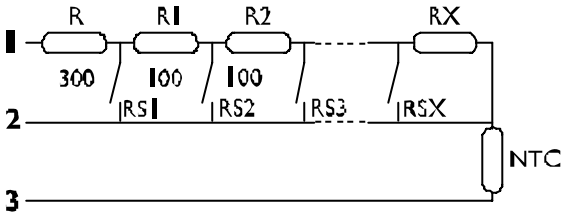
Figure 4




116181

1. AdBlue liquid discharge line - 2. AdBlue fluid return pipe - 3. Engine cooling hot fluid inlet pipe - 4. AdBlue (NTC) temperature sensor - 5. Engine cooling hot fluid outlet pipe - 6. Float (level sensor) - 7. AdBlue fluid heating coil - 8. AdBlue air vent

Figure 5




102308

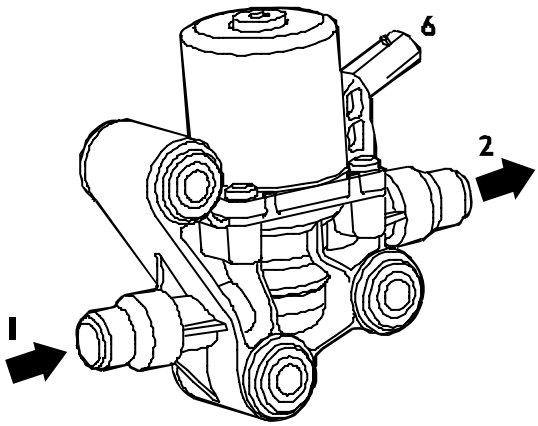
FUNCTIONAL WIRING DIAGRAM

The AdBlue fluid level gauge control consists of a device made up of a set of resistors, a float, a NTC temperature sensor, and a coil used to heat the fluid under low temperature conditions.

It informs the control unit of any current change due to the resistor determined by the float position with respect to the AdBlue fluid level.

## Switch valve

Figure 6




108127

FUNCTIONAL WIRING DIAGRAM

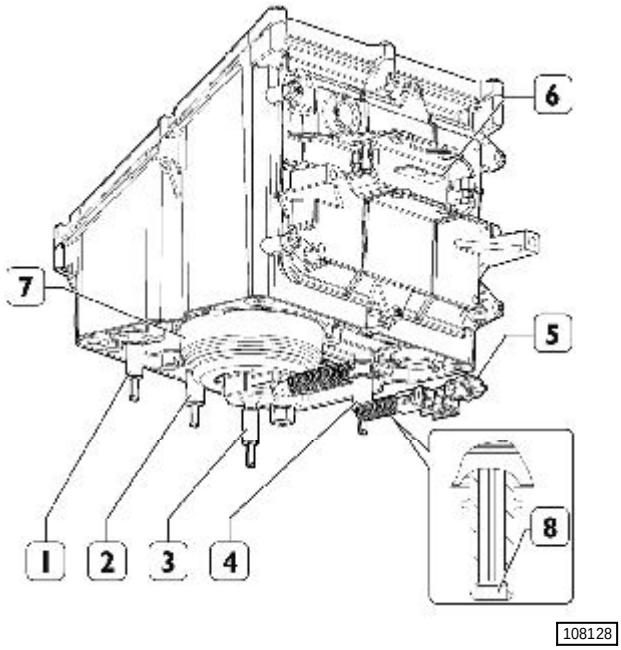
1. Coolant inlet - 2. Coolant outlet - 6. Electrical connection

The valve, which is a Normally Closed type valve, allows AdBlue tank to be heated by engine coolant.
The NTC (Figure 5) temperature sensor controls the by-pass valve which closes or opens (depending on temperature) the passage of the engine cooling hot fluid into the heating coil.

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## Pump module

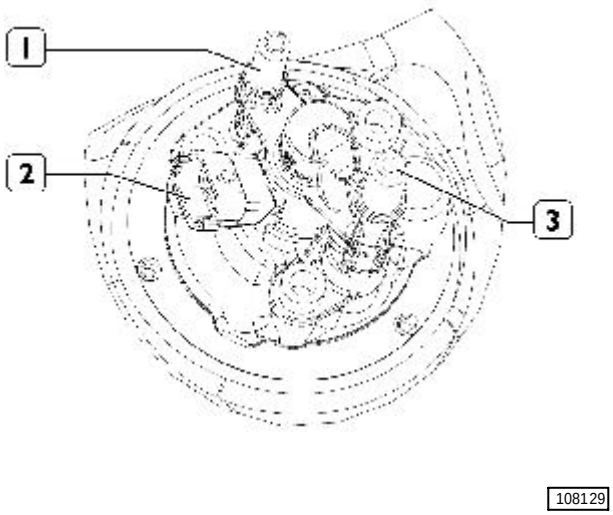
Figure 7




1. Pipe of AdBlue return to the tank - 2. Pipe of AdBlue return from measuring out module - 3. AdBlue solution outlet - 4. AdBlue solution inlet - 5. Electrical connection - 6. DUC (Dosing Control Unit) connector - 7. Filter - 8. Pre-filter.

## Dosing module

Figure 8

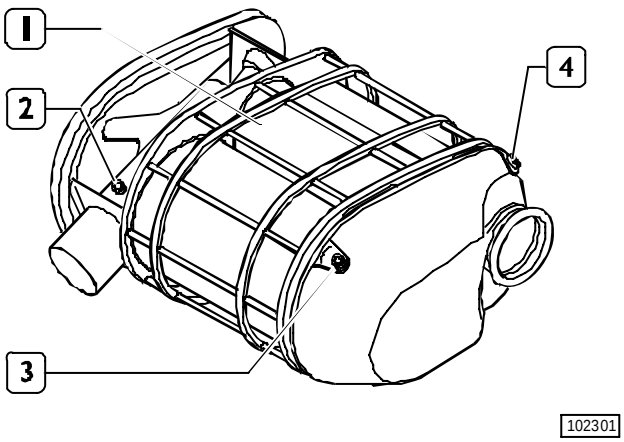



1. AdBlue inlet - 2. Electrical connection - 3. AdBlue outlet

Its task is to measure out the AdBlue solution to be sent to the exhaust pipe upstream of catalyst.

## Catalyst

Figure 9




Catalyst (1), equipped with sound-proofing material, replaces the exhaust silencer.

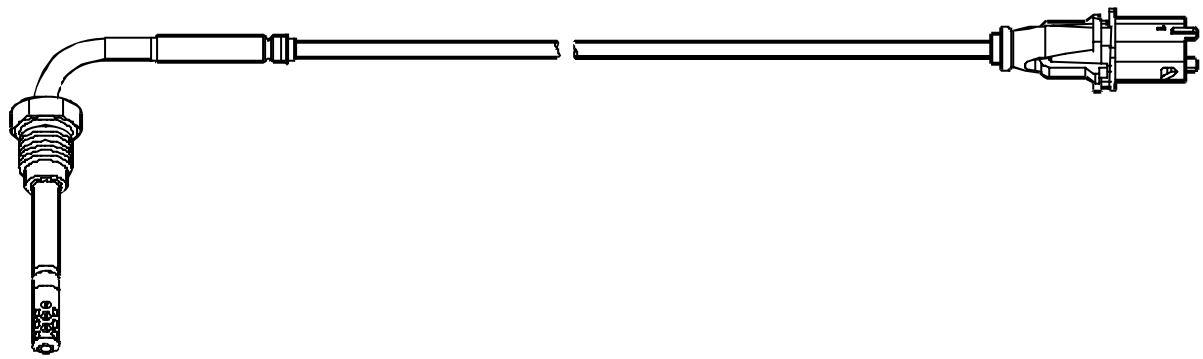
Inside the catalyst, the exhaust gas nitric oxides are, by reacting with ammonia, converted into free nitrogen and water vapour.

Temperature sensors (2 and 3) and nitric oxide detecting sensor (4) are fitted onto catalyst (1).

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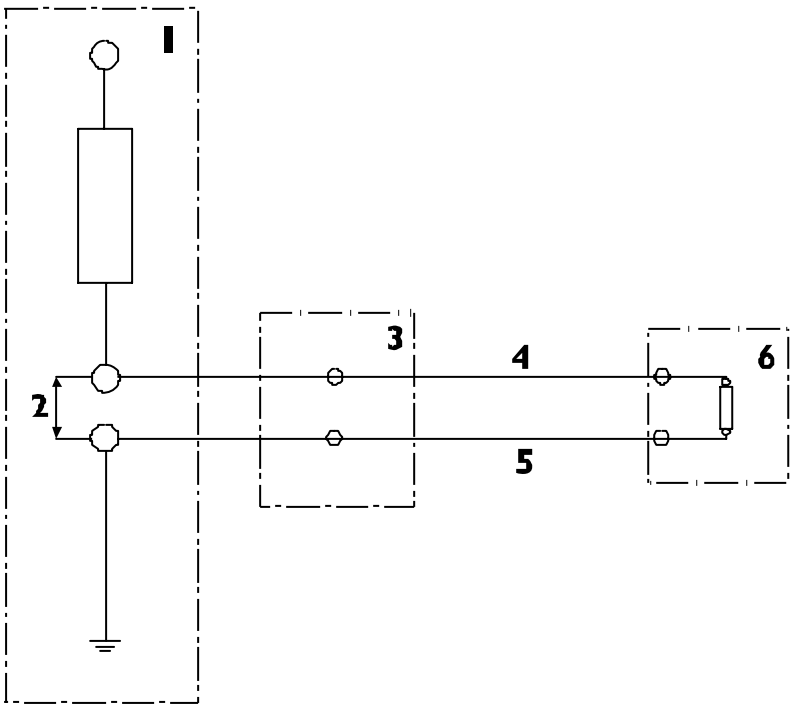
## Exhaust gas temperature sensor

Figure 10



102303

Figure 11




102304

FUNCTIONAL WIRING DIAGRAM

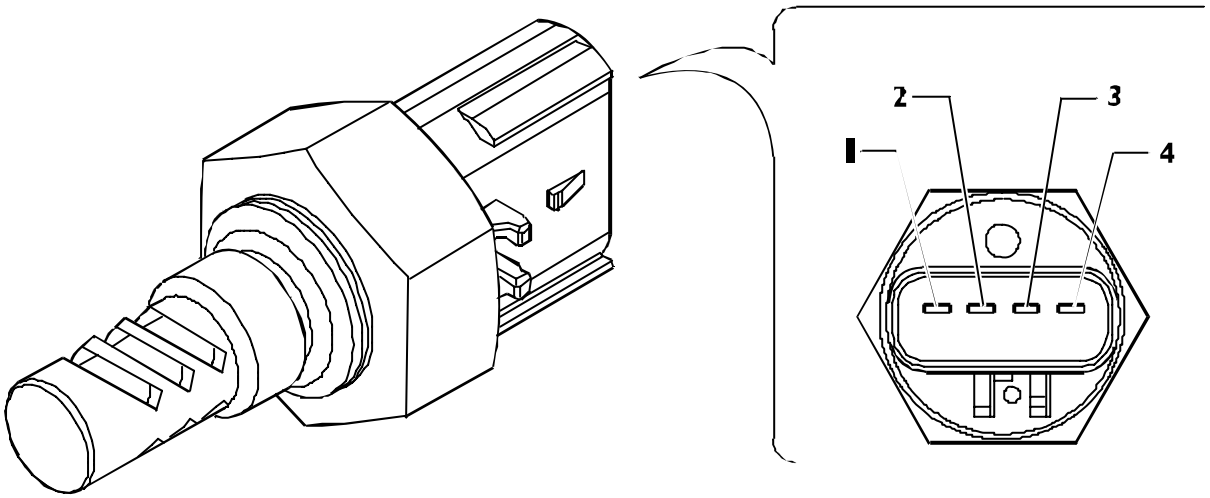
1. Supply voltage - 2. Variable output voltage - 3. Connector - 4. Signal cable (grey) - 5. Earth cable (white) - 6. Sensor.

The function of this sensor is to send the control unit the catalyst inlet and outlet exhaust gas temperature values required to calculate the amount of urea to be injected into the system.

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## Humidity detecting sensor

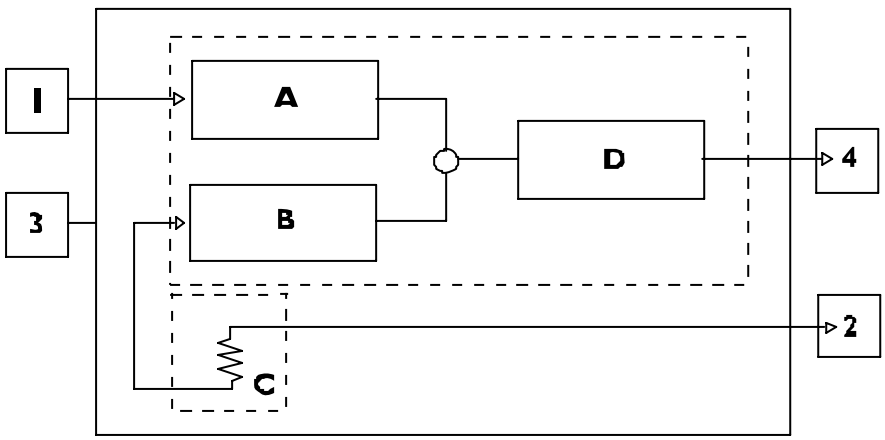
Figure 12




1. Temperature - 2. Earth - 3. Humidity percent value - 4. Power supply.

This sensor is located on the air filter output conveyor, and is used to inform the control unit of the amount (percentage) of humidity found in sucked air, to determine the calculation of nitric oxide emissions.

Figure 13




ELECTRIC BLOCK DIAGRAM

1. Earth - 2. Temperature - 3. Power supply unit - 4. Humidity percent value - A. Sample frequency generator - B. Reference oscillator - C. NTC temperature sensor - D. Amplifier lowpass filter

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# Diagnosis

Page

DIAGNOSIS . . . . . 261

- Diagnosis Instruments . . . . . 261
- Diagnosis on Cluster . . . . . 263
- DTC - FMI error codes . . . . . 265
- Trouble shooting according to symptoms . . . . 289

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# DIAGNOSIS

Fault diagnosis comprises two sections:

- The first one, organized by error codes (DTC-FMI), concerns faults that may be identified by the EDC control unit directly. These faults are mainly of an electric - electronic - pneumatic nature.
- The second one, organized by symptoms, describes the possible faults the electronic control unit cannot identify directly. These faults are mainly of a mechanical - pneumatic nature.

## SECTION 1

EDC system trouble shooting can be either by Cluster or diagnosis tools Modus, IT 2000 and E.A.SY.

Diagnosis with the cluster makes it possible to estimate the situation of faults in the system in advance, while the diagnosis instruments are essential to perform thorough diagnosis and operate on the single faults correctly.

Each single instrument displays the diagnosis and repair help.

### Diagnosis Instruments

MODUS (Maintenance and Diagnostic System)

A computerized fault-diagnosis station dedicated to diagnosing the brake systems, air suspensions, engines and systems controlled electronically.

The station is equipped with auxiliary functions, such as: programming electronic control units, consulting the spare parts catalogue and service time schedules.

The vehicle has a 30-pin diagnosis socket to interface with the instrument.

IT 2000 (IVECO Electronic Tester)

This makes it possible to take immediate action on the vehicle, identifying it with the chassis number.

It saves the results of diagnostics actions performed.

It can be used as a portable Personal Computer, too, being fitted for remote diagnosis.

By using MODUS as the mother station it is possible to update and configure the IT 2000.

IT 2000 interfaces with the vehicle via a 30-pin diagnosis socket.

E.A.SY.

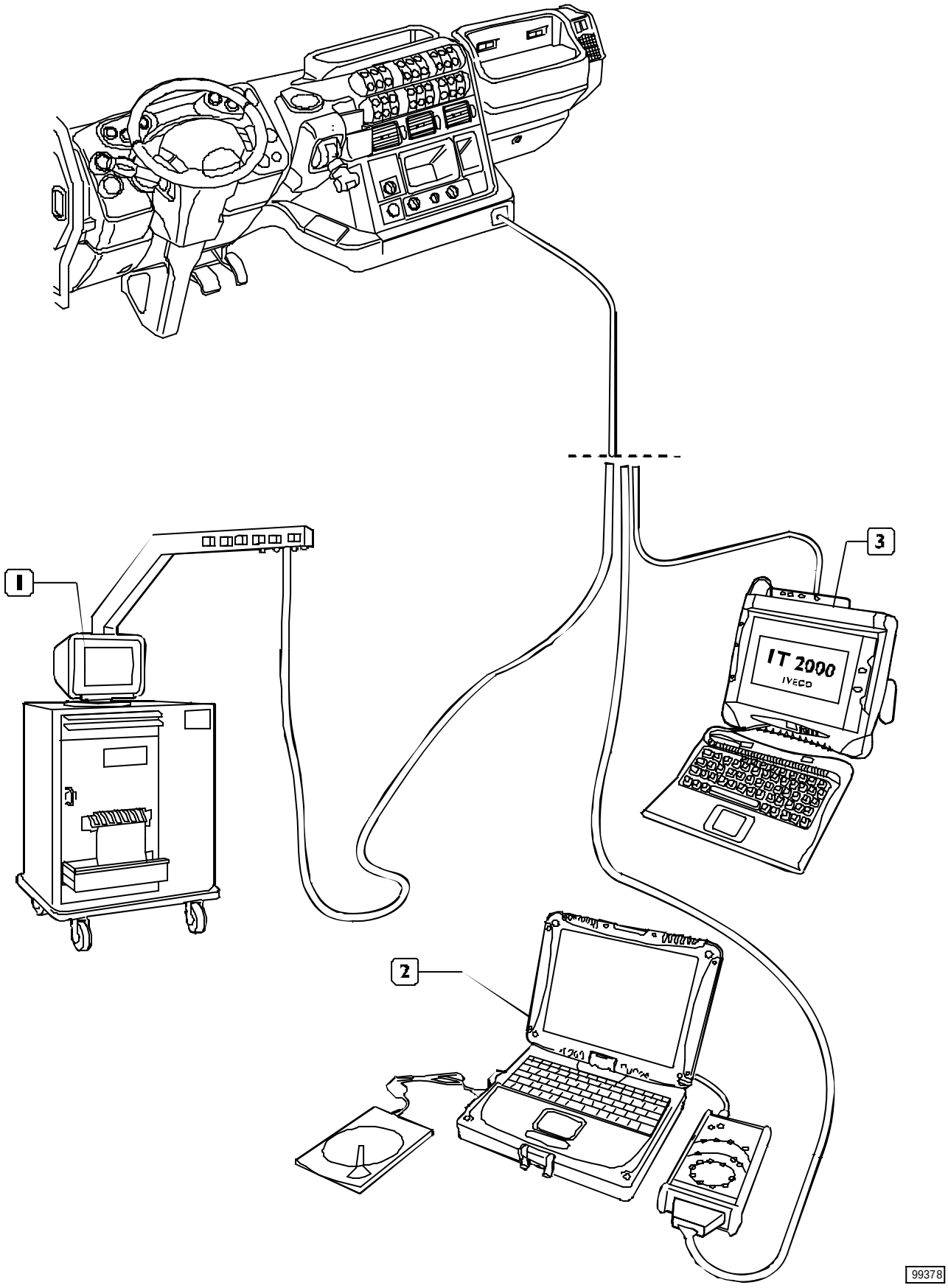
E.A.SY. system allows to simply make the diagnosis and programming of the various electronic central units aboard the vehicle.

E.A.SY. system is made up of ECI module communicating with the electronic central units and of a Panasonic PC.

ECI module, exploiting the Panasonic PC, also allows easy on the road interventions: in particular, thanks to Panasonic PC wireless technologies (e.g. GPRS), diagnostic interventions can be assisted by a remote expert centre.

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Figure 1



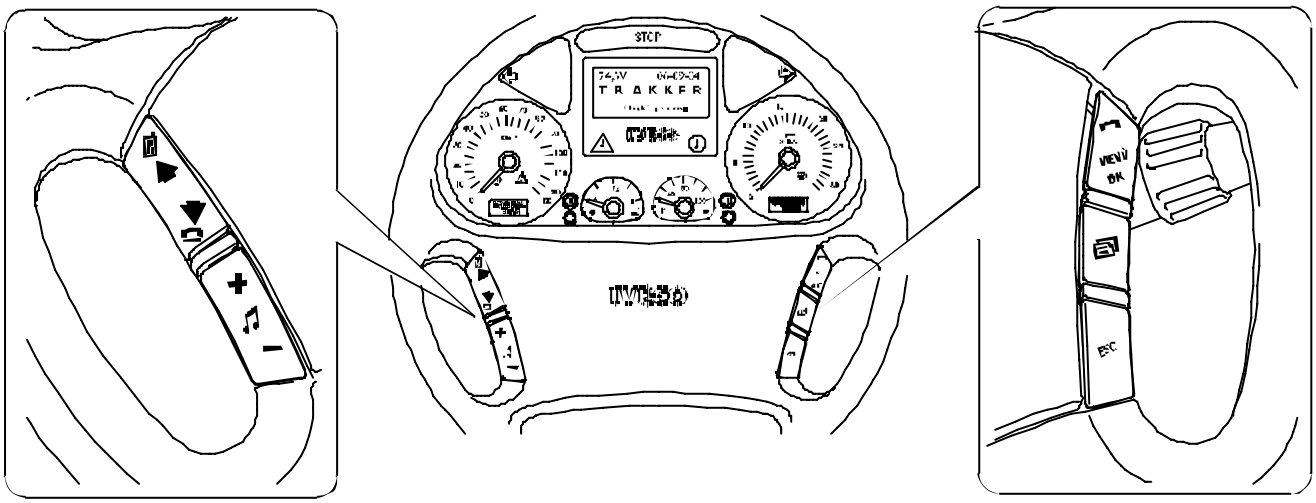

1. Modus - 2. E.A.SY. - 3. IT 2000

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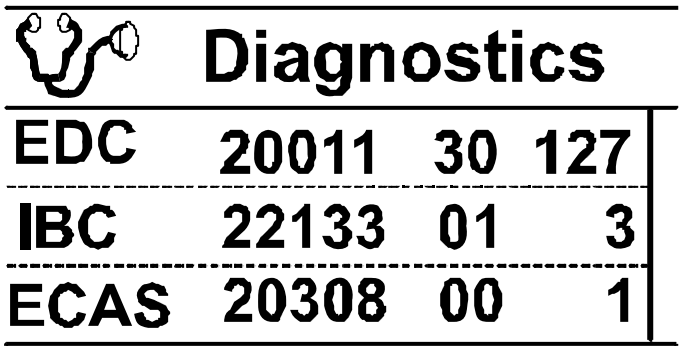
## Diagnosis on Cluster

Access to diagnostic screen is possible through "page" or " y " " b " keys.

Figure 2




98888




98885

Diagnosis information on the cluster is split into 4 columns:

- First column = central unit.
- Second column = central unit address plus fault order number.
- Third column = failure type.
- Fourth column = failure frequency.

The screen shows three error messages at most, but can store up to eight error messages. For displaying any further messages, just operate " y " and " b " keys.

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 113 | | ACCELERATOR PEDAL/ BRAKE PEDAL SUSPECT | | Vehicle acceleration very slow. Engine idle speed: 500 rpm. | Accelerator pedal and brake pressed simultaneously (for too long); Accelerator pedal blocked or faulty; Incorrect use of vehicle. | Check the accelerator pedal signal and pedal mechanical movement. | | | | |
| 116 | | CLUTCH SIGNAL SUSPECT | | The parameter reading shows that the clutch is pressed. | Clutch switch faulty or wiring problems in pedal. | Check clutch pedal switch and wiring. | | | | |
| 117 | | BRAKE PEDAL SIGNAL ERROR | | Slight power reduction | Main and secondary brake switch not synchronised. One of the two brake pedal switches may be stuck. | Check the synchronisation of both switches (signal) and wiring. | | | | |
| 119 | | PLAUSIBILITY +15 | | | Possible mechanical problem (in pawl) or electrical problem. | Check wiring. | | | | |
| 121 | | SPEED LIMITER W/ LIGHT | | Warning light permanently off. | Short circuit or defective wiring. | Check wiring. | | | | |
| 122 | | WARNING LIGHT EOBD | | Warning light permanently off. | Short circuit or defective wiring. | Check wiring. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 123 | | EDC LAMP | | Warning light permanently off. | Short circuit or defective wiring. | Check wiring. | | | | |
| 124 | | COLD START LAMP | | Warning light permanently off. | Short circuit or defective wiring. | Check wiring. | | | | |
| 125 | | MAIN RELAY DEFECT | | Possible problems during after-run. | Relay short circuit to battery positive or ground. | Check wiring between ECM and battery.<br>Replace relay if necessary. | | | | |
| 126 | | BATTERY VOLTAGE | | Possible problems during after-run. | Alternator or battery defective.<br>Possible wiring problem. | Check wiring.<br>Replace alternator regulator or battery<br>Replace the alternator if necessary. | | | | |
| 127 | | ENGINE BRAKE ELECTRO-VALVE | | Engine brake not operational. | Relay or wiring short-circuited or interrupted. | Check wiring.<br>Replace relay if necessary. | | | | |
| 128 | | MAIN RELAY - SHORT CIRCUIT TO BATTERY | | Possible problems during after-run. | Relay short circuit to battery positive or ground.<br>Relay may be faulty. | Check wiring between ECM and battery.<br>Replace relay if necessary. | | | | |
| 129 | | AIR-CONDITIONER COMPRESSOR RELAY | | Possible problems during after-run. | Relay short circuit to battery positive or ground.<br>Relay may be faulty. | Check wiring between ECM and battery.<br>Replace relay if necessary. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 12A | | RELAIS FOR ENGINE BRAKE VALVE | | Possible problems during after-run. | Relay short circuit to battery positive or ground.<br>Relay may be faulty. | Check wiring between ECM and battery.<br>Replace relay if necessary. | | | | |
| 12B | | THERMO-STARTER RELAY 1 (HEATER) | | Heater not working. | Relay or wiring short-circuited or interrupted. | Check wiring.<br>Replace relay if necessary. | | | | |
| 12C | | THERMO-STARTER RELAY 2 | | Heater not working. | Relay or wiring short-circuited or interrupted. | Check wiring.<br>Replace relay if necessary. | | | | |
| 12E | | MANAGEMENT SYSTEM PRE/POST-HEATING (ACTIVE) | | Grid heater permanently operating. | Grid heater short circuited to ground. | Check wiring and component. | | | | |
| 131 | | COOLANT TEMPERATURE SENSOR | | No reaction noticeable on behalf of the driver. | Sensorshort-circuited or value implausible. | Check the wiring. Replace sensor if necessary. | | | | |
| 132 | | COOLANT TEMPERATURE SENSOR (TEST) | | Slight power reduction. | Operation in extreme environmental conditions or sensor inaccurate. | Ensure the engine is not working in extreme environmental conditions.<br>Check the wiring and the sensor accuracy.<br>Replace sensor if necessary. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 133 | | AIR TEMPERATURE SENSOR BOOST AIR | | Slight power reduction. | Sensor short-circuited or value implausible. | Check the wiring. Replace sensor if necessary. | | | | |
| 134 | | BOOST PRESSURE SENSOR | | No reaction perceivable by the driver. Parameter recovery value: 2700 mbar. | Sensor short-circuited or difference between environmental pressure and turbo pressure implausible. | Check the wiring. Also check the environmental pressure sensor. Replace sensor if necessary. | | | | |
| 135 | | FUEL TEMPERATURE SENSOR | | Slight power reduction. | Sensor short-circuited or value implausible. | Check the wiring. Replace sensor if necessary. | | | | |
| 138 | | OIL PRESSURE SENSOR | | No reaction perceivable by the driver. Parameter recovery value: 3000 mbar. | Sensor short-circuited or value implausible. | Check the wiring and oil level. Replace sensor if necessary. | | | | |
| 13A | | OIL TEMPERATURE SENSOR | | No reaction perceivable by the driver. Parameter recovery value: coolant temperature value (if intact) otherwise 120°C). | Sensor short-circuited or value implausible. | Check the wiring. Replace sensor if necessary. | | | | |
| 13C | | ATMOSPHERIC TEMPERATURE SENSOR(HUMIDTIY?) | | No reaction perceivable by the driver. Parameter recovery value: 40°C. | Sensor short-circuited or value implausible. | Check the wiring. Replace sensor if necessary. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 141 | | CRANK-SHAFT SPEED | | No reaction noticeable on behalf of the driver. | Signal interrupted or wiring problem. Sensor installation may not be correct. | Check wiring and installation. Replace sensor if necessary. | | | | |
| 142 | | ENGINE WORKING ONLY WITH CAM-SHAFT SENSOR | | No reaction perceivable by the driver. | Signal interrupted or wiring problem. Sensor installation may not be correct. | Check wiring and installation. Replace sensor if necessary. | | | | |
| 143 | | CAM-SHAFT SENSOR | | No reaction perceivable by the driver. | Signal interrupted or wiring problem. Sensor installation may not be correct. | Check wiring and installation. Replace sensor if necessary. | | | | |
| 144 | | FAULT BETWEEN FLY-WHEEL SENSOR AND CAM-SHAFT | | No reaction noticeable on behalf of the driver. | Signal interrupted or wiring problem. Flywheel and timing sensor installation may be incorrect. | Check wiring and installation of both sensors. | | | | |
| 145 | | FAN RELAY | | No reaction perceivable by the driver. Fan off. | Short circuit or fan actuator faulty. | Check the wiring and the fan actuator. Replace the actuator if necessary. | | | | |
| 148 | | AIR-CONDITIONER COMPRESSOR RELAY | | Air conditioner permanently off. | Wiring or relay short-circuited. | Check the wiring. Replace relay if necessary. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 149 | | PRE-HEATING RELAY FUEL FILTER | | Filter heater not working. | Wiring or filter heater short-circuited. | Check the wiring. Replace the filter heater if necessary. | | | | |
| 151 | | INJECTOR CYLINDER 1 | | The engine runs on 5 cylinders. | Injector no.1 electric trouble. | Check correct tightness to torque of the connectors on the solenoid valve of the injector (1.36 - 1.92 Nm). Check the integrity of the injector coil and replace the injector if defective. If the coil is integral, check the wiring between the solenoid valve and EDC connector. | | | | |
| 152 | | INJECTOR CYLINDER 2 | | The engine runs on 5 cylinders. | Injector no.2 electric trouble. | Check correct tightness to torque of the connectors on the solenoid valve of the injector (1.36 - 1.92 Nm). Check the integrity of the injector coil and replace the injector if defective. If the coil is integral, check the wiring between the solenoid valve and EDC connector. | | | | |
| 153 | | INJECTOR CYLINDER 3 | | The engine runs on 5 cylinders. | Injector no.3 electric trouble | Check correct tightness to torque of the connectors on the solenoid valve of the injector (1.36 - 1.92 Nm). Check the integrity of the injector coil and replace the injector if defective. If the coil is integral, check the wiring between the solenoid valve and EDC connector. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 154 | | INJECTOR CYLINDER 4 | | The engine runs on 5 cylinders | Injector no.4 electric trouble | Check correct tightness to torque of the connectors on the solenoid valve of the injector (1.36 - 1.92 Nm). Check the integrity of the injector coil and replace the injector if defective. If the coil is integral, check the wiring between the solenoid valve and EDC connector. | | | | |
| 155 | | INJECTOR CYLINDER 5 | | The engine runs on 5 cylinders | Injector no.5 electric trouble | Check correct tightness to torque of the connectors on the solenoid valve of the injector (1.36 - 1.92 Nm). Check the integrity of the injector coil and replace the injector if defective. If the coil is integral, check the wiring between the solenoid valve and EDC connector. | | | | |
| 156 | | INJECTOR CYLINDER 6 | | The engine runs on 5 cylinders | Injector no.6 electric trouble | Check correct tightness to torque of the connectors on the solenoid valve of the injector (1.36 - 1.92 Nm). Check the integrity of the injector coil and replace the injector if defective. If the coil is integral, check the wiring between the solenoid valve and EDC connector. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 161 | | INJECTOR CYLINDER 1 / SHORT CIRCUIT | | One or more injectors (bank 1 or bank 2) not operating. | Possible short circuit in connections. Possible problem in injector coil. Possible problem in control unit. | Check wiring. Possible internal problem also in ECM. Replace the injector if necessary. | | | | |
| 162 | | INJECTOR CYLINDER 2 / SHORT CIRCUIT | | One or more injectors (bank 1 or bank 2) not operating. | Possible short circuit in connections. Possible problem in injector coil. Possible problem in control unit. | Check wiring. Possible internal problem also in ECM. Replace the injector if necessary. | | | | |
| 163 | | INJECTOR CYLINDER 3 / SHORT CIRCUIT | | One or more injectors (bank 1 or bank 2) not operating. | Possible short circuit in connections. Possible problem in injector coil. Possible problem in control unit. | Check wiring. Possible internal problem also in ECM. Replace the injector if necessary. | | | | |
| 164 | | INJECTOR CYLINDER 4 / SHORT CIRCUIT | | One or more injectors (bank 1 or bank 2) not operating. | Possible short circuit in connections. Possible problem in injector coil. Possible problem in control unit. | Check wiring. Possible internal problem also in ECM. Replace the injector if necessary. | | | | |
| 165 | | INJECTOR CYLINDER 5 / SHORT CIRCUIT | | One or more injectors (bank 1 or bank 2) not operating. | Possible short circuit in connections. Possible problem in injector coil. Possible problem in control unit. | Check wiring. Possible internal problem also in ECM. Replace the injector if necessary. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 166 | | INJECTOR CYLINDER 6 / SHORT CIRCUIT | | One or more injectors (bank 1 or bank 2) not operating. | Possible short circuit in connections.<br>Possible problem in injector coil.<br>Possible problem in control unit. | Check wiring.<br>Possible internal problem also in ECM.<br>Replace the injector if necessary. | | | | |
| 167 | | INJECTOR CYLINDER 1 / OPEN CIRCUIT | | One or more injectors (bank 1 or bank 2) not operating. | Possible injector connection problem (or disconnected internally).<br>Possible problem in control unit (capacitor). | Check wiring.<br>Possible internal problem also in ECM.<br>Replace the injector if necessary. | | | | |
| 168 | | INJECTOR CYLINDER 2 / OPEN CIRCUIT | | One or more injectors (bank 1 or bank 2) not operating. | Possible injector connection problem (or disconnected internally).<br>Possible problem in control unit (capacitor). | Check wiring.<br>Possible internal problem also in ECM.<br>Replace the injector if necessary. | | | | |
| 169 | | INJECTOR CYLINDER 3 / OPEN CIRCUIT | | One or more injectors (bank 1 or bank 2) not operating. | Possible injector connection problem (or disconnected internally).<br>Possible problem in control unit (capacitor). | Check wiring.<br>Possible internal problem also in ECM.<br>Replace the injector if necessary. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 16A | | INJECTOR CYLINDER 4 / OPEN CIRCUIT | | One or more injectors (bank 1 or bank 2) not operating. | Possible injector connection problem (or disconnected internally).<br>Possible problem in control unit (capacitor). | Check wiring.<br>Possible internal problem also in ECM.<br>Replace the injector if necessary. | | | | |
| 16B | | INJECTOR CYLINDER 5 / OPEN CIRCUIT | | One or more injectors (bank 1 or bank 2) not operating. | Possible injector connection problem (or disconnected internally).<br>Possible problem in control unit (capacitor). | Check wiring.<br>Possible internal problem also in ECM.<br>Replace the injector if necessary. | | | | |
| 16C | | INJECTOR CYLINDER 6 / OPEN CIRCUIT | | One or more injectors (bank 1 or bank 2) not operating. | Possible injector connection problem (or disconnected internally).<br>Possible problem in control unit (capacitor). | Check wiring.<br>Possible internal problem also in ECM.<br>Replace the injector if necessary. | | | | |
| 16D | | COMPRESSION TEST IN PROGRESS | | | Compression Test in progress. | After carrying out the compression test, turn the key OFF (after-run). | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 16E | | THE MINIMUM NUMBER OF INJECTIONS WAS NOT REACHED: STOP THE ENGINE | | More than 2 injectors not operating. | | See individual faults in injectors. | | | | |
| 171 | | BENCH 1 CC | | One or more injectors (bank 1 or bank 2) not operating. | Possible injector connection problem.<br>Injectors short-circuited. | Check wiring.<br>Possible internal problem also in ECM.<br>Replace the injector if necessary. | | | | |
| 173 | | BENCH 2 CC | | One or more injectors (bank 1 or bank 2) not operating. | Possible injector connection problem.<br>Injectors short-circuited. | Check wiring.<br>Possible internal problem also in ECM.<br>Replace the injector if necessary. | | | | |
| 17C | | BENCH 1 INJECTORS CHECK (INTERNAL ECU) | | One or more injectors (bank 1 or bank 2) may not be operating. | Fault in control unit. | Replace the engine control unit. | | | | |
| 189 | | EGR POWER ST. SHORT TO BATT. | | No fault perceived by the driver.<br>EGR not working. | Short circuit or EGR actuator faulty. | Check wiring.<br>Replace the EGR actuator if necessary. | | | | |
| 191 | | TURBINE ACTUATOR CONTROL ELECTROVALVE | | Poor performance | VGT actuator or wiring defective. | Check VGT wiring and actuator. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 192 | | TURBINE ACTUATOR CONTROL ELECTROVALVE SHORT CIRCUIT TO POSITIVE | | Poor performance | VGT actuator or wiring defective. | Check VGT wiring and actuator. | | | | |
| 193 | | TURBINE WHEEL REVS SENSOR | | Poor performance | Air filter blocked or turbine rpm sensor signal implausible. | Check the air filter and check parameters linked with the turbine by performing a road test (parameter acquisition). | | | | |
| 198 | | FAULT ON AT LEAST TWO OF THE FOLLOWING SENSORS: TURBINE SPEED, BOOT PRESSURE AND EXHAUST GAS PRESSURE | | Poor performance | Sensor signal implausible.<br>Sensor may be faulty. | Determine which turbine component caused the problem. | | | | |
| 199 | | TURBOCHARGER CONTROL BOOST PRESSURE FAILURE (PCR) | | Poor performance | Turbo sensor or actuator may be faulty.<br>Air filter may be blocked. | Check turbine sensors and actuator (parameter acquisition).<br>Check whether air filter is blocked. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 19A | | TURBINE SPEED EXCEEDING EVERY PERMITTED RANGE | | Poor performance | Turbo sensor or actuator may be faulty.<br>Air filter may be blocked. | Check turbine sensors and actuator (parameter acquisition).<br>Check whether air filter is blocked. | | | | |
| 19B | | TURBINE IN OVERSPEED (THE FAULT IS NOT DISPLAYED IF IT IS CAUSED BY A LOW ATMOSPERIC PRESSURE) | | Poor performance | Air filter blocked or turbine rpm sensor signal implausible. | Check the air filter and check parameters linked with the turbine by performing a road test (parameter acquisition). | | | | |
| 19F | | NOx SENSOR ERROR | | No effect perceived by the driver. | Sensor signal implausible.<br>Nox sensor may be faulty. | Check the Nox sensor. | | | | |
| 1A5 | | TIMEOUT OF CAN MESSAGE DM1DCU | | No effect perceived by the driver. | Problems in the Denoxtronic (on the CAN line). | Check wiring.<br>Check and correct any faults in the Denoxtronic control unit. | | | | |
| 1A6 | | TIMEOUT OF CAN MESSAGE SCR1 | | No effect perceived by the driver. | CAN configuration incorrect.<br>CAN connections defective.<br>Terminal resistance not suitable. | Check CAN line wiring.<br>Check Denoxtronic control unit wiring and operation. | | | | |
| 1AE | | HUMIDITY SENSOR | | No effect perceived by the driver. | Sensor short-circuited or faulty. | Check wiring<br>Replace sensor if necessary. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1AF | | SERIOUS EOBD FAULT FROM DE-NOX-TRONIC (EOBD FLASHING LIGHT) | | No effect perceived by the driver. | Problems in AdBlue dosing system. | Check the faults in the Denoxtronic and consult the control unit troubleshooting guide. | | | | |
| 1B1 | | ERROR ON CAN CON-TROLLER A | | No effect perceived by the driver. | CAN configuration incorrect. CAN connections defective. Terminal resistance not suitable. | Check CAN line wiring. Check terminal resistances. | | | | |
| 1B2 | | ERROR ON CAN CON-TROLLER B | | No effect perceived by the driver. | CAN configuration incorrect. CAN connections defective. Terminal resistance not suitable. | Check CAN line wiring. Check terminal resistances. | | | | |
| 1B3 | | ERROR ON CAN CON-TROLLER C | | No effect perceived by the driver. | CAN configuration incorrect. CAN connections defective. Terminal resistance not suitable. | Check CAN line wiring. Check terminal resistances. | | | | |
| 1B4 | | TIMEOUT CAN MESSAGE BC2EDC1 | | No effect perceived by the driver. | CAN configuration incorrect. CAN connections defective. Terminal resistance not suitable. | Check CAN line wiring. Check BC wiring and operation. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1B5 | | TIMEOUT CAN MESSAGE VM2EDC | | No effect perceived by the driver. | CAN configuration incorrect. CAN connections defective. Terminal resistance not suitable. | Check CAN line wiring. Check VCM wiring and operation. | | | | |
| 1B7 | | ERROR ON MESSAGES CAN IN TRANSMISSION | | No effect perceived by the driver. | CAN configuration incorrect. CAN connections defective. Terminal resistance not suitable. | Check CAN line wiring. Check ECM wiring and operation. | | | | |
| 1B9 | | ERROR ON THE EOBD LIGHT MANAGED BY THE CLUSTER) | | No effect perceived by the driver. | MIL/Body Controller warning light defective. | Consult the Body Controller troubleshooting guide and check the CAN line. | | | | |
| 1BA | | TIMEOUT CAN MESSAGE DASH DISPLAY | | No effect perceived by the driver. | CAN messages from VCM inconsistent. | Consult the VCM troubleshooting guide and check the CAN line. | | | | |
| 1BC | | TIMEOUT CAN MESSAGE AMBCOND | | No effect perceived by the driver. | CAN messages from VCM inconsistent. | Consult the VCM troubleshooting guide and check the CAN line. | | | | |
| 1BD | | TIMEOUT CAN MESSAGE CCVS | | No effect perceived by the driver. | CAN messages from VCM or BC inconsistent. | Consult the VCM/BC troubleshooting guide and check the CAN line. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1C2 | | ERROR MESSAGE CAN ETC1 | | No effect perceived by the driver. | CAN messages from ETC (gearbox) inconsistent. | Check the ETC connection with the CAN line. | | | | |
| 1C3 | | TIMEOUT IN RECEIVING TC01 CAN MESSAGE | | No effect perceived by the driver. | CAN messages from TCO inconsistent. | Check the TCO connection with the CAN line. | | | | |
| 1C6 | | ERROR MESSAGE CAN TSC1-PE | | No effect perceived by the driver. | CAN messages from TCU (Transmission Control Unit) inconsistent. | Check the TCU connection with the CAN line. | | | | |
| 1C8 | | ERROR MESSAGE CAN TSC1-VE | | No effect perceived by the driver. | CAN messages from TCU (Transmission Control Unit) inconsistent. | Check the TCU connection with the CAN line. | | | | |
| 1D1 | | ECU OVERRUN MONITORING ERROR | | No effect perceived by the driver. | Electrical interference or internal control unit problems. | If the error persists to replace ECU. | | | | |
| 1D2 | | ECU OVERRUN MONITORING ERROR | | No effect perceived by the driver. | Poor control unit programming/flash Possible internal fault. | Reprogram the central unit. If the error is repeated, replace the central unit, if needed. | | | | |
| 1D3 | | ECU OVERRUN MONITORING ERROR | | No effect perceived by the driver. | Poor control unit programming/flash Possible internal fault. | Reprogram the central unit. If the error is repeated, replace the central unit, if needed. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1D4 | | ECU OVERRUN MONI-TORING ERROR | | No effect per-ceived by the driver. | Ecu internal fail-ure. | If the error persists to replace ECU. | | | | |
| 1D5 | | ECU OVERRUN MONI-TORING ERROR | | No effect per-ceived by the driver. | Ecu internal fail-ure. | If the error persists to replace ECU. | | | | |
| 1D6 | | ECU IN-TERNAL ERROR (TPU) | | Control unit deactivation. | Electronic inter-ference or con-trol unit faulty. | If the error persists to replace ECU. | | | | |
| 1D8 | | ECU OVERRUN MONI-TORING ERROR | | No effect per-ceived by the driver. | Ecu internal fail-ure. | If the error persists to replace ECU. | | | | |
| 1E2 | | IMMOBIL-IZER | | The engine fails to start. | Problem in CAN line or immobi-liser control unit. | Check the Immobiliser control unit is correctly connected.<br>Enter the Immobiliser PIN code during the emergency procedure. | | | | |
| 1E3 | | ERROR FOR ECU INTERNAL MONI-TORING | | No effect per-ceived by the driver. | Ecu internal fail-ure. | If the error persists to replace ECU. | | | | |
| 1E4 | | ERROR FOR ECU INTERNAL MONI-TORING | | No effect per-ceived by the driver. | Ecu internal fail-ure. | If the error persists to replace ECU. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1E5 | | SENSORS POWER SUPPLY FAULT (12V) | | No effect perceived by the driver. | Excessive/insufficient battery voltage or possible internal control unit problem. | Check battery voltage or connections with the ECM. Replace the control unit if necessary. | | | | |
| 1E6 | | SENSOR POWER SUPPLY 1 | | No effect perceived by the driver. | Excessive/insufficient battery voltage or possible internal control unit problem. | Check battery voltage or connections with the ECM. Replace the control unit if necessary. | | | | |
| 1E7 | | SENSOR POWER SUPPLY 2 | | No effect perceived by the driver. | Excessive/insufficient battery voltage or possible internal control unit problem. | Check battery voltage or connections with the ECM. Check ECU, if required. | | | | |
| 1E8 | | SENSOR POWER SUPPLY 3 | | No effect perceived by the driver. | Excessive/insufficient battery voltage or possible internal control unit problem. | Check battery voltage or connections with the ECM. Replace the control unit if necessary. | | | | |
| 1E9 | | ECU OVERRUN MONITORING ERROR | | No effect perceived by the driver. | Excessive/insufficient battery voltage or possible internal control unit problem | Check battery voltage or connections with the ECM. Replace the control unit if necessary. | | | | |
| 1EA | | ECU OVERRUN MONITORING ERROR | | No effect perceived by the driver. | Excessive/insufficient battery voltage or possible internal control unit problem. | Check battery voltage or connections with the ECM. Replace the control unit if necessary. | | | | |
| 1EB | | ATMOSPHERIC PRESSURE SENSOR | | No effect perceived by the driver. Environmental pressure recovery value: 700 mbar. | Fault in sensor inside control unit. | Change ECU. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1FA | | TOO HIGH NUMBER OF REGENERATIONS DEMAND | | No reaction perceivable by the driver. Too many filter regenerations carried out. | Particulate filter may be blocked. | Check filter. | | | | |
| 1FB | | PERMANENT REGENERATION ON TRAP PARTICLE | | No reaction perceivable by the driver. | Catalytic converter not installed or damaged. | Check catalytic converter visually. | | | | |
| 1FC | | FIRST SENSOR EXAUSTED GAS TEMPERATURE | | No reaction perceivable by the driver. | Temperature sensors damaged or incorrectly fitted. | Check information and condition of sensors. | | | | |
| 21F | | TOO HIGH EFFICIENCY OF CATALYST SYSTEM | | No reaction noticeable on behalf of the driver. | Actuator coil faulty or not within specified tolerance limits. | Check actuator condition. | | | | |
| 225 | | INTERRUPTED AFTERRUN | | Slight power reduction. | The control unit is turned off by the general switch instead of by the key (k15). Possible problem in main relay or connections. | Check wiring and then replace the main relay. | | | | |
| 228 | | MAIN RELAY - SHORT CIRCUIT TO GROUND | | Slight power reduction. | Short circuit in main relay or relay faulty. | Check wiring between battery and ECM and then replace the main relay. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 232 | | COOLANT TEMPERATURE SENSOR ABSOLUTE TEST | | Slight power reduction | Extreme environmental conditions or sensor incorrectly adjusted. | Ensure the engine is working in non-critical conditions. Check the sensor connections and accuracy. Replace sensor if necessary. | | | | |
| 238 | | OIL LOW PRESSURE | | Slight power reduction | Sensor incorrectly adjusted or faults in lubrication system. | Check the sensor connections and accuracy. Check the lubrication system. | | | | |
| 23A | | OIL TEMPERATURE ABOVE NORMAL | | Slight power reduction | Sensor incorrectly adjusted or faults in lubrication system. | Check the sensor connections and accuracy. Check the lubrication system. | | | | |
| 27C | | BENCH 2 INJECTORS CHECK (INTERNAL ECU) | | One or more injectors (bank 1 or bank 2) may not be operating | Fault in control unit. | Replace the engine control unit. | | | | |
| 292 | | TURBINE ACTUATOR CONTROL ELECTROVALVE SHORT CIRCUIT TO GROUND | | Poor performance | VGT actuator or wiring defective. | Check VGT wiring and actuator. | | | | |
| 2A6 | | TIMEOUT OF CAN MESSAGE SCR2 | | No effect perceived by the driver | Problem in the Denoxtronic (on the CAN line). | Check the faults in the Denoxtronic and consult the control unit troubleshooting guide. Check wiring. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 2AF | | SERIOUS EOBD FAULT FROM DE-NOX-TRONIC (EOBD FLASHING LIGHT) | | No effect perceived by the driver. | Problems in AdBlue dosing system. | Check the faults in the Denoxtronic and consult the control unit troubleshooting guide. | | | | |
| 2B4 | | TIMEOUT CAN MESSAGE BC2EDC2 | | No effect perceived by the driver. | CAN configuration incorrect. CAN connections defective. Terminal resistance not suitable. | Check CAN line wiring. Check BC wiring and operation. | | | | |
| 2C6 | | TIMEOUT OF CAN MESSAGE TSC1-PE PASSIVE | | No effect perceived by the driver. | CAN messages from TCU (Transmission Control Unit) inconsistent. | Check the TCU connection with the CAN line. | | | | |
| 2C8 | | ERROR MESSAGE CAN TSC1-VR | | No effect perceived by the driver. | CAN messages from TCU (Transmission Control Unit) inconsistent. | Check the TCU connection with the CAN line. | | | | |
| 2C9 | | ERROR MESSAGE CAN TIME-DATE | | No effect perceived by the driver. | CAN messages from TC (tachograph) inconsistent. | Check the tachograph connection with the CAN line. | | | | |
| 2D3 | | ECU OVERRUN MONI-TORING ERROR | | No effect perceived by the driver. | Poor control unit programming/flash Possible internal fault. | Reprogram the central unit. If the error is repeated, replace the central unit, if needed. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 2FF | | ERROR CHECK OF CRITICAL TIME FOR OIL DILUTION | | Slight power reduction | Oil over-diluted. | Change the engine oil. | | | | |
| 392 | | TURBINE ACTUATOR CONTROL ELECTROVALVE | | Poor performance | Connection damaged. Battery voltage excessive (ECU overheating). | Check VGT connection and actuator. | | | | |
| 3AF | | SERIOUS EOBD FAULT FROM DENOXTRONIC (EOBD FLASHING LIGHT) | | No effect perceived by the driver. | Problems in AdBlue dosing system. | Check the faults in the Denoxtronic and consult the control unit troubleshooting guide. | | | | |
| 3C8 | | TIMEOUT OF CAN MESSAGE TSC1-VE PASSIVE | | No effect perceived by the driver. | CAN messages from TCU (Transmission Control Unit) inconsistent. | Check the TCU connection with the CAN line. | | | | |
| 3C9 | | ERROR MESSAGE CAN HRDV | | No effect perceived by the driver. | CAN configuration incorrect. CAN connections defective. Terminal resistance not suitable. | Check CAN line wiring. Check BC wiring and operation. | | | | |
| 3D3 | | ECU OVERRUN MONITORING ERROR | | No effect perceived by the driver. | Poor control unit programming/flash Possible internal fault. | Reprogram the central unit. If the error is repeated, replace the central unit, if needed. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 3FA | | REGENERATION DEMAND NUMBER 2 | | No effect perceived by the driver. | Too many regenerations carried out. | Check particulate filter and faults in sensors. | | | | |
| 4AF | | SERIOUS EOBD FAULT FROM DENOXTRONIC (EOBD FLASHING LIGHT) | | No effect perceived by the driver. | Problems in AdBlue dosing system. | Check the faults in the Denoxtronic and consult the control unit troubleshooting guide. | | | | |
| 4C8 | | TIMEOUT OF CAN MESSAGE TSC1-VR PASSIVE | | No effect perceived by the driver. | CAN messages from TCU (Transmission Control Unit) inconsistent. | Check the TCU connection with the CAN line. | | | | |
| 4FA | | REGENERATION DEMAND NUMBER 3 | | No effect perceived by the driver. | Too many regenerations carried out. | Check particulate filter and faults in sensors. | | | | |
| 5AF | | DM1DCU SPN5 MESSAGE | | No effect perceived by the driver. | Problems in AdBlue dosing system. | Check the faults in the Denoxtronic and consult the control unit troubleshooting guide. | | | | |

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Aquila Trucks Centres

Aquila Trucks Centres

SECTION 2

## Trouble shooting according to symptoms

| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Engine does not start | Inefficient battery. | Pre-heating resistor always on.<br>Check alternator efficiency.<br>Check electrical connections at the battery terminals. |
| | Starter inefficient. | Check / replace. |
| | Air heater inefficient. | Check power supply and ground connection.<br>Check heater remote control switch with active diagnosis. |
| | Main remote control switch (main relay) inefficient. | Check fuse efficiency.<br>Check remote control switch with active diagnosis. |
| | Fuel pump inefficient. | Check efficiency by checking the filter input pressure.<br>Check suction tightness. |
| | Fuel pre-filter - filter inefficient. | Check if clogged / change. |
| | 0.3 bar valve on fuel return inefficient. | Check its efficiency. If blocked, replace it. |
| | Fuel circuit inefficient. | Check the system tightness and carry out bleeding. |
| Engine overheating | Coolant level wrong. | Check possible leaks and restore the level. |
| | Water pump and fan control belts inefficient. | Check, adjust tension and change components, if needed. |
| | Water pump inefficient. | Overhaul or change the assembly. |
| | Thermostat inefficient. | Check if it remains blocked in closed position or partially open.<br>Change. |
| | Radiator inefficient. | Wash accurately and check if there are any fluid leaks. Change the component, if needed. |
| | Air filter and circuit pipes inefficient. | Make sure the manifolds and the pipes are not clogged.<br>Check the filter clogging indicator. Change the filter. |
| | Cylinder head gasket inefficient. | Check the water circuit pressure and change the cylinder head gaskets. |
| | Fan inefficient. | Replace. |

*(Continue)*

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Aquila Trucks Centres

| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Engine lacks power | Fuel circuit inefficient. | Check if the mesh filter in the tank, the fuel pre-filter and filter are clogged; in this case change them.<br>Check if the 0,3 bar valve on the fuel return is blocked in open position (low pressure) or in closed position (high temperature), and then replace it.<br>Check possible circuit leaks and the fuel pump efficiency. |
| | Injectors inefficient. | Seizure of the plunger of one of the injectors may occur or fuel may leak through the O - Ring.<br>Carry out the 'Engine Test and proceed according to the instructions displayed. |
| | Engine air suction circuit inefficient. | Remove circuit necks and replace the air filter if clogged.<br>Check the cartridge clogging indicator. |
| | Exhaust gas circuit inefficient. | Eliminate exhaust manifold leaks. |
| | Working temperature not correct. | Check cooling system. |
| | VGT actuator inefficient. | Carry out the Engine Test on the basis of the instructions displayed by the diagnosis instrument. |
| | Turbo-compressor inefficient. | Carry out the Engine Test on the turbine and check integrity of the following turbo-compressor components:<br>- rotating blades;<br>- bearings;<br>- modulating valve;<br>- VGT filter clogged;<br>- turbine actuator;<br>Change faulty component.<br>Engine Test with Modus – IT2000 – E.A.SY.. |
| | Injection mechanical system inefficient. | Check wear of the injector rocker arms, the roller, the rocker arm bushes and the camshaft tappets. |
| | Valve clearance inefficient. | Adjust valve clearance. |

*(Continue)*

Aquila Trucks Centres

| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Engine brake low efficiency | Head gasket inefficient. | Head grinding and change gasket. |
| | Injector holder inefficient. | Replace it. |
| | Turbo-compressor cooling system tightness inefficient. | Overhaul turbine. |
| | Bad fuel quality. | Check if there is water in the reservoir and remove it. |
| Engine smoke is light blue | Piston rings inefficient. | Overhaul piston-cylinder assembly. |
| | Turbo-compressor lubrication system tightness inefficient. | Overhaul turbine. |
| | Valve oil seal tightness inefficient. | Change valve guide gasket. |
| Engine brake low efficiency | Engine brake components inefficient. | Check correct operation of engine brake actuator cylinders of control solenoid valve.<br>Check cylinder control oil pipe tightness.<br>Check exhaust valve clearance. |
| | Turbo-compressor inefficient. | VGT blocked in open position.<br>VGT actuator faulty (tie rod blow-by).<br>Modulating valve faulty.<br>Wrong air supply to modulating valve.<br>Change inefficient components. |
| Engine stops | Fuel in the reservoir. | Carry out bleeding after refuelling. |
| | Infficiency of mesh filter, fuel pre-filter and filter. | Clean the mesh filter and replace the pre-filter and filter. |
| | Reservoir pipes not correctly connected. | If the pipes are inverted, the vehicle can be turned off after 200 ÷ 300 km even if the reservoir is without fuel because the engine fuel pipe has a lower height of suction.<br>Invert the pipes. |

*(Continue)*

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| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Excessive fuel consumption | Air filter inefficient. | Change. |
| | Fuel reservoir and pipes inefficient. | Eliminate possible leaks and replace worn out components. |
| Excessive or insufficient oil pressure | Overpressure valve works not correctly. | Check and replace, if needed. |
| | Oil pump and oil delivery pipes inefficient. | Check and replace, if needed. |
| | Main journals and connecting rod bearings inefficient. | Replace bearings and rectify the crankshaft, if needed. |
| | Engine oil SAE viscosity not correct. | Change the engine oil with one having the right viscosity. |

Aquila Trucks Centres

SECTION 3

# Clutch


| | Page |
|---|---|
| DESCRIPTION | 3 |
| - Clutch | 3 |
| MAIN DATA | 3 |
| TROUBLESHOOTING | 6 |
| TIGHTENING TORQUES | 8 |
| TOOLS | 8 |
| REMOVING AND REFITTING THE CLUTCH | 9 |
| - Removal | 9 |
| - Checks | 9 |
| - Refitting | 10 |
| REMOVING-REFITTING THE THRUST BEARING | 10 |
| REPLACING THE SUPPORT BEARING OF THE CLUTCH SHAFT | 10 |
| REMOVING-REFITTING THE PEDAL UNIT | 11 |
| - Removal (vehicles with EuroTronic gearbox) | 11 |
| - Removal (vehicles with ZF 9S/16 S... gearbox) | 12 |
| - Refitting | 13 |
| PEDAL | 13 |
| - Unit removal-assembly | 13 |
| CHECKING AND ADJUSTING STOPS ON CLUTCH PEDAL (vehicles with ZF 9S/16S gearboxes) | 14 |
| - Clutch stop | 14 |
| - Idle travel of clutch pedal | 14 |
| - Pedal control valve stroke | 14 |
| HYDRAULIC CONTROL (Vehicles with ZF 9S/16S gearboxes) | 15 |

Aquila Trucks Centres

Page

- Master cylinder . . . . . 15

- Clutch actuator . . . . . 17

SPRING PIN ADJUSTMENT GEARBOX ASSEMBLY . . . . . 18

SPECIFICATIONS FOR GEARBOX ASSEMBLY EUROTRONIC 12 AS 1930/2330/2530 . . . . . 19

SPRING PIN ADJUSTMENT GEARBOX EUROTRONIC 12 AS 1420 TD . . . . . 20

BLEEDING CLUTCH CIRCUIT . . . . . 21

Aquila Trucks Centres

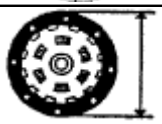
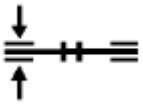
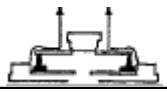
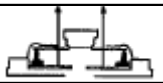
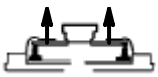
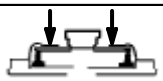
## DESCRIPTION

### Clutch

The clutch is of dry type with one disc and fitted with pull or push engaging mechanism with diaphragm spring. For the vehicles with ZF 9/16S mechanic gearbox, the clutch control is hydro-pneumatic and includes the main cylinder, with built-in oil tank, and the clutch actuator.For the vehicles with Euro Tronic gearbox, the clutch control is pneumatic and electronically controlled by the gearbox control unit.

## MAIN DATA

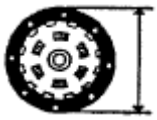
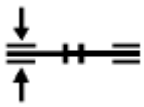
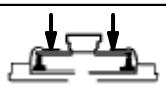
17" CLUTCH for F2B engines 9S 1310 TO / 9S 1311 TO gearboxes excluded

| | | | | |
|---|---|---|---|---|
|  | Type | | VALEO * | SACHS ** |
| | | | Dry single plate | |
|  | Engagement mechanism | | "Pull" with diaphragm spring | |
|  | Driven disc | | With friction seal | |
|  | Driven disc hub | | With spring drive | |
|  | Lining outer Ø | mm | 430 | 430 ± 1 |
|  | Lining inner Ø | mm | 242 | 240 + 3 |
|  | Plate thickness (new) | mm | 10 ± 0.3 | |
|  | Max. off-centering of driven plate | mm | ~ 0.4 | ~ 0.40 |
|  | Loaded minimum on new pressure plate | N | 34000 | 30900 |
|  | Loaded maximum with release | N | 8200 | 7000 |
|  | Minimum rise thrust pad | mm | 1.7 | |
|  | Disengagement stroke | mm | $12^{+2}$ | $12^{+2}$ |
|  | Maximum depression stroke | mm | 15.1 | 15 |
|  | Clutch control: | | - For mechanic gearboxes, main cylinder with built-in oil tank, clutch actuator with total recovery for driven disc wear<br>- For Euro Tronic gearboxes, electric-pneumatic actuator controlled by the gearbox control unit | |
|  | Type of fluid | | **Tutela TRUCK DOT SPECIAL** | |

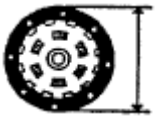
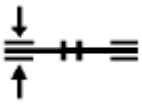
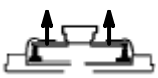
* For manual gearboxes (except for 9 speed 9S...)

** For EuroTronic gearboxes

Aquila Trucks Centres

| 17" CLUTCH - for F2B engine with gearbox - 9S 1310 TO / 9S 1311 TO | | | |
|---|---|---|---|
|  | Type | | SACHS |
| | | | Dry single plate |
|  | Clutch mechanism | | Push with diaphragm spring |
|  | Driven plate | | With friction seal |
|  | Driven plate hub | | With double torsion springs |
|  | Lining outer Ø | mm | 430 ± 1 |
|  | Lining inner Ø | mm | 242 |
|  | Plate thickness (new) | mm | 10 ± 0.3 |
|  | Max. off-centering driven plate | mm | 0.2 |
|  | Load on pressure plate (new) | Min. N | 18600 |
| | | Max. N | 20800 |
|  | Release load | N | 5800 |
|  | Minimum rise of thrust pad | mm | 1.7 |
|  | Disengagement stroke | mm | 10+2 |
|  | Maximum depression stroke | mm | 11 |
|  | Hydraulic control | | Master cylinder with oil tank incorporated - slave cylinder with total take-up of driven plate wear |
|  | Lubricant | | **Tutela TRUCK DOT SPECIAL** |

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| 17" CLUTCH - F3B engines | | | VALEO * | SACHS ** |
|---|---|---|---|---|
|  | Type | | Dry single plate | |
|  | Engagement mechanism | | "Pull" with diaphragm spring | |
|  | Driven disc | | With friction seal | |
|  | Driven disc hub | | With double flexible coupling | |
|  | Lining outer Ø | mm | 430 | 430 ± 1 |
|  | Lining inner Ø | mm | 260 | 254 |
|  | Plate thickness (new) | mm | 10.6 ± 0.3 | |
|  | Max. off-centering of driven plate | mm | 0.4 | 0.40 |
|  | Load on pressure plate (new) | Min. N | 35000 | 34200 |
|  | Loaded maximum with release (new) | N | 8600 | 7900 |
|  | Minimum rise thrust pad | mm | 1.7 | |
|  | Disengagement stroke | mm | $12^{+2}$ | $12^{+2}$ |
|  | Maximum depression stroke | mm | 16.6 | 18 |
|  | Hydraulic control | | - For mechanic gearboxes, main cylinder with built-in oil tank, clutch actuator with total recovery for driven disc wear<br>- For Euro Tronic gearboxes, electric-pneumatic actuator controlled by the gearbox control unit | |
|  | Oil type | | **Tutela TRUCK DOT SPECIAL** | |

* For manual gearboxes

** For EuroTronic gearboxes

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## TROUBLESHOOTING

**NOTE** For any actuator operation failure, on vehicles fitted with EuroTronic transmission, see the related transmission diagnosis.

| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Noise when clutch pedal is depressed | Thrust bearing excessively worn, damaged or not properly lubricated. | Replace thrust bearing. |
| | Excessive play between the splines on the transmission input shaft and the relative housing in driven plate hub. | Replace the shaft and also the driven plate if necessary. |
| Noise when the pedal is released | Springs of driven plate broken or weak. | Replace driven plate. |
| | Transmission input shaft worn. | Replace the shaft and also the driven plate if necessary. |
| | Thrust bearing has play in engagement sleeve. | Replace the thrust bearing. |
| The clutch snatches | Oil or grease on engine flywheel or on driven plate linings | Eliminate the problem causing the contamination; clean flywheel thoroughly then replace driven plate. |
| | Pressure plate distorted. | Replace the clutch. |
| | Uneven wear of friction linings due to run-out of driven plate. | Replace the driven plate. |
| | Diaphragm spring weak or fingers broken. | Replace the driven plate. |
| The clutch does not disengage | Oil or grease on driven plate linings. | Replace the shaft and also the driven plate if necessary. |
| | Transmission input spline damaged thus preventing driven plate from sliding. | Check and adjust the stroke of the operator cylinder with no load. |
| | Air in the hydraulic circuit (vehicles with EuroTronic transmission excluded). | Bleed the circuit. |
| The clutch slips | Driven plate linings worn or burnt. | Replace the driven plate. |
| | Diaphragm spring weak or fingers broken. | Replace the clutch. |
| | Oil or grease on driven plate linings. | Eliminate the problem causing the contamination and replace driven plate |

*(Continue)*

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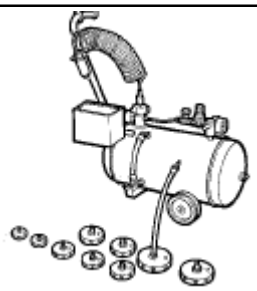
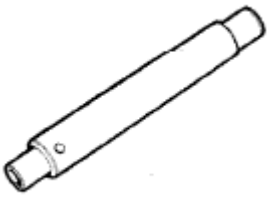
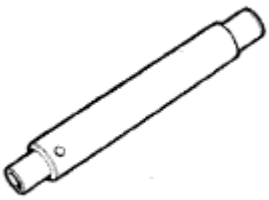
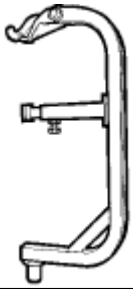
| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Abnormal wear of driven plate linings | Driver resting his foot on the clutch pedal while driving. | Driver must avoid the harmful habit and rest his foot on the clutch pedal only when necessary. |
| | Disc ring strained. | Replace disc ring. |
| | Diaphragm spring with weakened or broken fingers. | Replace the clutch. |
| | Insufficient operator cylinder stroke. | Check and adjust the stroke of the operator cylinder with no load. |

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## TIGHTENING TORQUES

| DESCRIPTION | TORQUE | |
|---|---|---|
| | Nm | (kgm) |
| Flanged hex screw fixing pressure plate to flywheel M12 | 65 ± 7 | (6.5 ± 0.7) |
| Nut for stud bolt fixing clutch casing to crankcase M10 | 46 ± 5 | (4.6 ± 0.5) |
| Stud bolt fixing clutch casing to crankcase M10x80 | 19 ± 2 | (2 ± 0.2) |

## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99306010** |  | Tool to bleed air from hydraulic clutch circuit |
| **99348004** |  | Universal extractor, internal from 5 to 70 mm |
| **99370264** |  | Guide pin to centre clutch disc |
| **99370280** |  | Guide pin to centre clutch disc |
| **99370547** |  | Mount for removing and refitting clutch assembly (to fit onto the hydraulic jack) |

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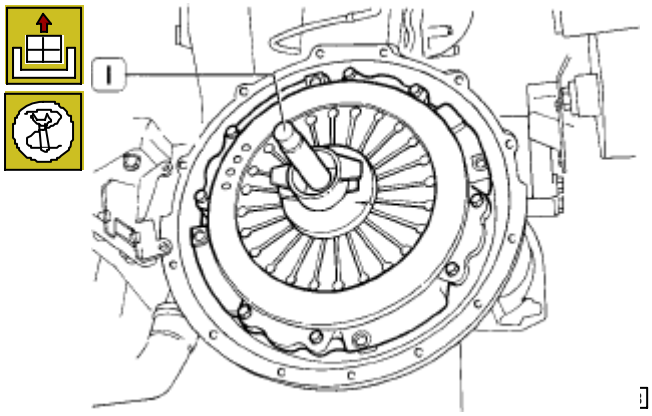
# 505210 REMOVING AND REFITTING THE CLUTCH

## Removal

This operation comprises:

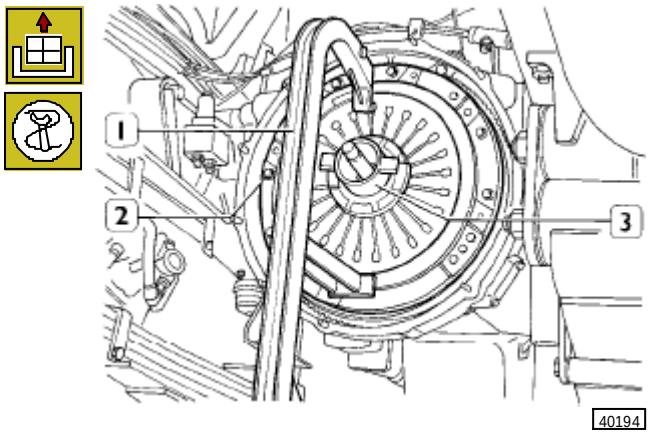
- Removing-refitting propeller shafts (see relevant section 505620).
- Removing-refitting gearbox (see relevant section 530210).

Figure 1



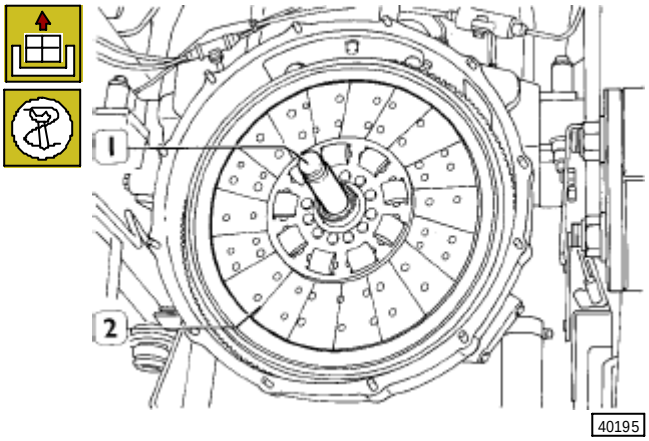

Fit the clutch locating pin 99370264 or 99370280 (1) into the support bearing of the transmission input shaft.

Figure 2




Fit the mount 99370547 (1) on the hydraulic jack and apply the mount to the pressure plate (3). Unscrew the screws (2) and remove the pressure plate from the engine flywheel.

Figure 3




Remove the clutch disc (2) by removing at the same time the locating pin 99370264 or 99370280 (1).

## Checks

The checks to make are as follows:

- The supporting surface of the driven disc, on the engine flywheel, must not be particularly worn or have too much scoring.
- The toothing of the ring gear of the engine flywheel must be neither deteriorated nor too badly worn.

If this is not the case, remove the engine flywheel (operation 540850).

In addition, check there is not even the slightest leakage of lubricant from the seal of the crankshaft rear cover: in which case, remove the flywheel as described under the relevant heading. Remove the rear cover together with the seal and replace it as described in section 2.

Check that the bearing or bushing supporting the gearbox input shaft mounted on the crankshaft is neither worn nor deteriorated, in which case it should be replaced.

Check the state of the pressure plate, the supporting surface of the driven disc must have no deformation, wear or sign of overheating and its spring or diaphragm must be sound.

Check the state of the driven disc:

- the friction linings must not be too worn, nor have any sign of overheating, nor be fouled with oil or grease.
- its hub must not have too much play on the gearbox input shaft.
- the torsion springs of the hub must not turn in their seats or be broken.

If you find any trouble at all, replace the part concerned. The clutch assembly is supplied as a spare in kit form.

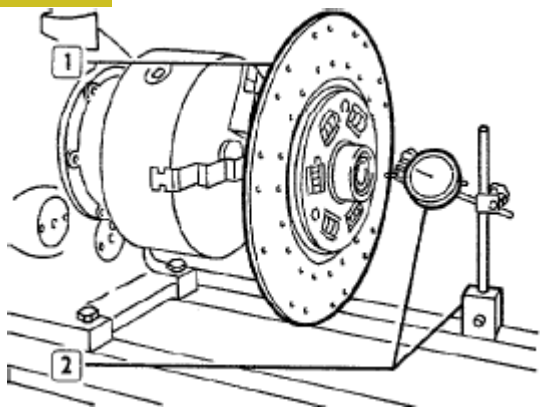
The following are supplied singly:

- The driven disc and the thrust bearing.

In this case it is necessary to mount the new parts of the same supply as the torsion spring being reused.

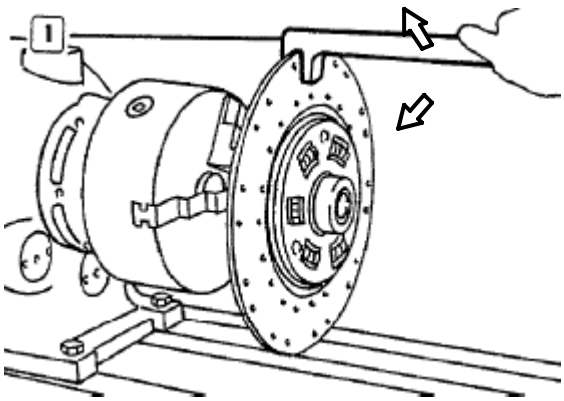
Aquila Trucks Centres

Figure 4




Before fitting a new driven disc it is necessary to check its centring as follows:
Position the driven disc (1) on a lathe. Then, with the aid of a dial gauge with a magnetic base (2), check that the surface of the disc is not off centre anywhere.
The maximum permissible eccentricity of the driven disc is 0.20 mm.

Figure 5




If the disc is off centre, use a fork wrench (1) as shown in the figure.

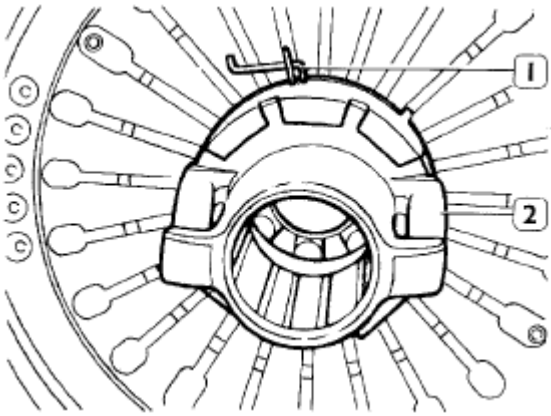
### Refitting

Fit the clutch assembly back on by performing the operations described for removal in reverse order and observing the following instructions:

- Thoroughly clean the supporting surface of the clutch plate of the engine flywheel with spirits or petrol. Any light scoring you find on it can be removed with abrasive cloth.
- Position the driven disc, always using the guide pin for perfect centring to prevent harmful stresses on the hub when refitting the gearbox.
- Position the clutch plate by matching the holes for the fixing screws with the ones on the engine flywheel.
- Mount and lock the fixing screws of the pressure plate to the required torque.
- Fit the gearbox back on after spreading the splined shaft with Molikote molybdenum disulphide grease.
- Adjust the push rod of the operator cylinder as described under the relevant heading (operation 505272).

## 505254 REMOVING-REFITTING THE THRUST BEARING

Figure 6




This operation comprises:

- Removing-refitting propeller shafts (see relevant section 505620).
- Removing-refitting gearbox (see relevant section 530210).

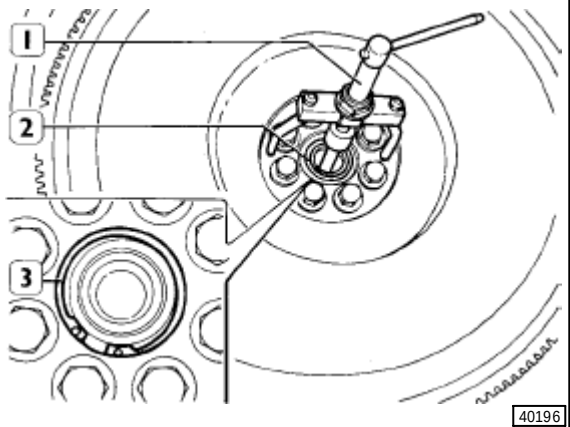
Using suitable pliers, open the snap ring (1), take the thrust bearing (2) out of the pressure plate.

Reverse these steps for fitting.

**NOTE** The new part has to be of the same supply as the pressure plate being reused.

## 540852 REPLACING THE SUPPORT BEARING OF THE CLUTCH SHAFT

Figure 7




This operation comprises:

- Removing-refitting propeller shafts (see relevant section 505620).
- Removing-refitting gearbox (see relevant section 530210).
- clutch removal/refitting (operation 505210).

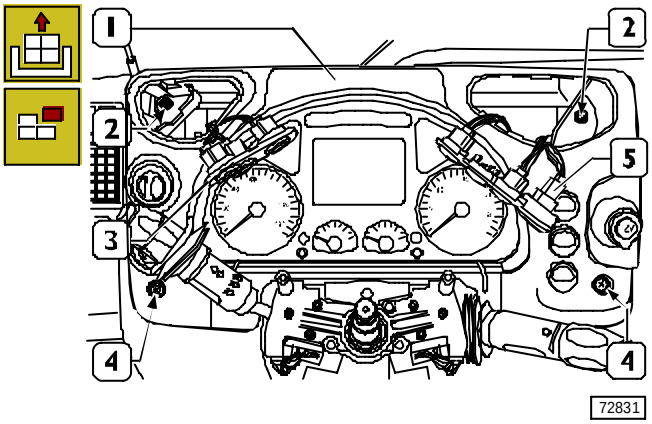
Using the appropriate pliers remove the split ring (3).
Using the universal extractor 99348004 (1) remove the bearing (2).
For refitting, use the appropriate beater.
Refit the split ring.

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## 502601 REMOVING-REFITTING THE PEDAL UNIT

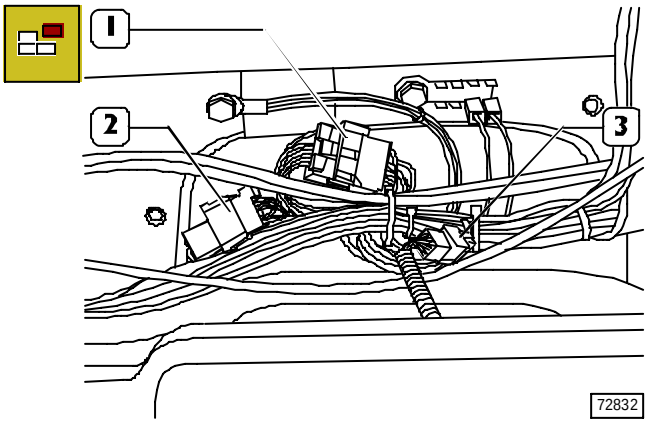
### Removal (vehicles with EuroTronic gearbox)

Figure 8



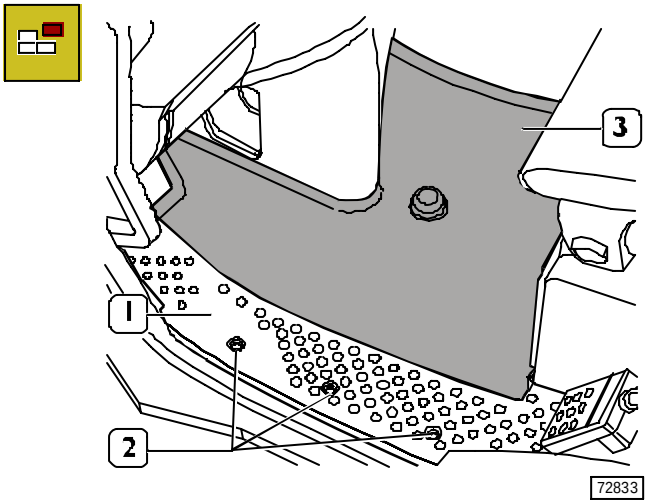

Remove the push-button panels (3 and 5) and the screw caps (4) from the instrument panel (1). Take out the screws (2 and 4), remove the instrument panel (1) and put it aside.

Figure 9



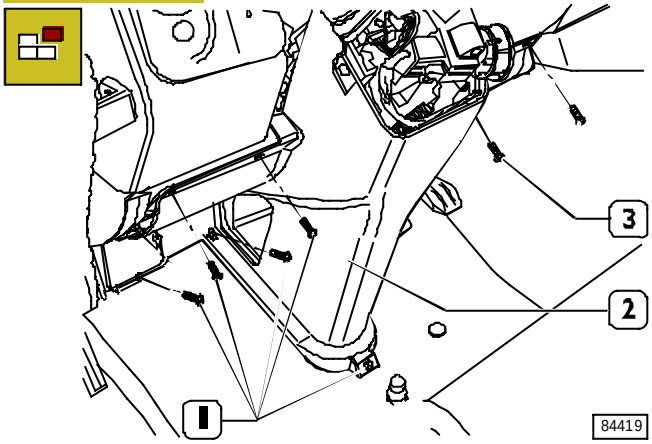

Disconnect the connections (1) of the windscreen wiper, (2) of the drive control system and (3) of the immobilizer.

Figure 10



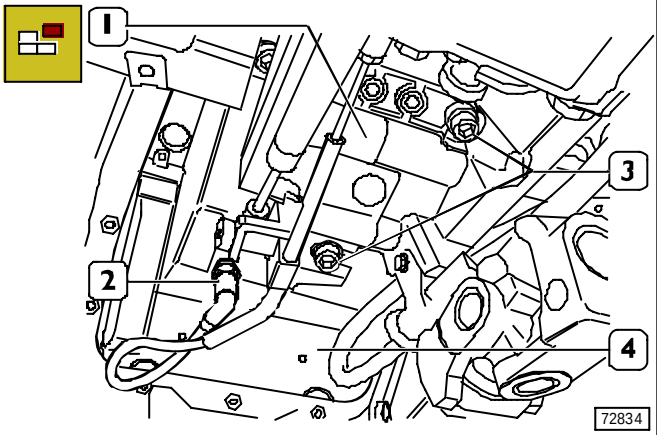

Take out the screws (2), remove the heel rest (1) and lift the mat (3).

Figure 11



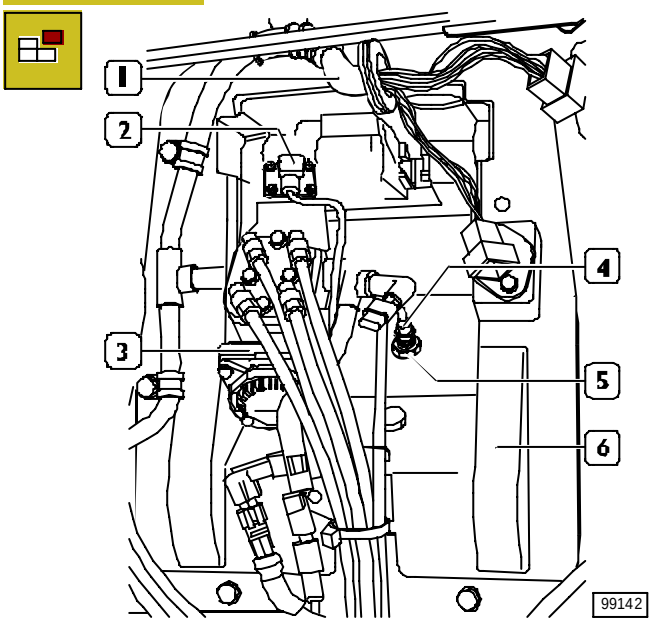

Remove the screws (1 and 3) and the guard (2).

Figure 12




Disconnect the piping (2).
Take out the screws (3) and disconnect the steering control mount (1) from the pedal unit (4).

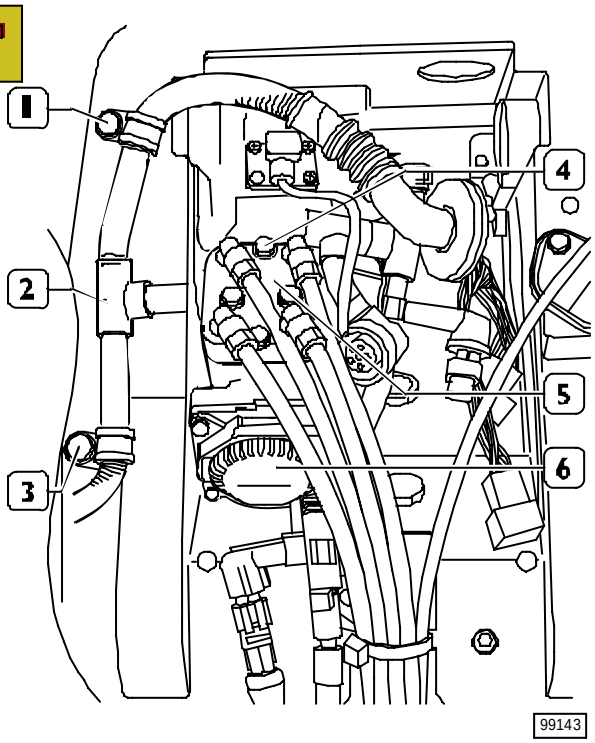
Figure 13




From outside the cab, lift the radiator cowling, extract the grommet (1) with the wiring from the pedal unit (6). Disconnect the piping (4) from the coupling (5). Disconnect sensor (2) electric connection from distributor (3).

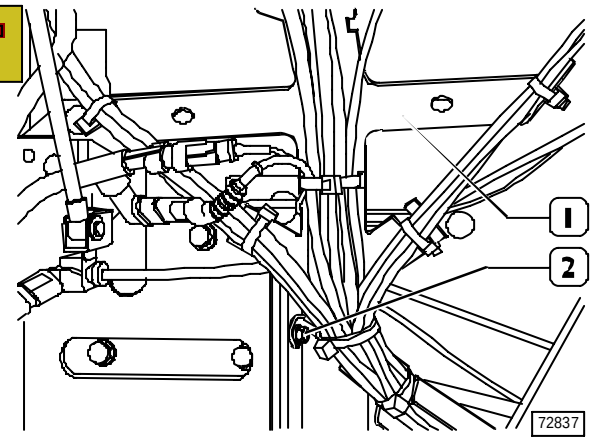
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Figure 14




Take out the screws (4) fixing the cover (5) of the control valve (6). Gradually lift the cover (5) to discharge the pressurized air in the system.
Take out the screws (1-3) fixing the wiring clamps (2) and pedal unit to the cab.

Figure 15

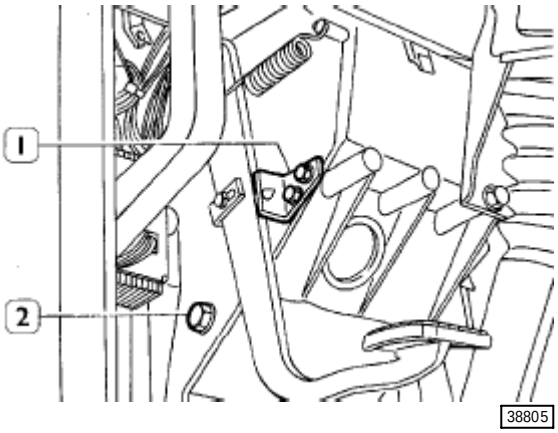



Take out the screw (2) fixing the bracket (1) supporting the piping and wiring and disconnect the pedal unit from the cab.

## Removal (vehicles with ZF 9S/16 S... gearbox)

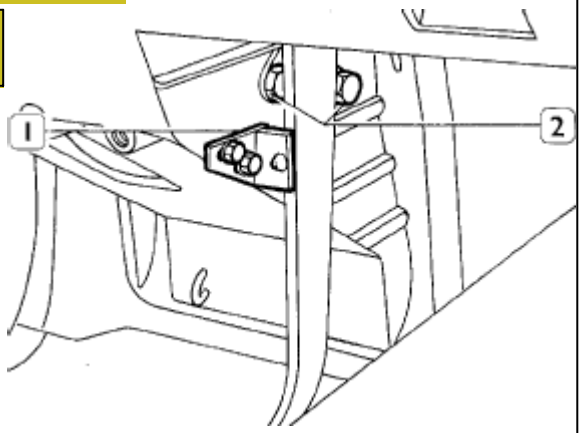
This differs from removing the pedal unit on vehicles with the EuroTronic gearbox in the following.

Figure 16



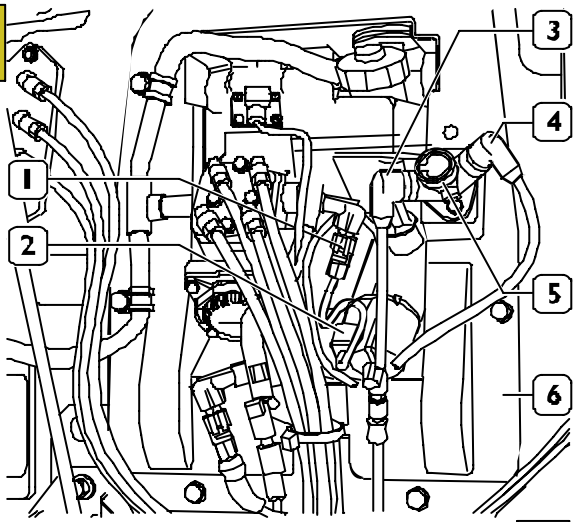

Disconnect the steering control mount as described in figures 8 – 9 – 10 – 11 - 12.
Remove the bracket (1) stopping the clutch pedal. Take out the screws (2) fixing the master cylinder to the pedal unit.

Figure 17




Remove the bracket (1) stopping the brake pedal. Take out the three screws (2) fixing the control valve to the pedal unit.

Figure 18

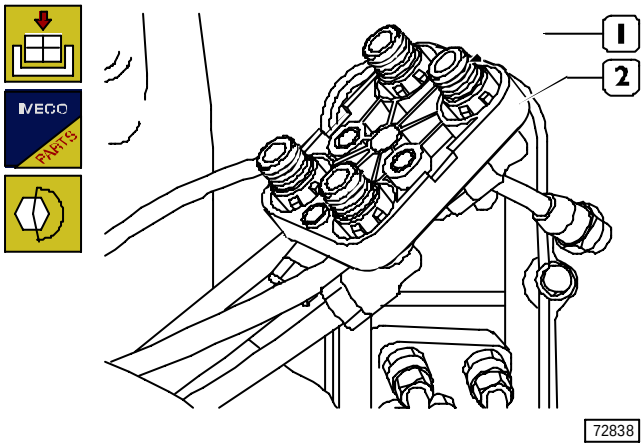



Lift the radiator cowling, disconnect the piping (3-4) from the splitter control button (5). Disconnect the electric connection (1) of the master cylinder (2) and remove this, together with the oil reservoir, from the pedal unit (6). Complete disconnecting the pedal unit as described in figures 13 – 14 - 15.

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## Refitting

Figure 19




For refitting, carry out the steps described for removal in reverse order. Then adjust the travel of the pedals as described under the relevant heading.

**NOTE** With each removal, the seals (1) of the coupling of the control valve cover (2) have to be replaced with new ones.

Tighten the screws and nuts to the required torque. After refitting, check and if necessary adjust the travel of the pedal as described under the relevant heading.

## PEDAL
## Unit removal-assembly

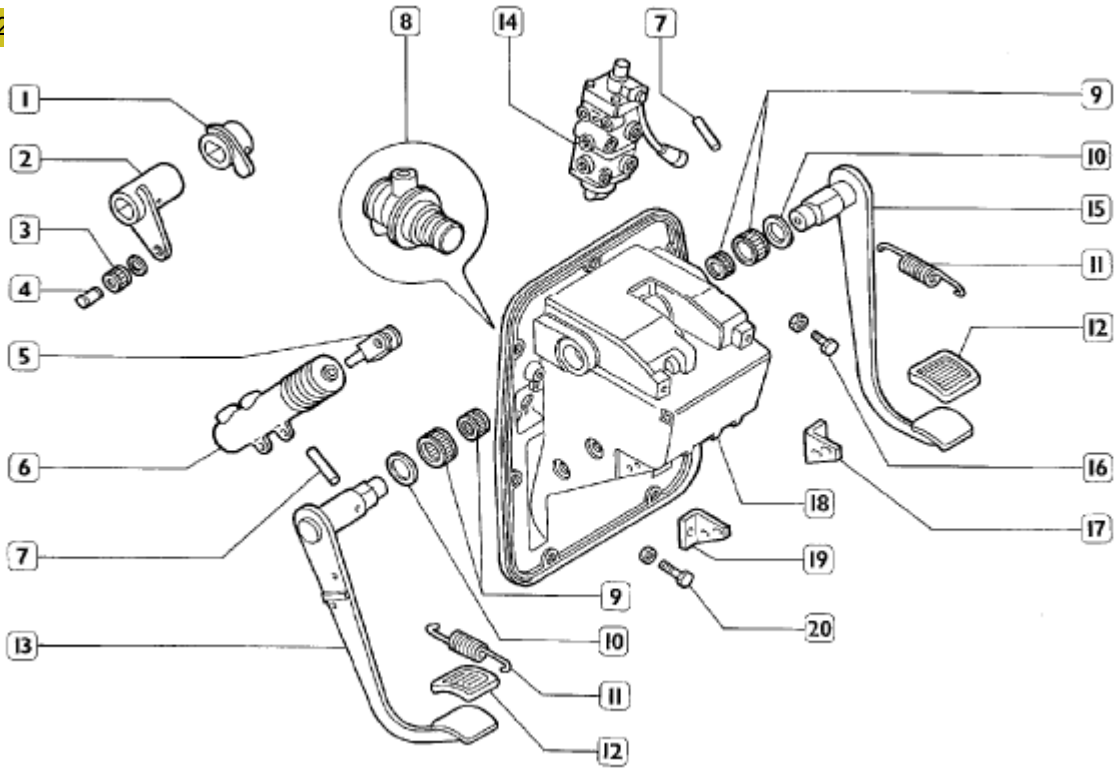
**(see Figure 20)**

Take out the springs (11) to return the pedals (13*-15). Eject the spring pins (7) so as to free the levers (1* and 2) from the pedals (13* and 15), which you should then extract from the pedal unit mount (18). To replace the roller bearings (9), use:

- the percussion extractor 99340205 to remove them;
- a suitable drift to fit them.

**NOTE** The roller bearings and associated shafts have to be lubricated with TUTELA MR3 grease.
Complete assembly by carrying out the steps performed for removal in reverse order.

Figure 2




1. Brake control lever – 2. Clutch control lever* - 3. Roller bearings – 4. Pin – 5. Fork – 6. Master cylinder* - 7. Spring pin – 8. Splitter control button* - 9. Roller bearings – 10. Washer – 11. Return spring – 12. Pedal cover – 13. Clutch pedal – 14. Control valve – 15. Brake pedal – 16. Brake pedal limit stop screw – 17. Brake pedal stop bracket – 18. Pedal unit mount – 19. Clutch pedal stop bracket – 20. Clutch pedal limit stop screw*

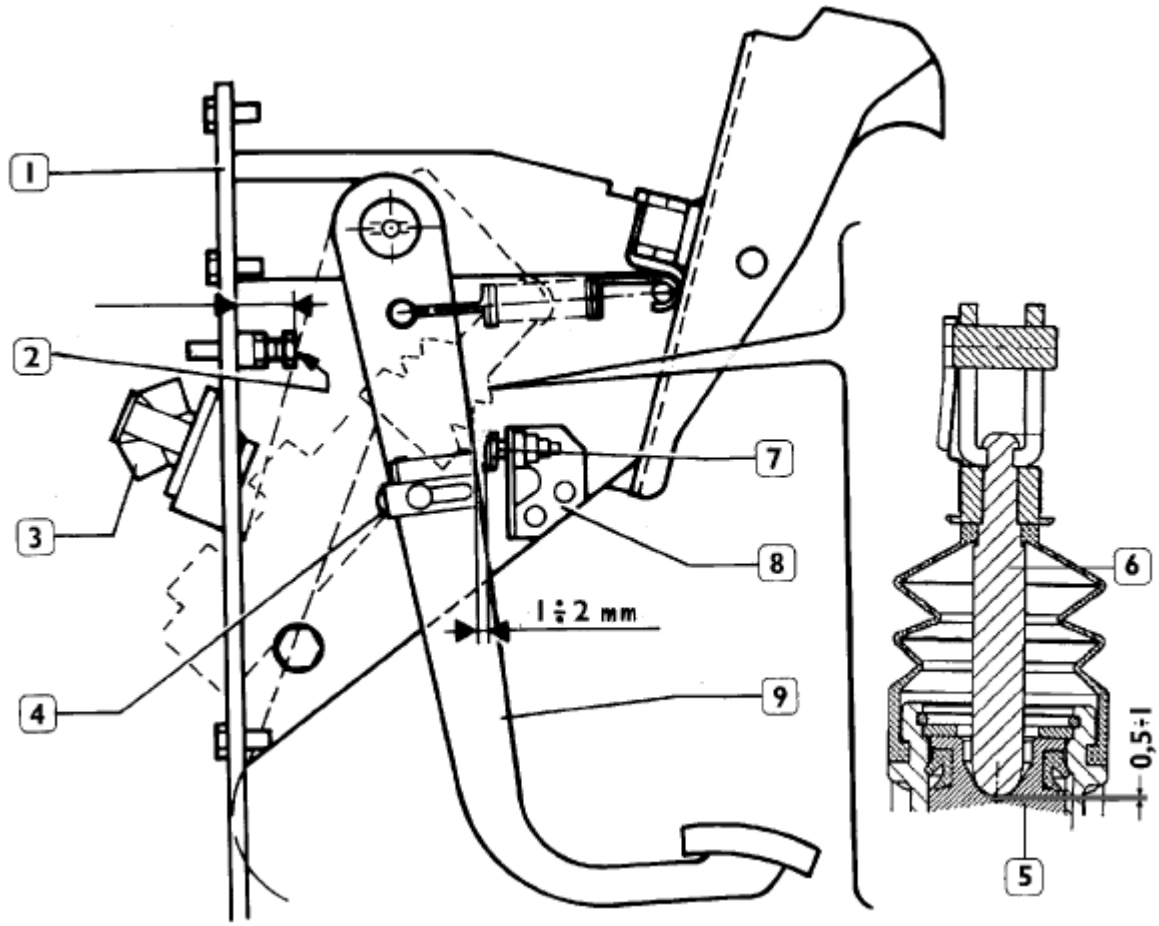
* Excluding vehicles with the EuroTronic gearbox.

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## CHECKING AND ADJUSTING STOPS ON CLUTCH PEDAL (vehicles with ZF 9S/16S gearboxes)

Figure 21




108470

### Clutch stop

Check the distance **A** between the pedal unit mount (1) and the end of the screw (2). It has to be 32.5 mm, turn the screw appropriately if it is not.

### Idle travel of clutch pedal

Work the clutch pedal (9) to take the cap (6) into contact with the piston (5) of the master cylinder.
In this condition, check the distance **B** between the clutch pedal (9) and the screw (7) that has to be 1 - 2 mm, turn the screw (7) appropriately if it is not.
The distance **B** corresponds to the clearance of 0.5 - 1 mm between the cap (6) and the piston (5) in the condition of the clutch pedal (9) in contact with the screw (7).

### Pedal control valve stroke

After adjusting the position of the bottom and top stop, adjust the travel of the piston of the pedal control valve.
Take the clutch pedal (9) into contact with the bottom stop screw (2) and keep it in this position.
Press the button of the control valve (3) fully down and, keeping it pressed, position the angle bracket (4) so that between it and the button there is a distance of 0.5 – 1 mm.
This is to prevent the pedal control valve from stopping the clutch pedal.

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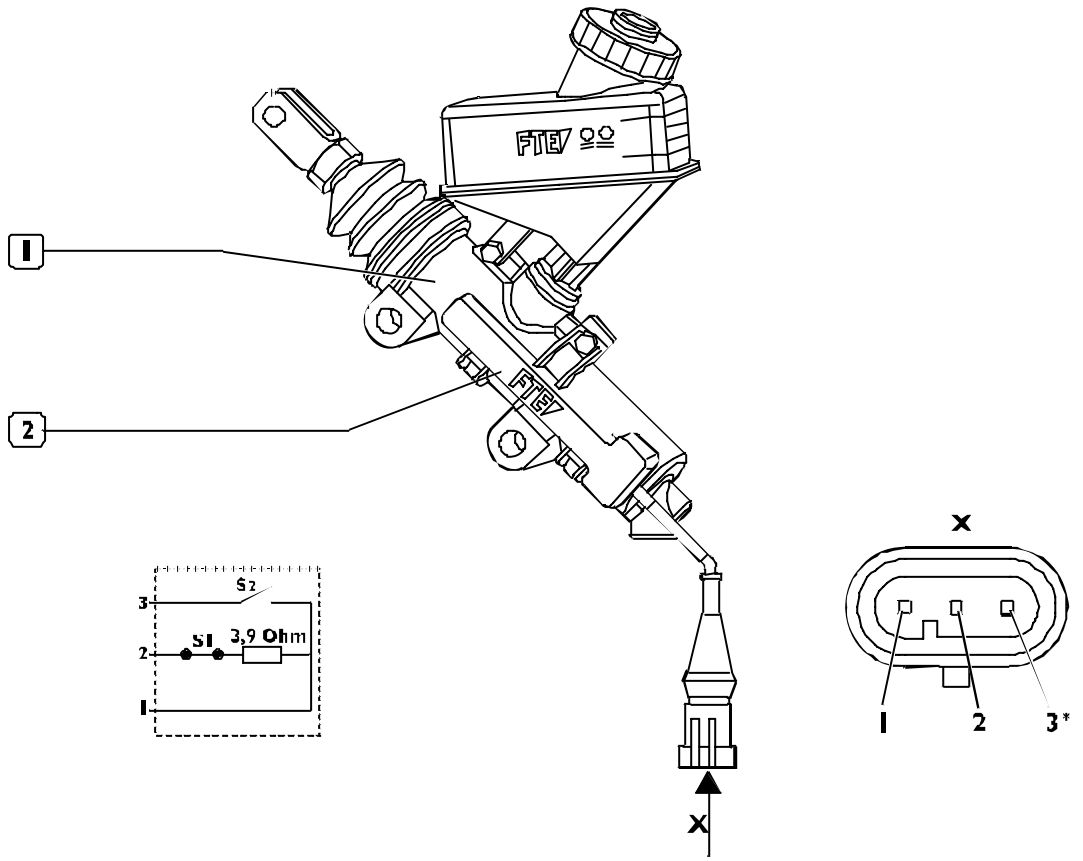
## HYDRAULIC CONTROL
**(Vehicles with ZF 9S/16S gearboxes)**

The hydraulic control is composed of:

- master cylinder with oil reservoir built in;
- clutch actuator with full recovery of driven disc wear.

### Master cylinder

Figure 22




108620

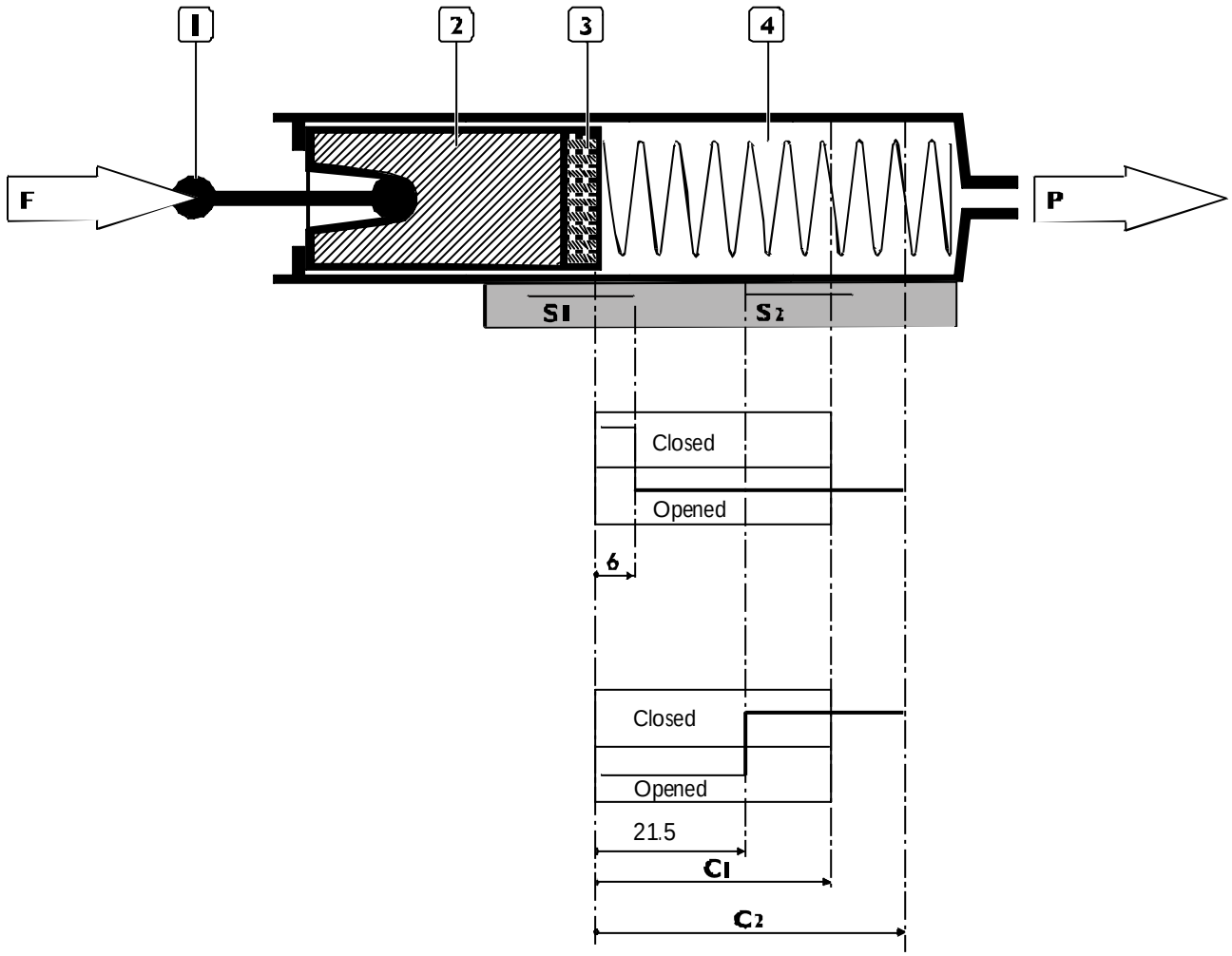
MASTER CYLINDER VIEW (* only for vehicles with F3B engine)

On master cylinder there are mounted following proximity (read) switches:

- $S_1$ N.A. (mounted on N.C. master cylinder) to disable Cruise Control;
- $S_2$ N.A. (mounted on N.A. master cylinder) only present on vehicles with F3B engine to protect synchronisers (synchro protection).

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Figure 23




FUNCTIONAL SCHEME
1. Push rod - 2. Piston - 3. Magnetic ring - 4. Cylinder

$S_1$ = Proximity switch to disable Cruise Control

$S_2$ = Proximity switch to protect gearbox synchronisers

$C_1$ = Working stoke 31 mm

$C_2$ = Working stoke 42 mm

F = Force applied by clutch pedal

P = Hydraulic pressure at servoclutch

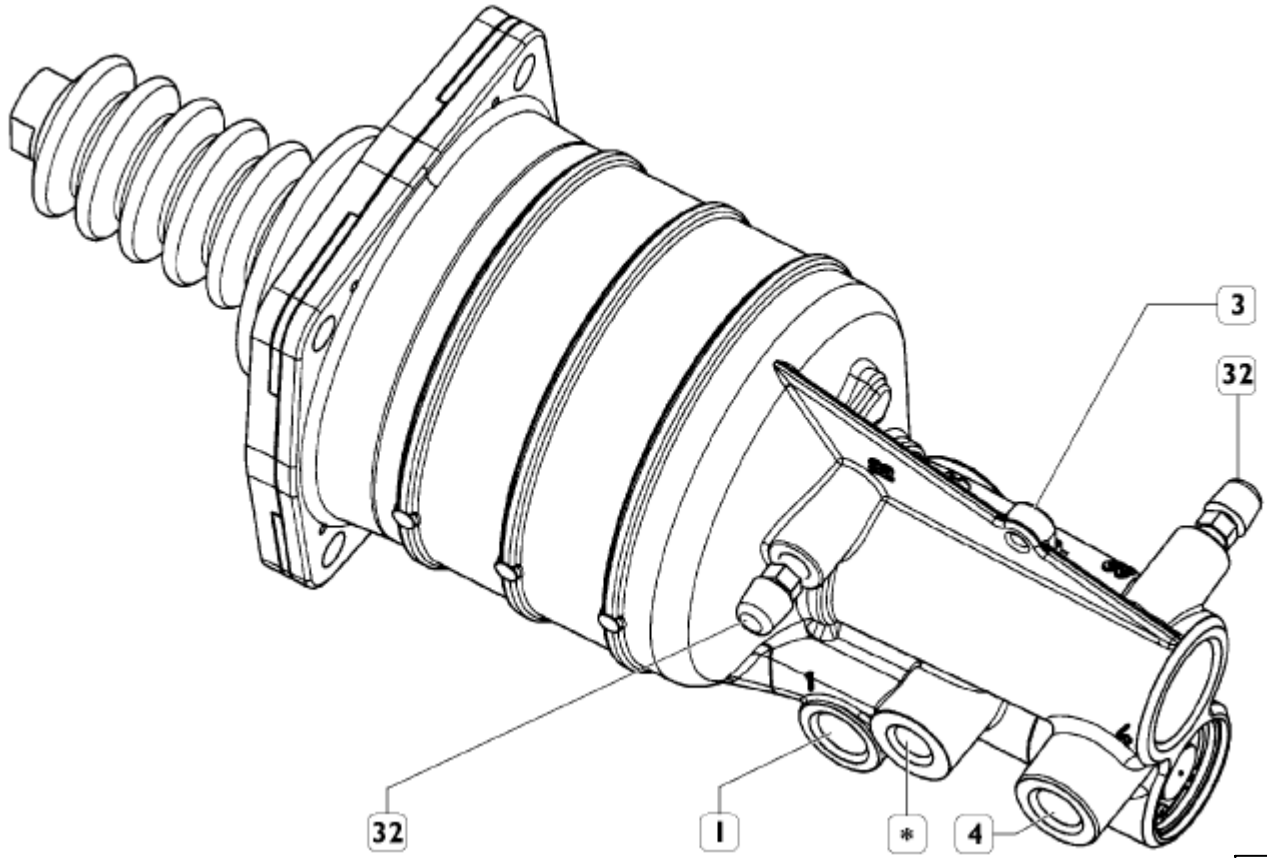
| CHARACTERISTICS | | S1 | S2 |
|---|---|---|---|
| Voltage | V | 48 max | |
| Current: | | | |
| min | mA | 5 | 5 |
| max | mA | 400 | 700 |
| Power | W | 10 max | 20 max |
| Permanent current | mA | 250 max | 700 max |

**NOTE** Switch S2 goes off at piston (2) stroke of 21.5 mm corresponding to 70% of clutch pedal disengagement travel, corresponding in turn to servoshift driving point.

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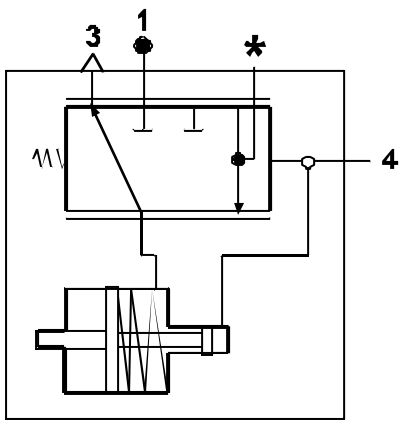
## Clutch actuator

Figure 24




1. Feed (compressed air)
3. Bleed (compressed air)
4. Drive (clutch liquid)
32. Bleed screw
* Fitting for valve drive

Figure 25




Functional scheme

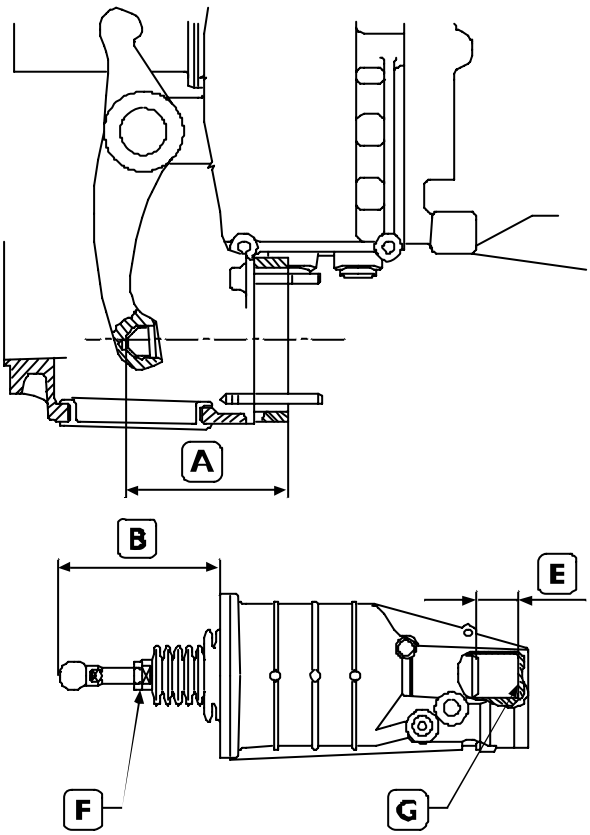
1. Feed (compressed air)
3. Bleed (compressed air)
4. Drive (clutch liquid)

| | | |
|---|---|---|
| Service pressure: | | |
| - clutch liquid (P4) | 40 | bar |
| - air (P1) | 11.5 | bar |
| Max pressure: | | |
| - clutch liquid (P4) | 120 | bar |
| - air (P1) | 13 | bar |

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## SPRING PIN ADJUSTMENT GEARBOX ASSEMBLY

Figure 26




**NOTE** Engines F2B with push clutch SACHS on gearboxes 9S 1310/11 TO do not need any adjustment.

Perform following operations:

- measure dimension (A) between clutch lever spherical cavity and actuator fixing plane; Disengagement lever must rest against thrust bearing.
- push ball spring pin up to stop (G); screw, or unscrew, spring pin (F) until dimension (B) is obtained.

  B = A - E
  (See values shown in below table).

| Engine | Clutch | E (mm) |
|---|---|---|
| F2B | Push clutch SACHS | do not need any adjustment |
| | Pull clutches VALEO | 30 |
| F3B | Pull clutches VALEO | 35 |

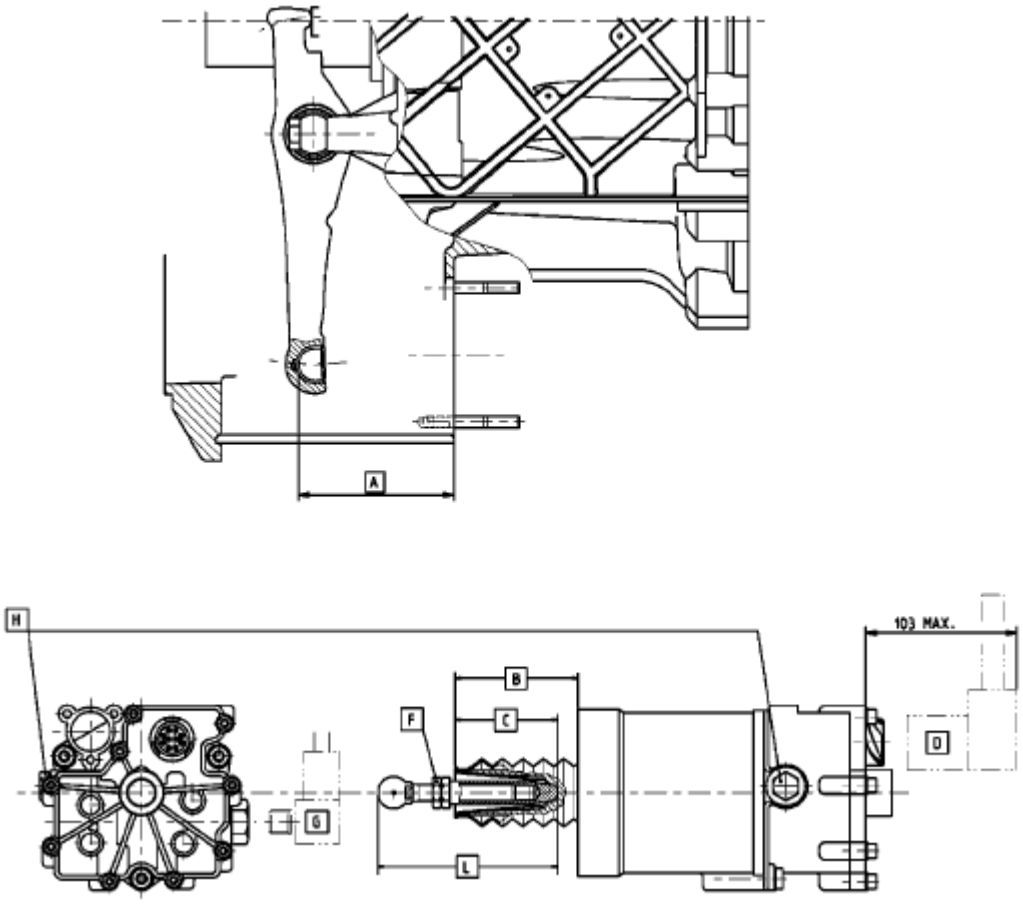
**NOTE** It is necessary to observe this adjustment to make the worn plate indicator trip, which is located in the operator cylinder, close to the complete wear of the friction linings.
The plate wear (90% of the friction material) is indicated by a significant increase in load on the pedal when disengaging the clutch.

**NOTE** Should any oil leaks from the main cylinder and/or the clutch actuator be detected, replace the involved component and bleed the hydraulic system.

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## SPECIFICATIONS FOR GEARBOX ASSEMBLY EUROTRONIC 12 AS 1930/2330/2530

Figure 27




A) Specifications for adjusting the clutch servo, when new and when the clutch is replaced:

1. Measure distance "**A**" between the clutch lever ball socket base and the clutch servo fastening surface. The lever should be resting on the thrust bearing.
2. Adjust the rod using the following equation: **L=A-(B-C)**+33 and secure with locknut "**F**". Tightening torque 52 Nm.

**NOTE**
- Measure dimension "**B**" with the clutch servo at the end of its travel (screw plug "**H**" open).
- The clutch wear travel to the clutch servo, set using software, is standardised at 30 mm, corresponding to clutch plate wear of 3 mm (minimum guaranteed clutch plate wear).

B) Fitting the clutch servo to the clutch casing:

1. Unscrew the screw plug "**H**" on the inspection hole to allow air to emerge from the inner chamber.
2. Move the clutch servo piston back by hand to overcome the resistance of the internal spring.
3. Retighten plug "**H**" by hand to hold the piston back.
4. Fit the pushrod in the lever ball socket.
5. Fit the clutch servo and secure using the four hex-headed bolts. Tightening torque 23 Nm.
6. Unscrew screw plug "**H**" and then retighten when the piston is forward. Tightening torque 25 Nm.
7. Connect electrical connector "**D**" and air delivery pipe "**G**".

C) Replacing the clutch servo:

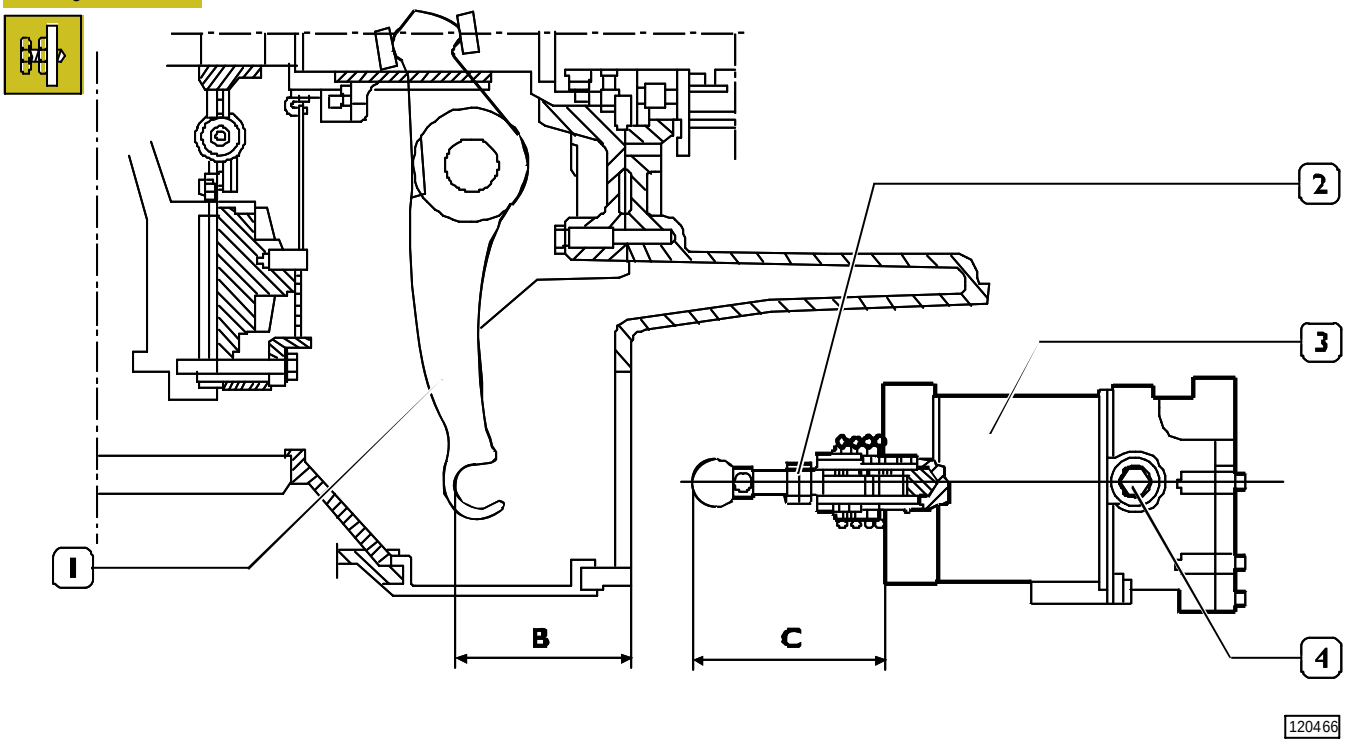
If replacing the clutch servo alone, proceed as described under point **B**, leaving pushrod adjustment setting "**L**" unchanged.

Before connecting the air pipe, ensure that the clutch servo is correctly fastened to the clutch casing.

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## SPRING PIN ADJUSTMENT GEARBOX EUROTRONIC 12 AS 1420 TD

Figure 28




**NOTE** In case of replacement of the clutch actuator, the previously set push rod length remains unvaried.
The push rod adjustment only occurs when the driven disc or the disc pusher are replaced.

Differently from ordinary operations, in case of vehicles equipped with 12 AS 1420 gearbox, instead of the wear level, the disconnecting stroke is adjusted. If the adjustment is not carried out correctly, the disc pusher is damaged.

Push forwards the disconnecting fork (1) and measure height in "B".

**Height C calculation**

**C = B + 33 mm**

*Example:*
*B = 57 mm*
*C = 57 mm + 33 mm = 90 mm*

**Height C adjustment**

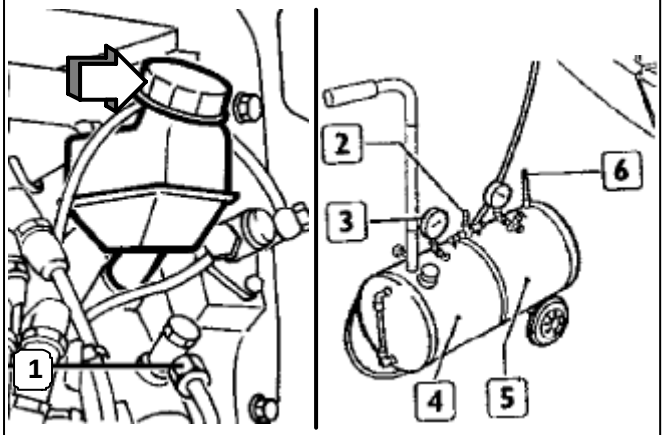
Assemble the push rod (2) into the clutch actuator (3). Loosen the screw (4) on the clutch actuator (3) until the cylinder comes out.
Measure the height "C" between the spherical head of the push rod and the bearing surface of the clutch actuator.
Adjust the push rod to reach the height "C".
Insert the push rod (2) into the head of the disconnecting fork (1).

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## BLEEDING CLUTCH CIRCUIT

Figure 29

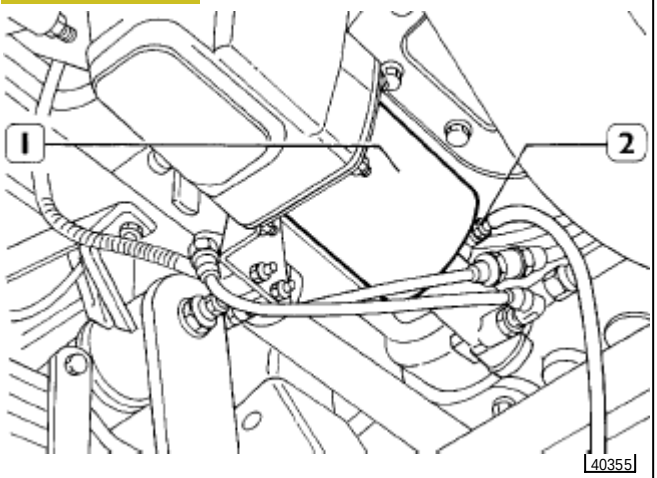





Bleed air from clutch hydraulic circuit after repairing clutch assembly or following periodic oil changes. Use air remover 99306010 for this purpose as follows:

- introduce compressed air into reservoir (5);
- fill reservoir (4) with Tutela TRUCK DOT SPECIAL fluid;
- replace clutch reservoir cover (⇒) with one of those provided with device 99306010 and connect device line to cover.

Figure 30




- apply a plastic pipe to bleed screw (2) of slave cylinder (1) and immerse the opposite end of the pipe in a recipient containing Tutela TRUCK DOT SPECIAL fluid. Undo bleed screw (1) by one turn, open (see Figure 29) crock (2) until pressure gauge (3) shows a reading of 1 ÷ 1,2 bars;
- when clutch fluid emerging from circuit is free of bubbles, tighten bleed screw and drain air from device reservoir (5) through valve (6).

**NOTE** When clutch fluid is changed, bleed master cylinder by loosening fitting (1, Figure 29) before bleeing clutch servo.

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SECTION 4

# 5302 Gearboxes


| | Page |
|---|---|
| GEARBOX ZF 9 S 1310 T.O. | 3÷12 |
| GEARBOX ZF 16 S 1620 T.D. - 2220 T.D. - 2520 T.O. | 13÷22 |
| ZF 16 S 1621 T.D. - 2221 T.D. - 2521 T.O. WITH INTARDER | 23÷40 |
| EUROTRONIC AUTOMATED 12 AS 1420 T.D. | 41÷46 |
| EUROTRONIC AUTOMATED 12 AS 1930 T.D. 12 AS 2330 T.O | 47÷56 |
| EUROTRONIC AUTOMATED WITH INTARDER 12 AS 1931 T.D. 12 AS 2331 T.O. | 57÷72 |
| EUROTRONIC GEARBOXES DIAGNOSTICS | 73÷170 |

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Aquila Trucks Centres

# 5302 Gearbox ZF 9 S 1310 T.O.


| | Page |
|---|---|
| GENERAL | 5 |
| LOCATION OF GEARBOX DESCRIPTION PLATE | 6 |
| GEAR CONTROL MODULE E 13 MP | 7 |
| DIAGRAM OF MODULE E 13 MP | 8 |
| GEAR CONTROL LEVER | 9 |
| MAIN DATA | 10 |

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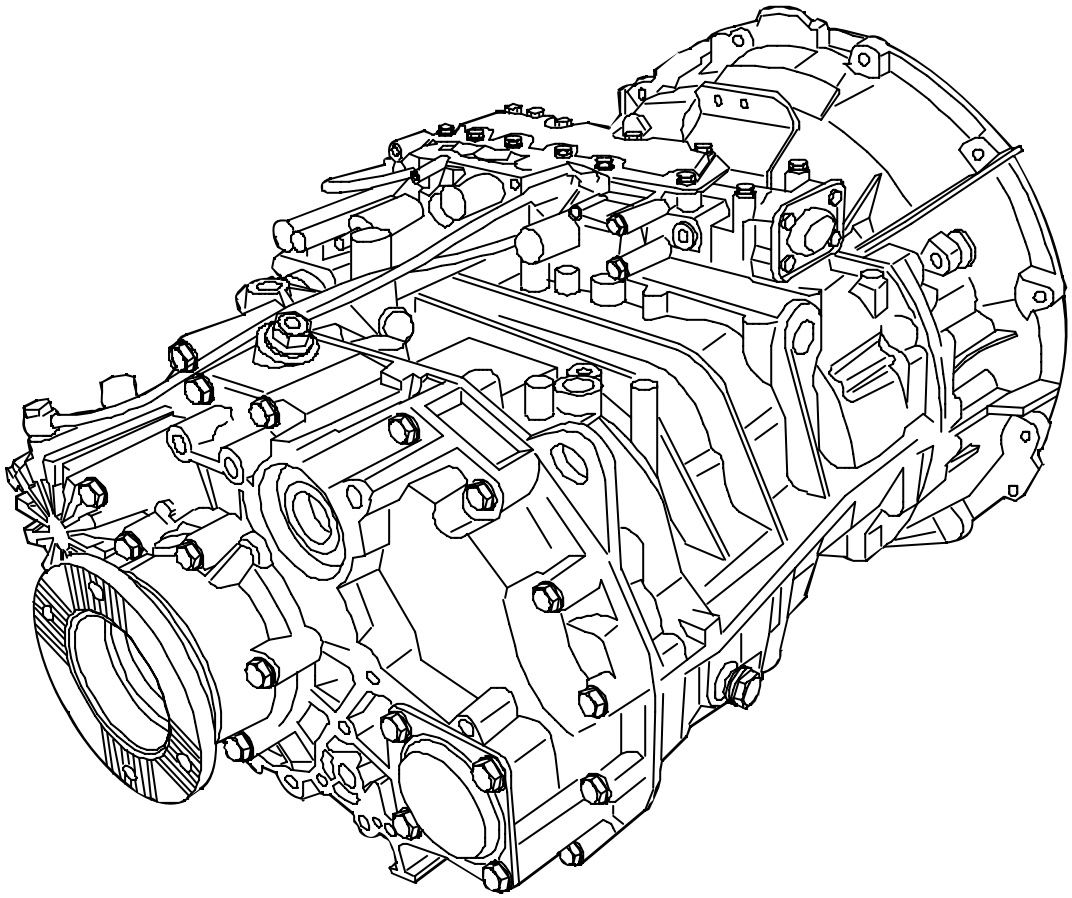
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## GENERAL

Gearbox ZF 9 S 1310 T.O. is mechanical type with synchronized gear engagement, with the exclusion of pick up gear and reverse gear, featuring front engagement.
It is made up of a a part featuring 4 forward gears with reverse gear, a pick up gear and a Epicyclic Reduction Gear Unit of planetary gears type on the rear part.
The E.R.G.unit (Epicyclic Reduction Gear Unit) enables splitting the number of gears of the four speed gearbox, thus, nine forward gears are available, crawler gear included, that can be engaged in sequence
The servoshift is a device comprising a mechanical/pneumatic module that integrates the G P attraction valves locking the clutch lanes and High / Low switching.

The device works mechanically if the pneumatic system breaks down.

Figure 1

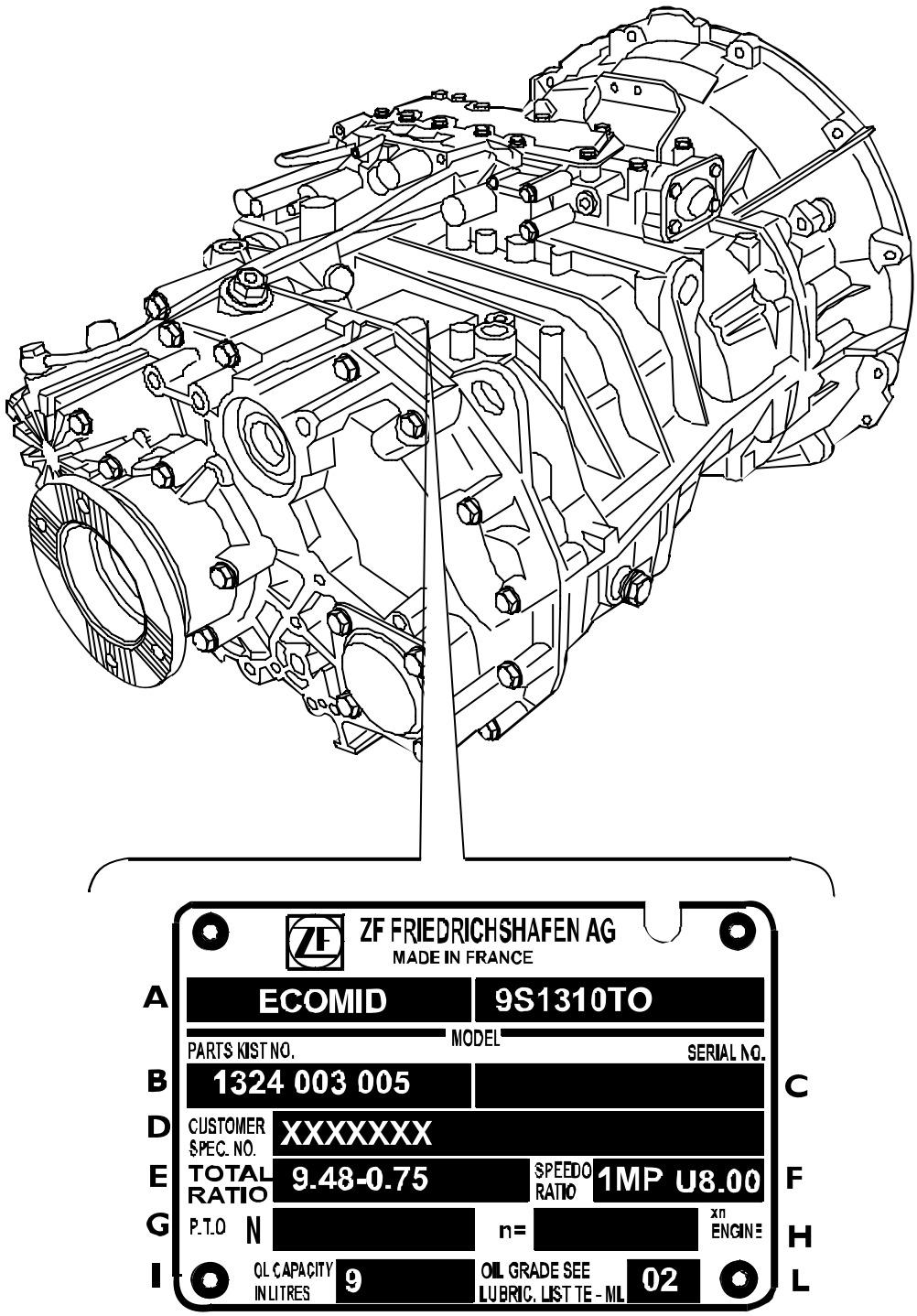


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## LOCATION OF GEARBOX DESCRIPTION PLATE

Figure 2



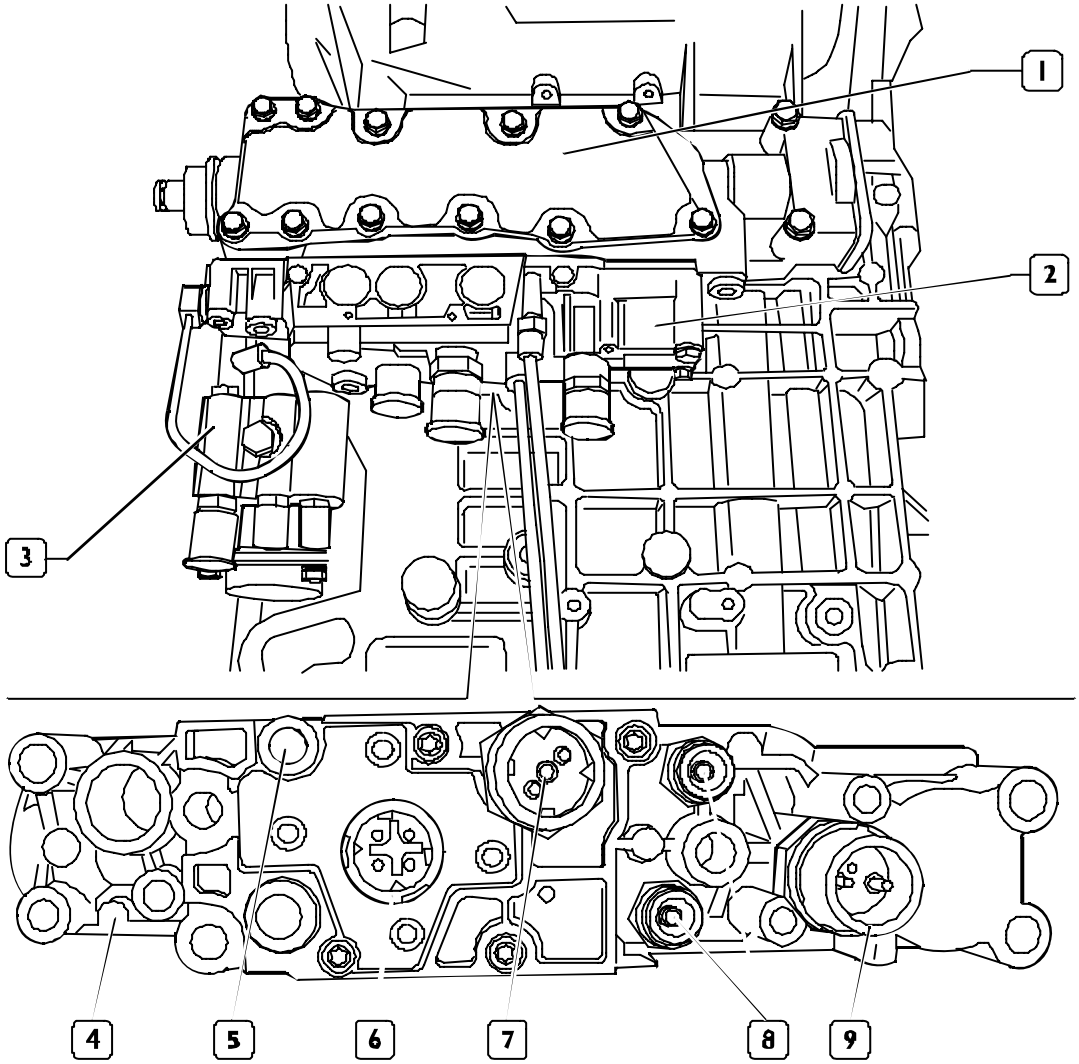

A = Type of transmission
B = ZF drawing no.
C = Production sequence number
D = Spare part IVECO drawing no.
E = Transmission gear ratio
F = Tachometer gear ratio
G = Type of power take-off
H = Power take-off gear ratio
I = Replacement oil amount
L = ZF lubricant list name

P.T.O. = Power take-off

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## GEAR CONTROL MODULE E 13 MP

Figure 3




1. Control tower - 2. Gear control module E13 MP - 3. Servo control - 4. Air Supply Module - 5. Pneumatic preselection connection, linked to switch on High - Low lever - 6. Electrical connector for solenoid valves - 7. Pressure switch - 8. GRE cylinder pneumatic connection line - 9. Neutral switch

The mechanically / pneumatically operated module E 13 MP integrates the valves activating the GP, lane lock and High - Low speed switching.

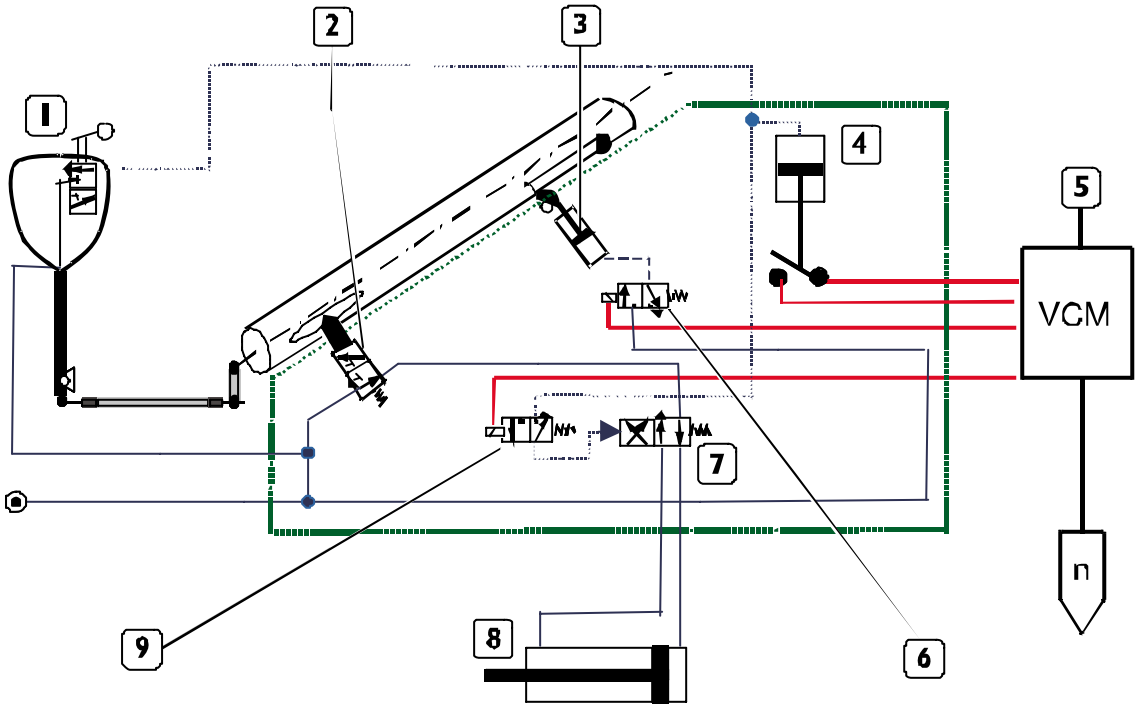
It offers the following advantages:

- gears are selected and engaged faster and with less effort;
- damping of vibrations from the control linkage, thus reducing noise levels;
- less stress on the synchronisers.

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## DIAGRAM OF MODULE E 13 MP

Figure 4




1. GRE pneumatic switch - 2. Valve enabling GRE engagement -3. Lane lock - 4. Pressure switch - 5. VCM control unit - 6. Lane locking solenoid valve - 7. GRE switching valve -8. GRE cylinder - 9. Switching solenoid valve

**NOTE** This operation is to be carried out only where the bearing is to replace.

**Lock speed range switching**

- Prevents switching from high to low speed when a certain number of revs is exceeded.
- Protects the synchronisers from excessively high peripheral speeds.
- Protects the clutch and engine from over-revving.

EXAMPLE:
If you are in 5th gear and the rev speed is > 1000 rpm it will NOT be possible to drop to 4th gear.

**Lane lock**

- Prevents incorrect engagement of $4^{th} \rightarrow 1^{st}$ instead of $4^{th} \rightarrow 5^{th}$

The driver intends to pass from 4th to 5th gear by switching the GP lever to high, but has forgotten to select GP - High on the selector: the lane lock function is activated to prevent selection of lane ½.

**NOTE** This operation is to be carried out only where the bearing is to replace.

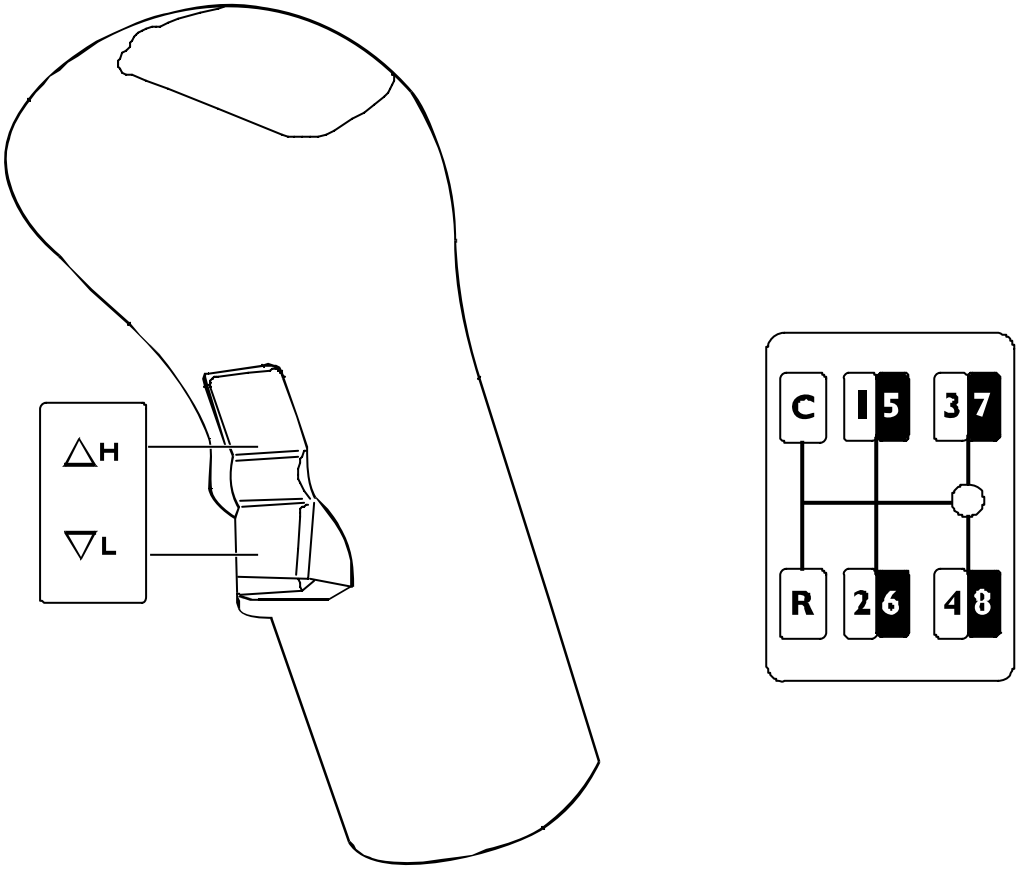
- Prevents incorrect engagement of $8^{th} \rightarrow 5^{th}$

The lane lock function prevents incorrect engagement of $8^{th} \rightarrow 5^{th}$ at a running speed of above 2000 rpm.

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## GEAR CONTROL LEVER

Figure 5

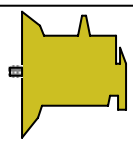
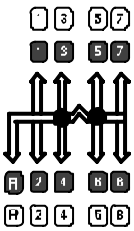
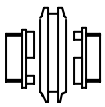



H = high gears - L = low gears

When engaging gears with super H, it is possible to change the ratio using the lever switch on the gear selector. If the lever switch is set to "Low" gears 1st to 4th are selected. If it is set to "High" gears 5th to 8th are selected.
The neutral position is at the centre of lane ¾.

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## MAIN DATA

| | GEARBOX | ZF 9 S 1310 T.O. |
|---|---|---|
|  | Type<br>Input torque Nm | Mechanical |
|  | Forward gears<br>Reverse gear | 9<br>1 |
|  | Control for the four main gears<br>E.R.U* control | Mechanical type<br>Pneumatic type |
|  | Power take off | On request |
|  | Gear Engagement:<br>$1^{st}$ - $2^{nd}$ - $3^{rd}$ - $4^{th}$ speeds and E.R.U.<br>Pickup speed and Reverse speed<br>Disengagement protection | <br>Freering synchronizer<br>Fast engage type<br>Sliding sleeves locked by rollers and springs |
|  | Gears | Helical toothing |

E.R.U * = Epicyclic reduction gear unit

T.O. = Truck Over Drive (Multiplied)

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| | | |
|---|---|---|
|  | Gear ratios | |
| | Crawler | 9.48 |
| | First speed | 6.58 |
| | Second speed | 4.68 |
| | Third speed | 3.48 |
| | Fourth speed | 2.62 |
| | Fifth speed | 1.89 |
| | Sixth speed | 1.35 |
| | Seventh speed | 1.00 |
| | Eighth speed | 0.75 |
| | Reverse speed | 8.97 |
|  | Type of Oil<br>Quantity | **Tutela Truck FE-Gear**<br>**Tutela ZC 90**<br>7.5 Kg. (8.5 lt) |

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**Gearboxes:**
**ZF 16 S 1620 T.D.**
**ZF 16 S 2220 T.D.**
**ZF 16 S 2520 T.O.**


| | Page |
|---|---|
| DESCRIPTION | 15 |
| LOCATION OF GEARBOX DESCRIPTION PLATE | 16 |
| OPERATION | 16/2 |
| - Slow range | 16/2 |
| - Fast range | 16/3 |
| EPICYCLIC REDUCTION GEAR CONTROL | 16/4 |
| - Reduced speeds | 16/4 |
| - Normal speeds | 16/5 |
| PNEUMATIC CONTROL OF GEARBOX | 16/6 |
| MAIN DATA | 17 |
| TIGHTENING TORQUES | 19 |
| TOOLS | 20 |
| GEARBOX FAULT DIAGNOSIS | 20/5 |
| REMOVAL-REFITTING THE GEARBOX | 21 |
| - Removal | 21 |
| - Refitting | 22 |
| OVERHAULING THE GEARBOX | 22/1 |
| - Servoshift gear box | 22/1 |
| - Removal | 22/1 |
| - Refitting | 22/1 |
| - Disassembly | 22/1 |
| - Assembòy | 22/3 |
| - Refitting | 22/5 |

https://truckmanualshub.com/

Aquila Trucks Centres


| | Page |
|---|---|
| - Removing the rear box | 22/7 |
| - Removing the epicyclic reduction gear unit (ERG) | 22/7 |
| - Fitting the epicyclic reduction gear unit (ERG) | 22/9 |
| - Refitting the epicyclic reduction gear unit (ERG) rear box | 22/12 |
| - Removing the gearbox | 22/12 |
| - Removing the main shaft | 22/15 |
| - Removing the drive input shaft | 22/18 |
| - Removing the transmission shaft | 22/19 |
| CHECKS | 22/19 |
| - Gerabox | 22/19 |
| - Bearings | 22/19 |
| - Shafts - gears | 22/19 |
| - Hubs - sliding sleeves - forks | 22/19 |
| - Rods forks | 22/19 |
| - Synchronizing devices | 22/20 |
| - BK-type single-cone synchronizing devices | 22/20 |
| - Fitting the transmission shaft | 22/20 |
| - Fitting the drive input shaft | 22/20 |
| - Fitting the main shaft | 22/22 |
| - Adjusting the main shaft | 22/24 |
| - Fitting the gearbox | 22/25 |
| - Adjusting splitter drive fork | 22/26 |
| - Oilpump | 22/27 |
| - Adjusting the transmission shaft bearing end float | 22/27 |
| - Drive input shaft cover | 22/28 |

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## DESCRIPTION

The ZF 16 S 1620 / 1920 / 2220 gearboxes in the T.D. (direct drive) or T.O. (overdrive) versions are composed of:

- A central box containing the main shaft, input shaft, layshaft and the gears for the four forward speeds and one reverse gear.
- A rear box containing the Epicyclic Reduction Gear Unit (ERG). Its function is to double the number of forward speeds by using epicyclic gears with helical toothing. This produces a range of gears that, starting with the four incoming speeds, makes it possible to have eight different ratios at the output (four normal speeds plus four reduced speeds).
- A front box containing the step-up gearing, called the "splitter", that makes it possible for each of the eight forward speeds and for the reverse gear to obtain an additional double selection. The "splitter" therefore halves the stagger between two successive ratios and each gear is divided into a slow ratio (L = slow ratio) and a fast ratio (S = fast ratio).

These gearboxes therefore have sixteen forward speeds with finely staggered ratios that can be engaged in succession and two reverse gears.

The synchronizing devices are the single-cone type.

Lubrication is made with a gear pump.

The double-H speed control is fitted with an air-operated "servoshift" device to improve speed selection and engagement.

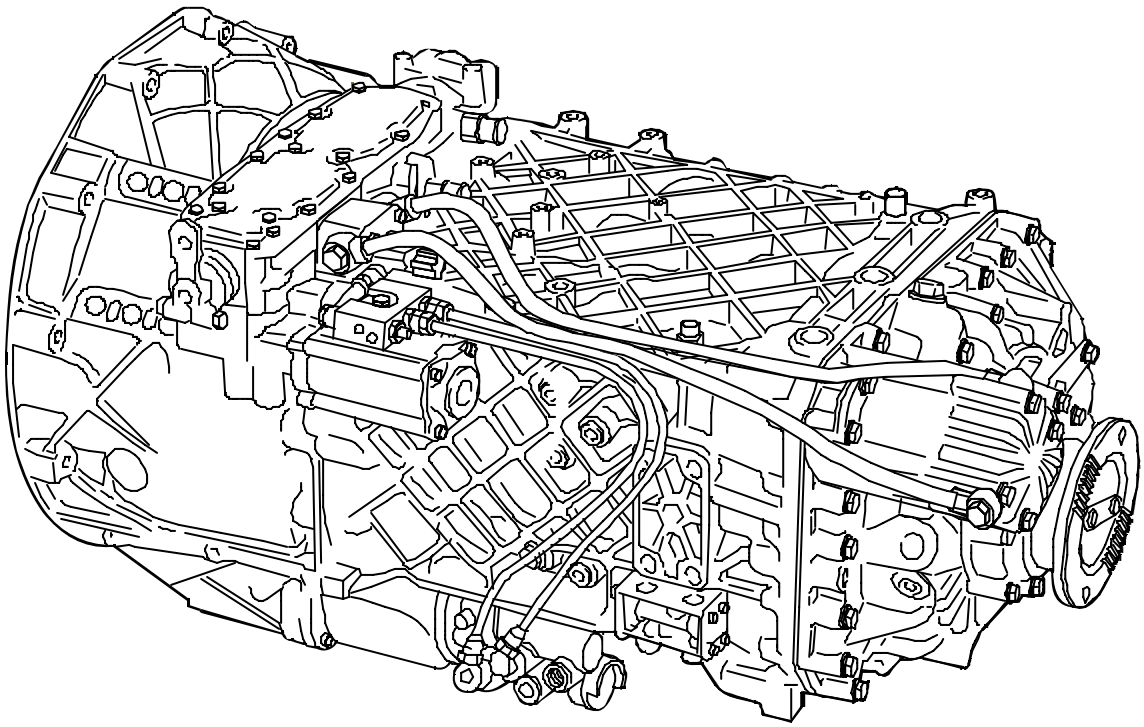
The servoshift is a device comprising a mechanical/pneumatic module and a double-acting cylinder.

The advantages of this device are:

- Faster speed selection and engagement with less effort.
- It cushions the vibrations of the control linkage, reducing noise.
- Less synchronizing device stress.

The device works mechanically if the pneumatic system breaks down.

Figure 1

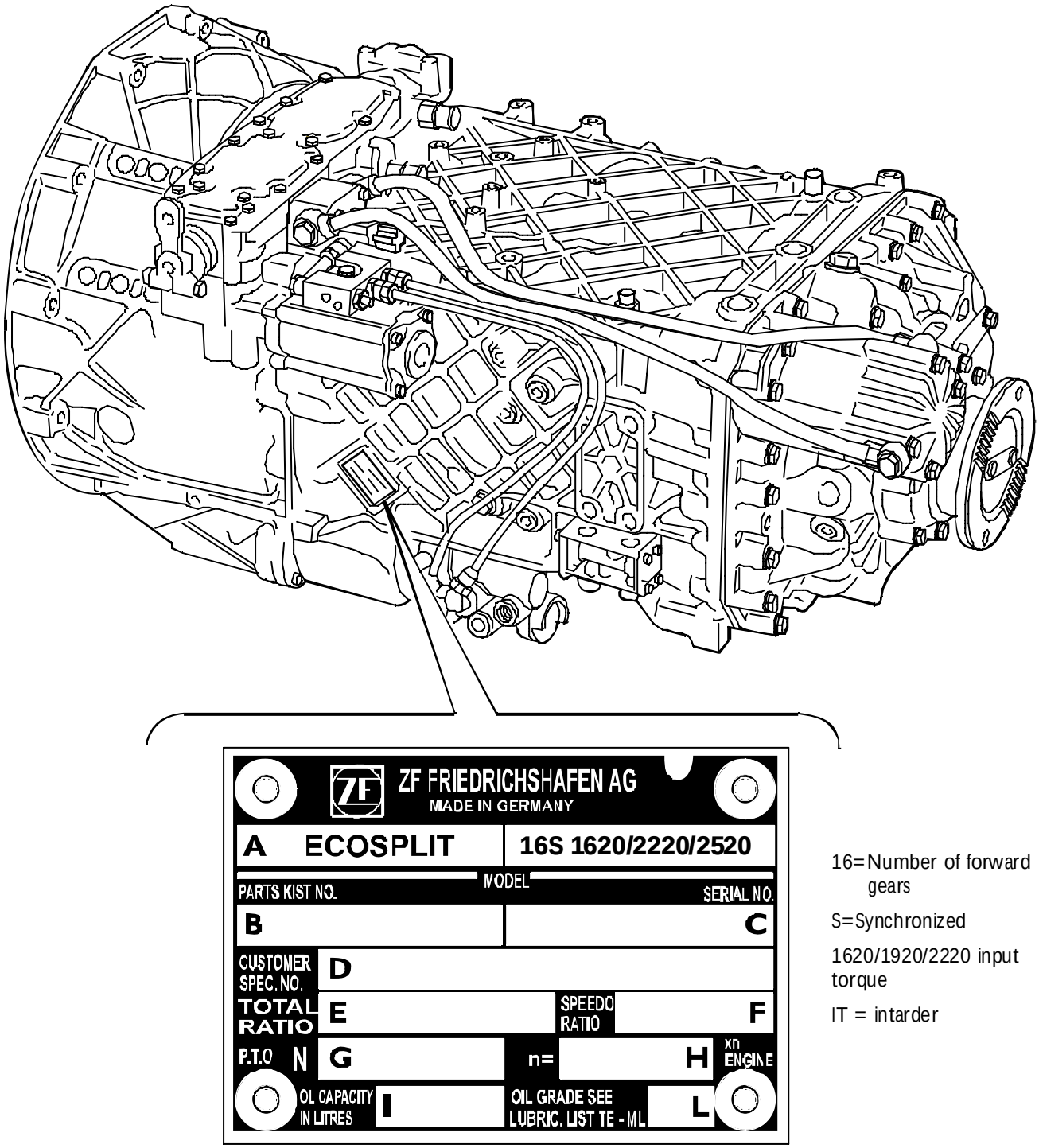


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## LOCATION OF GEARBOX DESCRIPTION PLATE

Figure 2




16=Number of forward gears

S=Synchronized

1620/1920/2220 input torque

IT = intarder

112202

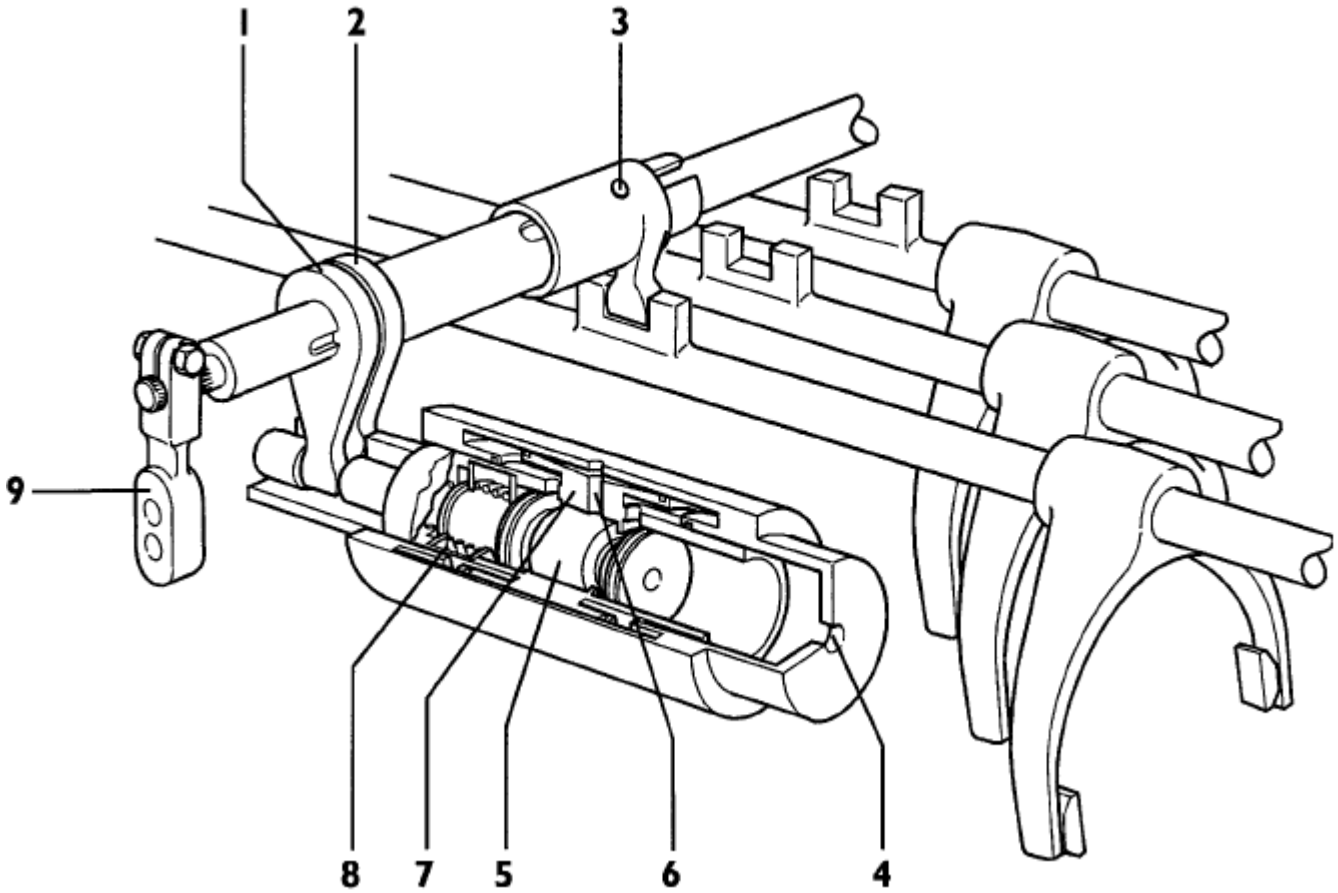
A = Type of transmission
B = ZF drawing no.
C = Production sequence number
D = Spare part IVECO drawing no.
E = Transmission gear ratio

P.T.O. = Power take-off

F = Tachometer gear ratio
G = Type of power take-off
H = Power take-off gear ratio
I = Replacement oil amount
L = ZF lubricant list name

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Figure 2/1

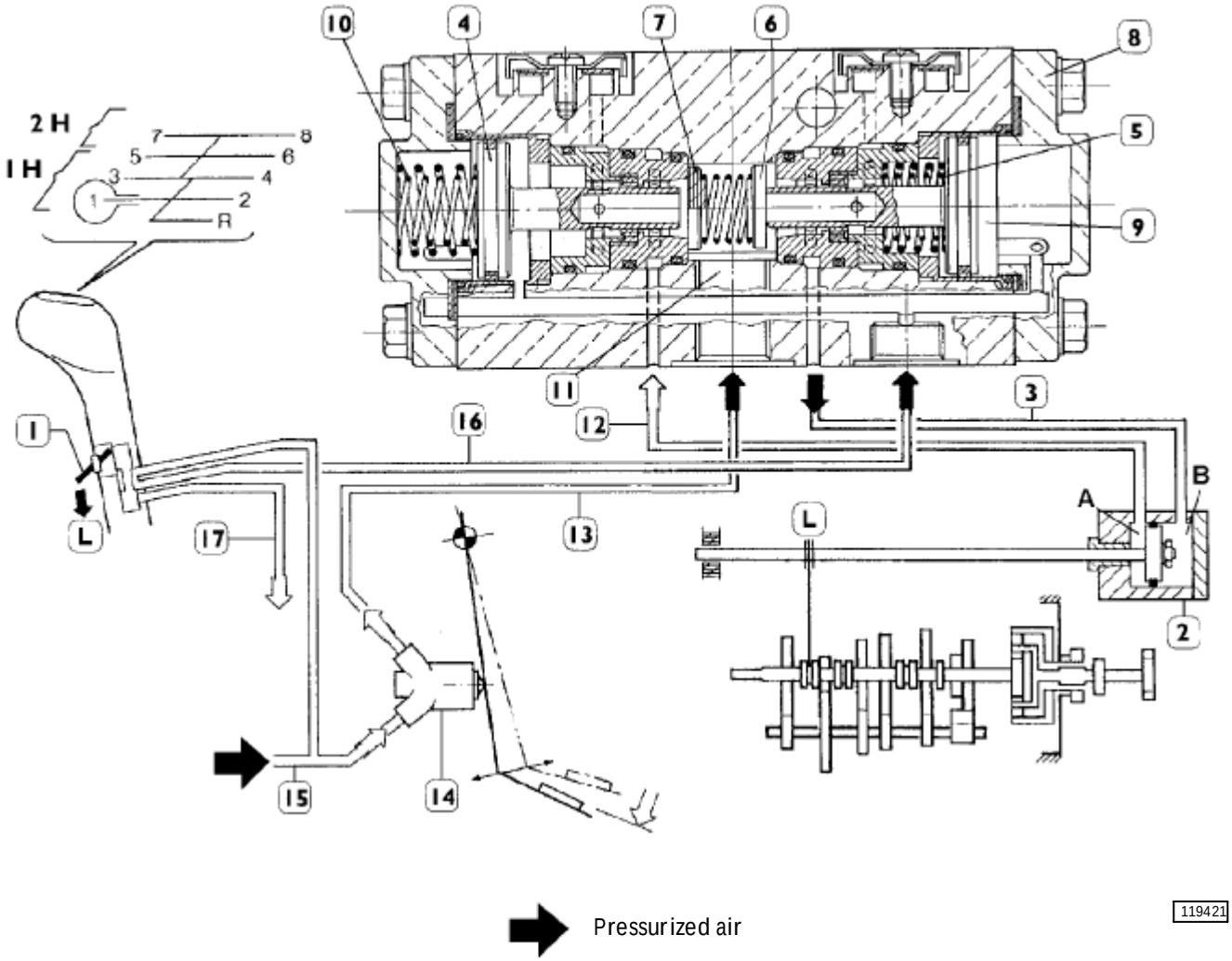



DETAIL OF SERVOSHIFT SPEED CONTROL
1. Control valve lever - 2. Speed control lever - 3. Idle roller - 4. Exhaust - 5. Control piston - 6. Intake - 7. Cylinder - 8. Reaction spring - 9. Longitudinal tie rod connection lever

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## OPERATION
### Slow range

Figure 2/2




PNEUMATIC DIAGRAM FOR PRE-SELECTION IN SLOW RANGE

The air from the services reservoir supplies the inhibitor valve (14) and the pre-selector (1) simultaneously, through the connecting pipe (15).

On shifting the pre-selector (1) downwards (position L of slow range), the air reaching the pre-selector (1) through the connecting pipe (16) supplies the double control valve (8).

The pressurized air, supplying the above-mentioned valve (8), pushes the pistons (4 and 9) to the left.

The movement of the pistons (4 and 9) makes it possible for the valve (7) to return to its seat and discharge the air contained in the left-hand chamber of the cylinder of the "splitter" (2) into the atmosphere through the connecting duct (12).

At the same time, the valve (6) moves and opens the passage for the air between the inlet duct (11) and the duct (3) connecting with the right-hand chamber of the cylinder of the splitter (2).

On pressing the clutch pedal, the air reaching the inhibitor valve (14) supplies the double control valve (8) through the connecting pipe (13).

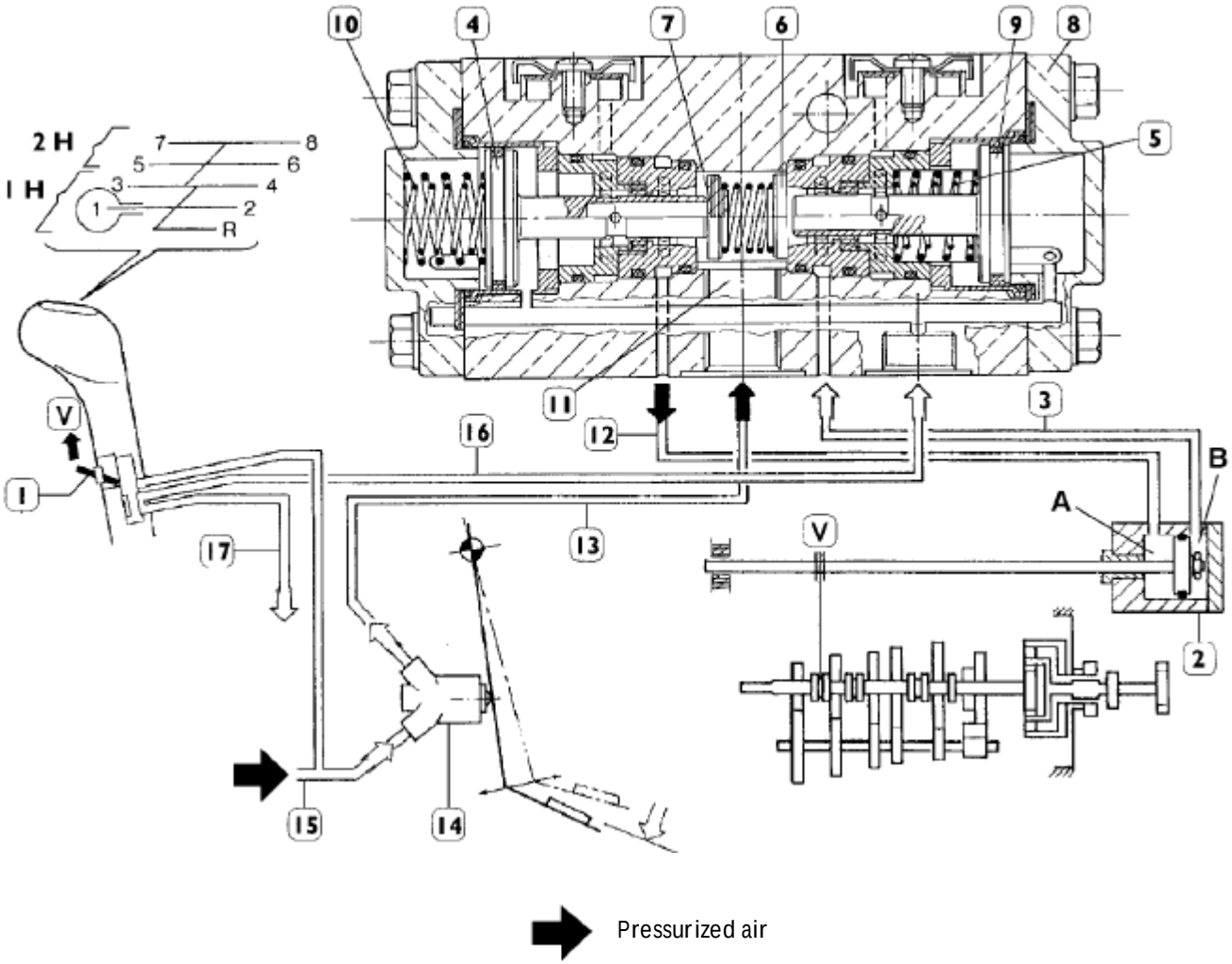
The air reaching the valve (8) passes through the inlet duct (11) and, finding the passage clear, supplies the right-hand chamber of the cylinder of the "splitter" (2) through the connecting duct (3).

The piston of this cylinder, moving to the left, then drives the entire train downline, causing the slow range to be engaged.

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## Fast range

Figure 2/3




PNEUMATIC DIAGRAM FOR PRE-SELECTION IN FAST RANGE

The air from the services reservoir supplies the inhibitor valve (14) and the pre-selector (1) simultaneously, through the connecting pipe (15).

On shifting the pre-selector (1) upwards (position S of fast range), the air passage between the supply pipe (15) and the double control valve (8) is closed, setting the connecting pipe (16) in communication with the outlet pipe (17).

As a result of the air being discharged by the double control valve (8), the reaction of the spring (10) and of the springs (5) pushes the pistons (4 and 9) to the right.

The movement of the pistons (4 and 9) makes it possible for the valve (6) to return to its seat and discharge the air contained in the right-hand chamber of the cylinder of the "splitter" (2) into the atmosphere through the connecting duct (3).

At the same time, the valve (7) moves and opens the passage for the air between the inlet duct (11) and the duct (12) connecting with the right-hand chamber of the cylinder of the "splitter" (2).

On pressing the clutch pedal, the air reaching the inhibitor valve (14) supplies the double control valve (8) through the connecting pipe (13).

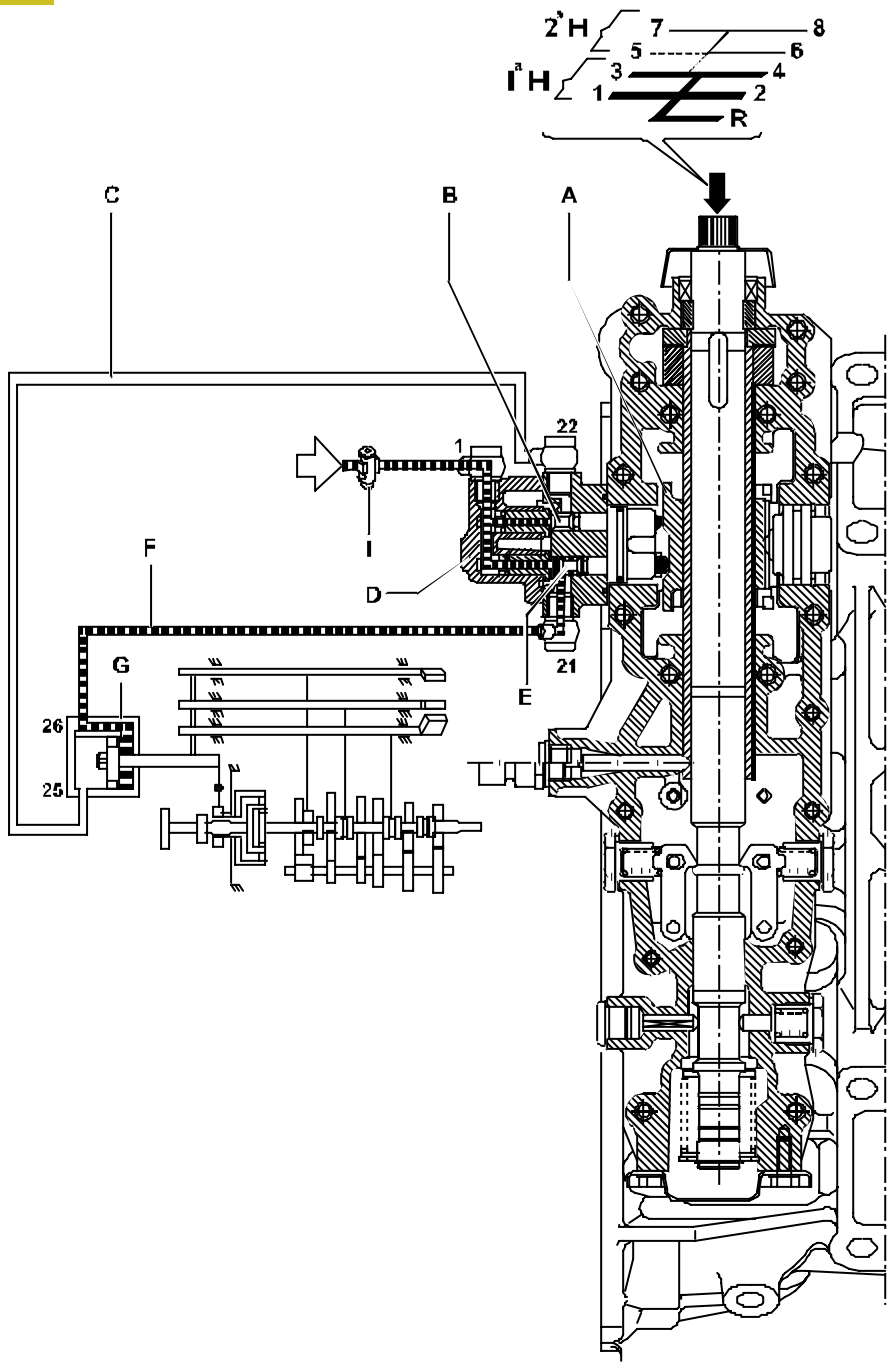
The air reaching the valve (8) passes through the inlet duct (11) and, finding the passage clear, supplies the right-hand chamber of the cylinder of the "splitter" (2) through the connecting duct (12).

The piston of this cylinder, moving to the right, then drives the entire train downline, causing the fast range to be engaged.

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## EPICYCLIC REDUCTION GEAR CONTROL
### Reduced speeds

Figure 2/4




PNEUMATIC SYSTEM DIAGRAM OF REDUCED SPEED ENGAGEMENT

The air from the vehicle's pneumatic system is reduced to a pressure of 9.5 bars by the pressure reduction unit (1). It then supplies the inhibitor valve D.

Now, taking the control lever onto the reduced speed position (1st H), the body A, integral with the speed control rod, opens the valve E that, via the pipe F, supplies the cylinder G.

The piston of the cylinder G, moving to the right, activates the ERG.

At the same time, the valve B closes, making it possible for the air from the pipe C to discharge into the atmosphere.

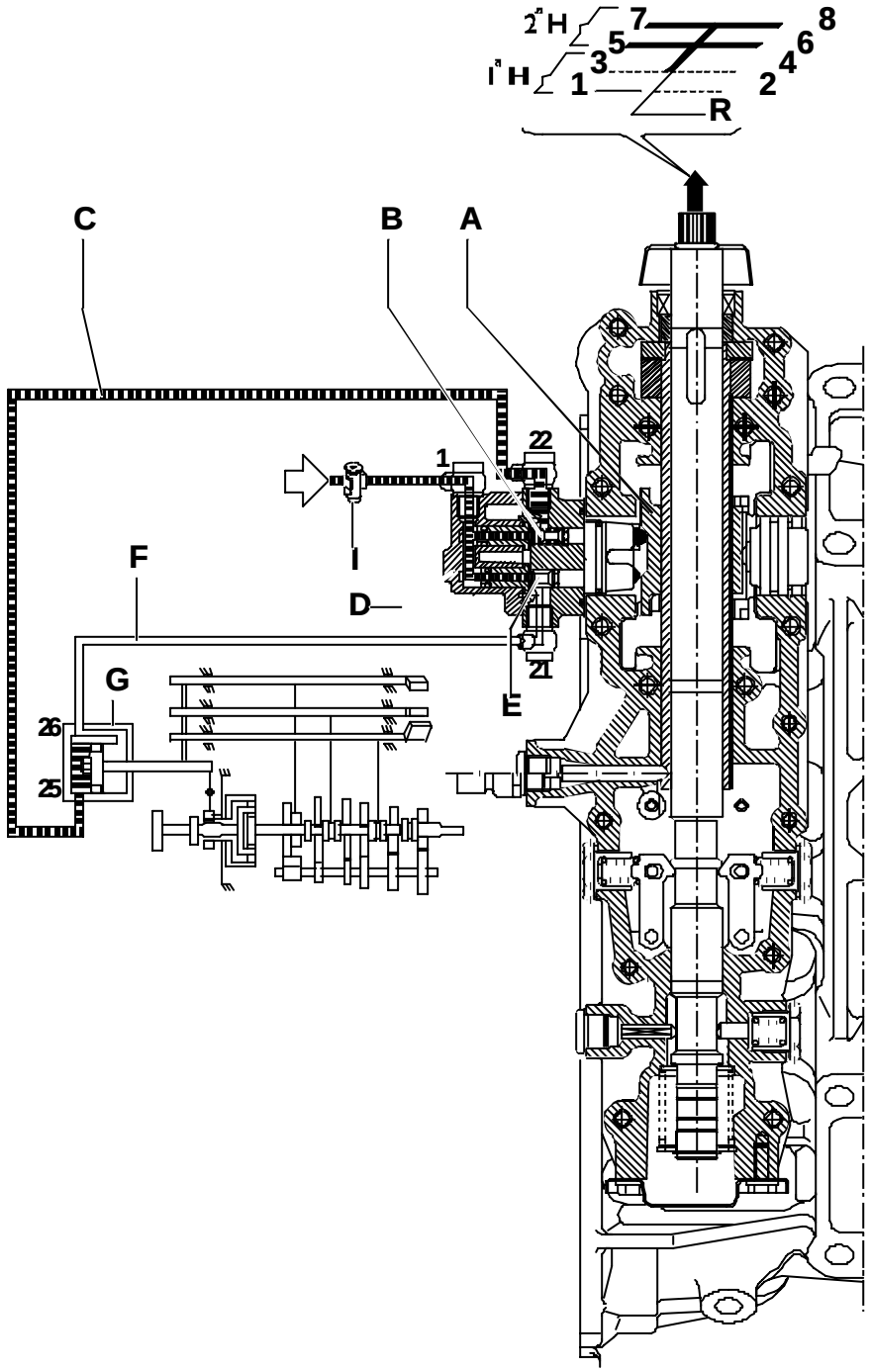
The movement of the piston causes the contact of the electric switch to close, which turns on the indicator light in the cab with the tortoise symbol.

**NOTE** The reduced speeds can be used in both slow range and fast range conditions, depending on the position of the pre-selector.

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## Normal speeds

Figure 2/5




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PNEUMATIC SYSTEM DIAGRAM OF NORMAL SPEED ENGAGEMENT

The air from the vehicle's pneumatic system is reduced to a pressure of 9.5 bars by the pressure reduction unit (1). It then supplies the inhibitor valve D.

Now, taking the control lever onto the normal speed position (2nd H), the body A, integral with the speed control rod, opens the valve B that, via the pipe C, supplies the cylinder G.

The piston of the cylinder G, moving to the right, deactivates the ERG.

At the same time, the valve E closes, making it possible for the air from the pipe F to discharge into the atmosphere.

The movement of the piston causes the contact of the electric switch to close, which turns off the indicator light in the cab.

**NOTE** The normal speeds can be used in both slow range and fast range conditions, depending on the position of the pre-selector.

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## PNEUMATIC CONTROL OF GEARBOX

Figure 2/6

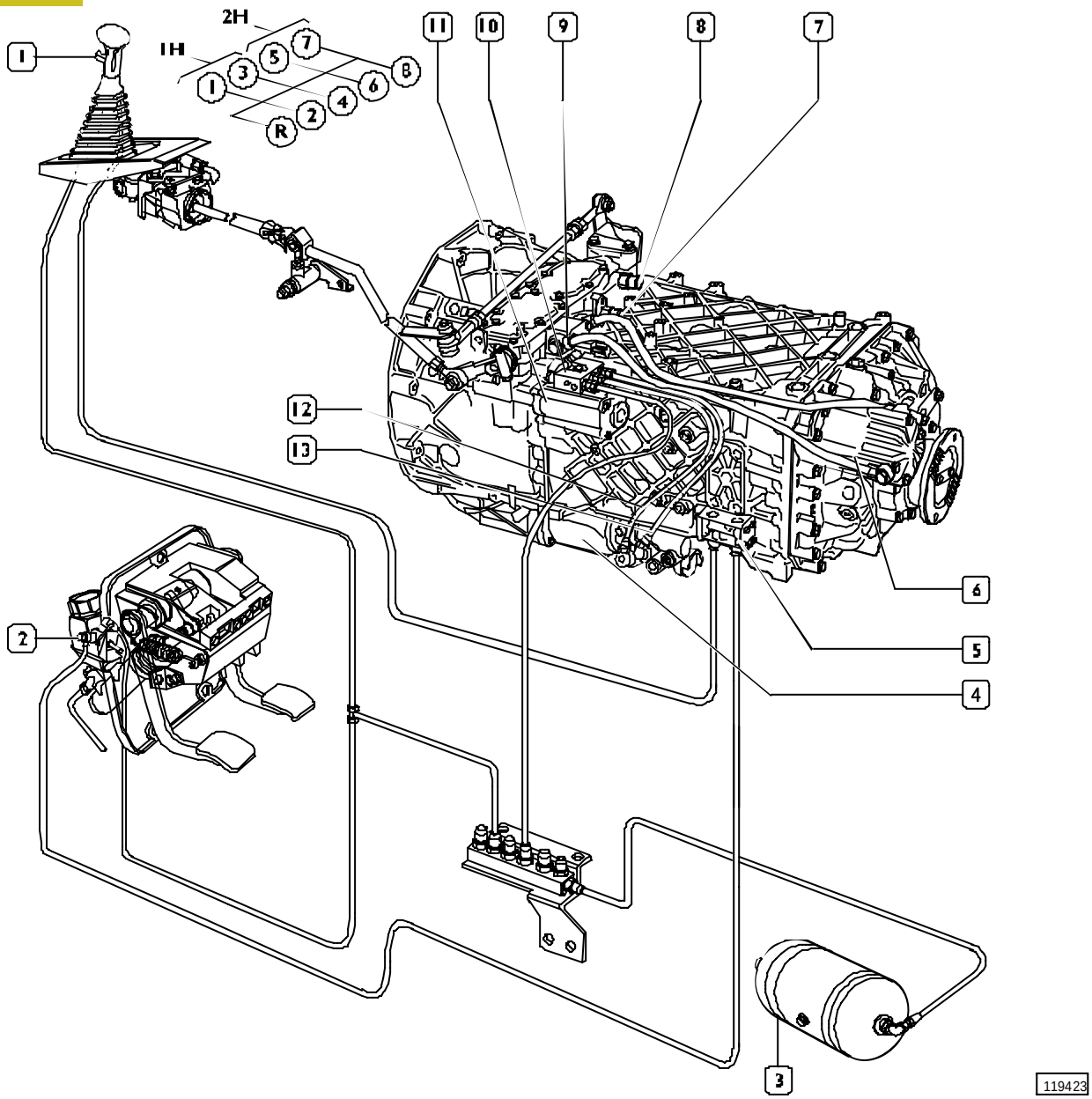



DIAGRAM OF PNEUMATIC CONTROL OF GEARBOX WITH SERVOSHIFT
1. Splitter control selector - 2. Inhibitor valve - 3. Services reservoir - 4. Servo-clutch - 5. Double control valve - 6. ERG driving cylinder - 7. Switch signalling gearbox in neutral - 8. Reverse gear switch - 9. Control valve - 10. Distributor - 11. Servoshift - 12. Piping - 13. Piping

The splitter (slow speeds - fast speeds) and epicyclic reduction gear unit are air operated and controlled with the speed control lever.

The selector (1) pre-selects the L range (slow) and V range (fast) via the double control valve (5). They are inserted via the inhibitor valve (2) when the clutch pedal is pressed.

The epicyclic unit engages and disengages automatically when passing from the 1st H to the 2nd H and vice versa.

When the gearbox is in neutral, the driving cylinder (6) is operated by the pressurized air via the control valve (9).

Through the piping (12), the distributor (10) supplies the servo-clutch (4) that, if operated with the clutch pedal, supplies the servoshift (11) through the piping (13).

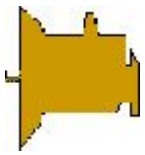
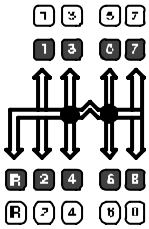
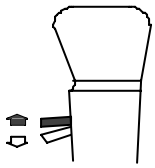
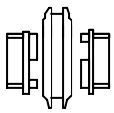
A switch (8) on the gearbox control turns on the reversing light when reverse gear is engaged.

The switch (7) signalling when the gearbox is in neutral is on the cover of the gear control.

Another switch on the ERG driving cylinder (6) turns on the indicator light in the cab (with the symbol of the tortoise) when the epicyclic reduction gear is engaged.

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## MAIN DATA

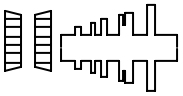
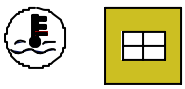
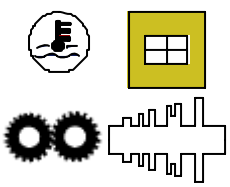
| GEARBOX | | |
|---|---|---|
| | Type | Mechanical |
|  | Torque at input<br>ZF 16 S 1620 T.D.<br>ZF 16 S 2220 T.D.<br>ZF 16 S 2520 T.O. | <br>1700<br>2200<br>2500 |
|  | Speeds | 16 forward speeds<br>2 reverse speeds |
|  | Control of the four main speeds<br>ERG control *<br>Splitter control | Mechanical<br>Pneumatic<br>Pneumatic |
|  | Power take-off | On request |
|  | Gear engagement:<br><br>Forward speeds<br><br>Reverse gear<br><br>Gear anti-disengagement | <br><br>Free ring synchronizer<br>Bk-type single cone $1^{st}$-$2^{nd}$-$3^{rd}$-$4^{th}$-$5^{th}$-$6^{th}$ speed<br><br>Quick engagement<br><br>Sliding sleeves held by pawls and springs. |
|  | Gear wheels | Helical-toothed |

* ERG = Epicyclic reduction gear unit

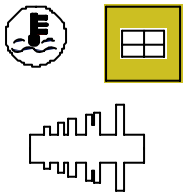
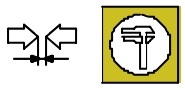
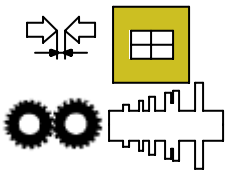
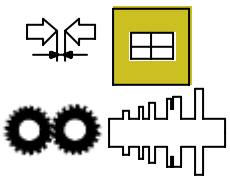
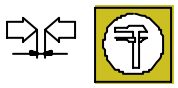
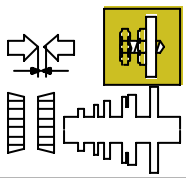
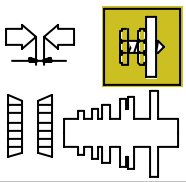
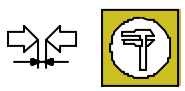
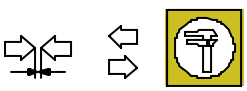
T.D. = Truck Direct Drive
T.O. = Truck Over Drive (Multiplied)

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Aquila Trucks Centres

| GEARBOX | | ZF 16 S 1620 T.D.<br>ZF 16 S 1920 T.D.<br>ZF 16 S 2220 T.D. | ZF 16 S 2520 T.O. |
|---|---|---|---|
|  | Gear ratio | | |
| | 1ª | 16.41 | 13.80 |
| | 2ª | 13.80 | 11.54 |
| | 3ª | 11.28 | 9.49 |
| | 4ª | 9.49 | 7.93 |
| | 5ª | 7.76 | 6.53 |
| | 6ª | 6.53 | 5.46 |
| | 7ª | 5.43 | 4.57 |
| | 8ª | 4.57 | 3.82 |
| | 9ª | 3.59 | 3.02 |
| | 10ª | 3.02 | 2.53 |
| | 11ª | 2.47 | 2.08 |
| | 12ª | 2.08 | 1.74 |
| | 13ª | 1.70 | 1.43 |
| | 14ª | 1.43 | 1.20 |
| | 15ª | 1.19 | 1.00 |
| | 16ª | 1.00 | 0.84 |
| | 1ª RM | 15.36 | 12.92 |
| | 2ª RM | 12.92 | 10.80 |
|  | Type of oil | Tutela Truck FE-Gear<br>Tutela ZC 90 | |
| | Quantity | Dry change | |
| | ZF 16 S 1620 T.D. Kg | 10 | |
| | litres | 11 | |
| | ZF 16 S 1920 T.D. Kg | 12 | |
| | ZF 16 S 2220 T.D./T.O. litres | 13 | |
|  | Transmission and main shaft bearings | tapered rollers | |
| | | tapered rollers | |
|  | Drive output flange assembly temperature | Max. 70 °C | |
|  | Transmission shaft gear assembly temperature | 160 ÷ 180 °C | |

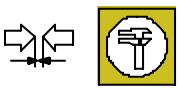
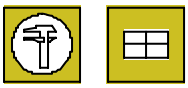
Aquila Trucks Centres

| GEARBOX | | |
|---|---|---|
|  | Main and transmission shaft bearing and fixed hub assembly tempature | 100° |
|  | End float:<br>- ERG* planet wheel shaft bearing<br>- ERG* fixed hub split ring<br>- Transmission shaft bearing split ring | with adjusting ring: 0 ÷ 0.1 mm; without adjusting ring: 0 ÷ 0.26 mm<br>0 ÷ 0.1 mm<br>0 ÷ 0.1 mm |
|  | End float of gear of drive input shaft, first, second and third speed | minimum 0.2 mm |
|  | Fourth speed gear end float | minimum 0.05 mm |
|  | End float between planet wheel holder and ERG* planet wheels | 0.4 ÷ 1.3 mm |
|  | End float of bearings of shafts: main and transmission on drive input side | 0.0 ÷ 0.1 mm |
|  | Main shaft rear bearing split ring end float | 0.0 ÷ 0.05 mm |
|  | Wear limit check distance of synchronizer rings:<br>- first/second speed<br>- third/fourth speed<br>- ERG * | 1.5 mm at 50 Nm (5 kgm)<br>0.8 mm<br>1.2 mm |
|  | Reverse gear idler end float | 0.4 ÷ 1.5 mm |
|  | End float or pre-load of half rings of main and drive input shafts | from - 0.05 to + 0.05 |

* ERG = Epicyclic reduction gear unit

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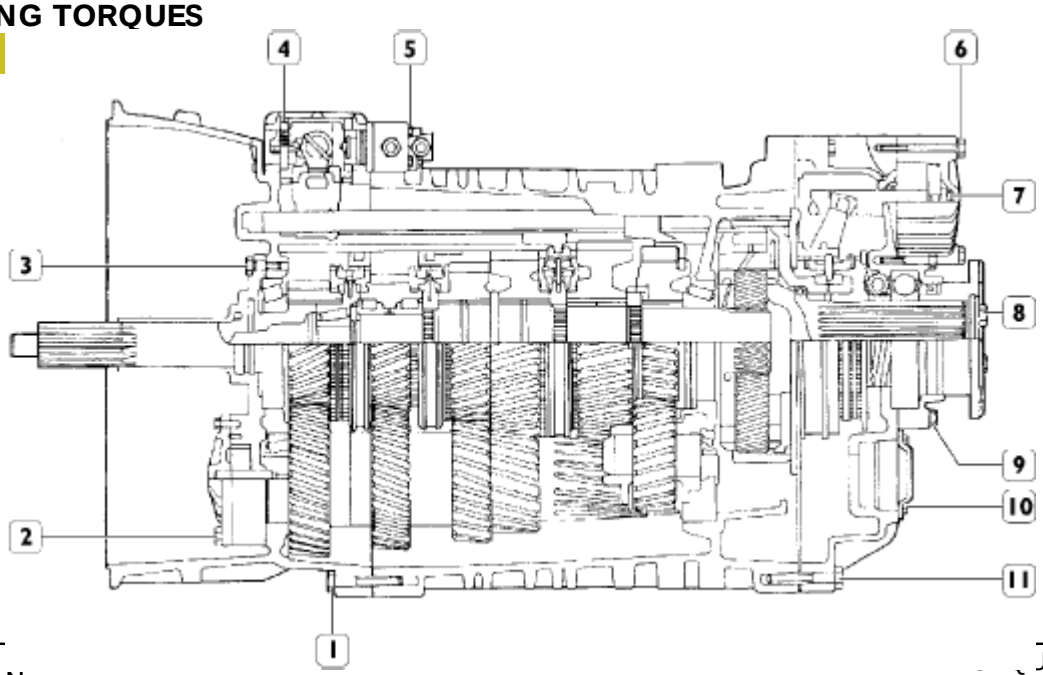
Aquila Trucks Centres

| GEARBOX | | |
|---|---|---|
|  | Distance for the clearance adjustment of the sliding blocks of the splitter control fork on the relevant sliding sleeve | 94.1 mm<br>107.9 mm |
|  | Clearance of the sliding blocks of the forks in the seats of the sliding sleeves | 0.6 ÷ 1.2 mm |
|  | Assembly distance of twin-lipped seal on rear cover | 12.5 $^{+1.0}$ mm |

Aquila Trucks Centres

## TIGHTENING TORQUES

Figure 3

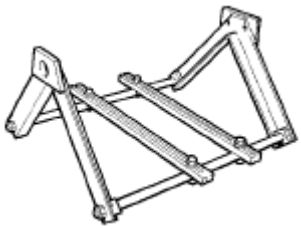
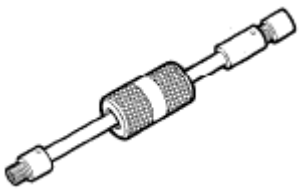
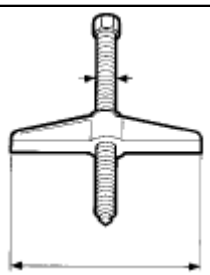
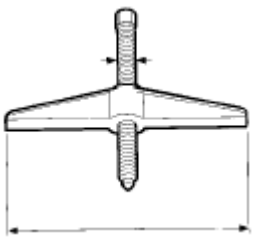
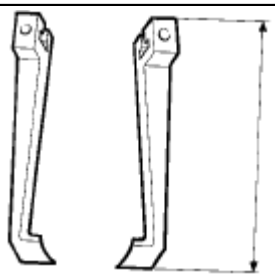



| | DESCRIPTION | TORQUE | |
|---|---|---|---|
| | | Nm | kgm |
| 1 | Screws fixing splitter box | 50 | 5 |
| 2 | Screws fixing oil pump | 46 | 4.6 |
| 3 | Screws fixing drive input shaft cover | 46 | 4.6 |
| 4 | Screws fixing gearbox | 43 | 4.3 |
| 5 | Screws fixing valve to gearbox | 23 | 2.3 |
| 6 | Screws fixing ERG* cylinder to the box | 50 | 5.0 |
| 7 | Self-locking nuts fixing splitter control rods and ERG to pistons | 150 | 15.0 |
| 8 | Screws fixing drive output flange | 120 | 12 |
| 9 | Screws fixing rear cover | 50 | 5 |
| 10 | Screws fixing PTO fitting cover | 79 | 7.9 |
| 11 | Screws fixing ERG* box | 50 | 5 |
| | Fixing screws | | |
| | - M18 x 1.5 | 35 | 3.5 |
| | - M22 x 1.5 | 50 | 5 |
| | - M24 x 1.5 | 60 | 6 |
| | Clutch disengagement bearing drive fork support fastening screws | 150 | 15 |
| | Screws fixing RM gearbox bottom cover | 49 | 4.9 |
| | Screws fixing gearbox side cover | 23 | 2.3 |
| | Socket-head screws fixing pipes | 35 | 3.5 |
| | Oil drain plugs | 80 | 8.0 |
| | Oil drain plugs M38 x 1.5 with magnetic filter | 140 | 14.0 |
| | Pressure switches / pulse transmitters | 50 | 5.0 |
| | Screws fixing oil pump cover | 46 | 4.6 |
| | Switches on gearbox | 35 | 3.5 |
| | Screws fixing splitter control valve | 9,5 | 0.9 |
| | Nut for screw fixing lever to gearbox control rod | 5 | 4.9 |
| | Threaded pins for articulation of ERG* control fork | 250 z | 25 z |
| | Oil vapour breather pipe | 10 | 1 |
| | Push rods for positioning rods | 50 | 5 |
| | Screw for reverse gear shaft retaining plate (if applicable) | 86 | 8.6 |
| | Screws fixing fork on splitter control shaft | 60 | 6 |

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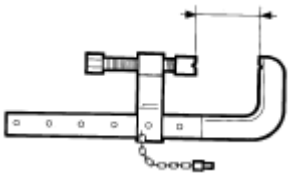
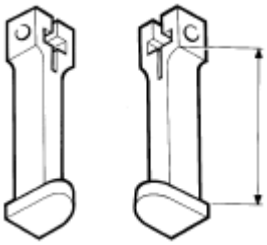
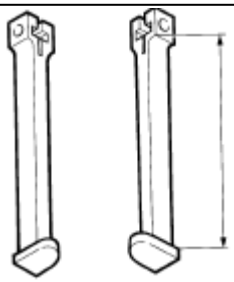
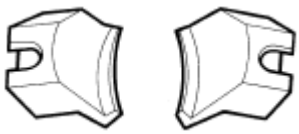
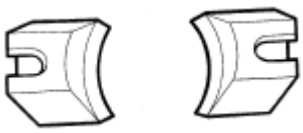
Aquila Trucks Centres

## TOOLS

| TOOL No. | | DESCRIPTION |
|---|---|---|
| **99322205** |  | Rotary stand for overhauling assemblies |
| **99322225** |  | Stand for supporting assemblies (to be fitted on stand 99322205) |
| **99340205** |  | Percussion extractor |
| **99341003** |  | Single-acting bridge |
| **99341004** |  | Single-acting bridge |
| **99341012** |  | Pair of brackets |

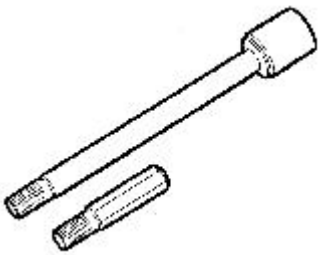
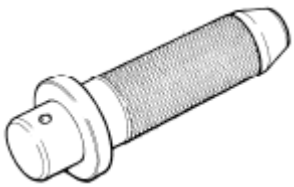
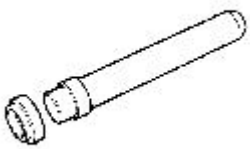
Aquila Trucks Centres

## TOOLS

| TOOL No. | | DESCRIPTION |
|---|---|---|
| **99341015** |  | Clamp |
| **99341019** |  | Pair of tie rods with grips |
| **99341020**<br>**99341021** |  | Pair of tie rods with grips |
| **99341022** |  | Grips |
| **99341024**<br>**99341025** |  | Grips |
| **99345058** |  | Extractor reaction block |

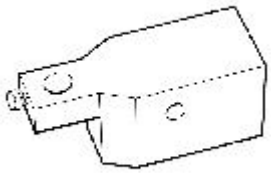
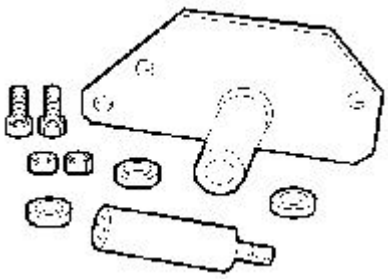
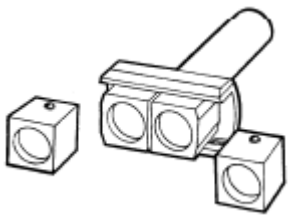
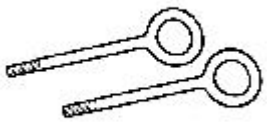
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## TOOLS

| TOOL No. | | DESCRIPTION |
|---|---|---|
| **99345097** |  | Reaction tool to extract sun gear and drive in main shaft oil pipe |
| **99347092** |  | Pin to extract gearbox front and rear centring pins (use with 99340205) |
| **99360502** |  | Rings to remove and refit reduction gear unit |
| **99370006** |  | Grip for interchangeable drifts |
| **99370007** |  | Grip for interchangeable drifts |
| **99370113** |  | Beater for mounting the gasket and/or bushings of control box for the gears |

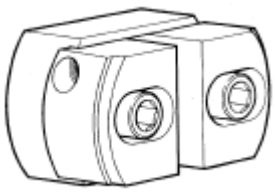
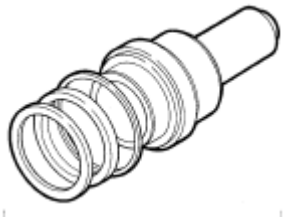
Aquila Trucks Centres

## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99370415** |  | Door base of comparator to adjust secondary shaft bearings (to be used with 99395604) |
| **99370420** |  | Key for fitting gasket on gearbox front cover (use with 99370006) |
| **99370449** |  | Tool to extract and insert main shaft |
| **99370450** |  | Tool to adjust splitter control fork |
| **99370465** |  | Tool to notch safety plates |
| **99370565** |  | M10 eyebolts (2) for lifting various assemblies |

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## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99370629** |  | Mount to support gearbox when removing and refitting it on the vehicle |
| **99371050** |  | Brackets to support gearbox when overhauling (use with 99322205 - 99322225) |
| **99374093** |  | Drift to mount external bearing races (91-134) (use with 99370007) |
| **99374221** |  | Key to fit gaskets on rear cover |
| **99374370** |  | Key to fit oil deflector on direct drive shaft (use 99370006) |
| **99395604** |  | Dial gauge (0-10 mm) |

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## GEARBOX FAULT DIAGNOSIS

Principal operational anomalies:

| Visible Failure | Possible cause | Repair action |
|---|---|---|
| **NOISE** | Excessive clearance between gears. | Overhaul the gearbox and replace worn gears. |
| | Gears, bearings, synchronizer rings and connecting parts worn. | Replace worn parts. |
| | Insufficient lubricating oil level in the gearbox. | Top up to correct level with **Tutela ZC 90** or **Tutela Truck Fe-Gear** oil. |
| **GEARS DISENGAGE SPONTANEOUSLY AND ENGAGE INCORRECTLY** | Gears not properly engaged. | Fully engage gears before releasing clutch pedal. |
| | Gearshift forks broken. | Remove transmission, overhaul and replace parts as necessary. |
| | Synchroniser rings worn | Inspect gears and sliding sleeves for gear engagement, replacing any which are damaged; replace synchroniser rings |
| | Defective operation of epicyclic reduction gear | Inspect and replace damaged parts |
| **GEARS DIFFICULT AND STIFF TO ENGAGE** | Forks stiff on rods | Dismantle the transmission and look for the cause of the stiffness; repair as necessary |
| | Movement of sliding sleeves obstructed | Inspect and repair as necessary |
| | Transmission filled with unsuitable fluid. | Drain the oil and refill with **Tutela ZC 90** or **Tutela Truck Fe-Gear** oil |
| | Clutch not disengaging | Adjust control or replace. |
| **PNEUMATIC CONTROL SYSTEM DEFECTIVE OR INEFFICIENT *** | Defective air pipe connections | Check the connections and restore them if necessary. |
| | Air pipe bent and/or crushed | Replace the pipe |
| | Air leaks from the pipe. | Check there are no leaks in the pipes and fittings; use an acoustic appliance or soapy water. Replace or tighten the seal if necessary. |
| | Air leaks from the pressure reduction valve. | Replace the valve or its seals. |
| | Defective pressure reduction valve setting. | Check the valve pressure. Replace if necessary. |
| | Air leaks from the inhibitor valves. Inhibitor valves do not work. | Check the inhibitor valves. If necessary, replace the valves or their seals. |
| | Air leaks from the driving cylinders. | Replace the gaskets and seals of the driving cylinders. |
| * The checks have to be made with the engine switched off and the air tanks full. | | |

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## 530210 REMOVING-REFITTING THE GEARBOX

### Removal

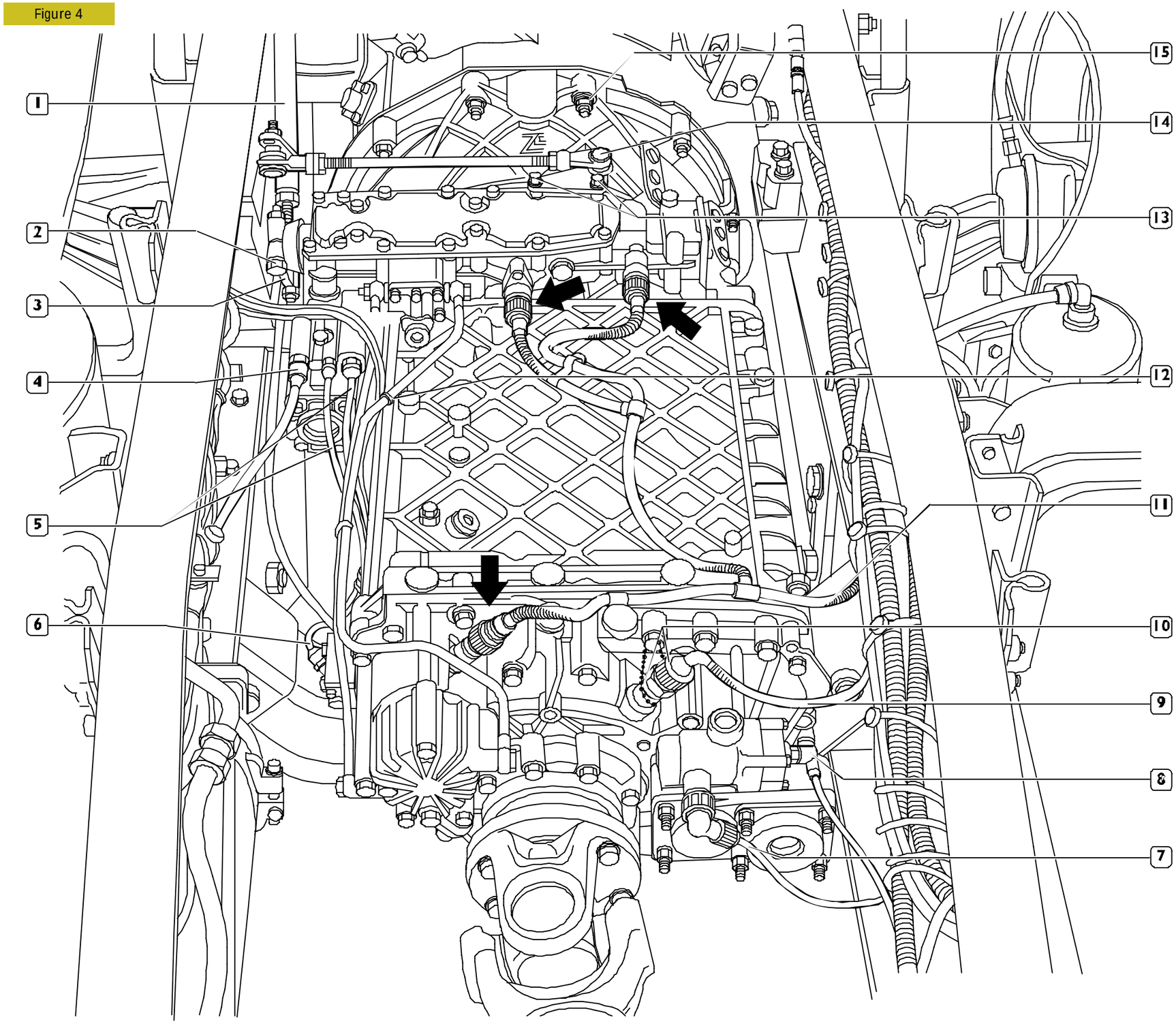
To remove the gearbox, proceed as follows:

- Set the vehicle over a pit or on a lift.
- Disconnect the battery cables to prevent any short-circuiting.
- Disconnect the cable (11) using the connectors (→) and breaking the safety lead off the screw (10).
- Disconnect the connector (7) and the pipe (8) from the power take-off (if applicable).
- Disconnect the air pipes (4) and (5).
- Free the pipes (6) from the clamps (12).
- Undoing the fasteners (13), disconnect the tie rod (14) from the gearbox.
- Loosen the screw (2) and extract the lever (3) together with the tie rod (1) from the gearbox after marking its position for reassembly.
- Remove the fasteners (15) of the gearbox bell, accessible from above.

**NOTE** For gearboxes with the intarder, proceed as follows:

- Drain off the engine coolant and disconnect the pipes from the heat exchanger.
- If the cross member of the chassis frame prevents you from removing the gearbox, you need to drain off the oil from the intarder; take out the nuts and screws fixing the heat exchanger to the intarder, remove the stud bolts and detach the heat exchanger.

Figure 4



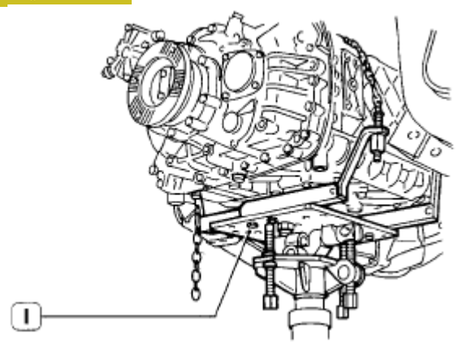
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Aquila Trucks Centres

Working from under the vehicle:

- Disconnect the pipes (1) and (2), previously freed from the clamps.
- Unscrew the nuts (5) and tie the clutch cylinder (6) to the vehicle's chassis frame appropriately.
- Undoing the side fasteners (8), take off the cross member (7).
- Place a hydraulic jack equipped with the mount 99370629 (1, SENZA CODICE) under the gearbox.
- Disconnect the propeller shaft (10) by undoing the screws (9) and tie it to the vehicle's chassis frame appropriately so it will not interfere with the removal of the gearbox.
- Complete removing the gearbox bell fasteners (4).
- Afterwards, extract the gearbox from the engine by bringing it suitably back out of the space occupied by the exhaust pipe (3). Then lower the jack and take out the gearbox.

Figure 6




45369

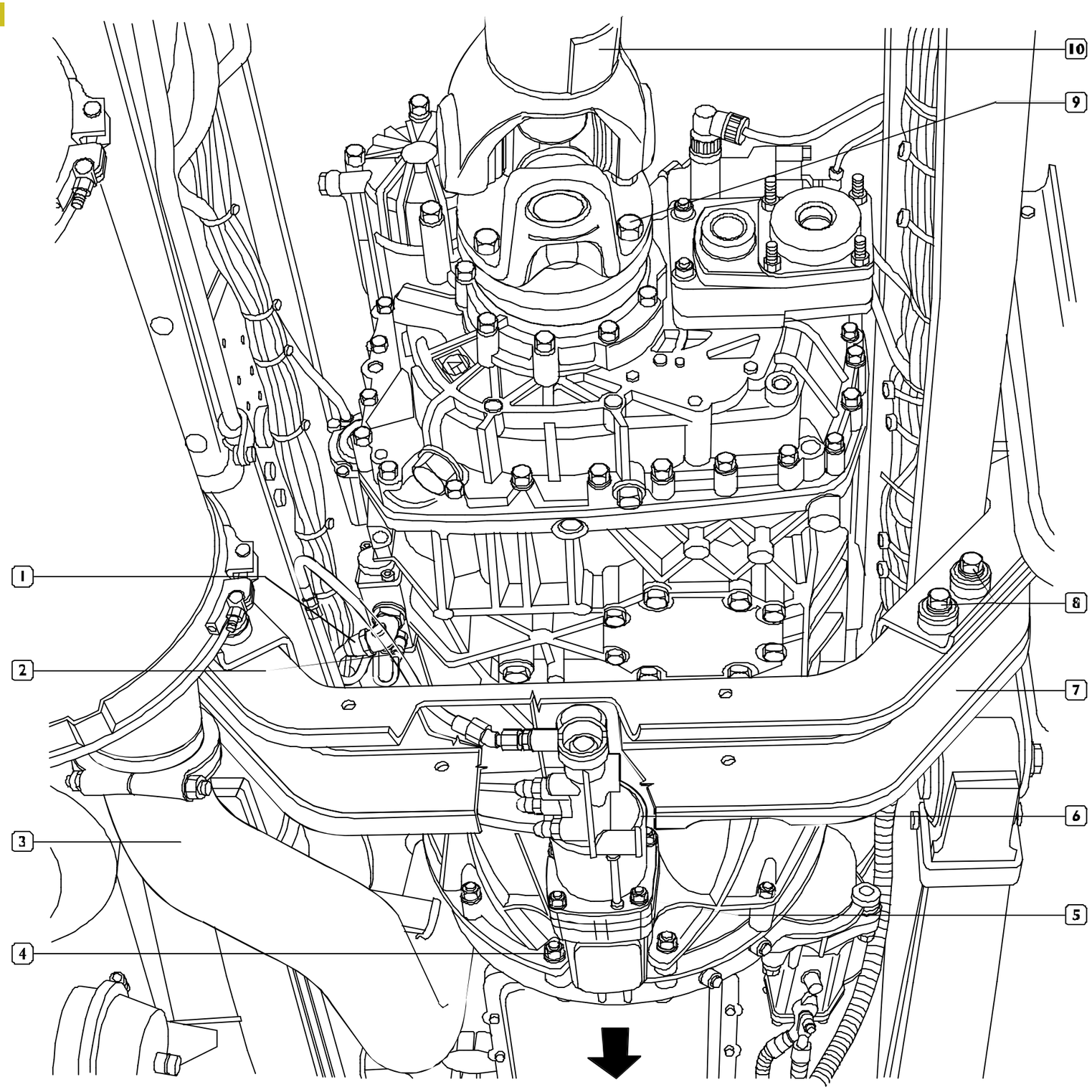
## Refitting

Carry out the operations performed for removal in reverse order and tighten the fixing nuts and screws to the required torque.

**NOTE** For gearboxes with the intarder, proceed as follows:

- Refit the heat exchanger to the intarder, inserting new seals; fit the stud bolts and tighten the fixing screw and nuts to the required torque.
- Connect the coolant pipes to the heat exchanger and replenish the gearbox with the required amount of oil.
- Fill the engine cooling system as described in Section 2 Engine.

Figure 5




71752

Aquila Trucks Centres

## 530210 OVERHAULING THE GEARBOX

**NOTE** Wash the assembly thoroughly before overhauling.

The specific and/or general tools must be used in the way for which they were designed.

To facilitate assembly, put the removed parts away on the specific tray in their order of removal.

Upon assembly, the following must always be replaced with new parts: the gaskets and seals, spring pins, safety plates and springs. Nuts and screws must be tightened to the prescribed torque with their thread dry and degreased.

Keep to the specific regulations when disposing of lubricant and detergents.

**NOTE** There follows a description of the operations for overhauling the ZF 16 S 2520 gearbox that, unless stated otherwise, hold for the ZF 16 S 1920/2220/ 2320 gearboxes too.

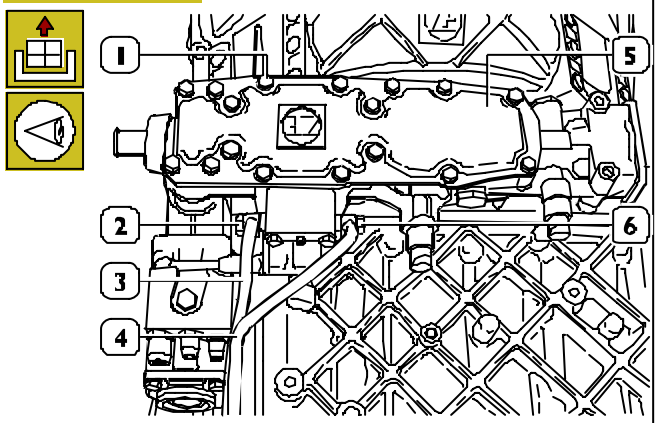
Fit the supporting brackets 99371031 to the assembly.

Using ropes with hooks and a movable lift, position the assembly on the rotary stand 99322205 together with the mount 99322225.

### 530220 Servoshift gear box

### Removal

Figure 6/1




Note down the assembly position of the pipes (3 and 4) and disconnect them from the gearbox (5) by unscrewing the fittings (2 and 6) together with the washers.

Unscrew the fixing screws (1) and remove the gearbox (5) together with the servoshift from the gearbox.

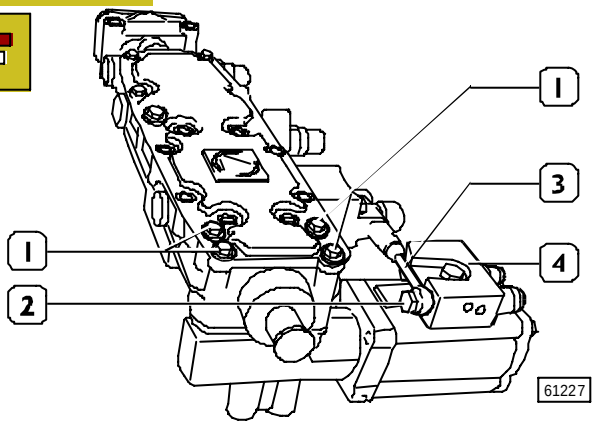
**NOTE** The servoshift cannot be overhauled. Replace it if you find any trouble.

### Refitting

For refitting, carry out the steps described for removal in reverse order, fitting new seals and tightening the fixing screws (1) and fittings (2 and 6) to the required torque.

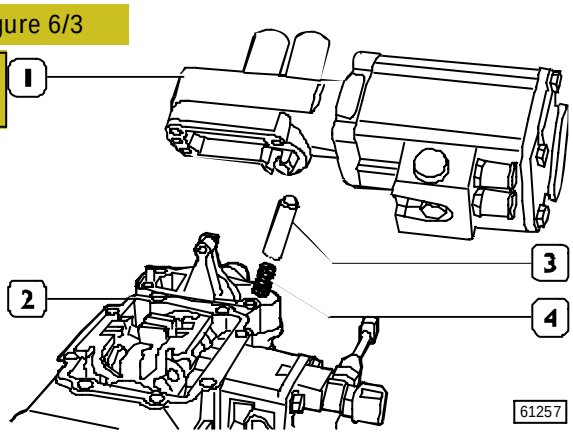
### Disassembly

Figure 6/2




Unscrew the fitting (2) and disconnect the air pipe (3) from the distributor (4).

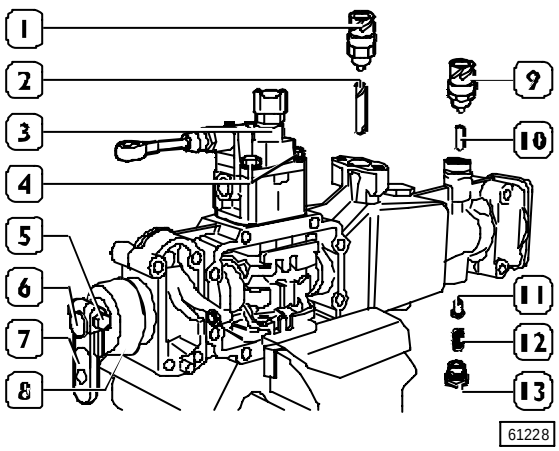
Figure 6/3




Unscrew the screws (1, Figure 6/2) and disconnect the servoshift (1) from the gearbox (2).

Take out the push rod (3) with the spring (4).

Figure 6/4




Mark the assembly position of the lever (7) on the rod (6). Loosen the nut (5) and remove the lever (7) from the rod (6).

Extract the cup (8).

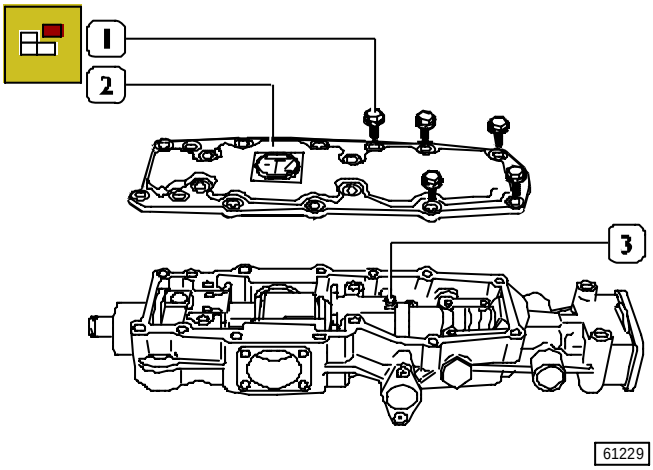
Remove:

- the valve (3) after taking out the screws (4).
- the switches (1 and 9) with their washers and push rods (2 and 10).
- the plug (13) with its washer, the spring (12) and the push rod (11).

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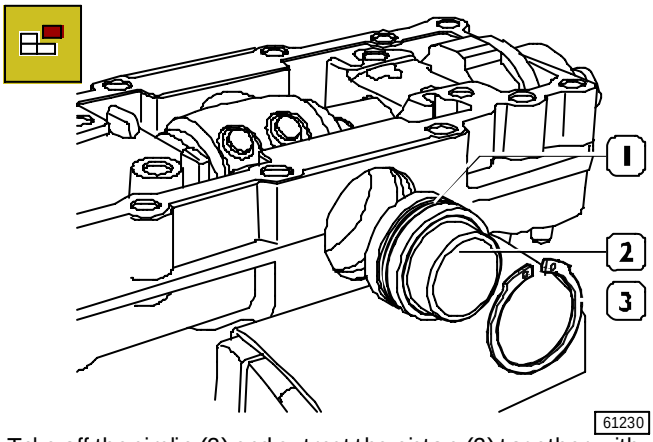
Figure 6/5




Unscrew the screws (1) and take off the top cover (2).

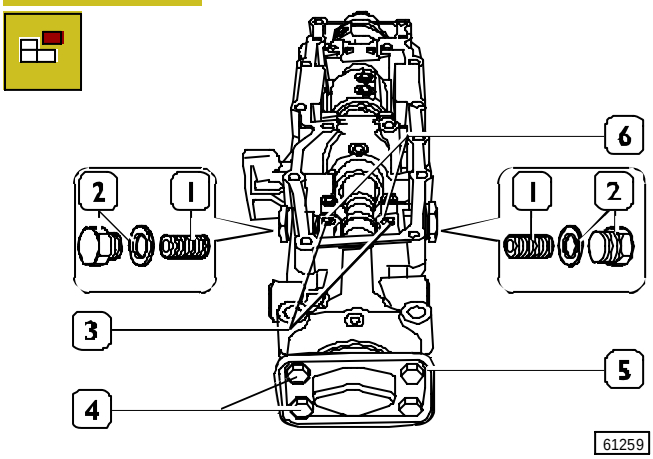
Extract the pin (3).

Figure 6/6




Take off the circlip (3) and extract the piston (2) together with the ring (1).

Figure 6/7

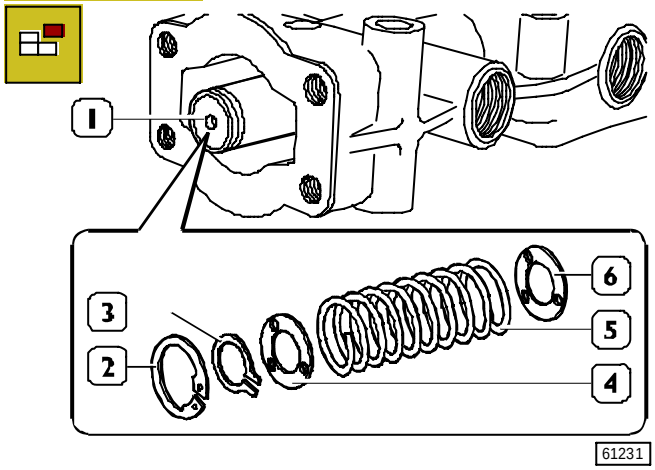



Unscrew the plugs (2) with the washers, extract the springs (1) and remove the levers (6).

If necessary, take out the pins (3).

Unscrew the screws (4) and remove the cover (5).

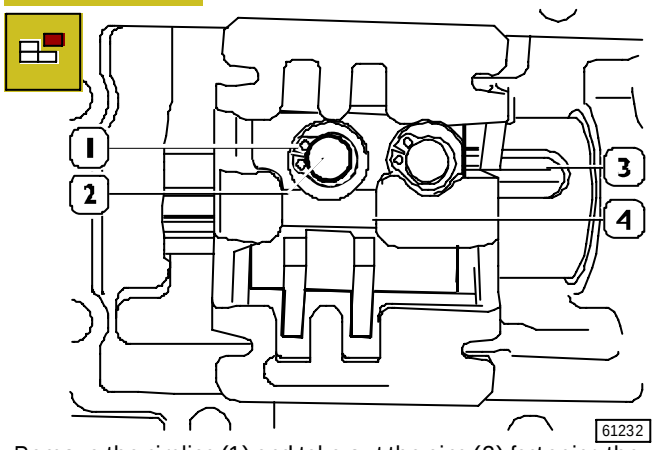
Figure 6/8




Remove the circlip (2) from the rod (1).

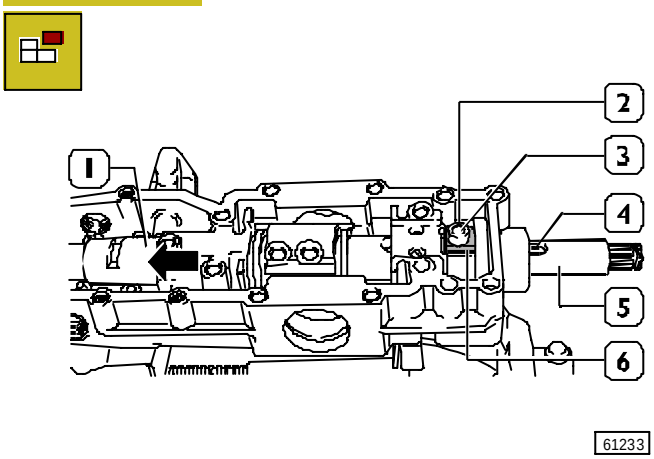
Use the washer (4) to limit the action of the spring (5) and remove the split ring (3), extract the washer (4), the spring (5) and the washer (6).

Figure 6/9




Remove the circlips (1) and take out the pins (2) fastening the drive (4) to the rod (3).

Figure 6/10

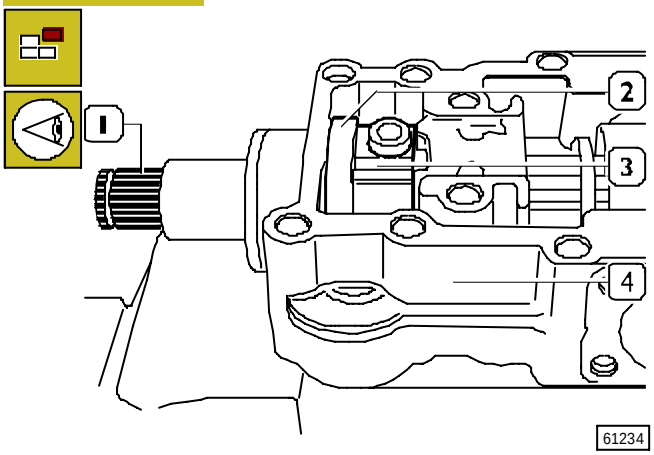



Move the sleeve (1) in the direction of the arrow.

Strike a punch on the top of the lever (6) to make it come out of the bearing (3) and pin (2), freeing the latter from the groove (4) in the rod (5).

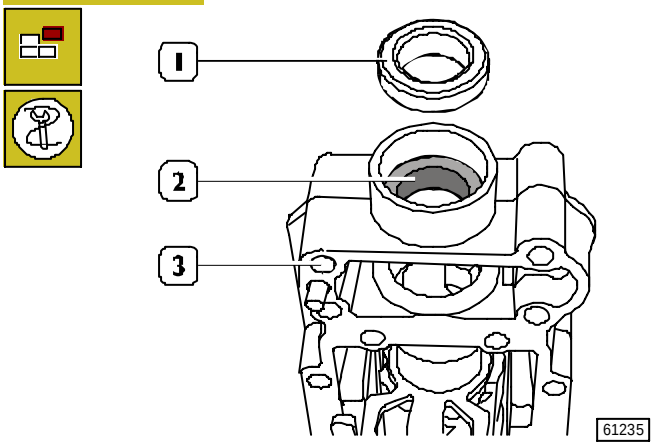
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Figure 6/11



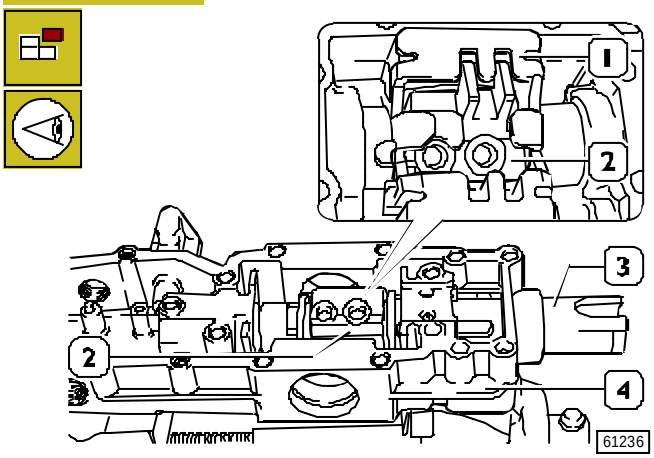

Note down the assembly position of the levers (2 and 3) and take them out of the box (4) extracting the rod (1).

Figure 6/12




Using the male extractor 99348004, extract the bushing (2) and the seal (1) from the box (3).

Figure 6/13

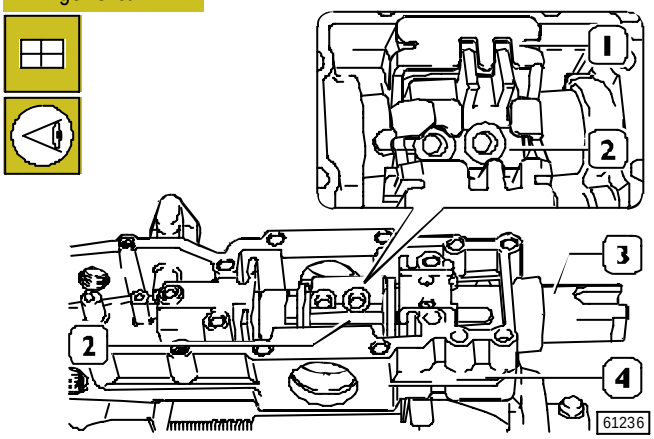



Note down the assembly position of the locking element (1) and drive (2) and take them out of the box (4) after extracting the sleeve (3).

## Assembly

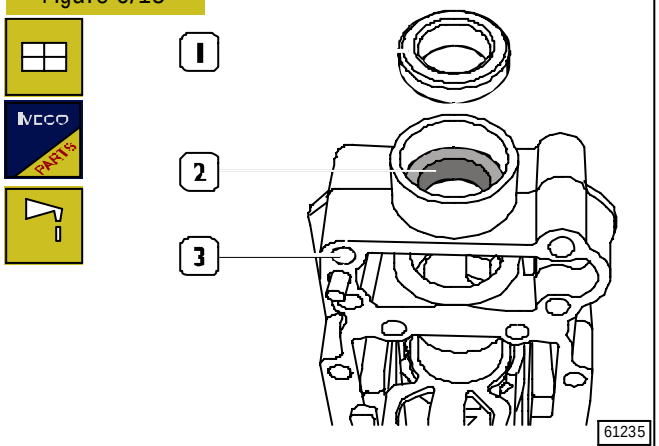
**NOTE** When assembling, always replace the sealing elements with new parts: rings, copper washers, flat gaskets, o-rings and roller bearings with the pins. Check that the springs have not broken nor yielded.

Figure 6/14




Position the locking element (1) and the drive (2) in the box (4) as marked during removal and put on the sleeve (3).

Figure 6/15

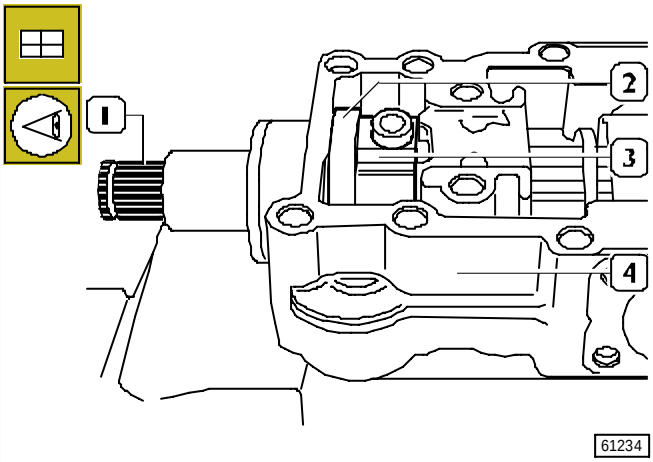



Using drift 99370113, mount the bushing (2) in the box (3).

Using a suitable keying device, fit the seal (1) in the box (3). Lubricate the inside of the seal (1) with grease.

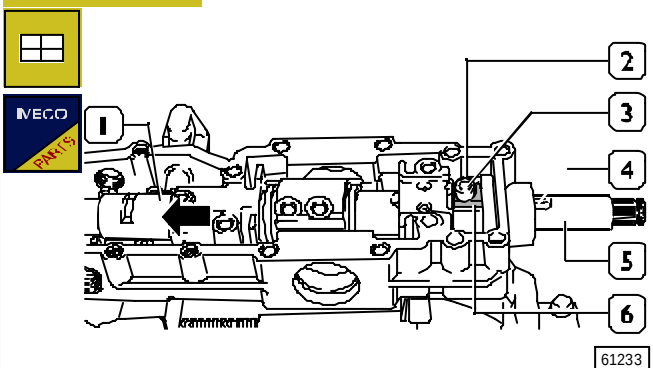
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Figure 6/16




Position the levers (2 and 3) in the box (4) as marked during removal and put on the rod (1).

Figure 6/17

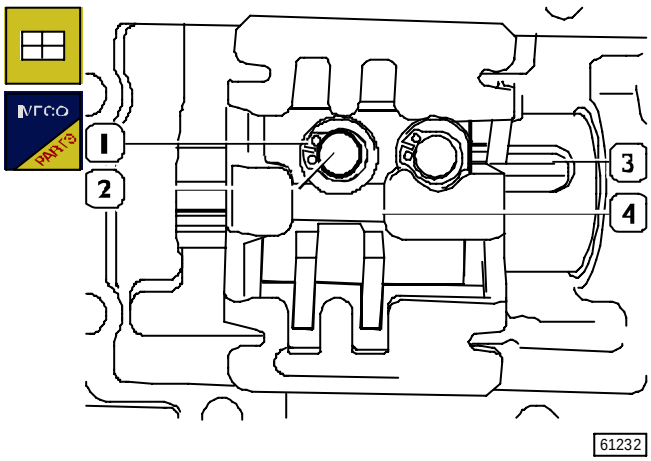



Move the sleeve (1) in the direction of the arrow.

Fit a new roller bearing (3) and pin (2) on the lever (6). Position the rod (5) so that the groove (4) corresponds with the roller (3) and pin (2).

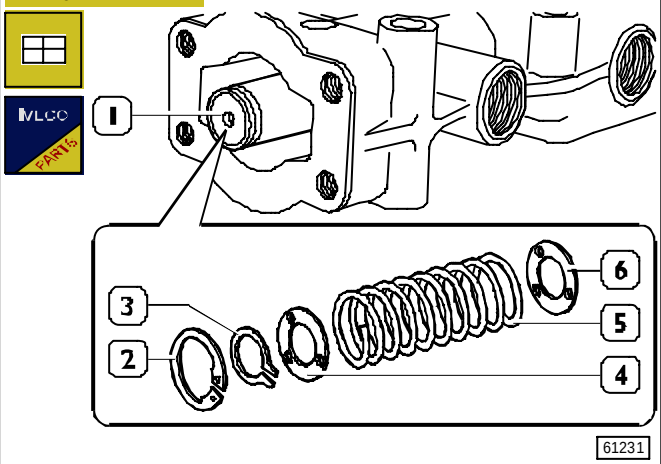
Resting the lever (6) on a flat surface, carefully strike the bearing (3) and pin (2) so they go into a position flush with the top of the lever (6) and correctly enter the groove (4) in the rod (5).

Figure 6/18




Fasten the drive (4) to the rod (3), putting on the pins (2) and mount new circlips (1) on these.

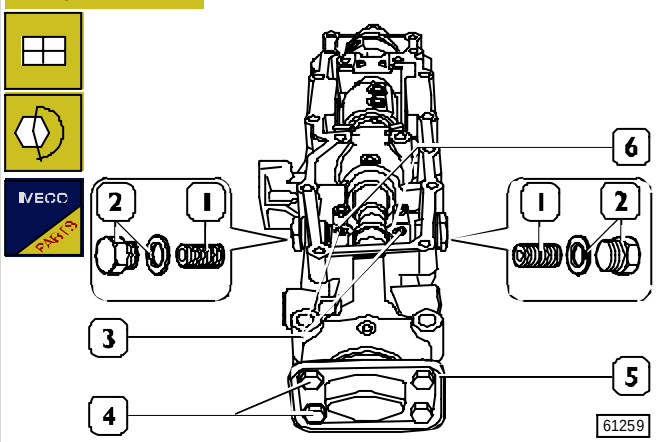
Figure 6/19




On the rod (1), position: the washer (6), spring (5), washer (4) and fit on a new split ring (3).

Fit on a new circlip (2).

Figure 6/20

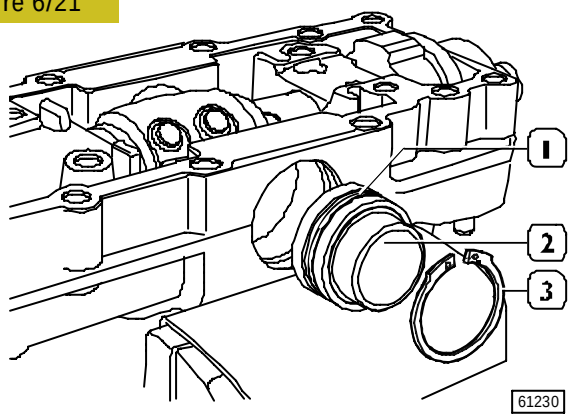



Fit on the cover (5) with a new gasket, screw down the screws (4) and tighten them to the required torque.

Position the levers (6) on the pins (3). Screw down the plugs (2) with the new washers and springs (1) and tighten them to the required torque.

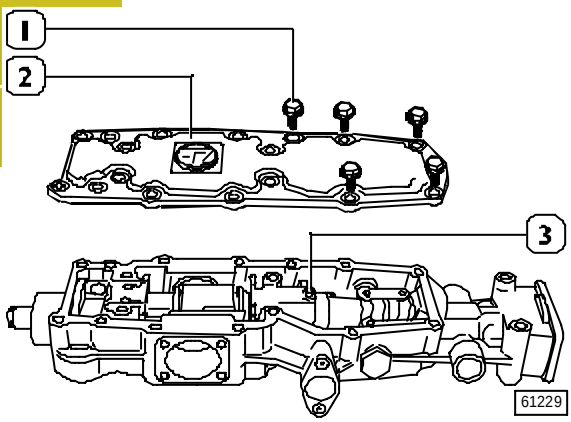
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Figure 6/21




Fit a new ring (1) on the piston (2) and fit this in the box, securing it with the circlip (3).

Figure 6/22

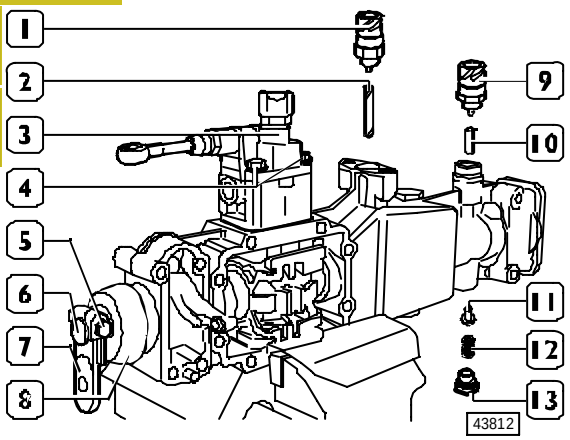



Insert the pin (3) in the box.

Put the top cover (2) on with a new gasket.

Screw down the screws (1) and tighten them to the required torque.

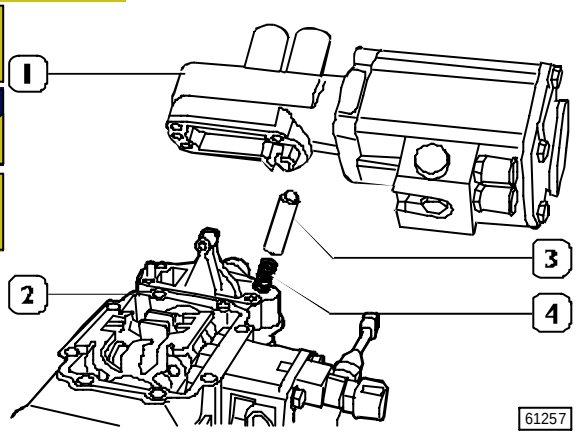
Figure 6/23




Complete gearbox assembly by fitting:

- push rod (11), spring (12), plug (13) with a new seal;
- push rods (2 and 10), switches (1 and 9) with the new washers;
- cup (8), lever (7) on the rod (6) in the position marked during removal and tighten the nut (5) to the required torque.
- valve (3) and tighten screws (4) to the specified torque.

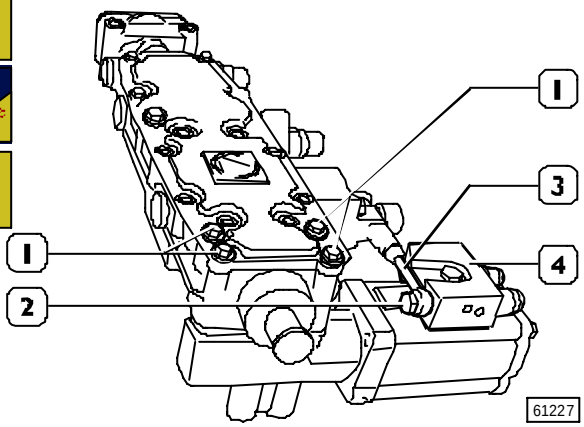
Figure 6/24




Position the push rod (3) with the spring (4) in the box (2).

Refit the servoshift (1) with a new gasket.

Figure 6/25

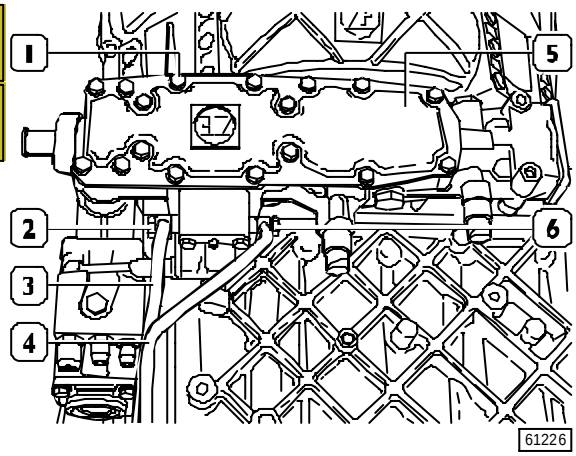



Screw down the screws (1) and tighten them to the required torque.

Connect the air pipe (3) to the distributor (4), screwing down the fitting (2) with new copper gaskets and tightening it to the required torque.

## Refitting

Figure 6/26

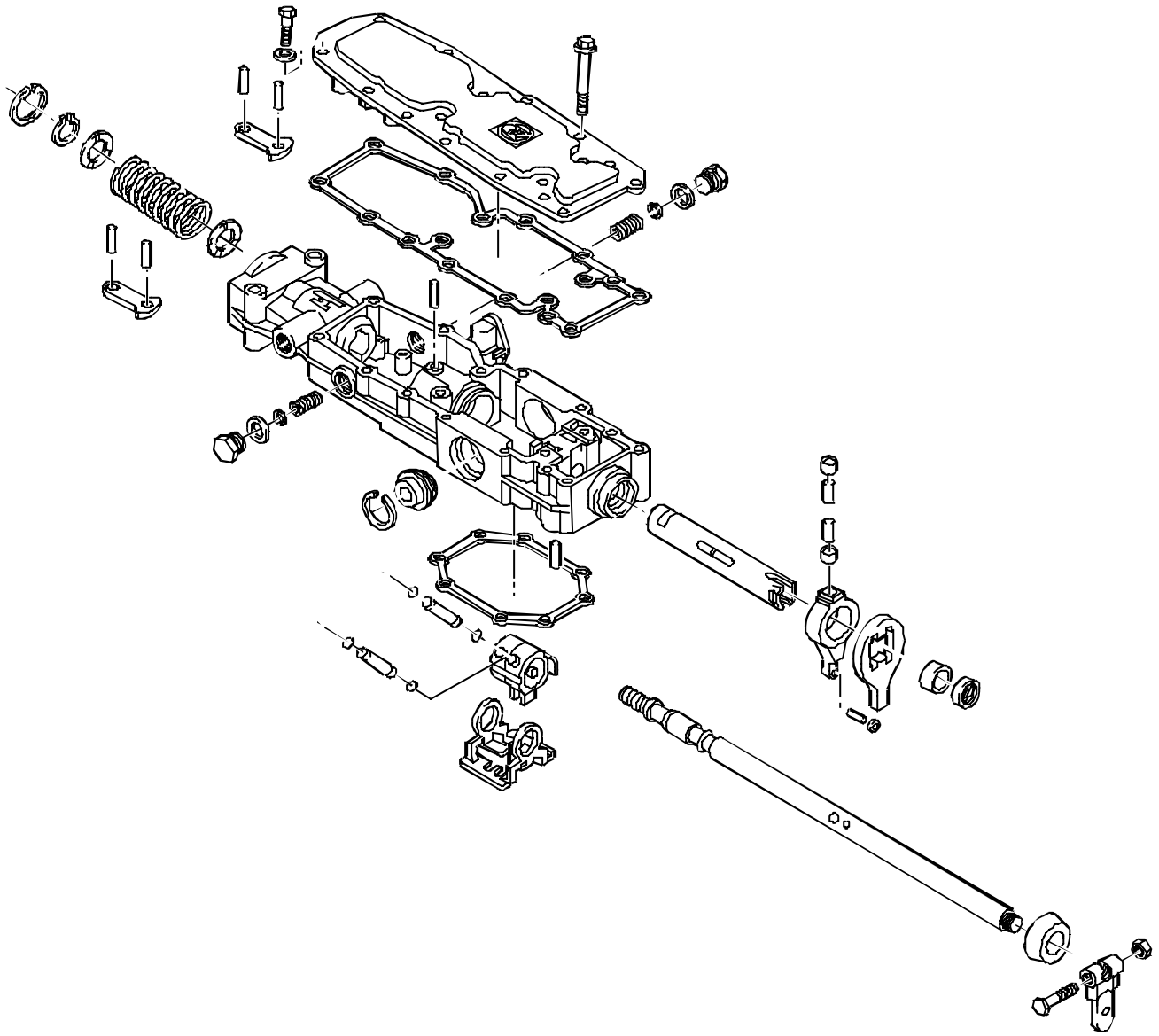



Refit the gearbox (5), screw down the fixing screws (1) and tighten them to the required torque.

Connect the pipes (3 and 4) to the box (5), in the position found at removal, with the fittings (2 and 6) together with the new washers.

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Figure 6/27



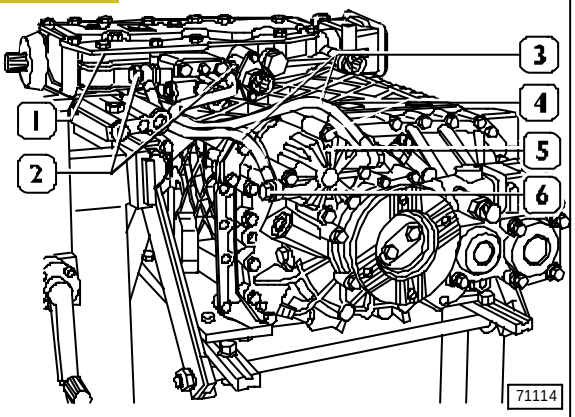
61237

PARTS COMPRISING THE GEARBOX

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## Removing the rear box

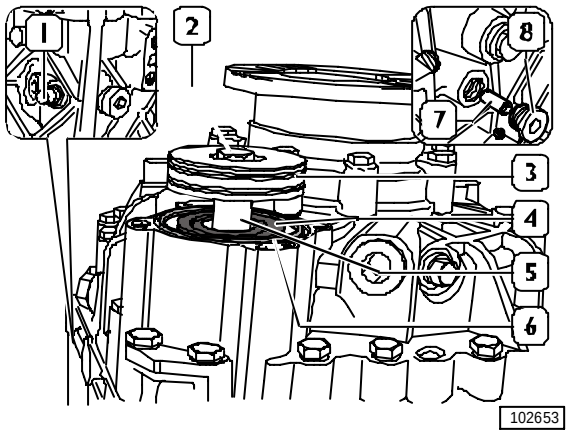
Figure 6/28




Remove the gearbox (1) as described under the relevant heading.

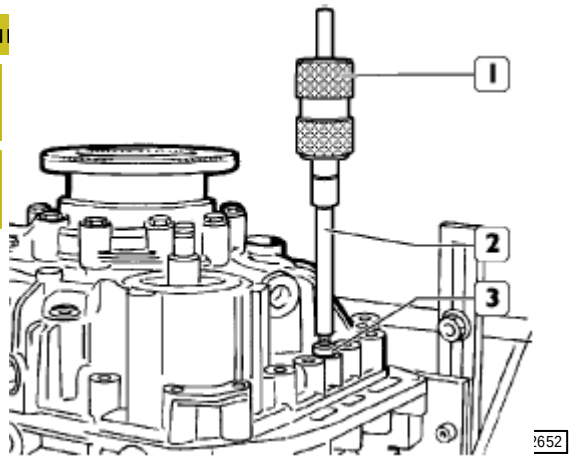
Take note of the assembling position of pipes (3) on G.R.E. control cylinder (5), then disconnect the pipes by unscrewing adapters (6) complete with washers.

Figure 6/29



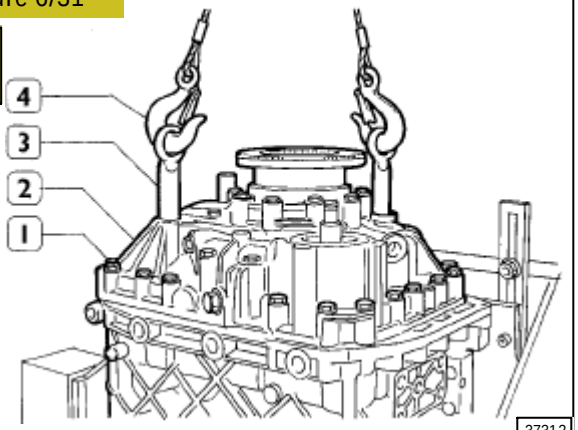

Unscrew nut (2), unthread plunger (3) complete with two seal rings and with antivibration ring from rod (5) controlling epicyclic reduction unit. Remove seal ring (6).Take off rod (5) seal (4) with a screw driver. Unscrew push rod 145N (1) positioning rod (5). Remove plug (8) and dismount pin (7).

Figu




Extract 3 epicyclic reduction unit box centering pins (3) by knockout 99340205 (1) and pin 99347092 (2)

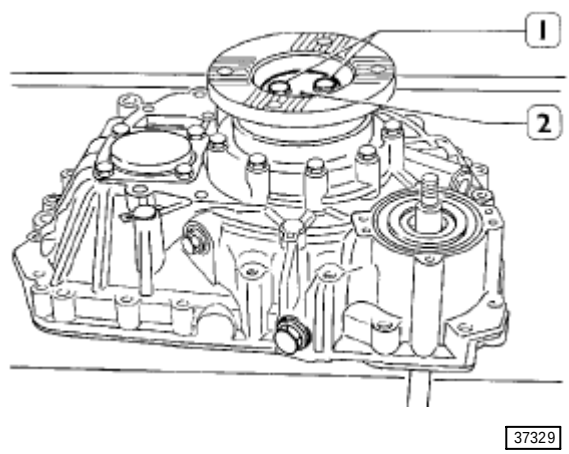
Figure 6/31




Unscrew the screws (1). Screw the eyebolts 99370565 (3) onto the rear box. Using hooks (4) and a movable lift, detach the rear box (2) from the gearbox.

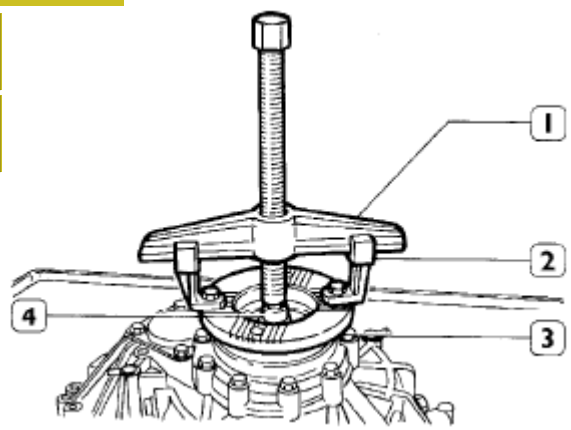
## Removing the epicyclic reduction gear unit (ERG)

Figure 6/32




Take off safety plate (if present), unscrew two screws (1), take off push disk (2) and underlying seal ring.

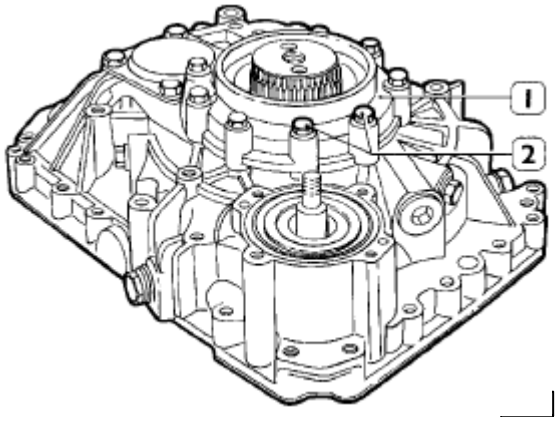
Figure 6/33




Extract the drive output flange (3) using the extractor composed of: tie rods 99341018 (2), bridge 99341003(1), reaction block 99345058 (4).

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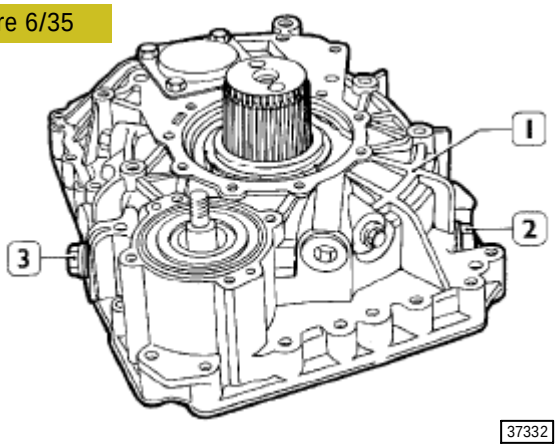
Figure 6/34




Unscrew screws (2), take off cover (1) and remove support bearing and seal ring from the cover.

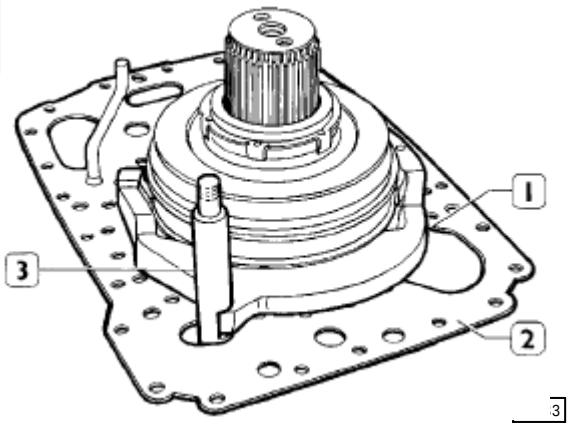
**NOTE** For bearing disassembly, follow the instructions provided on page 27 of this section.

Figure 6/35




Unscrew the pins (2 and 3) and remove the box (1) from the ERG unit.

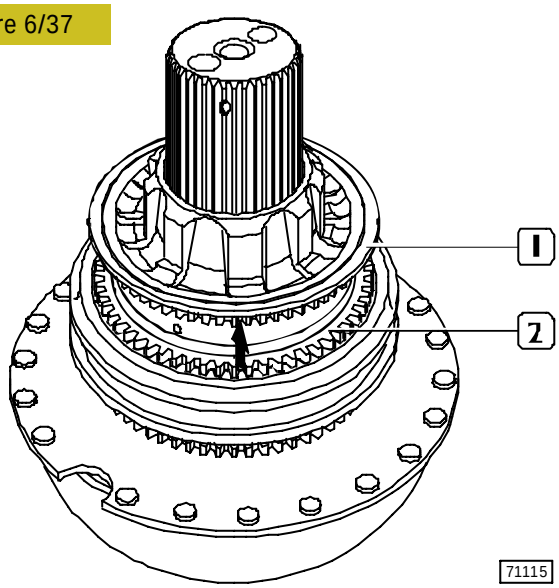
Figure 6/36




Extract the rod (3), fork (1) together with the sliding blocks controlling the ERG unit.

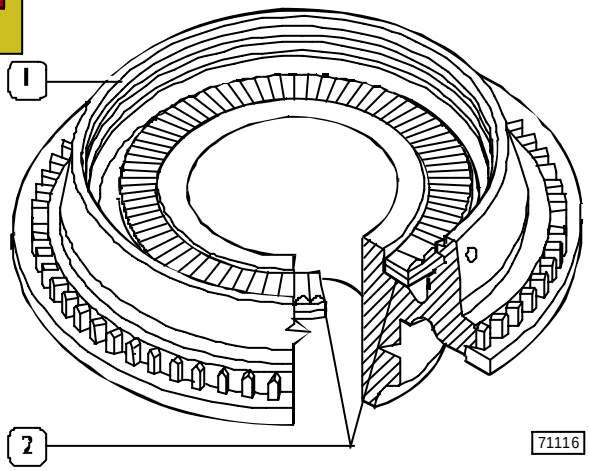
Remove the middle plate (2).

Figure 6/37



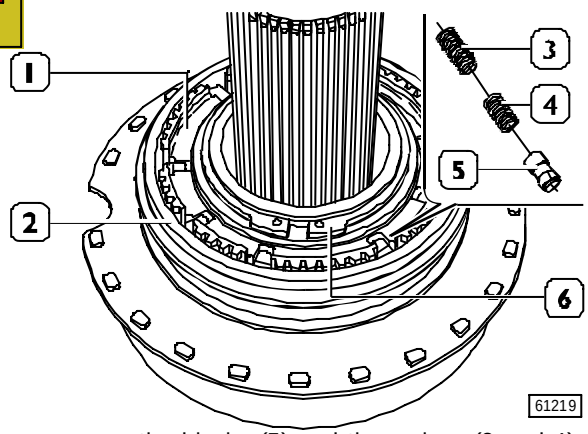

Remove the coupling body (1) together with the fifth wheel bearing and synchronizer ring (2) from the hub for the sliding sleeve.

Figure 6/38




Take the fifth wheel bearing (2) out of the coupling body (1).

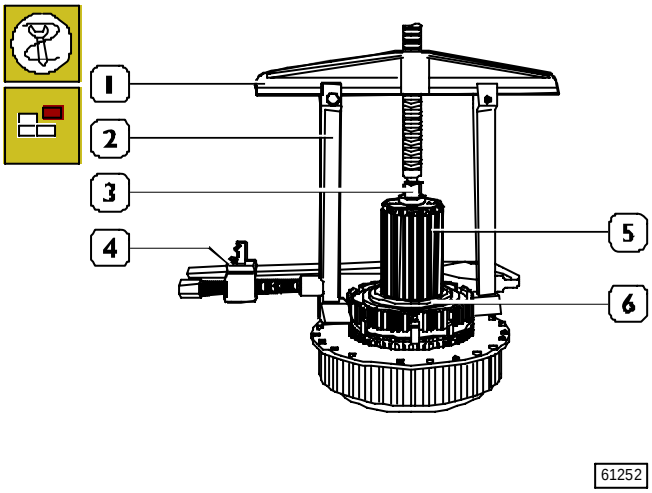
Figure 6/39




Taking care over the blocks (5) and the springs (3 and 4) coming out of the hub (1), take the sliding sleeve (2) out of the hub. Remove the circlip (6).

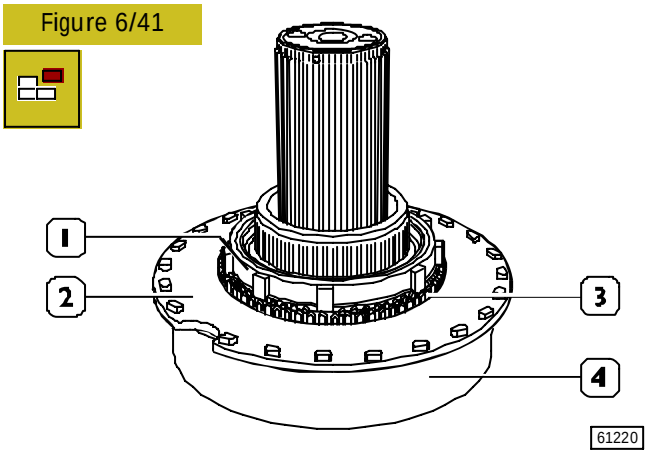
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Figure 6/40




With an extractor composed of bridge 99341003 (1), brackets 99341015 (2), reaction part 99345058 (3) and clamp 99341015 (4), extract the hub (6) for the sliding sleeve from the ERG shaft (5).

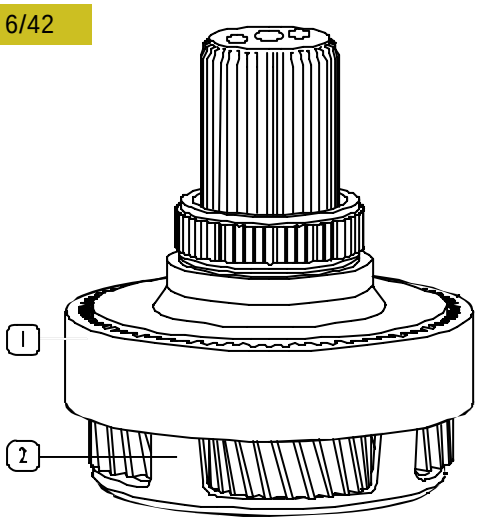
Figure 6/41




Remove the synchronizer ring (1) and the coupling body (3) together with the plate (2) from the ring gear (4).

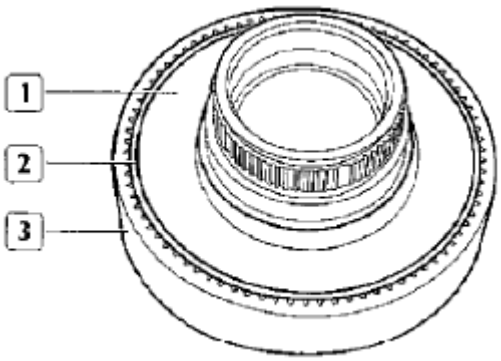
Levering under the coupling body (3), extract this from the plate (2).

Figure 6/42



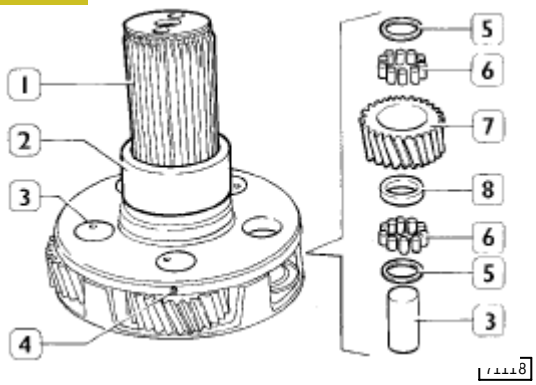

Remove the ring gear (1) from the planet wheel shaft (2).

Figure 6/43




Take off the ring (2) and separate the ring gear (3) from the mount (1).

Figure 6/44




Take off the spacer (2), push the spring pins (4) inside the pins (3) and, with an appropriate drift, extract the pins (3) from the planet wheel shaft (1). Extract the planet wheels (7) together with the adjustment rings (5-8) and rollers (6) from the planet wheel shaft (1).

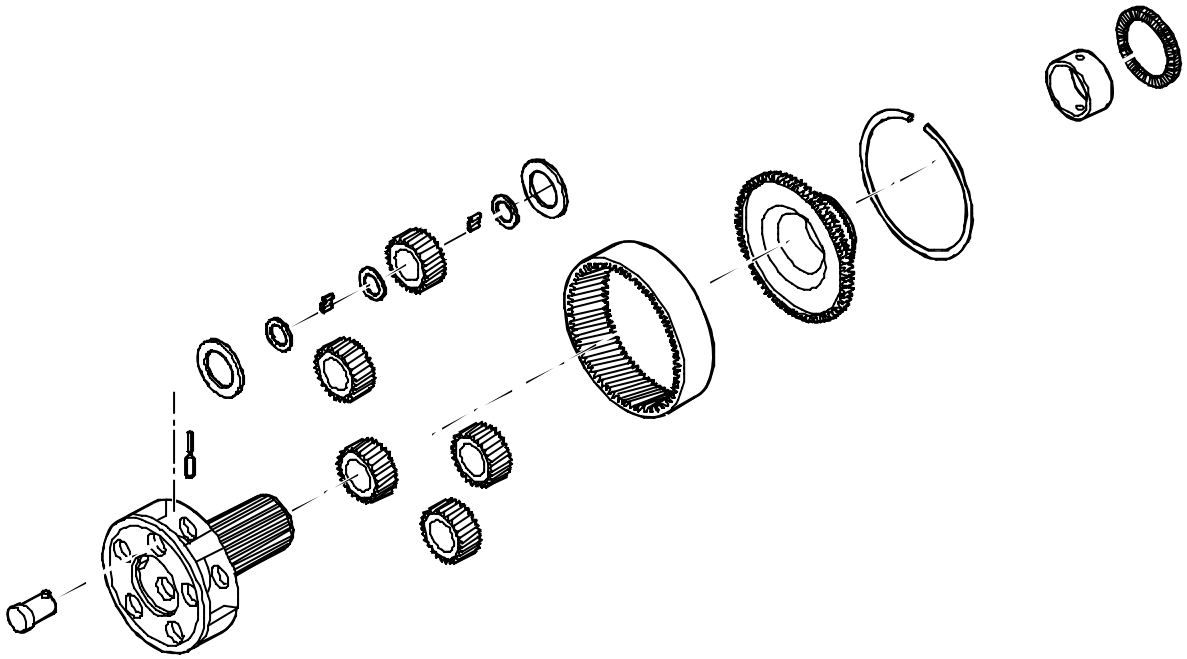
## Fitting the epicyclic reduction gear unit (ERG)

To fit the epicyclic reduction gear unit, carry out the steps described for removal in reverse order. The operations and assembly phases requiring specific tools, clearance checks, adjustments or special precautions are described below. The tightening torques are given in the specific table.

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Figure 6/45

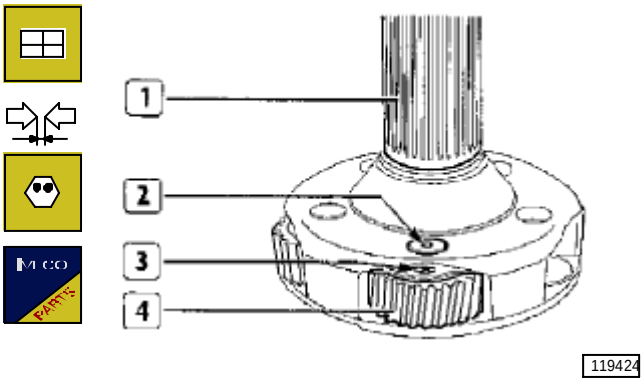


61176

COMPONENT PARTS OF THE EPICYCLIC REDUCTION GEAR UNIT

**NOTE** When fitting the internal rings of the bearings and the hub for the sliding sleeve, they will first need to be heated to approximately 100 °C for roughly 15 minutes.

Figure 6/46

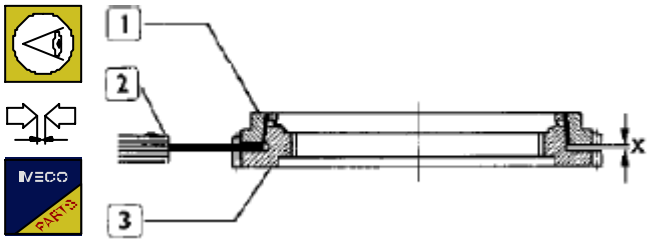



119424

Fit the pins (2) of the bearings in the planet wheel holder (1), making the reference marks "0" punched on the pins tally with the holes (3) for the spring pins.

Fit the spring pins in the holes (3) and notch them.

Figure 6/47

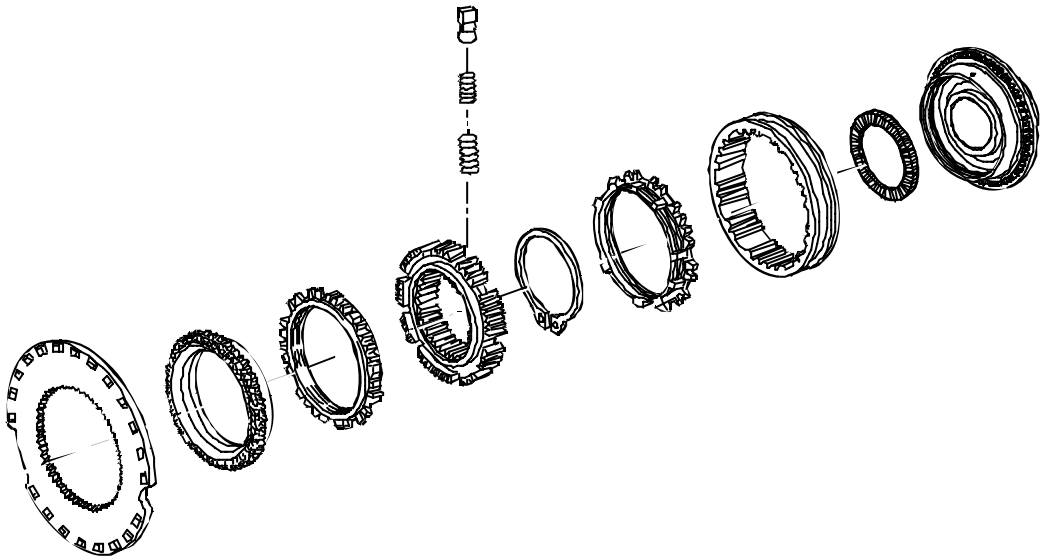



Before putting the synchronizing devices back together, check the wear of the synchronizer rings (1) and of the coupling bodies (3). Using a feeler gauge (2), measure the distance between the synchronizer ring (1) and the coupling body (3) at two opposite points. If the measured distance (X) is less than 1.2 mm, replace the synchronizer ring (1) or the coupling body (3).

Do not get the checked parts mixed up (it is recommended to mark them).

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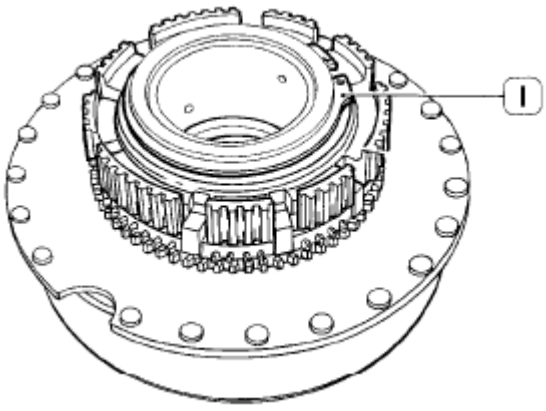
Figure 6/48



71410

COMPONENT PARTS OF THE EPICYCLIC REDUCTION GEAR UNIT SYNCHRONIZING DEVICE

Figure 6/49




71119

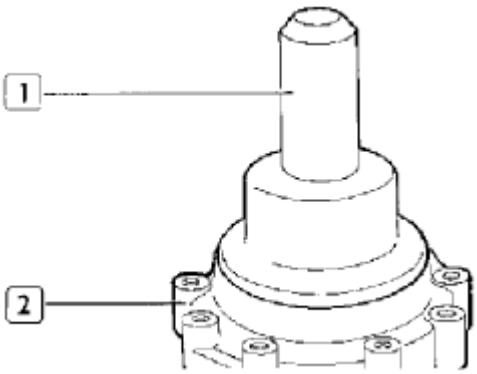
Check the clearance between the ring (1) and its seat.

The clearance has to be between 0.0 and 0.1 mm.

**NOTE**

The circlip (1) is supplied as a spare with a different thickness.

Figure 6/50




19565

Using the keying device 99374221 (1) fit the seal in the cover (2) of the drive output flange.

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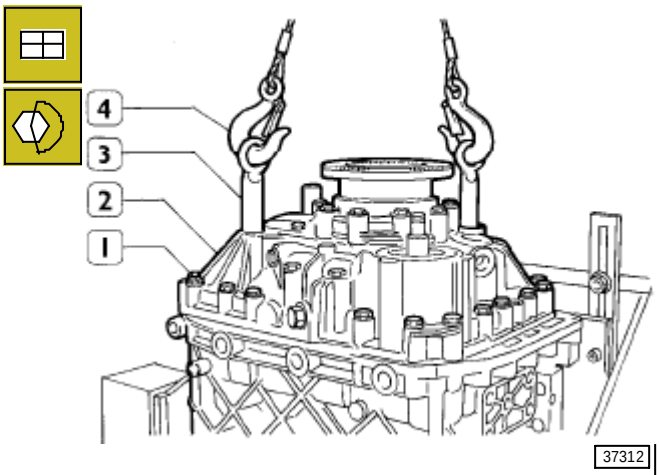
## Refitting the epicyclic reduction gear unit (ERG) rear box

To refit the rear box of the epicyclic reduction gear unit, carry out the steps described for removal in reverse order.

The operations and assembly phases requiring specific tools, clearance checks, adjustments or special precautions are described below.

The tightening torques are given in the specific table.

Figure 6/51

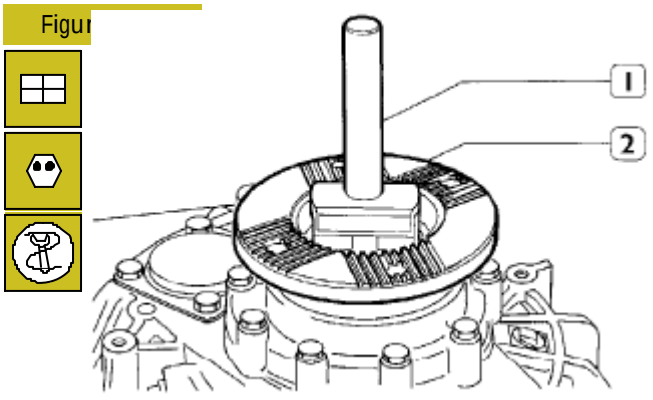



37312

Screw the eyebolts (3) onto the rear box (2), fit the ropes with hooks (4) and, with a movable lift, mount the rear box on the gearbox.

Tighten the screws (1) to the required torque.

Figur



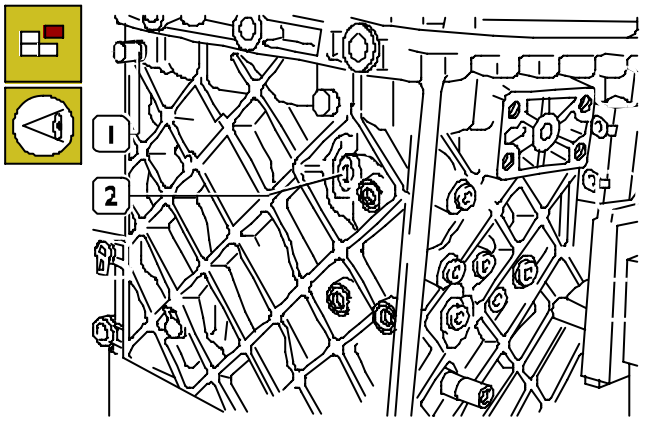

37359

After tightening the two screws fixing the drive output flange (2), fit the safety plate on them and notch it with tool 99370465 (1).

Take the gearbox off the stand and restore the oil level.

## Removing the gearbox

Figure 6/53

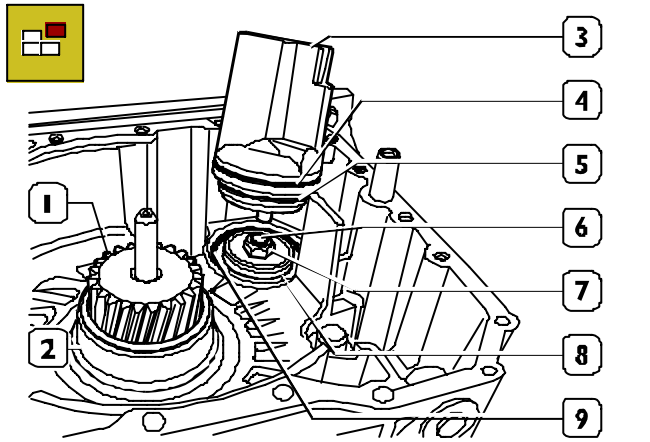



106401

Remove the rear box of the epicyclic reduction gear unit as described under the relevant heading.

Dismount oil vapour vent (1) and plug (2).

Figure 6/54




119200

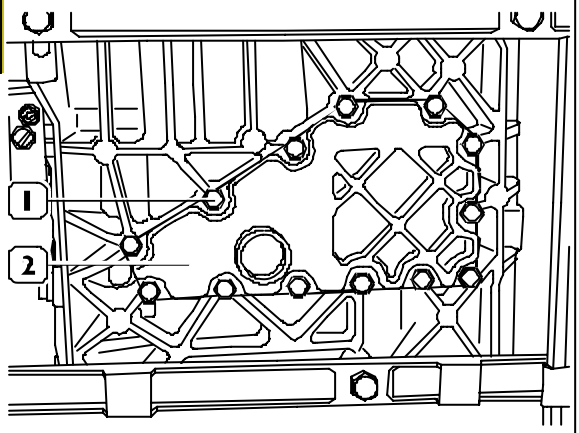
Remove the splitter driving cylinder (3) together with the rings (4-5).

Take off the ring (9). Unscrew the nut (7) and remove the piston (8) from the rod (6).

If present, disassemble the spacer ring (2) from the primary shaft (1).

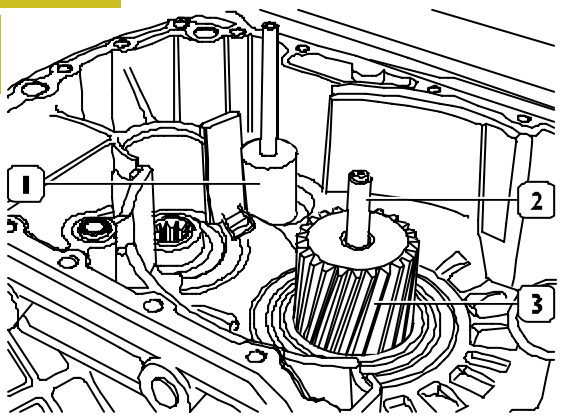
Aquila Trucks Centres

Figure 6/55




Unscrew the screws (1) and take off the cover (2).

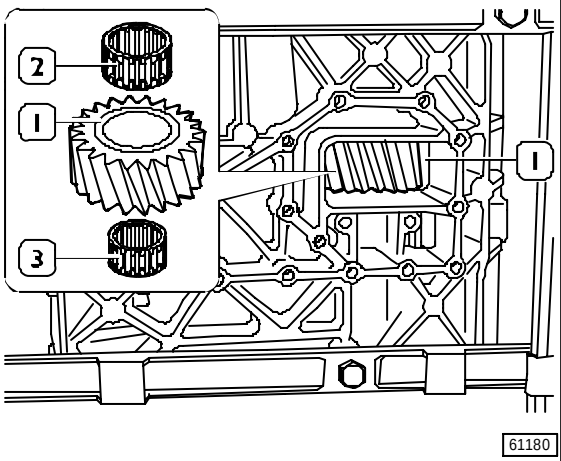
Figure 6/56




Extract the reverse gear shaft (1).

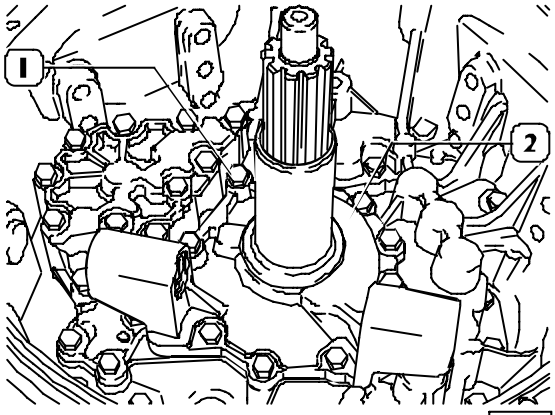
Disassemble the tube (2) from the primary shaft (3), previously measuring the tube's projection from the shaft itself.

Figure 6/57




Take out the reverse idler gear (1) together with the roller bearings (2 and 3).

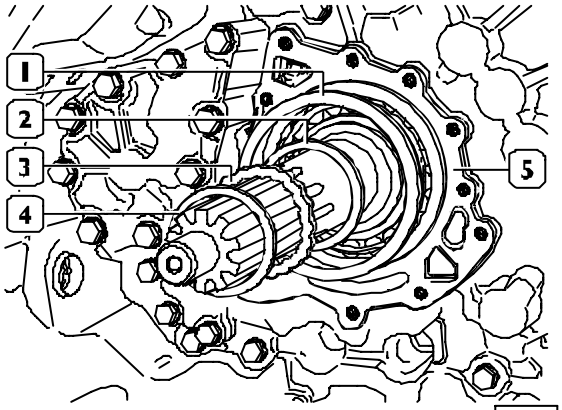
Figure 6/58




Unscrew screws (1) and dismount drive cover (2).

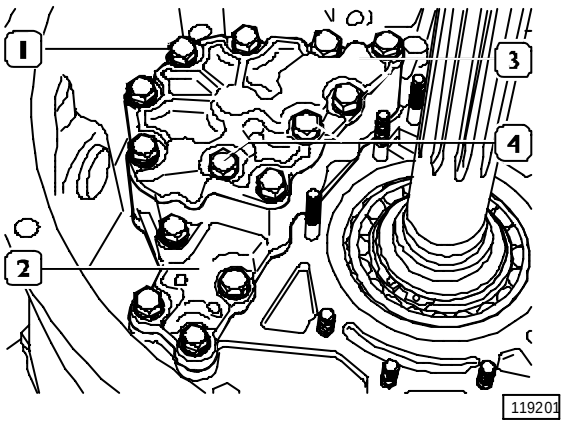
**NOTE** Screws (1, Figure 6/58 and 1, Figure 6/60) must be replace at every dismounting operation since their thread is coatted with sealing micro capsules.

Figure 6/59




Take off the thrust washer (4), spring (3), thrust washer (2), adjustment ring (1) and gasket (5).

Figure 6/60



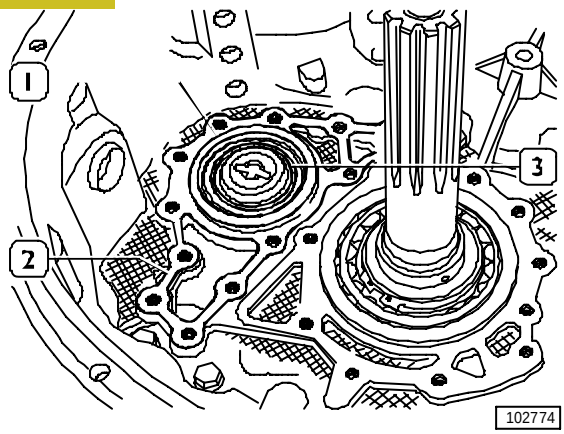

Unscrew screws (1) and dismount oil pump (2).

**NOTE** To remove the oil pump (2), do not unscrew the screws (4). These screws secure the cover (3) to the pump body and are unscrewed when the part has been removed solely to overhaul the oil pump.

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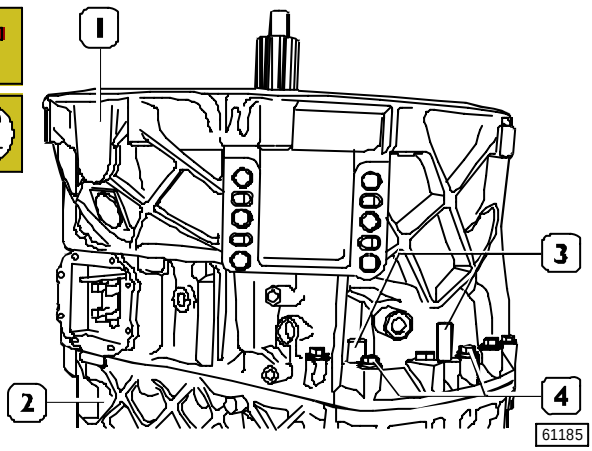

Aquila Trucks Centres

Figure 6/61




Remove the adjustment rings (1) from the tapered roller bearing (3). Take off the gasket (2).

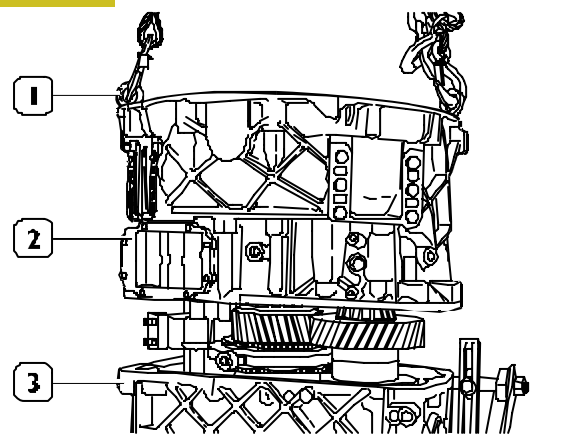
Figure 6/62




Using extractor 99340205 and tool 99347092, remove the cover centering pins (3) in front (1) of the gear box (2).

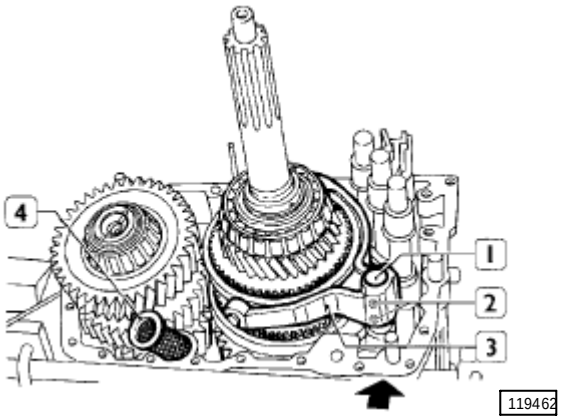
Unscrew the screws (4) and the nuts fixing the front cover (1) to the gearbox (2).

Figure 6/63



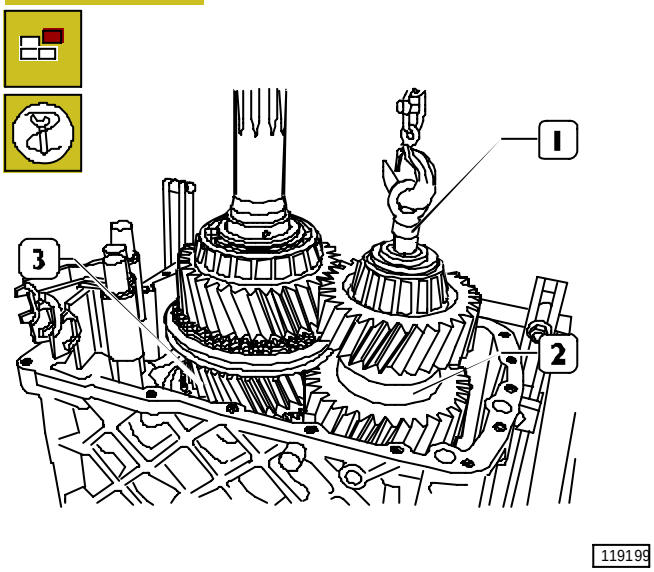

Fit suitable hooks (1) onto the front cover (2) and, using a rope and lift, remove it from the gearbox (3).

Figure 6/64




If necessary, loosen the splitter shaft hardener marked with 235N (→), unscrew the two hexagon socket head cap fastening screws (2), extract the splitter control shaft (1) and remove the relative fork (3) complete with sliding manifold pads.

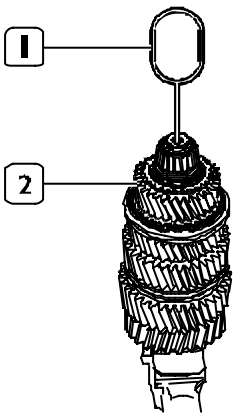
Figure 6/65




Use the eyebolt 99360502 (1) to remove the secondary shaft (2) from the gear box, after making sure that it has been released from the primary one (3).

Aquila Trucks Centres

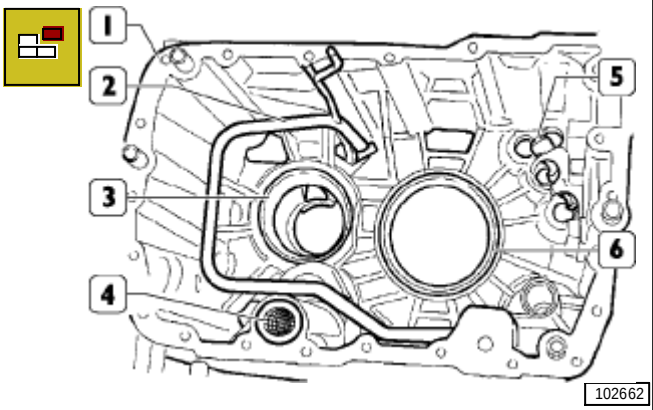
Figure 6/66




Remove the motion input shaft.Insert the tool 99370449 (1) into the primary shaft (2) and constrain with the relative retaining nut. Release the control rods (3) operating with a suitable screw (4) on the latch (2, Figure 6/67).
Clamp tool 99370449 (1) to the hoist, lift primary shaft (2) and tighten it by a vice.
Remove tool 99370449 (1).

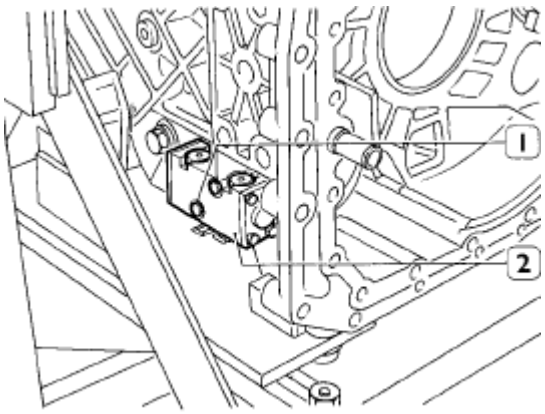
**NOTE** When disassembling the rods and the forks, be sure to take note of the correct assembly position.

Figure 6/67




Remove the gear bolt (5) together with the spring from the gearbox (1). Using an appropriate drift, extract the two outer rings (3) and (6) of the bearings, ERG side, of the transmission and main shafts. Dismount filter (4) and clean it accurately. Clean the lubricating oil delivery pipes (2) with a jet of compressed air.

Figure 6/68

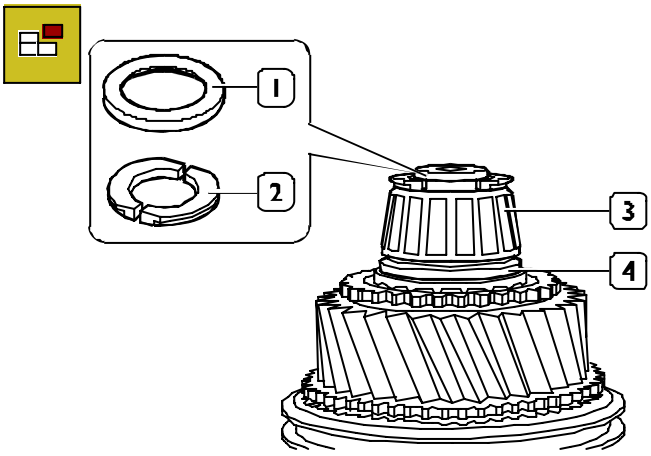



Unscrew the 2 screws (1) and take out the splitter control valve (2).

**NOTE** Do not dismantle the splitter control valve (2), it cannot be overhauled. Replace it if you find any trouble.

## Removing the main shaft

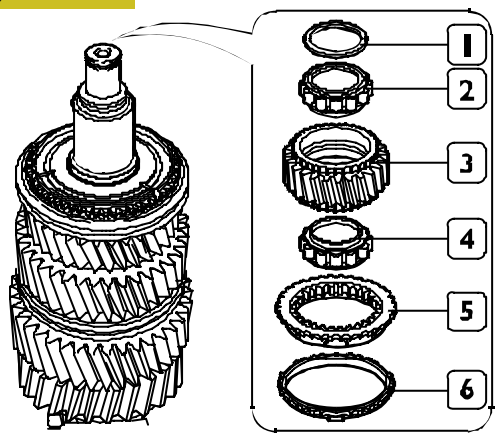
Figure 6/69




Lift the notch of the retaining ring (1) and remove the half rings (2). Using a suitable extractor, remove the ring inside the tapered roller bearing (3), extract the thrust washer (4).

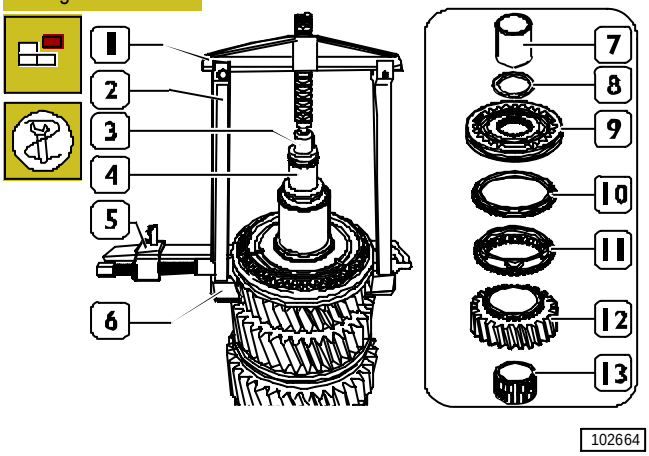
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Figure 6/70




From primary shaft, dismount: ring (1), bearing (2), the gear of IV gear (3), bearing (4), coupling body (5) and synchroniser ring (6).

Figure 6/71

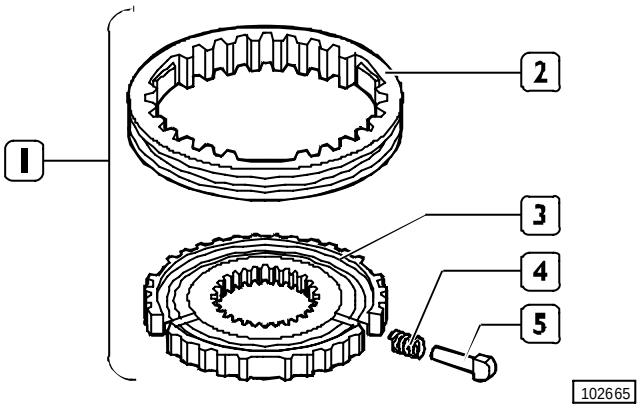



By an extractor made up of: bridge 99341003 (1), tie rods 99341020 (2), block 99345058 (3), grips 99341024 (6) and clamp 99341015 (5), dismount, from primary shaft (4):

- gear of III gear (12);
- coupling body (11);
- synchroniser ring (10);
- synchroniser unit (9);
- spacer ring (8);
- bushing (7).

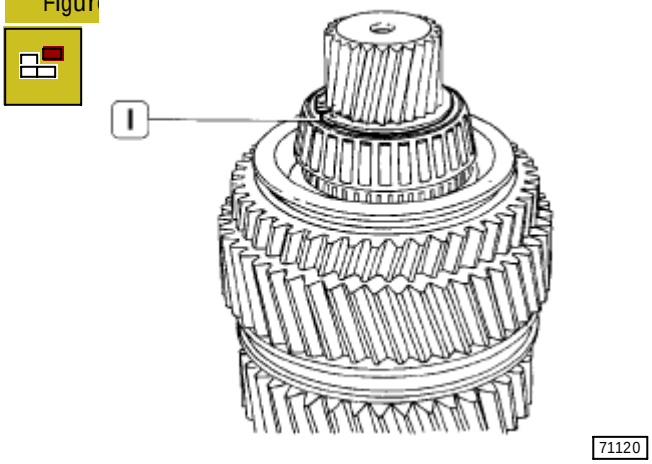
Dismount needle bearing (13).

Figure 6/72



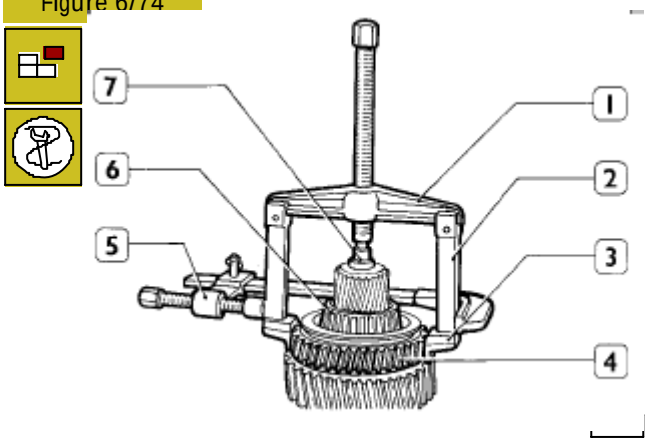

Dismantle the synchronizer unit (1). Remove the sliding sleeve (3) from the hub (2), taking care over the pins (5) and springs (4) coming out in order to collect them.

Figure 6/73




Overturn the main shaft in the vice and take out the split ring (1).

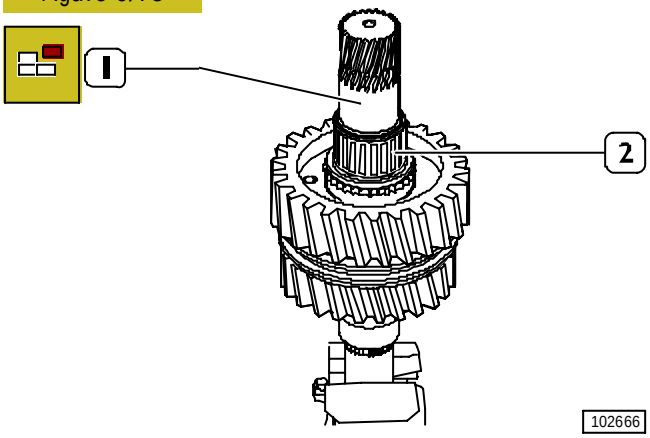
Figure 6/74




Take out the reverse gear (4) and the internal ring (6) of the bearing, ERG side, with an extractor composed of: grips 99341024 (3), tie rods 99341019 (2), bridge 99341004 (1), reaction block 99345058 (7), clamp 99341015 (5).

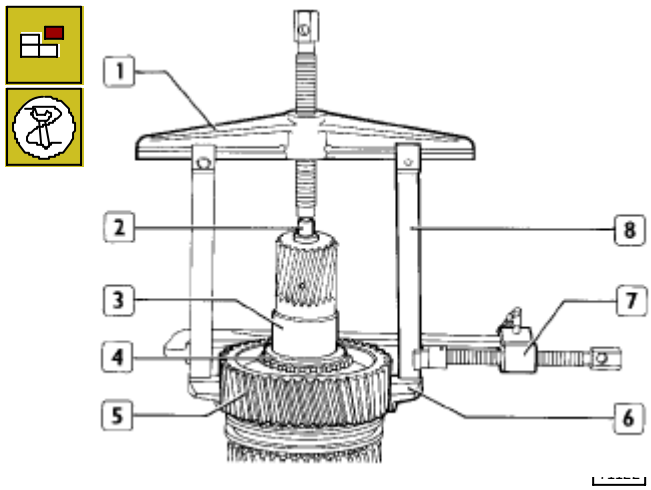
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Figure 6/75



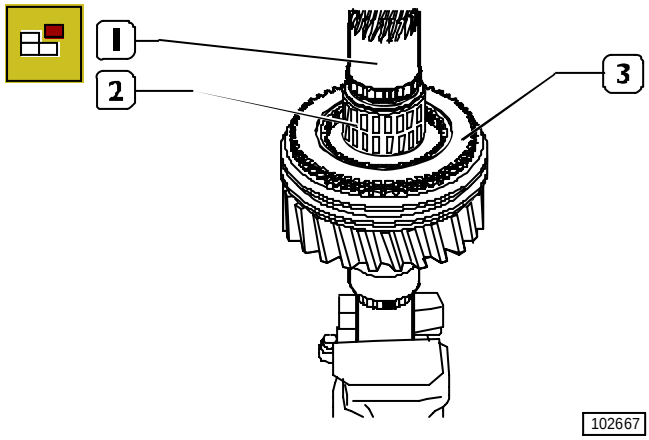

Dismount, from primary shaft (1), needle bearing (2).

Figure 6/76



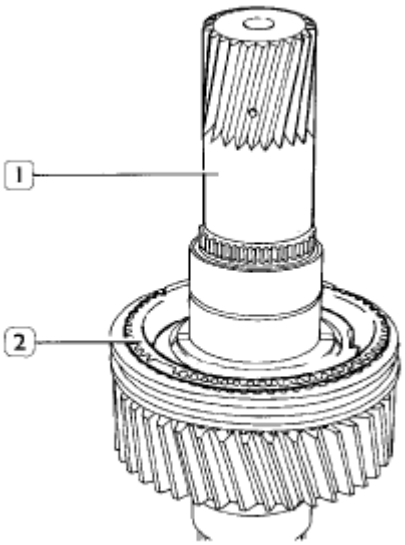

Extract the gear of 1st gear (5), coupling body (4) and bushing (3) of the bearing of the gear of reverse gear by an extractor made up of: grips 99341024 (6), tie rods 99341020 (8), bridge 99341004 (1), counter-block 99345058 (2), clamp 99341015 (7).

Figure 6/77



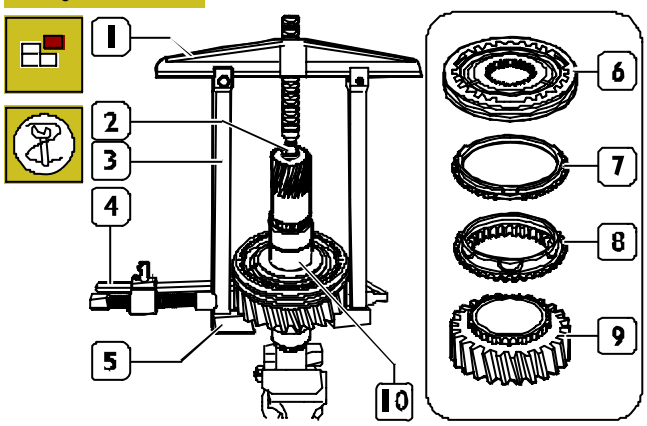

Dismount, from primary shaft (1), needle bearing (2), coupling body (3).

Figure



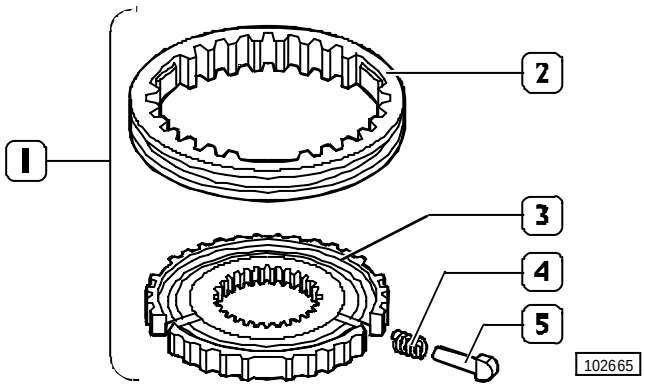

Remove the synchronizing ring (2) from the primary shaft (1).

Figure 6/79




By an extractor made up of: bridge 99341004 (1), counter-block 99345058 (2), tie rods 99341024 (3), grips 99341024 (5), clamp 99341015 (4), dismount: gear of II gear (9), coupling body (8), synchroniser ring (7), synchroniser unit (6) and bushing (10).

Figure 6/80



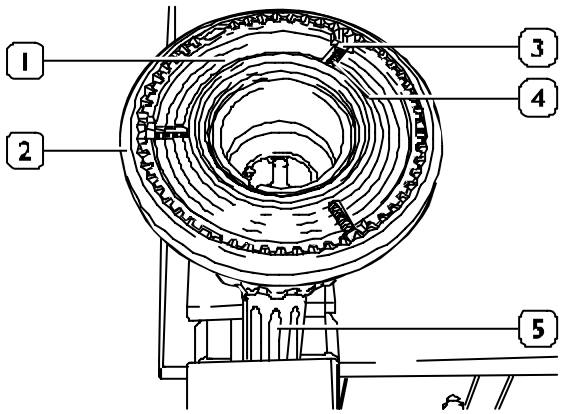

Dismantle the synchronizer unit (1). Remove the sliding sleeve (3) from the hub (2), taking care over the pins (5) and springs (4) coming out in order to collect them.

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## Removing the drive input shaft

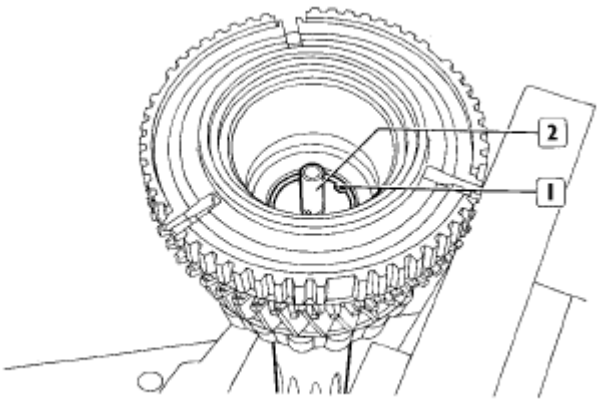
Figure 6/81




61192

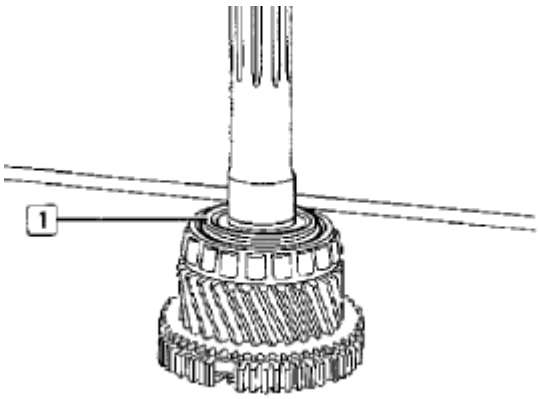
Tighten the drive input shaft (5) in the vice. Remove the sliding sleeve (2) from the hub (1) and taking care over the pins (3) and springs (4) coming out in order to collect them.

Figure 6/82



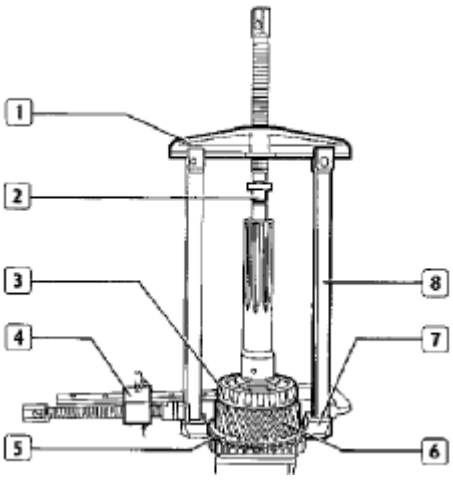

Take out the split ring (1) and remove the tube (2).

Figure 6/83




Take out the retaining ring (1) and the divided ring beneath.

Figure 6/84

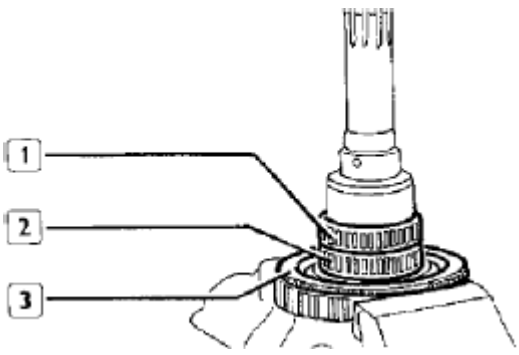



27470

Extract the coupling body (5), gear (6) and internal ring (3) of the drive input shaft bearing with an extractor composed of:

- grips 993410245 (7);
- tie rods 99341021 (8);
- bridge 99341003 (1);
- reaction block 99345058 (2);
- clamp 99341015 (4).

Figure 6/85



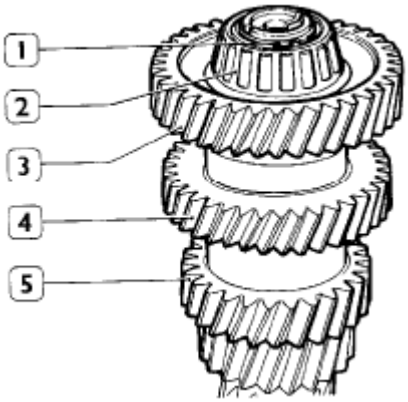

19525

Extract the bearings (1 and 2) and the synchronizer ring (3).

Aquila Trucks Centres

## Removing the transmission shaft

Figure 6/8




Take off the split ring (1) and using an appropriate extractor take out the internal ring (2) of the bearing on the splitter side.

Use the same method, after turning over the transmission shaft, to extract the internal ring of the bearing on the ERG side.

**NOTE** The two roller bearings of the transmission shaft are not interchangeable. Take care to put them aside separately and to mark them so they will not get swapped over during assembly.

Using a hydraulic press, extract the gears (3, 4 and 5) from the transmission shaft.

## CHECKS
### Gearbox

The gearbox and its covers must have no cracks.

Contact surfaces between covers and gear box must not result to be damaged or deformed. Remove any sealant residues from the threaded holes for the screws fastening oil pump and drive inlet cover.

The seats of the bearings, shafts and gear control rods must be neither damaged nor too worn.

Check that the holes, pipes and lubrication grooves are not obstructed by grease or foreign bodies.

### Bearings

The roller bearings or roller cages must be in a perfect state of repair and show no signs of wear or overheating.

### Shafts - gears

The bearing seats on the shafts must be neither damaged nor worn. The gear teeth must be neither damaged nor worn.

### Hubs - sliding sleeves - forks

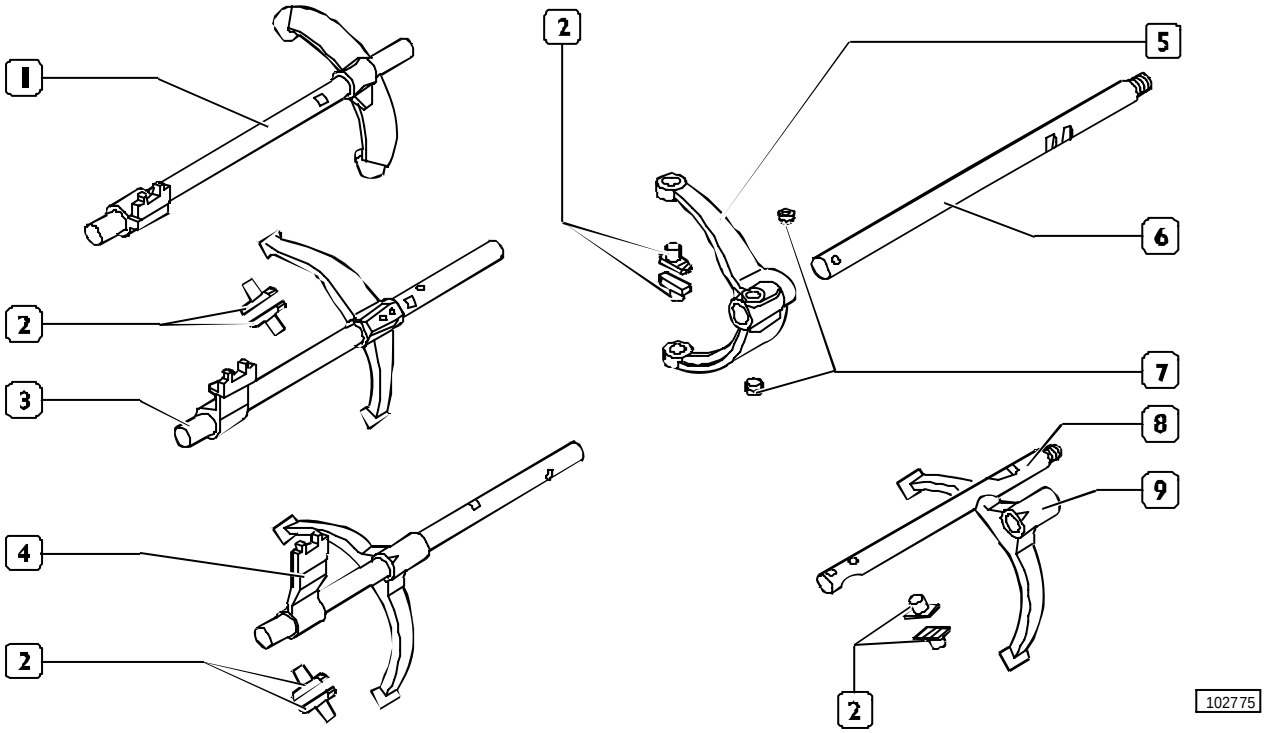
The grooves on the hubs and sliding sleeves must not be damaged. The sliding sleeve has to slide freely on the hub. The blocks or pins for positioning the sliding sleeve must not be damaged or worn. The coupling teeth of the sliding sleeves must not be damaged.

### Rods - forks

The forks must be integral and their blocks must have no end float, in the radial throat of the sleeve, greater than 0.6 ÷ 1.2 mm.

Where fork (5) is dismounted, on mounting, adjust its position on rod (6) as described in relating chapter.

Figure 6/87




1. Rod with reverse gear fork - 2. Sliding blocks - 3. Rod with I-II gear fork - 4. Rod with III-IV gear fork - 5. Splitter drive fork - 6. Rod for fork (5) - 7. Screw - 8. Rod for fork (9) - 9. epicyclic reduction unit drive fork

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## Synchronizing devices

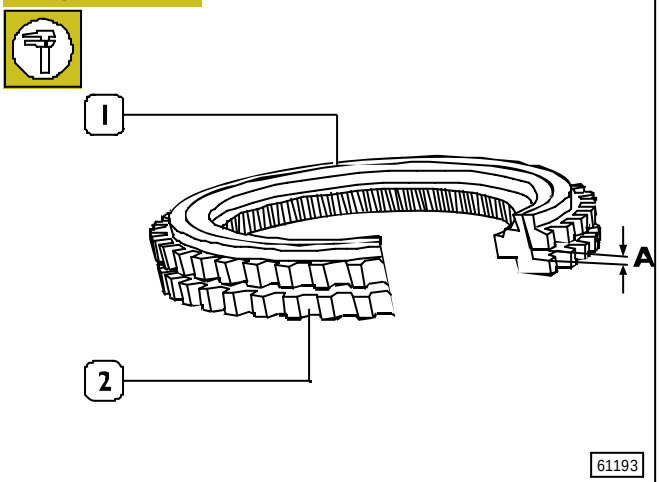
Check the wear of the synchronizer rings as follows:

**NOTE** After the check, the synchronizer rings must be marked on the respective gears to prevent their position getting swapped over at the time of assembly.

- Visually check that the friction surface is not undulated.

## BK-type single-cone synchronizing devices

Figure 6/88




Position the synchronizer ring (1) on the coupling body (2).

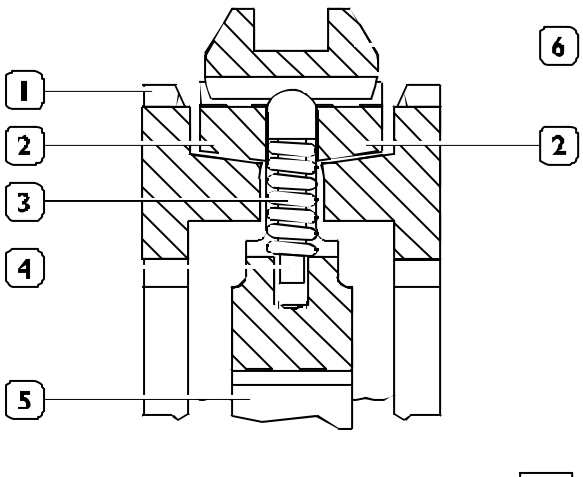
Turn the synchronizer ring (1) so as to ensure correct coupling on the coupling body (2).

Using a feeler gauge, check the distance A on two diametrically opposite points.

It must be no less than:

- 0.8 for the gears and splitter;
- 1.2 for the epicyclic reduction gear unit.

Figure 6/89

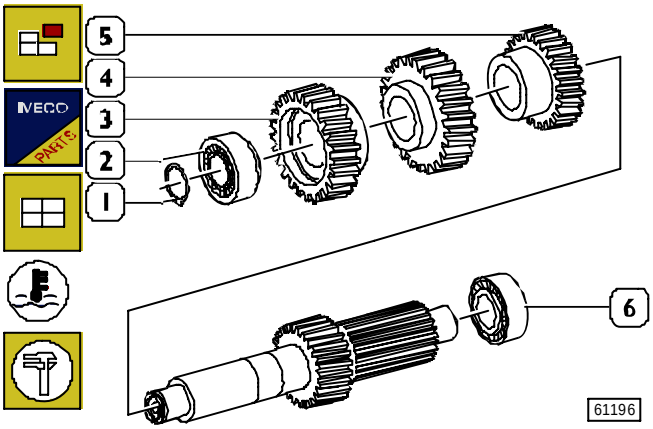



1. Coupling body - 2. Synchronizer ring - 3. Compression spring - 4. Pin - 5. Synchronizer hub - 6. Sliding sleeve.

## Fitting the transmission shaft

To mount the transmission shaft, carry out the steps described for removal in reverse order. The operations and assembly phases requiring specific tools, clearance checks, adjustments or special precautions are described below.

Figure 6/90




Heat the gears (5, 4 and 3) to 160 °C ÷ 180 °C for approximately 15 minutes and drive them onto the shaft using a press.

**NOTE** For assembly, the internal rings of the tapered roller bearings must first be heated to approximately 100 °C for roughly 15 minutes.

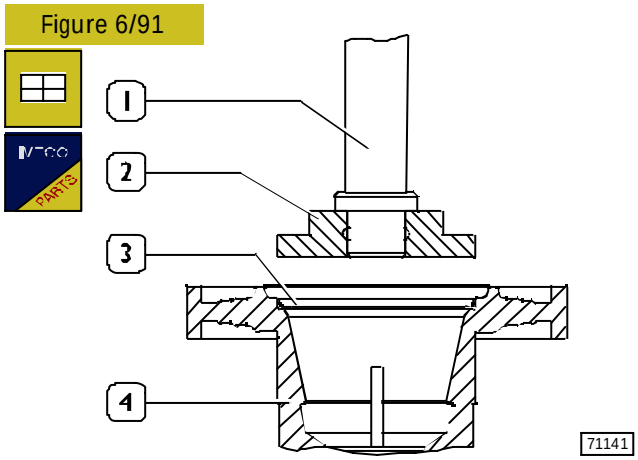
Mount the internal ring of the bearing (2) on the splitter side, the circulip (1) and check the clearance between the circlip (1) and its seat with a feeler gauge; the clearance has to be between 0.0 and 0.1 mm.

## Fitting the drive input shaft

To mount the drive input shaft, carry out the steps described for removal in reverse order.

The operations and assembly phases requiring specific tools, clearance checks, adjustments or special precautions are described below.

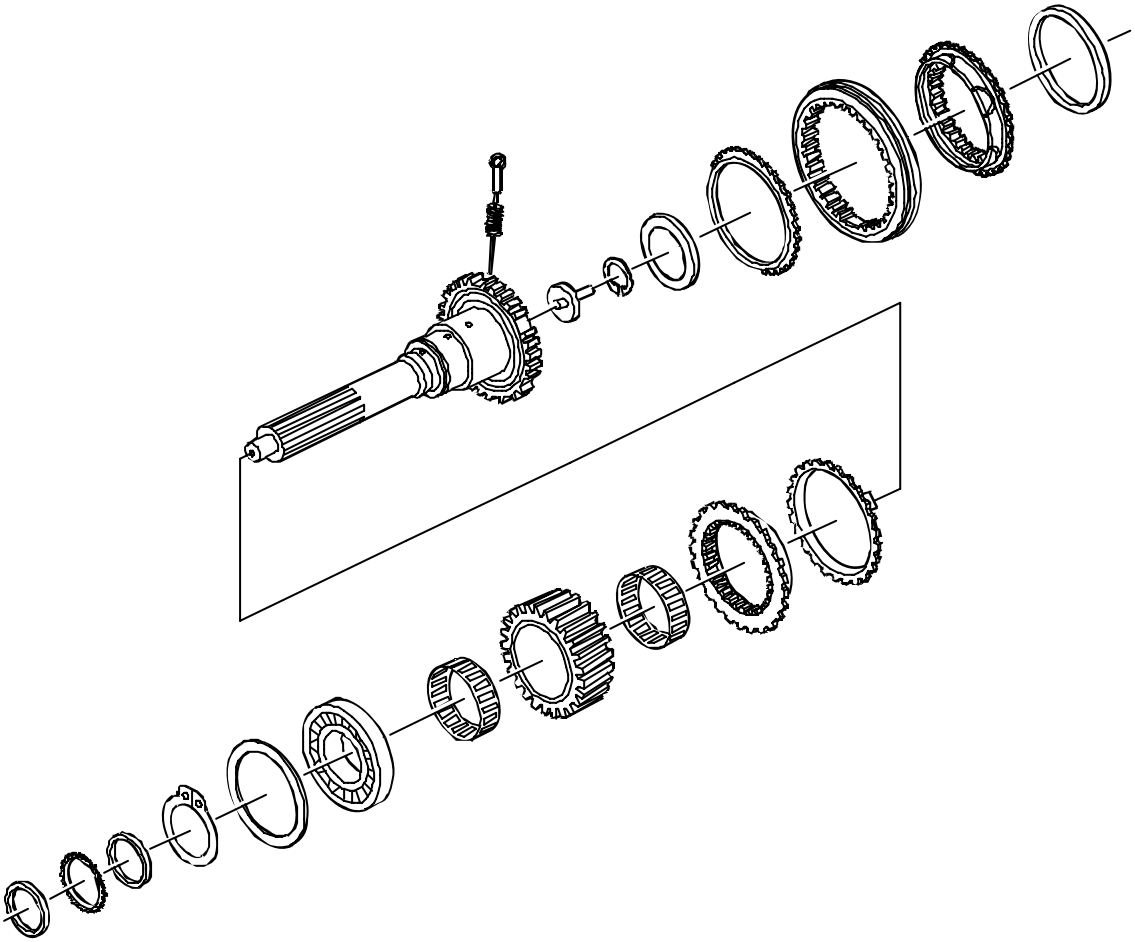
Figure 6/91




If you need to replace the ring (3) of the drive input shaft (4), to remove it use general tools, for assembly use the keying device 99374370 (2) and grip 99370006 (1).

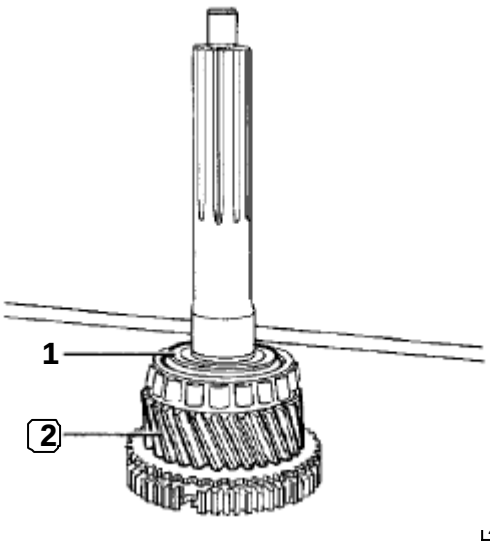
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Figure 6/92




COMPONENT PARTS OF THE DRIVE INPUT SHAFT

Figure 6/93




Using a feeler gauge, check the end float of the drive input gear (2), it must be at least 0.2 mm.

In addition, check the tolerance between the divided ring (1) and its seat, it has to be between -0.05 ÷ +0.05 mm.

**NOTE** The divided ring (1) is supplied as a spare with different thicknesses.

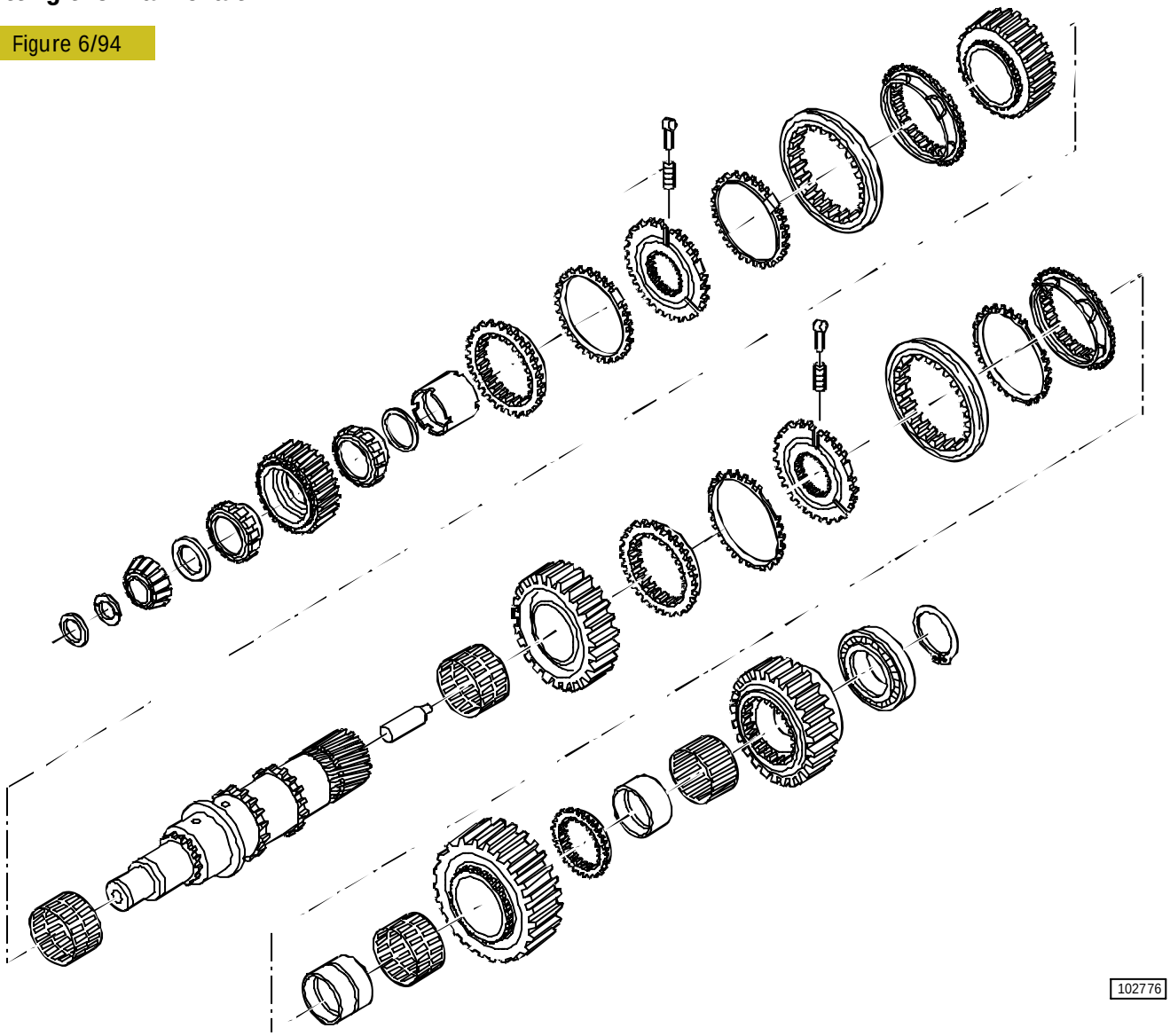
After mounting the divided ring (1), fit onto it the retaining ring and notch it at two diametrically opposite points.

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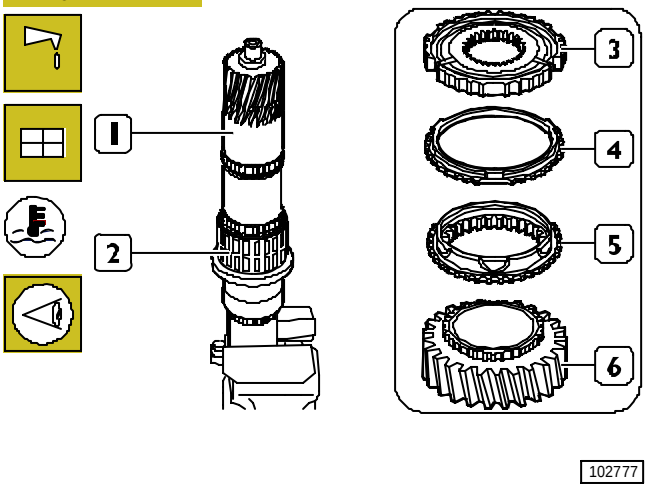
## Fitting the main shaft

Figure 6/94




COMPONENT PARTS OF THE MAIN SHAFT

Figure 6/95



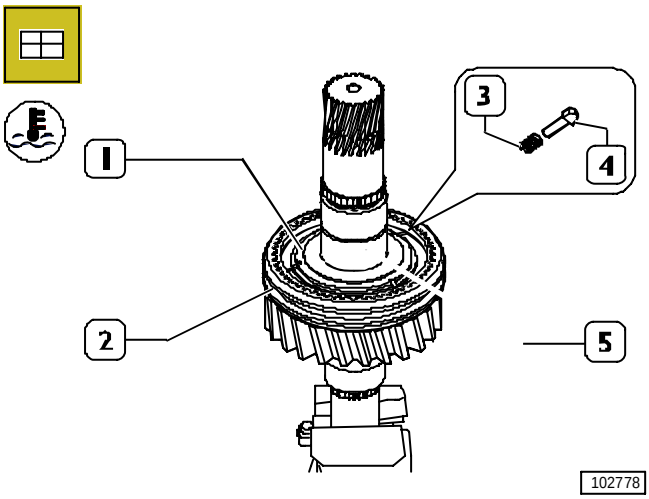

Tighten primary shaft (1) by a vice and mount, on it:

- lubricated needle bearing (2);
- gear of II gear (6);
- coupling body (5);
- synchroniser ring (4).

Heat hub (3) at 120 °C temperature and mount it on primary shaft (1), paying attention that synchroniser ring projections are correctly positioned into hub (3) seats.
Check that gear (6) axial clearance is 0.2 mm.

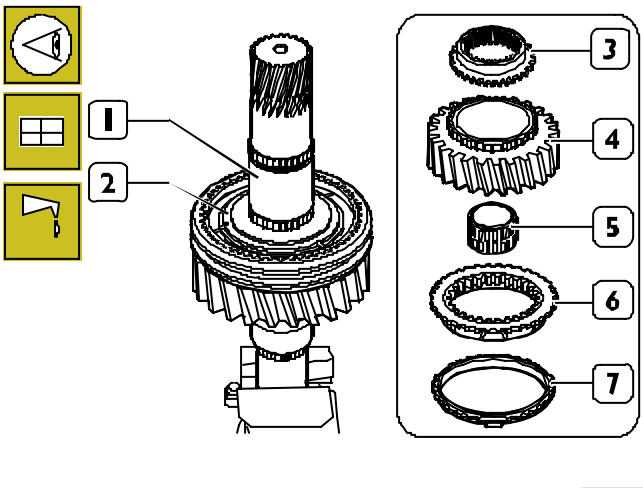
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Figure 6/96




Mount sliding sleeve (2) on hub (1). Fit, into hub (1) seats: springs (3) and pins (4) adjusting them under sliding sleeve (2).
Heat bushing (5) at 120 °C and mount it on primary shaft.

Figure 6/97

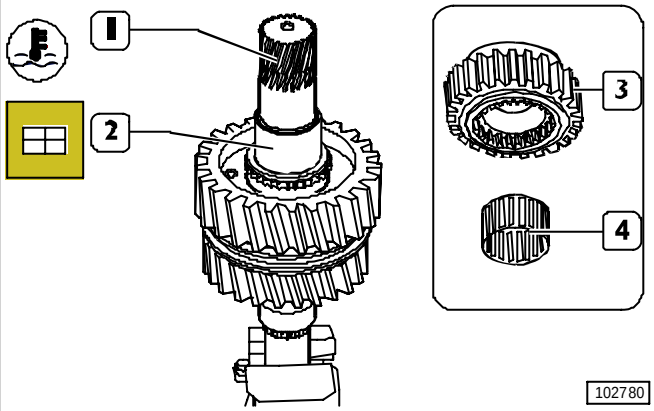



Mount, on primary shaft (1):

- synchroniser ring (7) in such a way that projections are fit into hub (2) seats;
- coupling ring (6);
- lubricated needle bearing (5);
- gear of I gear (4).

Heat toothed ring (3) at 120 °C and mount it on primary shaft (1).
Check that the axial clearance of gear of I gear (4) is 0.2 mm.

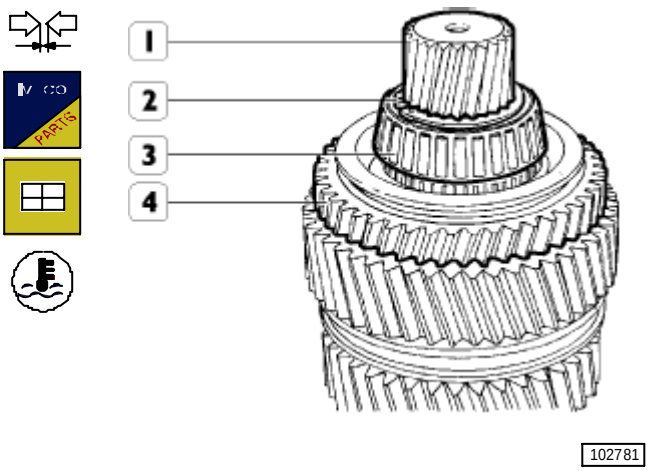
Figure 6/98




Heat bushing (2) at 120°C and mount it on primary shaft (1).
Mount, on primary shaft (1):

- lubricated needle bearing (4);
- gear(3) of reverse gear.

Figure 6/99




Heat taper roller bearing (3) at 100°C and mount it on primary shaft (1).
Mount spring ring (2).

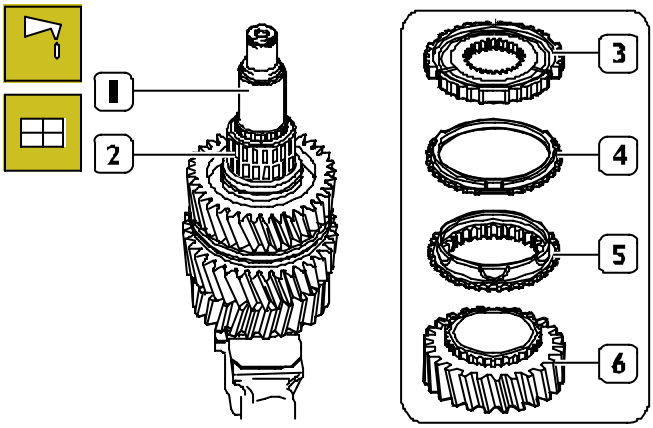
Check the clearance between the split ring (2) and its seat with a feeler gauge. The clearance has to be between 0.0 and 0.1 mm.

**NOTE** The split ring (2) is supplied as a spare with different thicknesses.

Check that the axial clearance of gear (4) of reverse gear is 0.4 ÷ 1.15 mm.

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Figure 6/100




Put primary shaft (1) upside down.

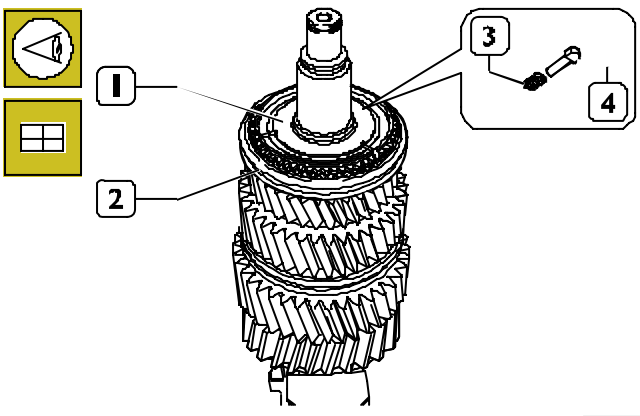
**NOTE** For the operation, use tool 99370449.

Mount, on primary shaft (1):

- lubricated needle bearing (2);
- gear of III gear (6);
- coupling body (5);
- synchroniser ring (4).

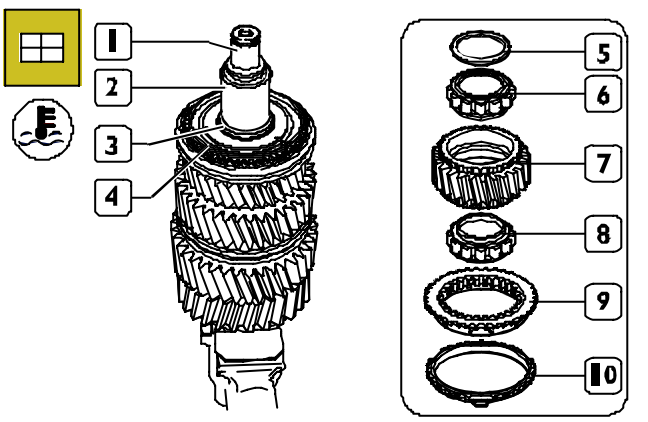
Heat hub (3) at 120 °C temperature and mount it on primary shaft (1), paying attention that synchroniser ring projections are correctly positioned into hub (3) seats.
Check that gear (6) axial clearance is 0.2 mm.

Figure 6/101




Mount sliding sleeve (2) on hub (1). Fit, into hub (1) seats: springs (3) and pins (4) adjusting them under sliding sleeve (2).

Figure 6/102

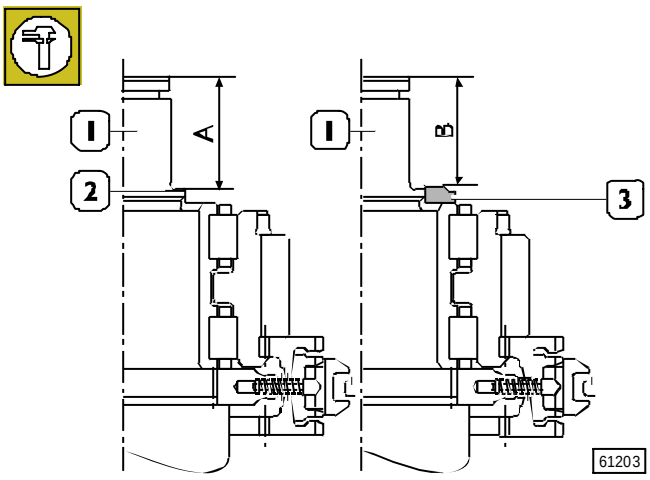



Mount, on primary shaft (1), spacer ring (3).
Heat bushing (2) at 120°C and mount it on primary shaft (1).
Mount:

- synchroniser ring (10) in such a way that its projections are positioned into hub (4) seats;
- coupling body (9);
- gear of IV gear (7), complete with roller bearings (6 and 8);
- spacer ring (5).

## Adjusting the main shaft

Figure 6/103




Determine rib ring thickness for gear of IV gear, operating as below.

Measure the distance A between the end of the shaft (1) and the seat (2) supporting the tapered roller bearing.

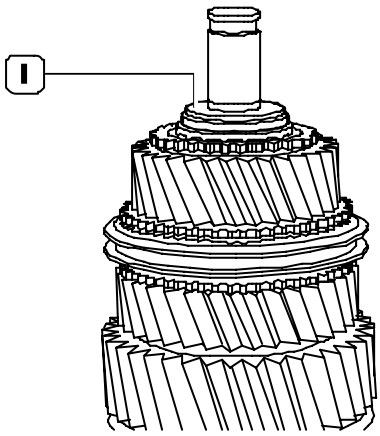
Mount the thrust washer (3) and measure the distance B between this and the end of the main shaft (1).

The difference A - B must be between +0.07 and -0.08 mm..

If a different value is found, replace rib ring (3) by another one having suitable thickness.

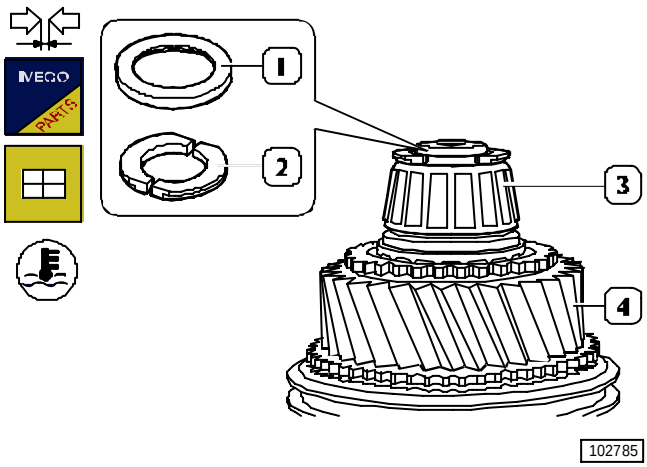
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Figure 6/104




Assemble the adjustment ring (1) having a thickness set in the previous measurements.

Figure 6/105




Mount the bearing (3), previously heated to 100°C.

Mount the divided ring (2) whose thickness produces an end float for it in its seat of -0.05 ÷ +0.05 mm.

Mount the retaining ring (1) and notch it at several points the same distance apart under the divided ring (2).

Check that the axial clearance of gear of IV gear (4) is 0.05 mm.

## Fitting the gearbox

To mount the gearbox assembly, carry out the steps described for removal in reverse order. The operations and assembly phases requiring specific tools, clearance checks, adjustments or special precautions are described below.

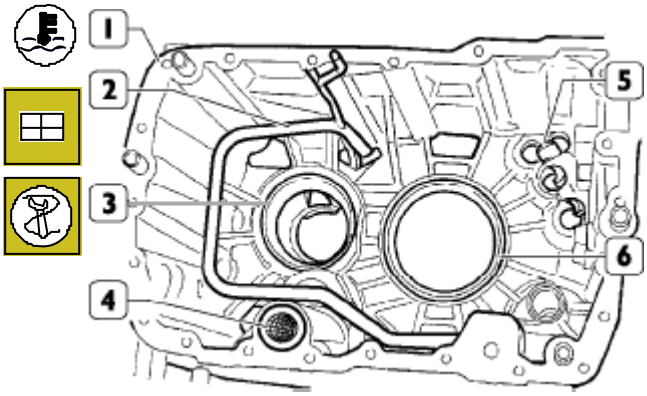
The tightening torques are given in the specific table.

**NOTE** Any rings and seals, ring nuts, spring pins, safety plates and self-locking screws found to be worn and all parts that are not fully efficient or are scored, dented or deformed must be replaced at the time of assembly.
Thread of screws fastening oil pump and drive inlet cover is originally coated with sealing material; therefore, screws must be replaced by new ones at every dismounting operation.

The flat gaskets should be fitted dry, without any jointing compound or grease.

Before fitting the twin-lipped seals, fill the gap between the two lips with TUTELA MR3.

Figure 6/106

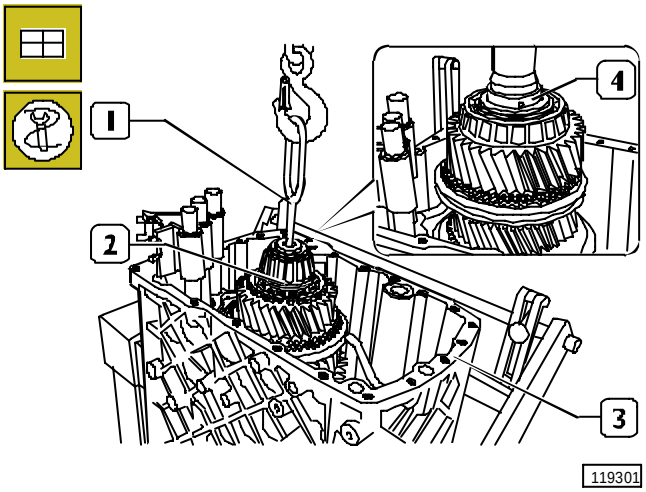



Heat bearings (3 and 6) seats at 60 °C temperature and mount bearings outer rings with handgrip 99370007 and knocker 99374093.
Mount oil filter (4), pipings (2) and latch (5) with relating spring..

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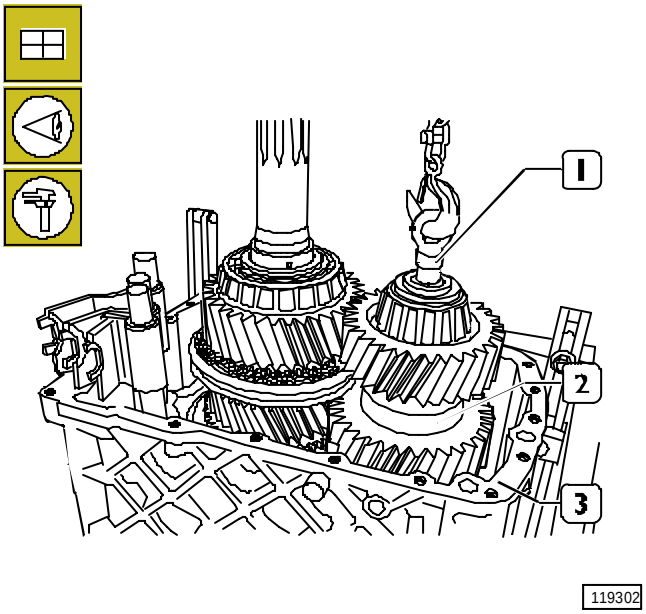

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Figure 6/107




Clamp the primary shaft (2) in a vice and introduce tool 99370449 (1) into it and constrain it using the related retaining nut. Hook the tool 99370449 (1) to the lifter and lift the primary shaft (2) and insert it inside the gear box (3), being careful to assemble the rods and forks in the same position measured during the disassembly phase. Using a suitable screw inserted in the gear box hole, push the latch so that the rods can be inserted in their corresponding seats

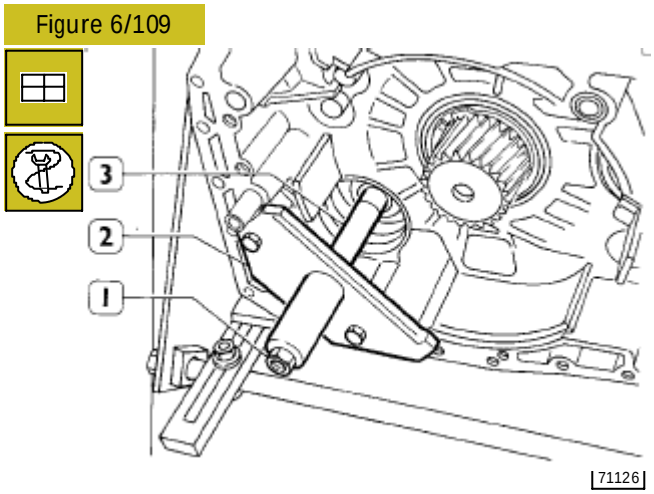
Figure 6/108




Use the eyebolt 99360502 (1) to lift the secondary shaft (2) and insert it, after properly moving the primary one, inside the gear box.

## Adjusting splitter drive fork

Figure 6/109

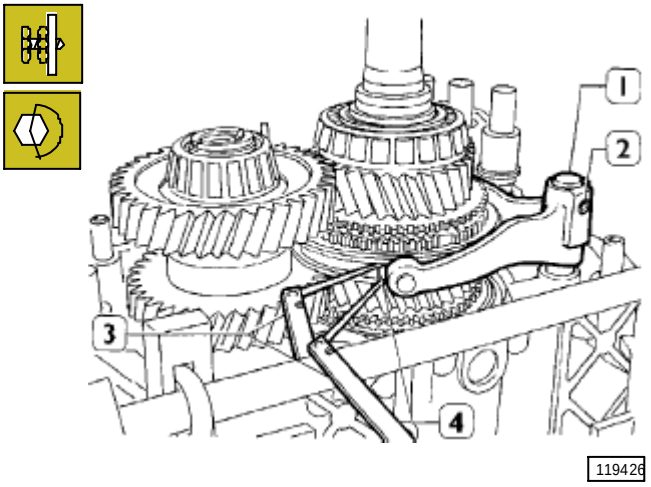



Mount tool 99370450 (2) on gearbox. For gearboxes 16 S 1920/2220/2520 tool 99370450 (2) must be provided with spacer (3) having following thickness:

- 16 S 1920/2220 = 13.8 mm.
- 16 S 2520 = 13.5 mm.

Insert the splitter drive fork control rod and secure it by means of nut (1).

Figure 6/110




Using the two socket-head screws (2), position the splitter control fork (1) so that the two sliding blocks (4) are centred in the throat of the sliding sleeve. Use two feeler gauges (3) for this purpose.

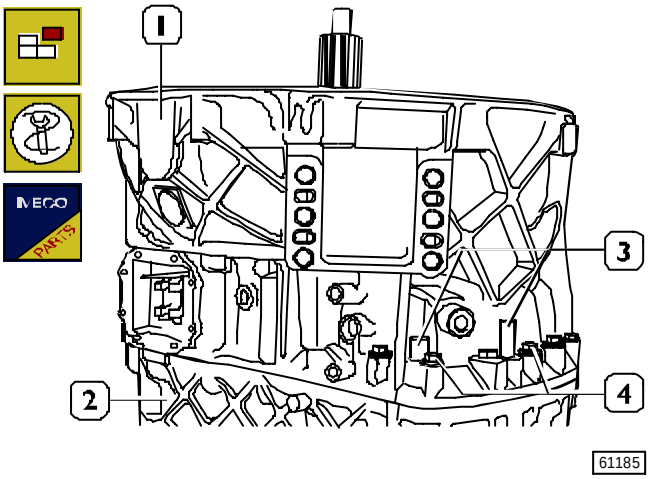
After making the adjustment, tighten the two screws (2) to the required torque.

Screw the splitter control rod setscrew onto the gearbox, tightening it to the required torque.

Take the adjustment tool 99370450 (2, Figure 6/109) out of the gearbox together with the spacer (3) after unscrewing the nut (1, Figure 6/109).

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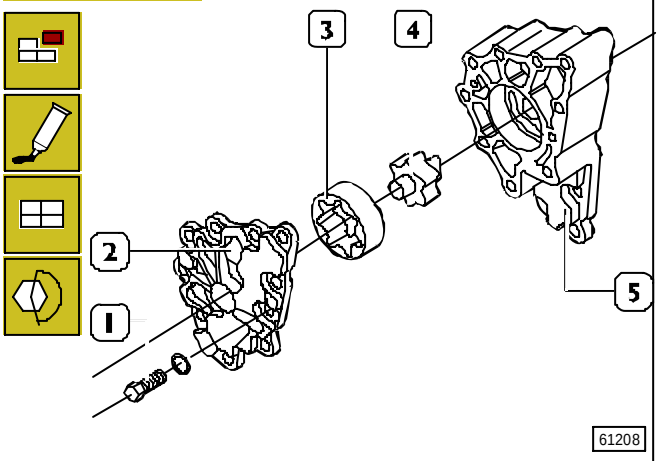
Figure 6/111




Position a new gasket on gear box (2).
Mount front cover (1).
Screw screws (4) without fully tightening them, fully fit in centering pins (3) and tighten screws (4) with prescribed torque.

## 534010 Oil pump

Figure 6/112



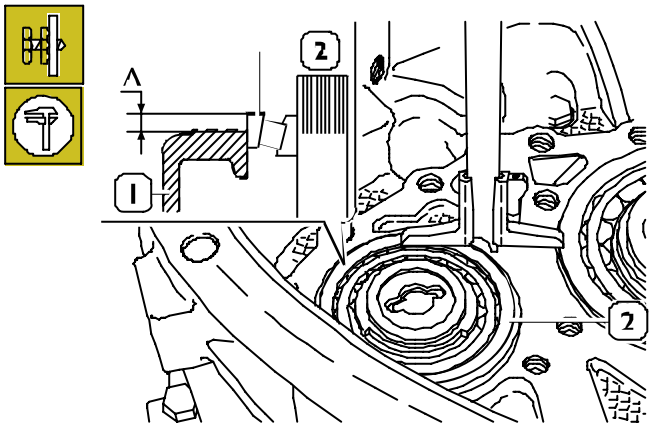

To dismantle the oil pump: unscrew the screws (1), take the cover (2) off the pump body (5) and extract from this the external (3) and internal (4) rotors.
To reassembly, carry out these steps in reverse order.

**NOTE** Apply a light layer of LOCTITE 574 on the mating surface of the cover (2).

Tighten the screws (1) to the required torque.

## Adjusting the transmission shaft bearing end float

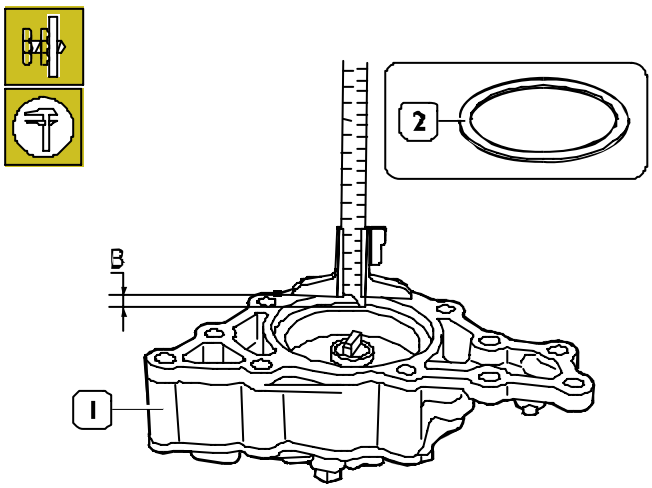
Figure 6/113




Determine the thickness S of the rings (2, Figure 6/114) for adjusting the end float of the transmission shaft bearing (2) as follows:

- Turn the shafts and check that the outer ring (2) of the bearing rests without any clearance on the bearing rollers.
- Measure the distance A between the plane of the front box (1) and the outer ring (2) at two diametrically opposite points.

Figure 6/114




Measure the depth B of the seat of the bearing (2, Figure 6/113) on the pump body (1).

The thickness S of the adjustment ring (2) is determined by the following equation:

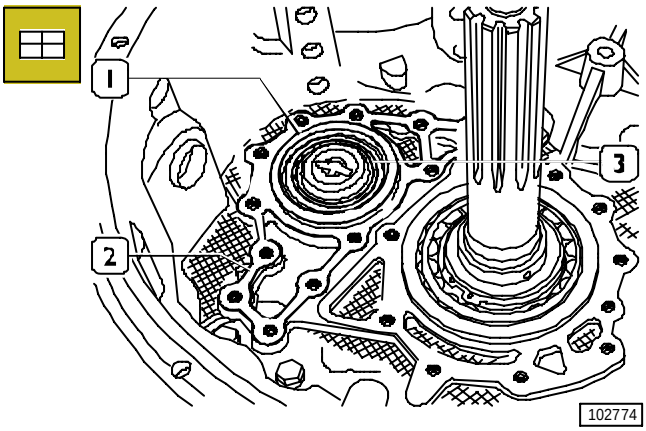
$$S = [B - (A - C)] - D$$

Where:
- A - B, measurements taken;
- C, thickness of gasket;
- D, end float of 0 - 0.1 mm.

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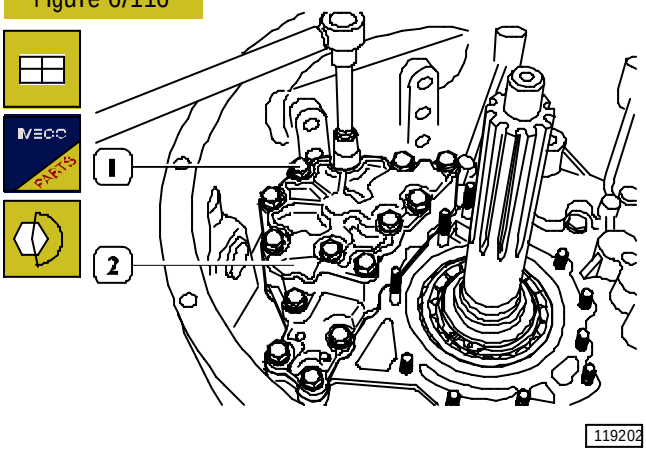

Aquila Trucks Centres

Figure 6/115




Mount new gasket (2).
Position adjusting ring (1), by thickness determined in previous measurement, on the outer ring of taper roller bearing (3).

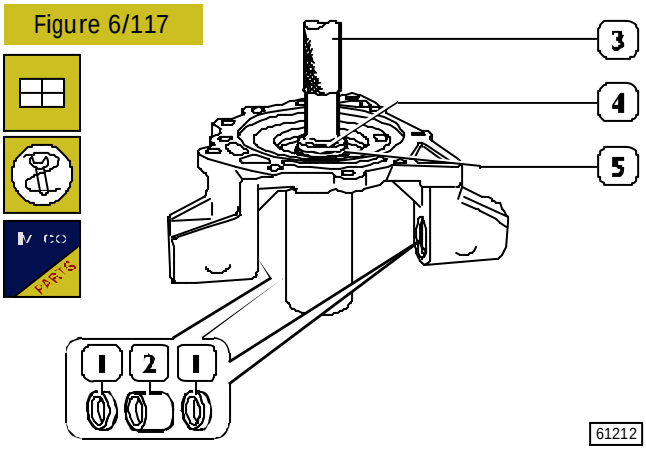
Figure 6/116




Mount oil pump (2) complete with adjusting ring (2).
Screw new screws (1) and tighten them with prescribed torque.

## 530511 Drive input shaft cover

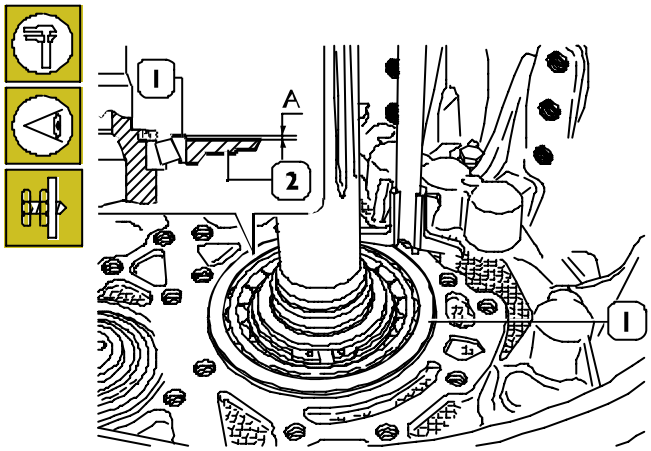
Figure 6/117




To replace the seals (1) and bushings (2), use general tools to remove - fit them.

To fit the seal (5) use the keying device 99370420 (4) and grip 99370006 (3).

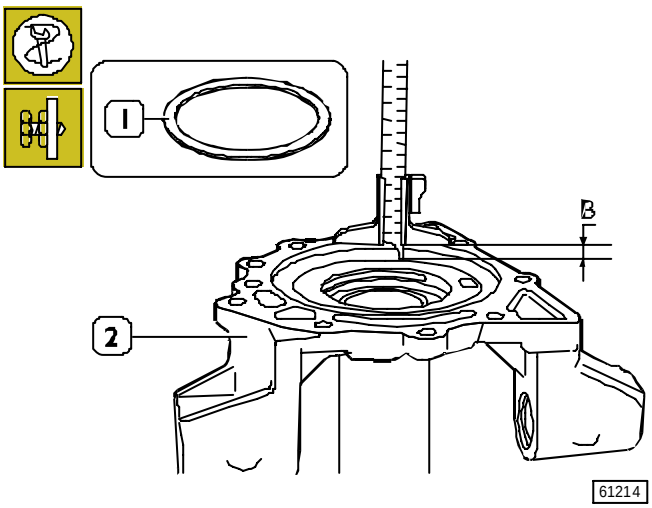
Figure 6/118




Determine the thickness S of the drive input shaft bearing adjustment ring as follows:

- Turn the drive input shaft and check that the outer ring (1) rests without any clearance or pre-load on the rollers of the internal ring of the bearing.
- Measure the protrusion of the bearing (1) from the plane of the front cover (2), distance A.

Figure 6/119




- Measure the depth B of the seat of the bearing (1, Figure 6/118) on the cover (2).

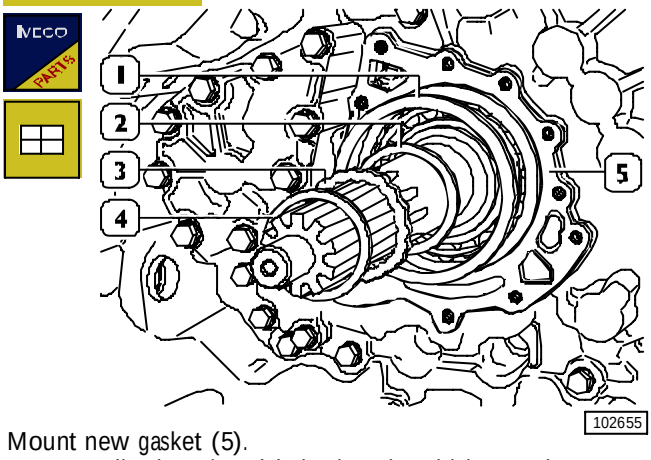
The thickness S of the adjustment ring (1) is determined by the following equation:

$$S = [B - (A - C)] - D$$

Where:
- A - B, measurements taken;
- C, thickness of gasket;
- D, end float of 0 - 0.1 mm.

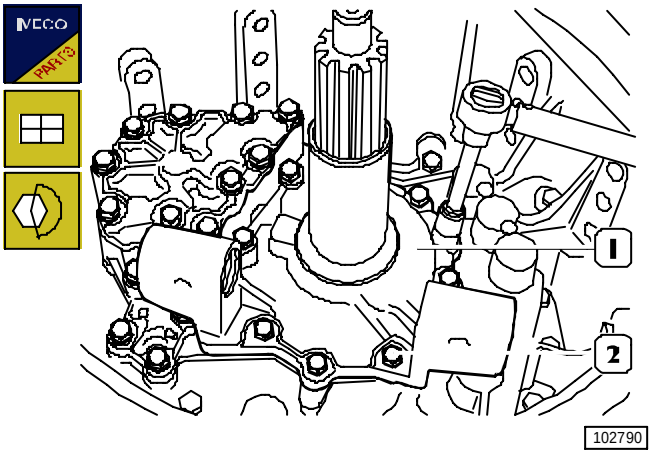
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Figure 6/120




Mount new gasket (5).
Mount: adjusting ring (1) having the thickness that was determined in previous measurement, rib ring (2), spring (3) and rib ring (4).

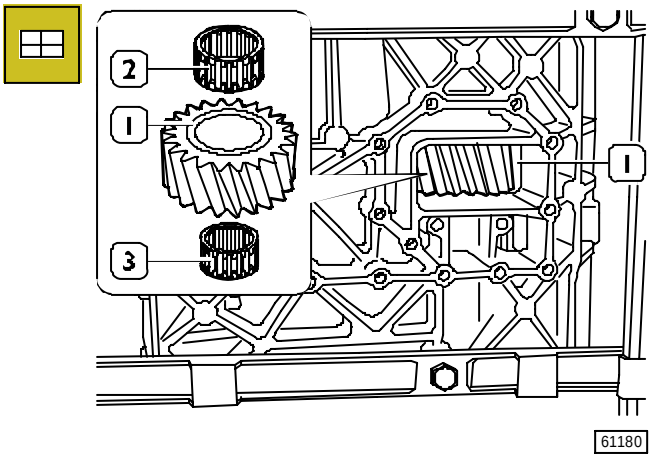
Figure 6/121




Mount cover (1).

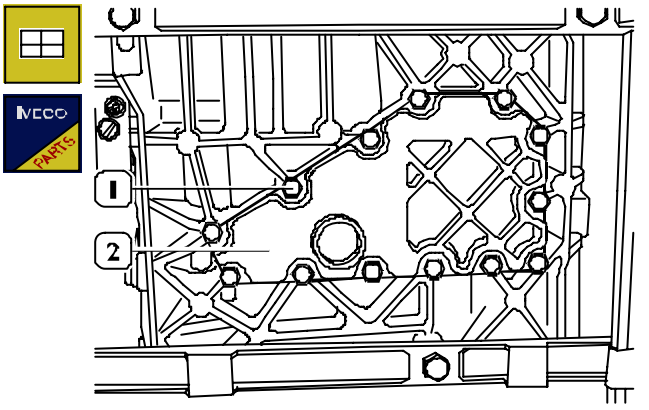
Screw new screws (2) and tighten them with prescribed torque.

Figure 6/122



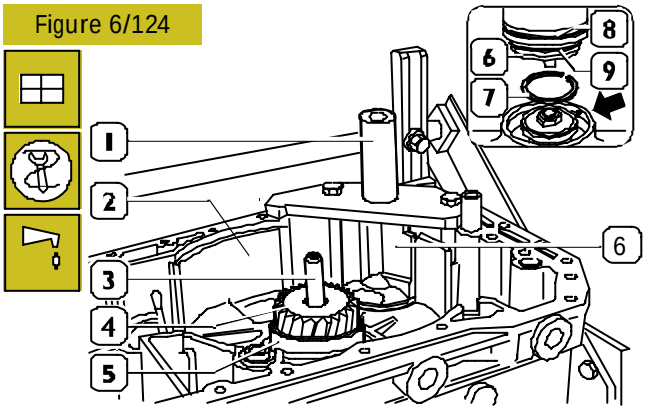

Put gear box upside down.
Mount gear of reverse gear transmission (1) complete with needle bearings (2 and 3). Mount the shaft for gear of reverse gear.

Figure 6/123




Mount cover (2) with a new gasket, screw screws (1) and tighten them with prescribed torque.

Figure 6/124




Use tool 99345097 to assemble the tube (3) in the primary shaft and check that its projection is equal to what was measured upon disassembly (if this information is not available, check that the tube penetrates approx. 10 mm inside the box).

Mount the spacer (5) on the main shaft (4), position the seal (6) in the seat of the splitter driving cylinder.

**NOTE** Position the cut of the ring (7) by the hole (→).

Mount the seals (8 and 9) on the cylinder (6) and lubricate them.

Fit the cylinder (6) in the gearbox.

Position the tool 99370450 (1) on the gearbox (3) so as to keep the cylinder (6) in the seat. Supply the splitter control valve (2, Figure 6/68) with compressed air (max. 6.8 bars) and listen to check the internal piston works and there are no air leaks.

Take off the tool 99370450 (1).

Mount rod positioning pegs.

Refit the epicyclic reduction gear unit box as described under the relevant heading.

Replenish the gearbox with lubricating oil of the required grade and quantity.

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# ZF gearboxes with Intarder, hydraulic retarder, types: ZF 16 S 1621 T.D. ZF 16 S 2221 T.D. ZF 16 S 2521 T.O.


| | Page |
|---|---|
| MAIN DATA | 25 |
| TOOLS | 26 |
| OVERHAULING THE GEARBOX | 32 |
| - Removing the hydraulic retarder from the gearbox on the stand | 32 |
| - Refitting the hydraulic retarder | 34 |
| - Recording the bearing end clearance of the epicycloidal reduction unit | 33 |
| - Removing the epicyclic reduction gear unit (ERG) | 35 |
| - Component parts of the epicyclic reduction gear unit | 35 |
| - Refitting the epicyclic reduction gear unit (ERG) rear box | 40 |


**NOTE** Recover the adjustment rings from the stator and from the epicyclic assembly shaft bearing.

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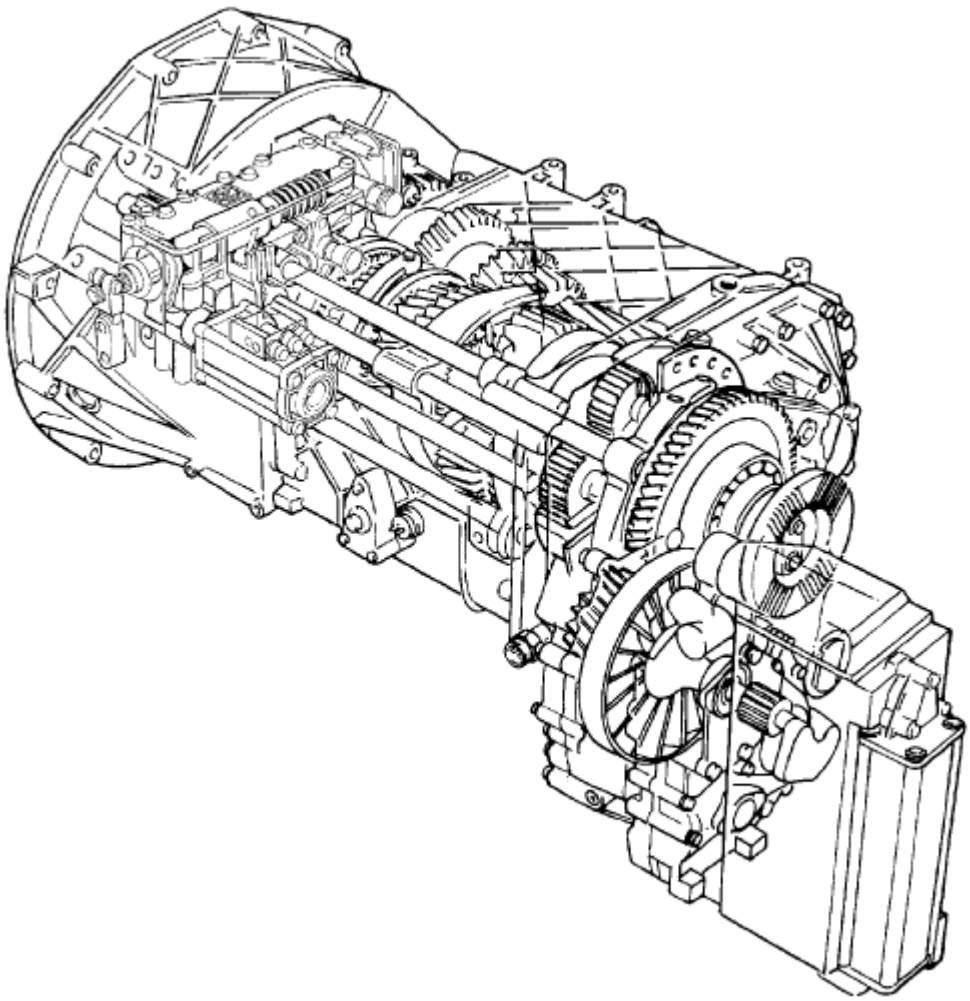
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**NOTE** The technical data, tightening torques and procedure for overhauling the gearbox differ from the 16 S 1620 T.D. - 16 S 2220 T.D. - 16 S 2520 T.O. gearbox in the following.

## MAIN DATA

| GEARBOX WITH INTARDER | | | 16 S 1621 T.D. | 16 S 2221 T.D.<br>16 S 2521 T.O. |
|---|---|---|---|---|
|  | Maximum braking torque | Nm | 3000 | |
| | Braking capacity | kW | 420 | |
|  | Type of oil | | Tutela Truck FE-Gear<br>Tutela ZC 90 | |
| | Quantity after overhauling gearbox and retarder drained completely | l | 18.5 | 21.5 |
| | | kg | 16.5 | 19.5 |

Figure 1



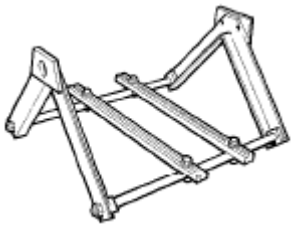
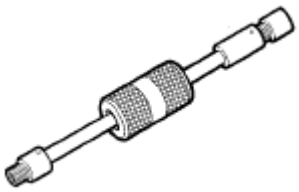
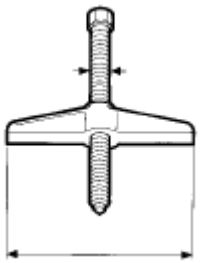
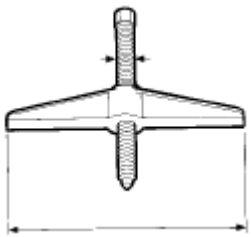
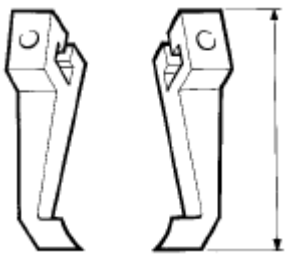
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GEARBOX ASSEMBLY WITH RETARDER

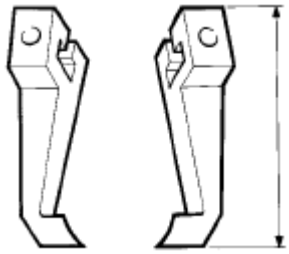
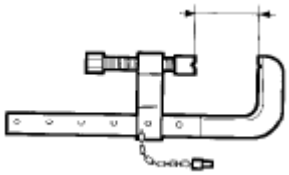
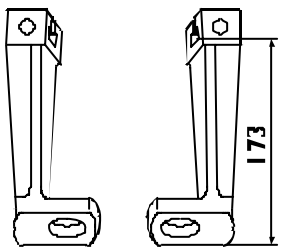
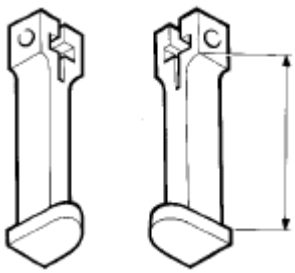
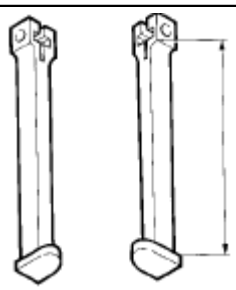
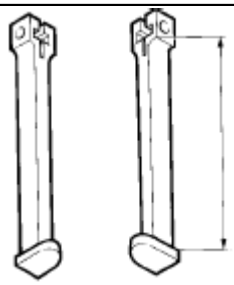
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## TOOLS

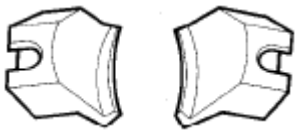
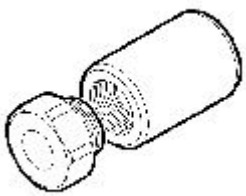
| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99322205** |  | Rotary stand for overhauling assemblies |
| **99322225** |  | Stand for supporting assemblies (to be fitted on stand 99322205) |
| **99340205** |  | Puller with slide-hammer |
| **99341003** |  | Single-acting bridge |
| **99341004** |  | Single-acting bridge |
| **99341009** |  | Pair of brackets |

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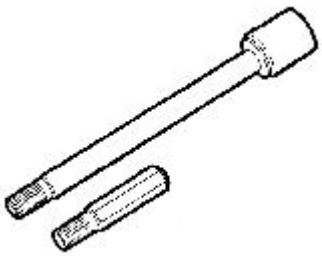
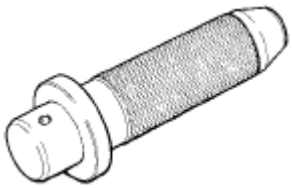
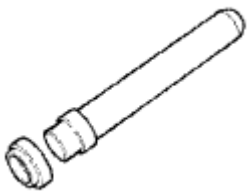
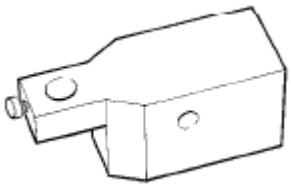
| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99341012** |  | Pair of brackets |
| **99341015** |  | Clamp |
| **99341018** |   | Pair of brackets with hole |
| **99341019** |  | Pair of tie rods with grips |
| **99341020** |  | Pair of tie rods with grips |
| **99341021** |  | Pair of tie rods with grips |

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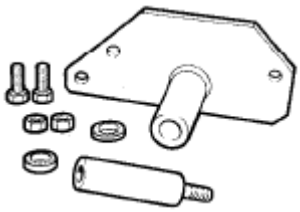
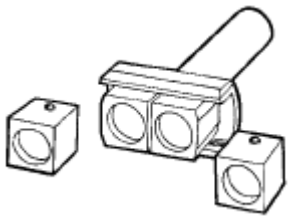
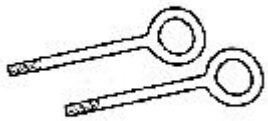
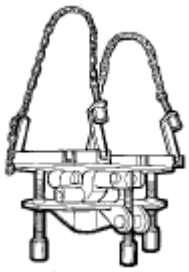
| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99341022** |  | Grips |
| **99341024** |  | Grips |
| **99341025** |  | Grips |
| **99342143** |  | Pin to extract reverse gear shaft (use with 99340205) |
| **99345058** |  | Extractor reaction block |
| **99345097** |  | Reaction tool to extract sun gear and drive in main shaft oil pipe |

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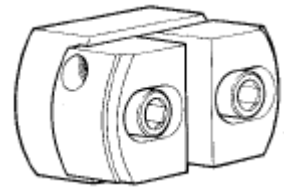
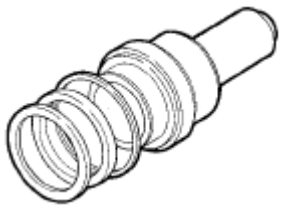
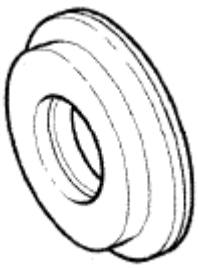
| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99347092** |  | Pin to extract gearbox front and rear centring pins |
| **99370006** |  | Grip for interchangeable drifts |
| **99370007** |  | Grip for interchangeable drifts |
| **99370113** |  | Drift to mount seal and/or bushings on gearbox |
| **99370415** |  | Dial gauge stand to adjust transmission shaft bearing end float (use with 99395604) |
| **99370420** |  | Key for fitting gasket on gearbox front cover (use with 99370006) |

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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99370449** |  | Hook to lift main shaft |
| **99370450** |  | Tool to adjust splitter control fork |
| **99370465** |  | Tool to notch safety plates |
| **99370565** |  | M10 eyebolts (2) for lifting various assemblies |
| **99370629** |  | Mount to support gearbox when removing and refitting it on the vehicle |
| **99371050** |  | Brackets to support gearbox when overhauling (use with 99322205 - 99322225) |

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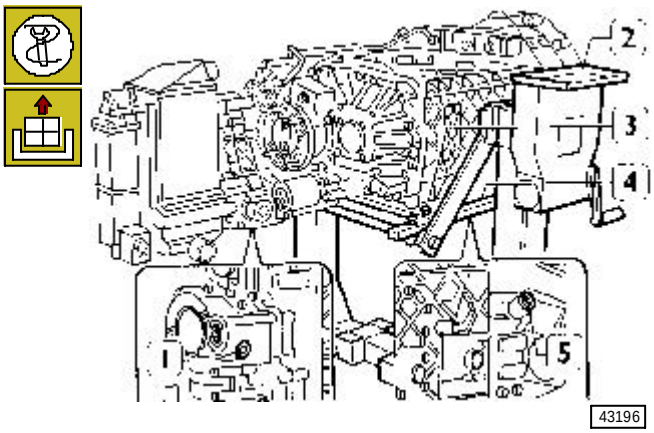
| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99374093** |  | Drift to mount external bearing races (Ø 91 ÷ 134 mm) (use with 99370007) |
| **99374221** |  | Key to fit gaskets on rear cover |
| **99374370** |  | Key to fit oil deflector on direct drive shaft (use with 99370006) |
| **99395604** |  | Dial gauge (0÷10 mm) |

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## 530210 OVERHAULING THE GEARBOX

### Removing the hydraulic retarder from the gearbox on the stand

Figure 2



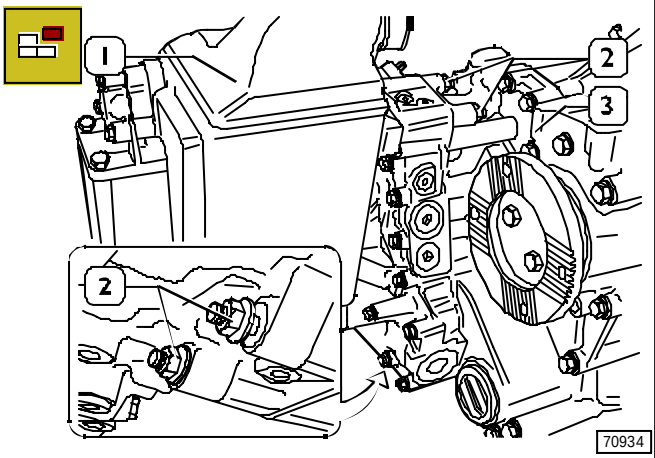

Fit the brackets 99371050 (3) onto the assembly.

Using ropes with hooks and a movable lift, put the assembly on the rotary stand 99322205 (2) together with the mount 99322225 (4).

Take off the plug (5) and drain the lubricating oil from the gearbox.

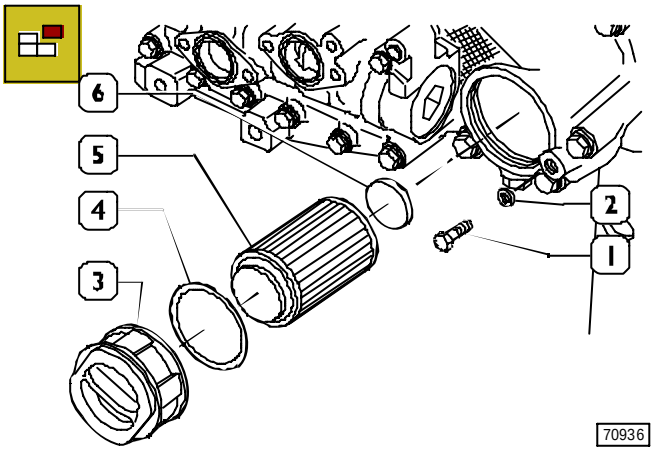
Take off the plug (1) and drain the lubricating oil from the hydraulic retarder.

Figure 3



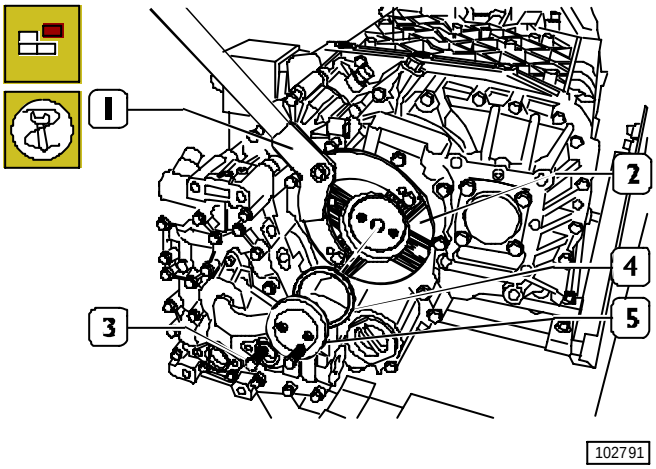

If applicable, remove the four nuts (2) fixing the heat exchanger (1) to the hydraulic retarder (3) and detach the heat exchanger (1).

Figure 4



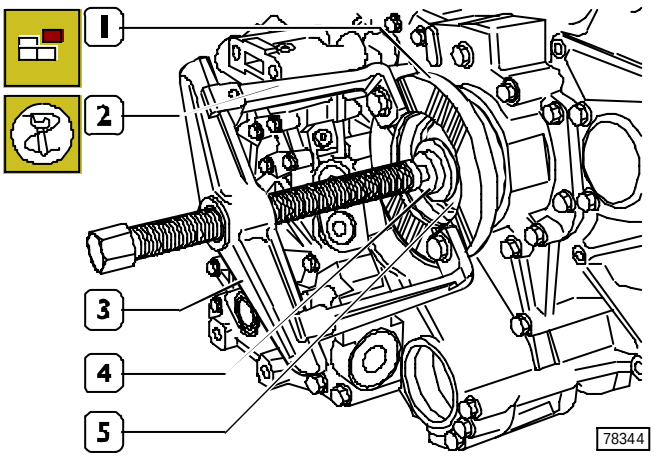

Remove the screw (1) and the washer (2) beneath. Extract the plug (3) with the seal (4), oil filter (5) and magnet (6). Drain any oil that is present.

Figure 5




Block rotation of the sleeve (2) by applying the lever 99370317 (1) to it and remove the screws (3), disc (5) and underlying seal (4).

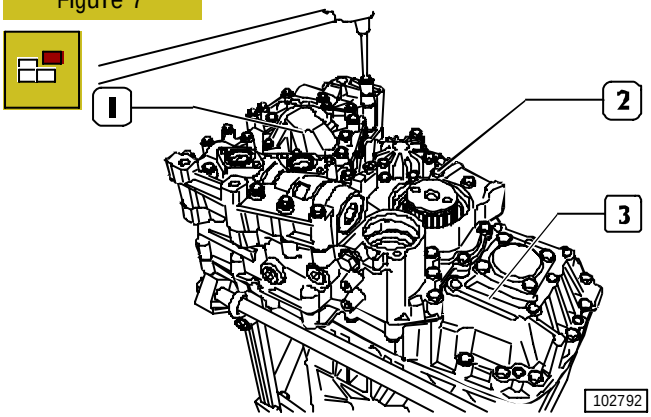
Figure 6




Using an extractor composed of the bridge 99341003 (3), brackets 99341018 (2) and reaction block 99345058 (4), remove the sleeve (1) from the shaft (5).

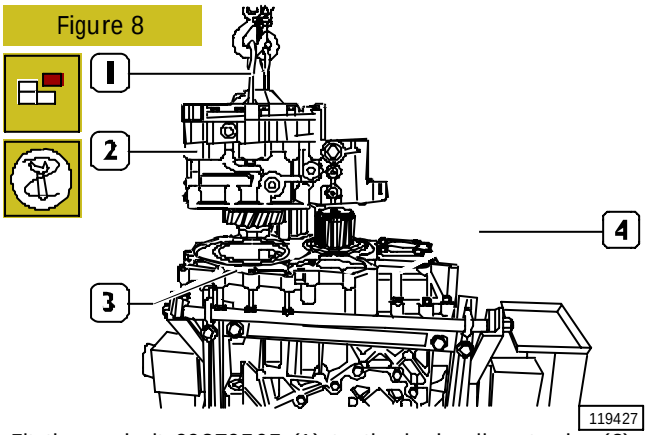
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Figure 7




Remove the screws (2) fixing the hydraulic retarder (1) to the rear box (3).

Figure 8



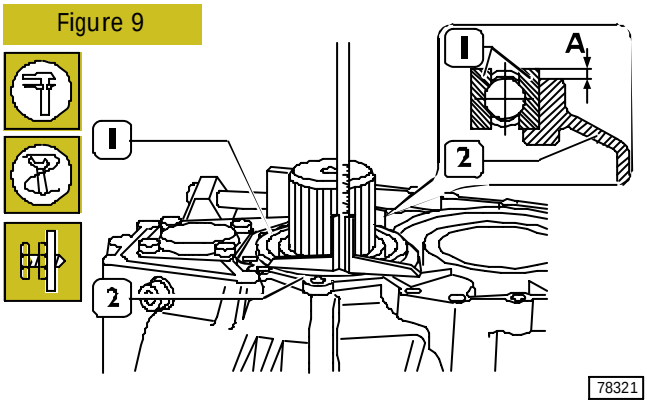

Fit the eyebolt 99370565 (1) to the hydraulic retarder (2). With special ropes and lifter, detach the hydraulic retarder (2) from the rear box (4).
Remove the gasket (3).

## Refitting the hydraulic retarder

Prior to reattachment determine the thickness of the ball bearing end clearance adjustment ring as follows:

## Recording the bearing end clearance of the epicycloidal reduction unit

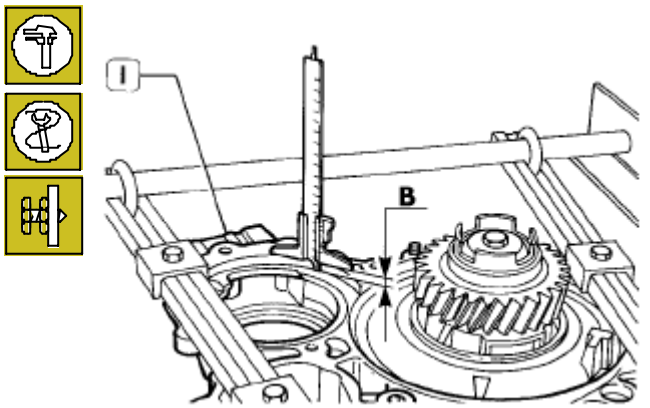
Figure 9




Determine the ball bearing end clearance adjustment shim (1) as follows:

- measure the projection of the bearing (1) from the rear box surface (2): dimension A.

Figure 10




- measure the distance between the mating surface (1) of the half box decelerator and the bearing support surface (1, Figure 9): dimension B;
- measure the thickness of the gasket between the decelerator and the transmission: dimension C.

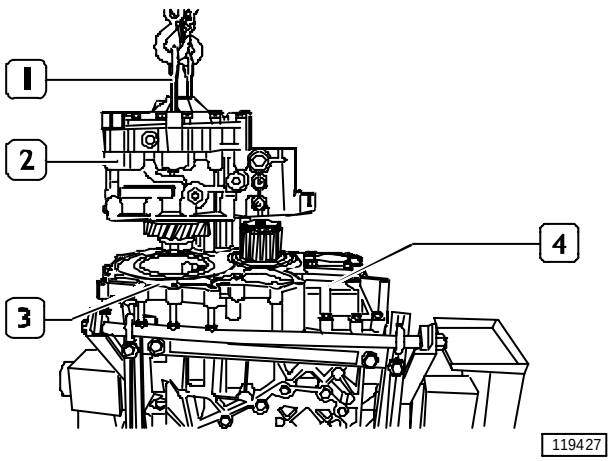
Thickness S of adjustment ring is given by the following equation:

S = [B + C - A] - G

where:

- B - C - A = measured values
- G = 0.1 mm: ball bearing end play (1, Figure 9) (0 to 0.1 mm).

Figure 11



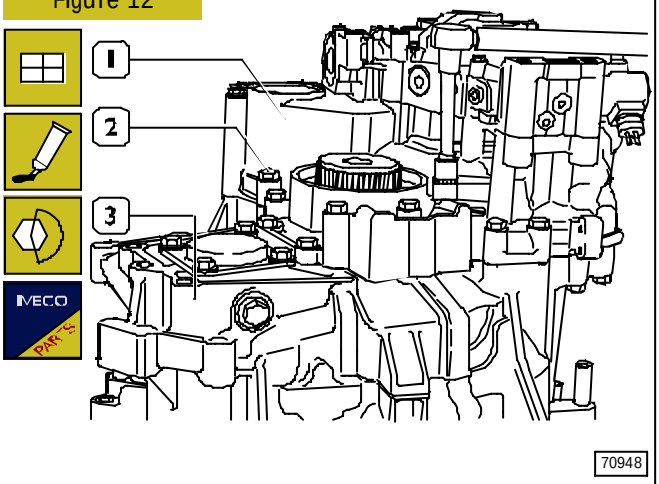

Fit the eyebolt 99370565 (1) to the hydraulic retarder (2) and lift it with a hoist.

Fit a new gasket (3) on the rear box (4).

Mount the hydraulic retarder (2) on the rear box (4) making sure that the gasket (3) gets positioned correctly.

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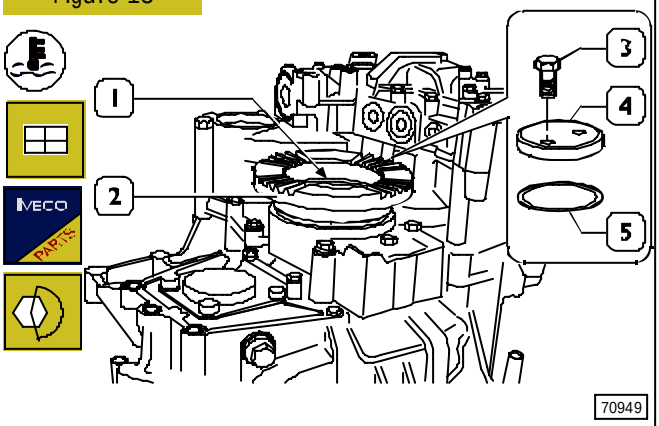
Figure 12




70948

Screw down the screws (2) fixing the hydraulic retarder (1) to the rear box (3) and tighten them to the prescribed torque.

Figure 13

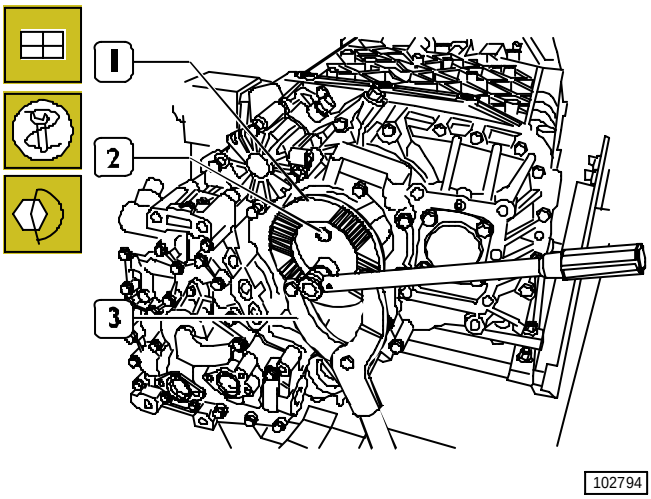



70949

Heat the flange (2) to approx. 80°C and fit it onto the spider shaft (1).

Fit on a new seal (5), the disc (4), screw down the screws (3) and tighten them to the prescribed torque.

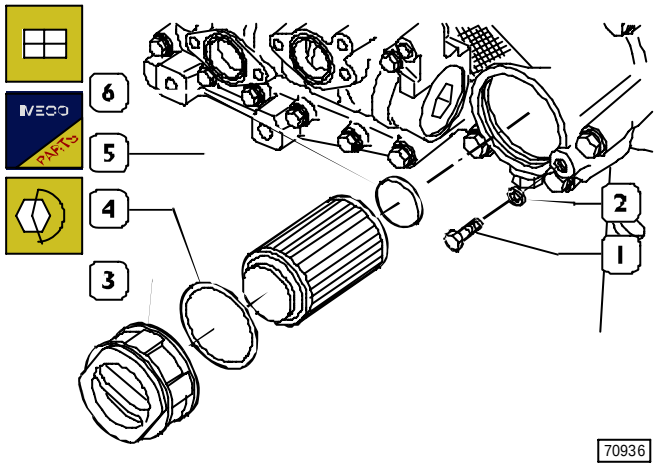
Figure 14




102794

Block rotation of the sleeve (1) by applying the lever 99370317 (3) and tighten the fixing screws (2) to the prescribed torque.

Figure 15

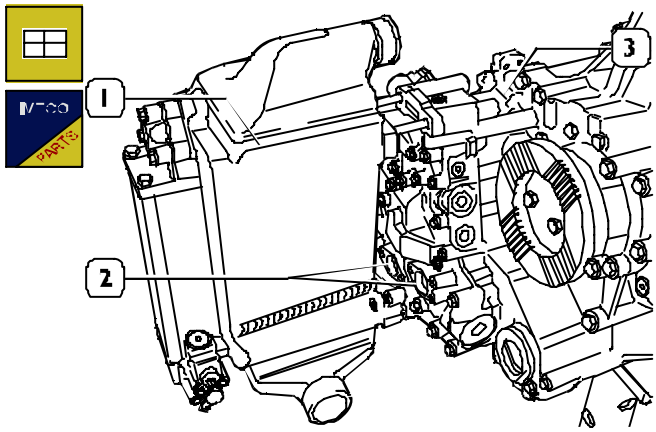



70936

Position the magnet (6) on the filter (5) and insert this into the hydraulic retarder. Fit the plug (3) with a new seal (4).

Screw down the fastening screw (1) with the washer (2).

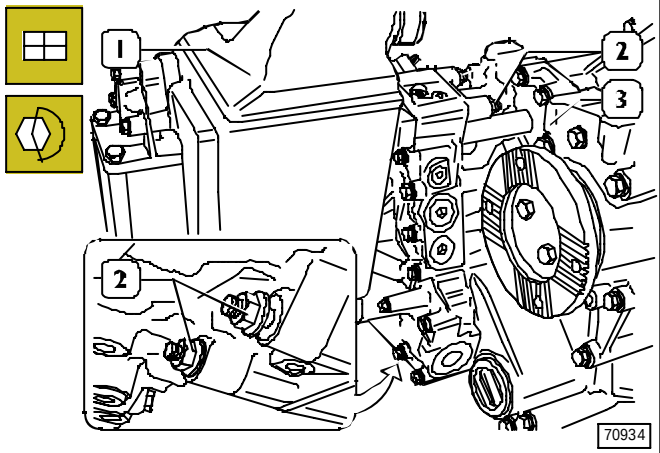
Figure 16




70955

Fit two new seals (2) on the hydraulic retarder (3) and mount the heat exchanger (1) (if applicable).

Figure 17



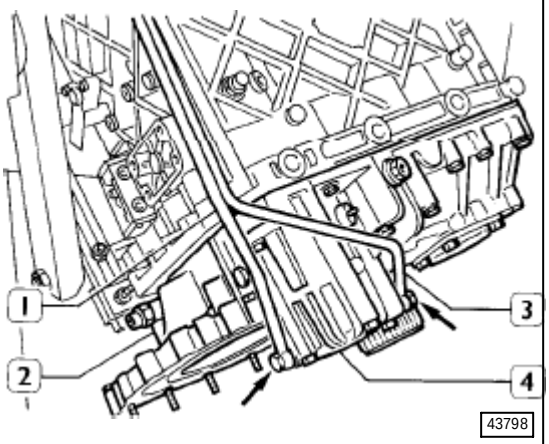

70934

Screw down the four nuts (2) fixing the heat exchanger (1) to the hydraulic retarder (3) and tighten them to the prescribed torque.

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## Removing the epicyclic reduction gear unit (ERG) rear box

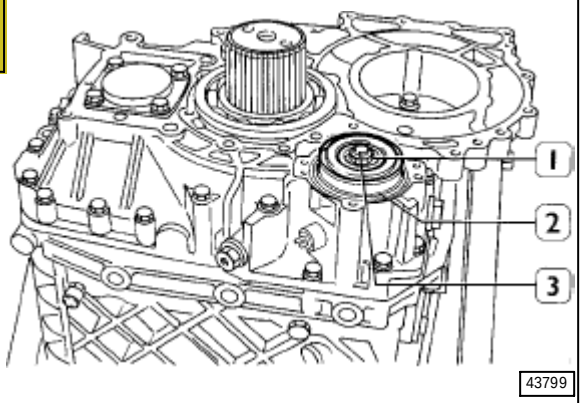
Figure 18




Remove the hydraulic retarder as described under the relevant heading.

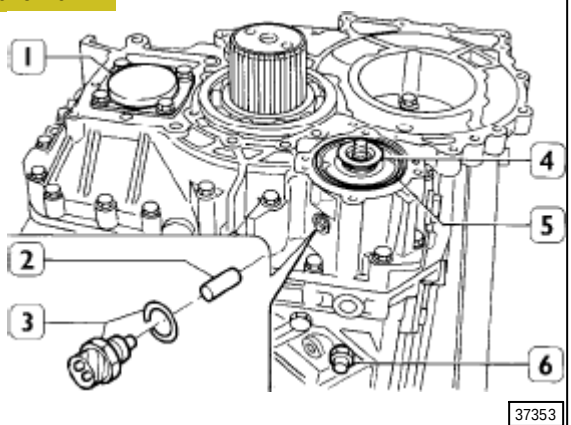
Take off the fittings (→) and disconnect the pipes (1 and 3) from the cylinder (4). Remove the cylinder (4) from the ERG rear box (2).

Figure 19



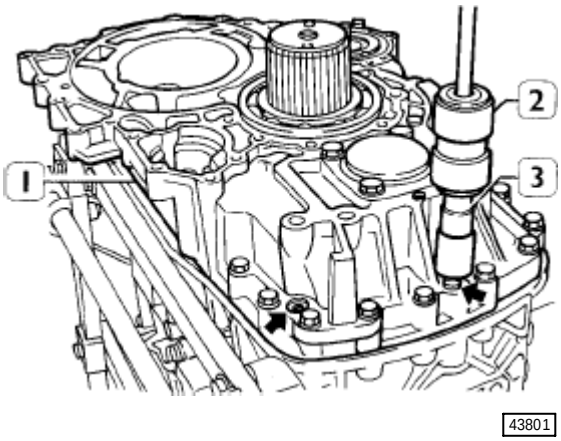

Remove the nut (1) and extract the piston (2) from the rod (3).

Figure 20




Remove the seal (5), gasket (4), switch (3), push rod (2) and retaining push rod 145N (6) from the ERG rear box (1).

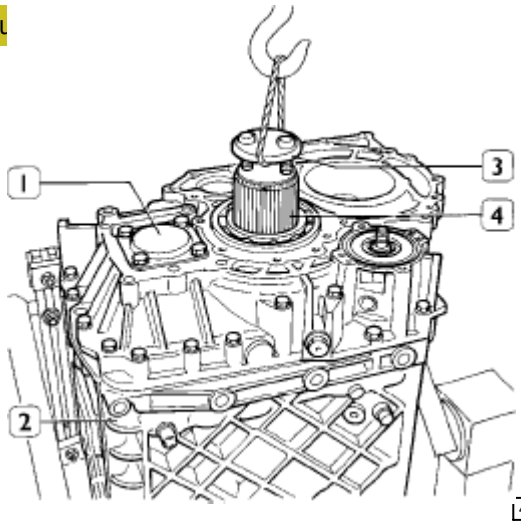
Figure 21




Using the percussion extractor 99340205 (2) and part 99342143 (3), extract two of the three centring pins from the ERG rear box (1).

**NOTE** The arrows show the outside pins to extract; there is a third pin inside.

Figu



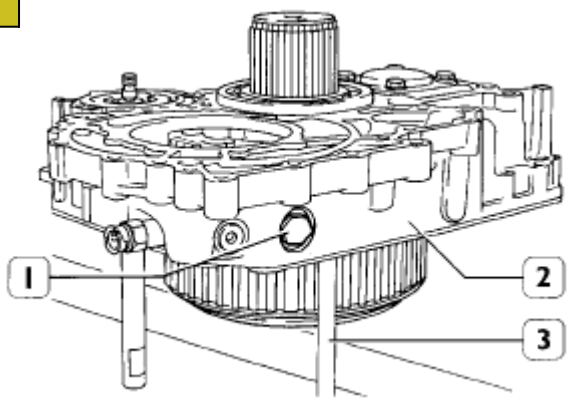

Take out the screws fixing the ERG rear box (1) to the gearbox (2). Fasten the retaining plate (3) to the shaft (4) with two screws. Using a rope and hydraulic lift, remove the ERG box (1) from the gearbox (2).

## Removing the epicyclic reduction gear unit (ERG)

**NOTE** Here we describe the steps to remove and fit the ERG epicyclic reduction gear unit that differ from the ones given for gearboxes without the Intarder.

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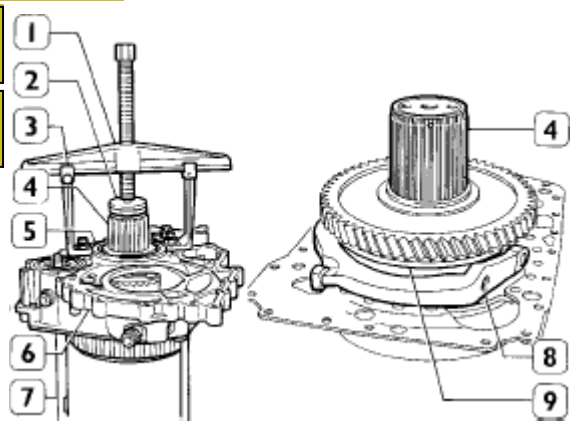
Figure 23




119428

Place the epicycloidal reduction unit (2) on the work bench and disassemble the two G.R.E. control knuckle joint pins (1) (8, Figure 24) .
Remove the intarder oil pump intake pipe (3).

Figure 24



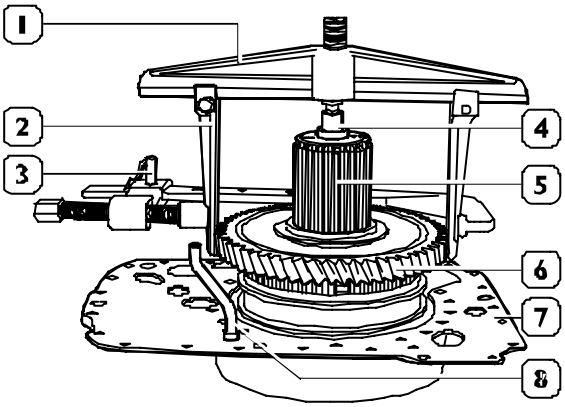

36804

Using the extractor composed of bridge 99341003(1), tie rods 99341018 (3) and block 99345058 (2) fitted onto the ERG box, as shown in the figure, extract the bearing (5) and the box (6) from the ERG shaft (4).

**NOTE** While extracting them, hold back the rod (7) to then take it out of the box (6) when it is freed from the fork (8).

Take the fork (8) with its blocks out of the sliding sleeve (9).

Figure 25

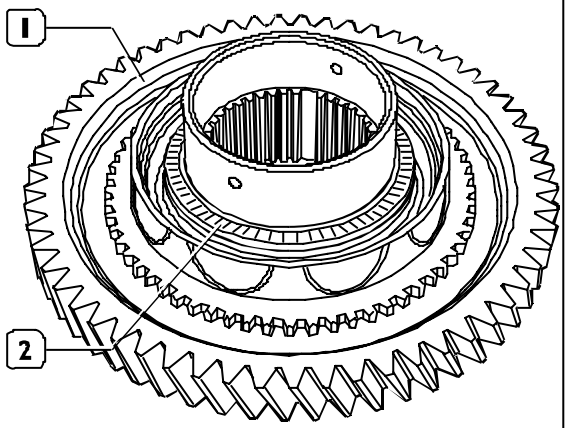



61216

Using the extractor composed of bridge 99341004 (1), brackets 99341012 (2), part 99345058 (4) and clamp 99341015 (3), extract the gear (6) from the ERG shaft (5).

Take off the plate (7) with the tube (8) for lubrication.

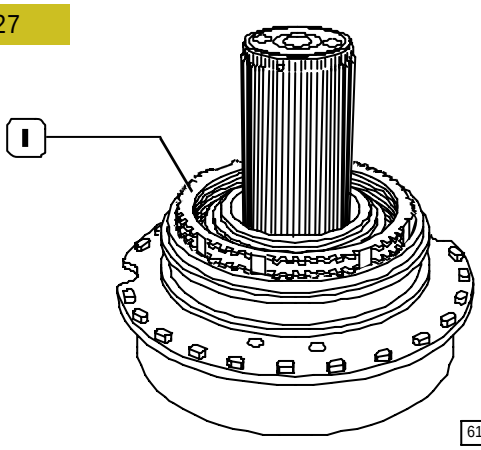
Figure 26




61217

Remove the fifth wheel bearing (2) from the gear (1).

Figure 27

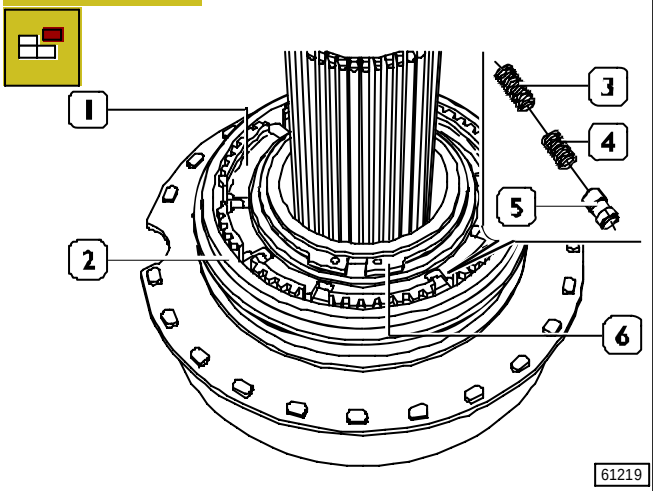



61218

Take the synchronizer ring (1) out of the sliding sleeve hub.

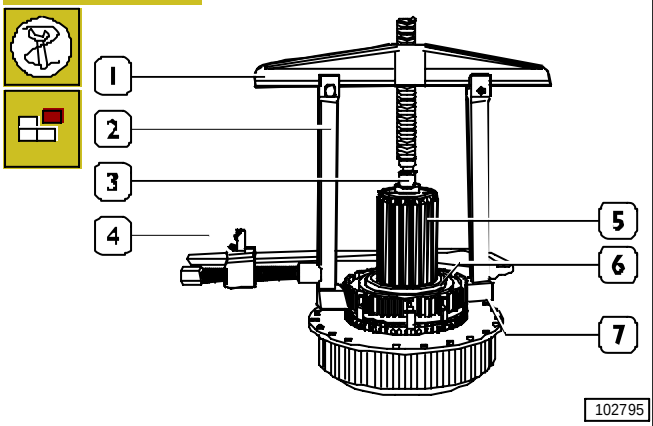
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Figure 28



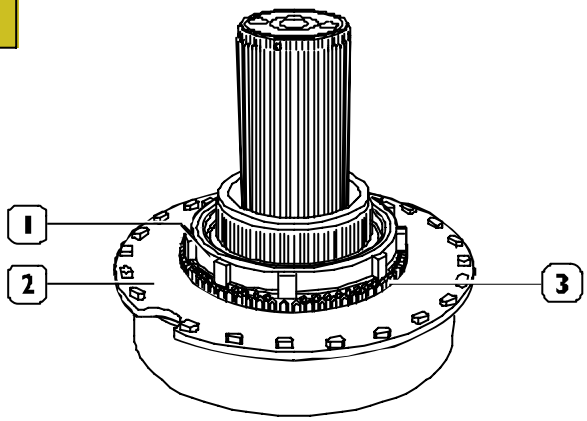

Taking care over the blocks (5) and springs (3 and 4) coming out of the hub (1), extract the sliding sleeve (2) from the hub and remove the seal (6).

Figure 29




Extract hub (6) for sliding sleeve from epicyclic reduction unit shaft ( 5) with extractor made up of bridge 99341003 (1), brackets 99341021 (2), counter-part 99341058 (3) and grips 99341025 (7) clamp 99341015 (4).

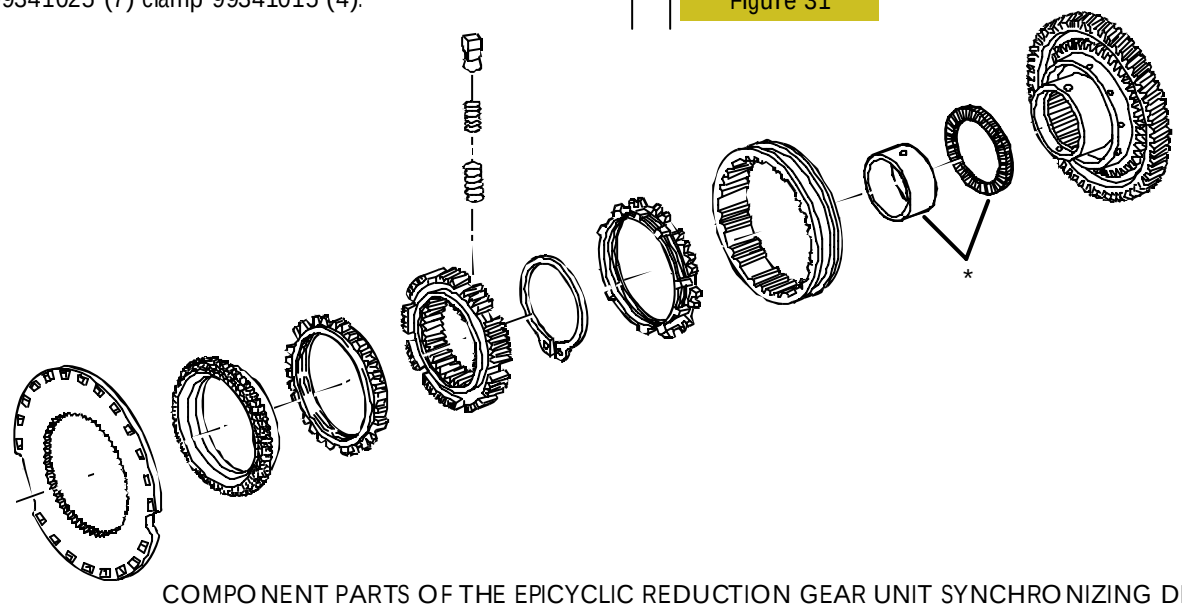
Figure 30




Take off the synchronizer ring (1) and the coupling body (3) together with the plate (2).

Levering under the coupling body (3), extract it from the plate (2).

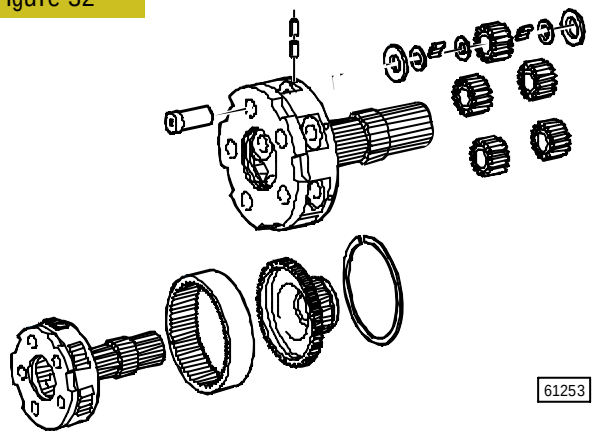
Figure 31




COMPONENT PARTS OF THE EPICYCLIC REDUCTION GEAR UNIT SYNCHRONIZING DEVICE

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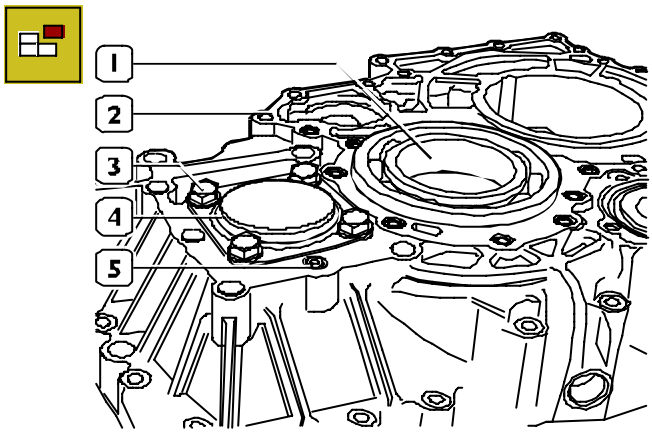
Figure 32




COMPONENT PARTS OF THE EPICYCLIC REDUCTION GEAR UNIT

Remove the epicyclic reduction gear unit as described for gearboxes with no Intarder.

Figure 34

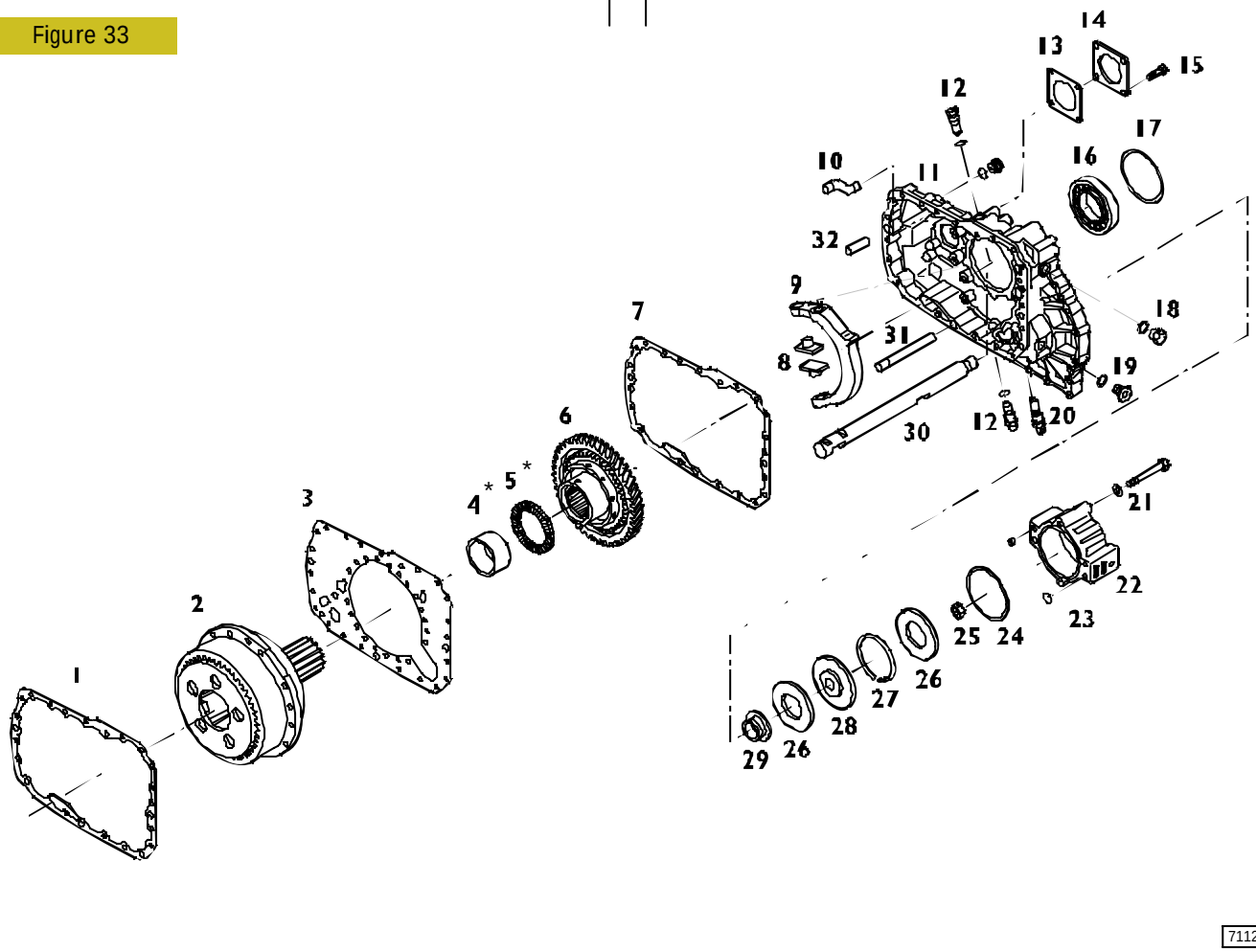



Remove the ball bearing (1) from the ERG box (2).

Unscrew the screws (3) and remove the cover (4).

Unscrew the screw (5).

Figure 33

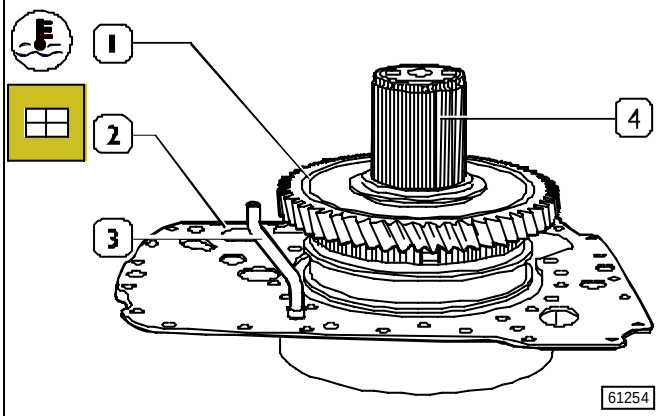



COMPONENT PARTS OF THE ERG CONTROL AND BOX

1. Gasket - 2. ERG - 3. Plate - 4. Bushing - 5. Fifth wheel bearing - 6. Gear - 7. Gasket - 8. Sliding blocks - 9. Fork - 10. Nozzle tube - 11. ERG box - 12. Pin for fork articulation with washer - 13. Gasket - 14. Cover - 15. Screw - 16. Ball bearing - 17. Adjustment ring - 18. Plug with seal - 19. Plug with seal - 20. Sensor - 21. Screw with washer - 22. Cylinder - 23. Seal - 24. Seal - 25. Nut - 26. Seal - 27. Spacer ring - 28. Piston - 29. Seal - 30. Rod - 31. Tube - 32. Pin.

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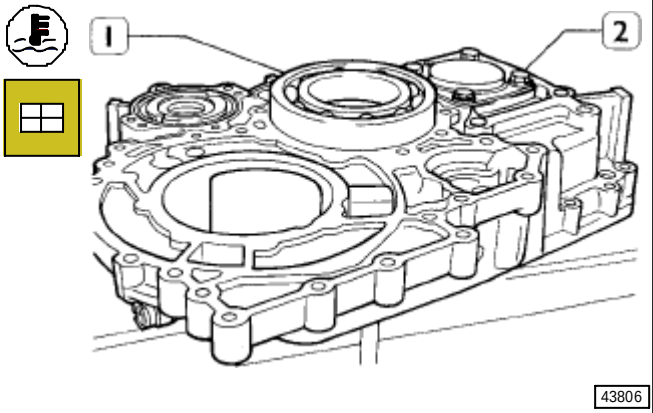
Figure 35




Position the plate (2) together with the tube (3) on the ERG (4).

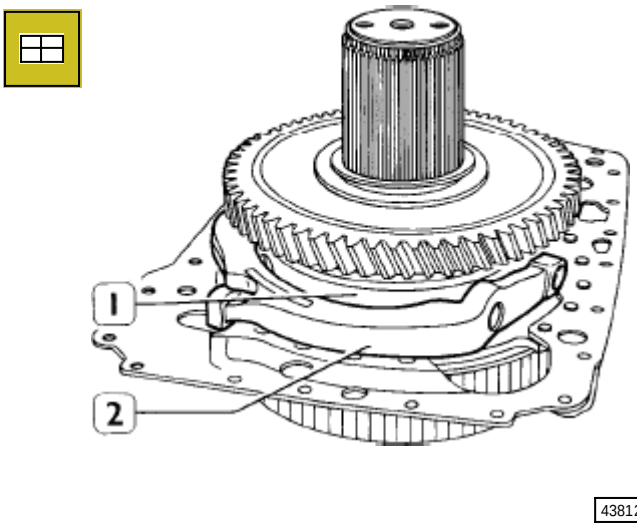
**NOTE** Heat the gear (1) to a temperature of 160°C for no longer than 10 sec.
Fit the gear (1) on the ERG shaft (3).

Figure 36



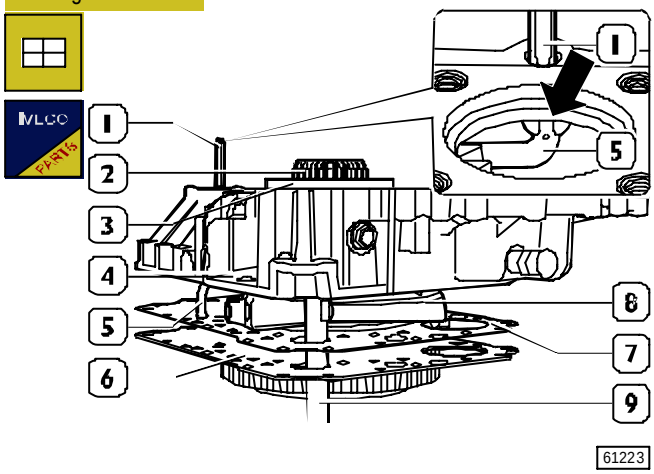

Heat the seat of the ball bearing (1) on the ERG rear box (2) to approx. 60°C and mount the ball bearing (1).

Figure 37




Set the fork (2) with its blocks on the sliding sleeve (1).

Figure 38




Place a new gasket (7) on the plate (6).

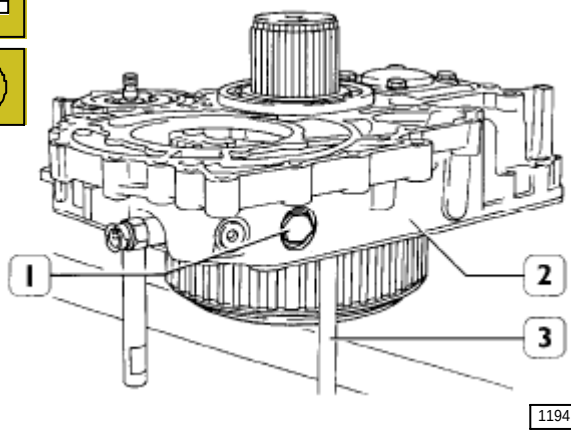
Partially fit the ball bearing (3) with the box (4) on the ERG shaft (2).

Insert the rod (9) into its seat in the box (4).

Position the fork (8) in the slot of the shaft (9) and keep it in this position until the assembly of the ball bearing (3) on the shaft (2) has been completed, heating the seat of the latter.
Check that the plate slots (6) coincide with those of the plate (2, Figure 35), otherwise, the epicycloidal reduction unit (G.R.E.) rear box cannot be reattached.

**NOTE** When fitting the bearing (3), guide the tube (5) with a punch (1) so it goes into its seat (→) in the box (4).

Figure 39

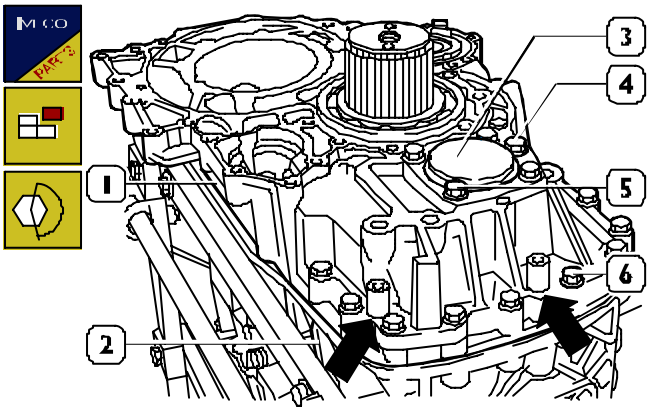



Constrain the fork (2, Figure 37) to the box using two joint pins (1), and tighten them to the prescribed torque.
Insert the intarder oil pump intake pipe (3) into the appropriate seat.

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## Refitting the epicyclic reduction gear unit (ERG) rear box

Figure 40




61224

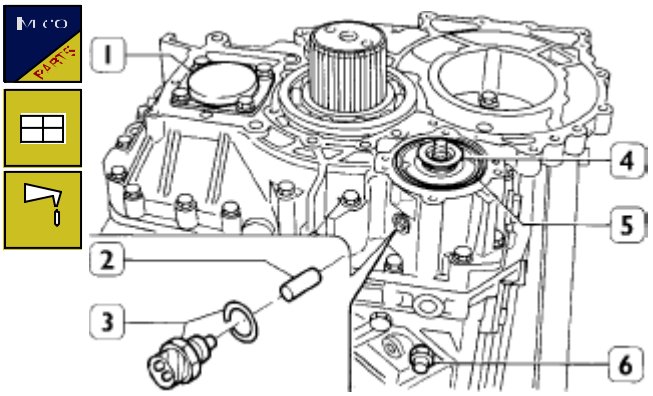
Put a new gasket on the gearbox (2) and refit the ERG rear box (1).

Fit the two centring pins (→) and tighten the fixing screws (6) to the required torque.

Mount the cover (3) with a new gasket and tighten the screws (5) to the required torque.

Screw down the plug (4).

Figure 41

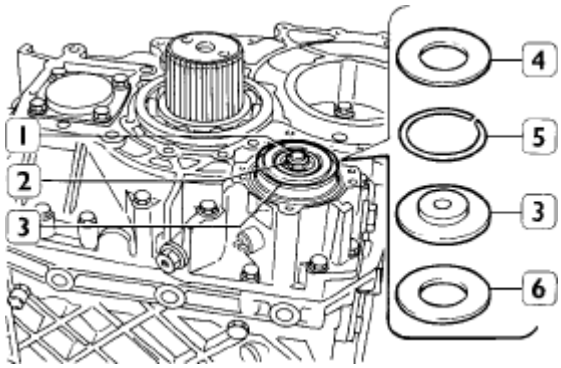



37353

Insert the push rod (2) into the gearbox and fit the switch (3) with the washer. Mount the retaining push rod 145N (6).

Lubricate the seal (5), gasket (4) and mount them on the box (1).

Figure 42

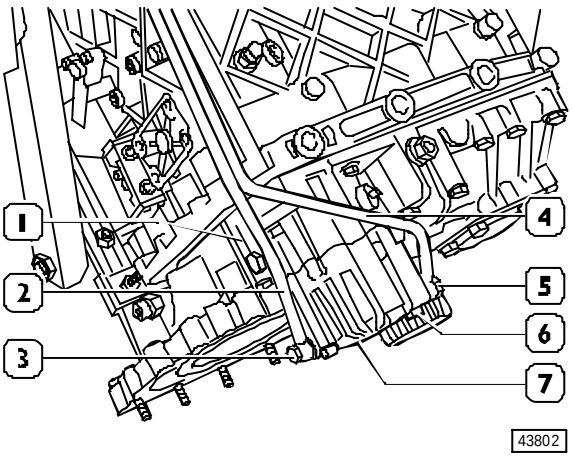



43815

Change the seals (4 and 6), spacer ring (5) of the piston (3) and lubricate them.

Fit the piston (3) on the rod (1) and tighten the nut (2) to the required torque.

Figure 43




43802

Lubricate the inside of the cylinder (7), fit it on the box (1) and tighten the fixing screws (6) to the required torque.

Connect the pipes (2 and 4) to the cylinder (7), screwing down the fittings (3 and 5) with new washers and tightening them to the required torque.

Reconnect hydraulic decelerator as described in relating chapter and fill the unit with oil by prescribed quantity and quality.

Aquila Trucks Centres

# Gearbox
# Euro Tronic 12 AS 1420 T.D.


| | Page |
|---|---|
| DESCRIPTION | 43 |
| LOCATION OF GEARBOX DESCRIPTION PLATE | 43 |
| MAIN DATA | 45 |
| TIGHTENING TORQUES | 46 |
| TOOLS | 46/1 |
| OVERHAULING THE GEARBOX | 46/6 |
| - Checks | 46/6 |
| - Preliminary works | 46/6 |
| CLUTCH ACTUATOR | 46/6 |
| - Clutch actuator removal | 46/6 |
| - Clutch actuator reassembly | 46/7 |
| GEARBOX ACTUATOR | 46/7 |
| - Gearbox actuator removal | 46/7 |
| - Gearbox actuator reassembly | 46/8 |
| REAR BOX | 46/8 |
| - Rear box removal | 46/8 |
| - Rear box disassembly | 46/9 |
| - Synchronizer disassembly | 46/11 |
| - Synchronizer assembly | 46/11 |
| SATELLITE HOLDER SHAFT | 46/12 |
| - Satellite holder shaft disassembly | 46/13 |
| - Satellite holder shaft assembly | 46/14 |
| - Rear box assembly | 46/15 |
| - Output cover assembly | 46/15 |
| - Output flange assembly | 46/16 |
| CLUTCH CASING | 46/16 |
| DISCONNECTING FORK | 46/16 |

https://truckmanualshub.com/
Aquila Trucks Centres


| | Page |
|---|---|
| - Disassembly | 46/16 |
| - Assembly | 46/16 |
| - Disassembly of the front cover | 46/16 |
| - Disassembly of the oil pump | 46/17 |
| - Clutch casing removal | 46/17 |
| - Disassembly of the input shaft | 46/18 |
| - Shaft removal | 46/18 |
| - Disassembly of the main shaft | 46/19 |
| SPLITTER CONTROL FORK | 46/21 |
| - Disassembly/Assembly | 46/21 |
| GEAR CONTROL FORKS | 46/21 |
| - Disassembly | 46/21 |
| - Assembly | 46/21 |
| SECONDARY SHAFT | 46/21 |
| - Disassembly | 46/21 |
| - Assembly | 46/22 |
| - Assembly of the main shaft | 46/22 |
| - Assembly of the motion input shaft | 46/23 |
| - Rear box assembly | 46/24 |
| - Rear box disassembly | 46/24 |
| GEARBOX CASING | 46/24 |
| - Disassembly | 46/24 |
| - Assembly | 46/25 |
| - Shaft reassembly | 46/25 |
| - Clutch casing reassembly | 46/26 |
| - Adjustment of the axial clearance of bearings of the motion input shaft and of the secondary shaft | 46/27 |
| - Adjustment of the axial clearance of the motion input shaft | 46/28 |
| - Adjustment of the secondary shaft axial clearance | 46/29 |
| - Assembly of the front cover | 46/29 |

Aquila Trucks Centres

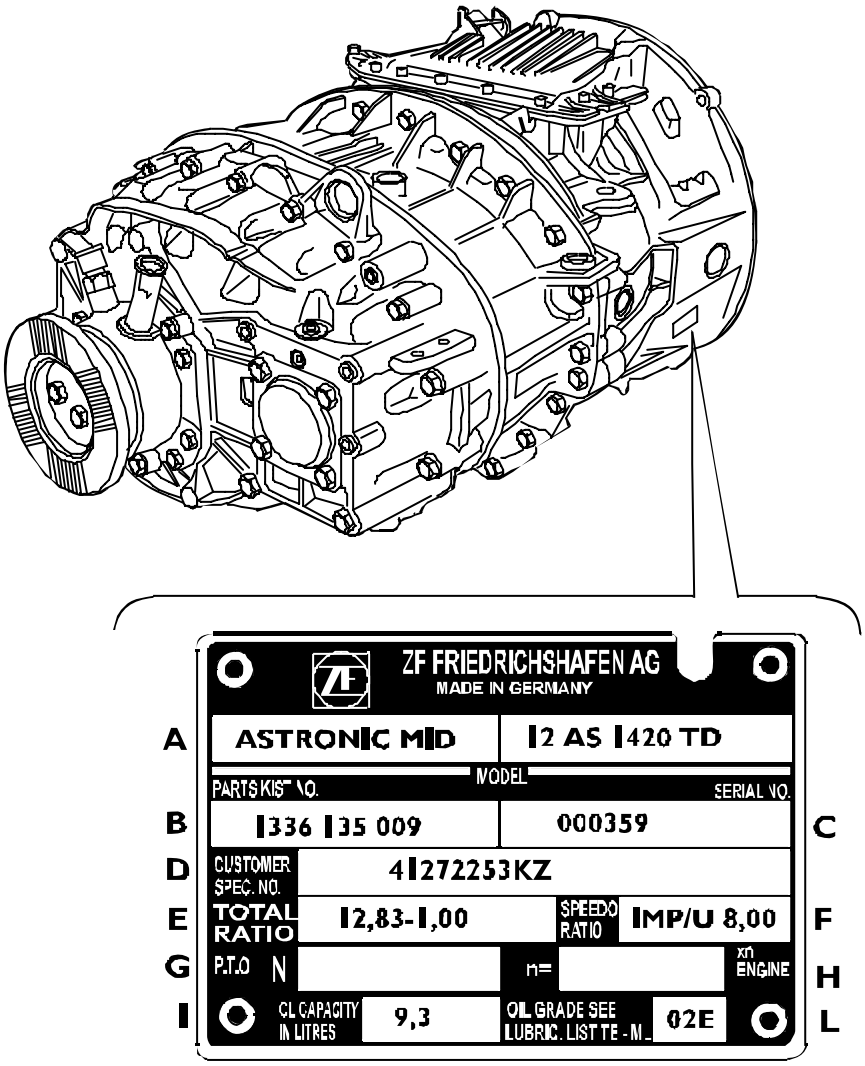
## DESCRIPTION

The EuroTronic gearbox 12 AS 1420 T.D. is mechanical with electro-pneumatic control.
The driver can choose whether to program gear selection/engagement manually or automatically. The shafts and gears have helical toothing that reduces operating noise.
The main shaft gear coupling is obtained with sleeves with front toothing.
The splitter and epicyclic reduction gear unit engagement is synchronized.
The speeds are selected with finely staggered ratios and can be engaged in succession with the coupling of the epicyclic reduction gear unit "ERG" and the "Splitter" slow or fast speed unit.
On engaging the "ERG", the speeds of the main shaft are doubled. The ratios obtained in this way are further doubled with the engagement of the "Splitter". Each single ratio is thus divided into a fast or slow ratio.

T.D. = Truck Direct drive

## LOCATION OF GEARBOX DESCRIPTION PLATE

Figure 1



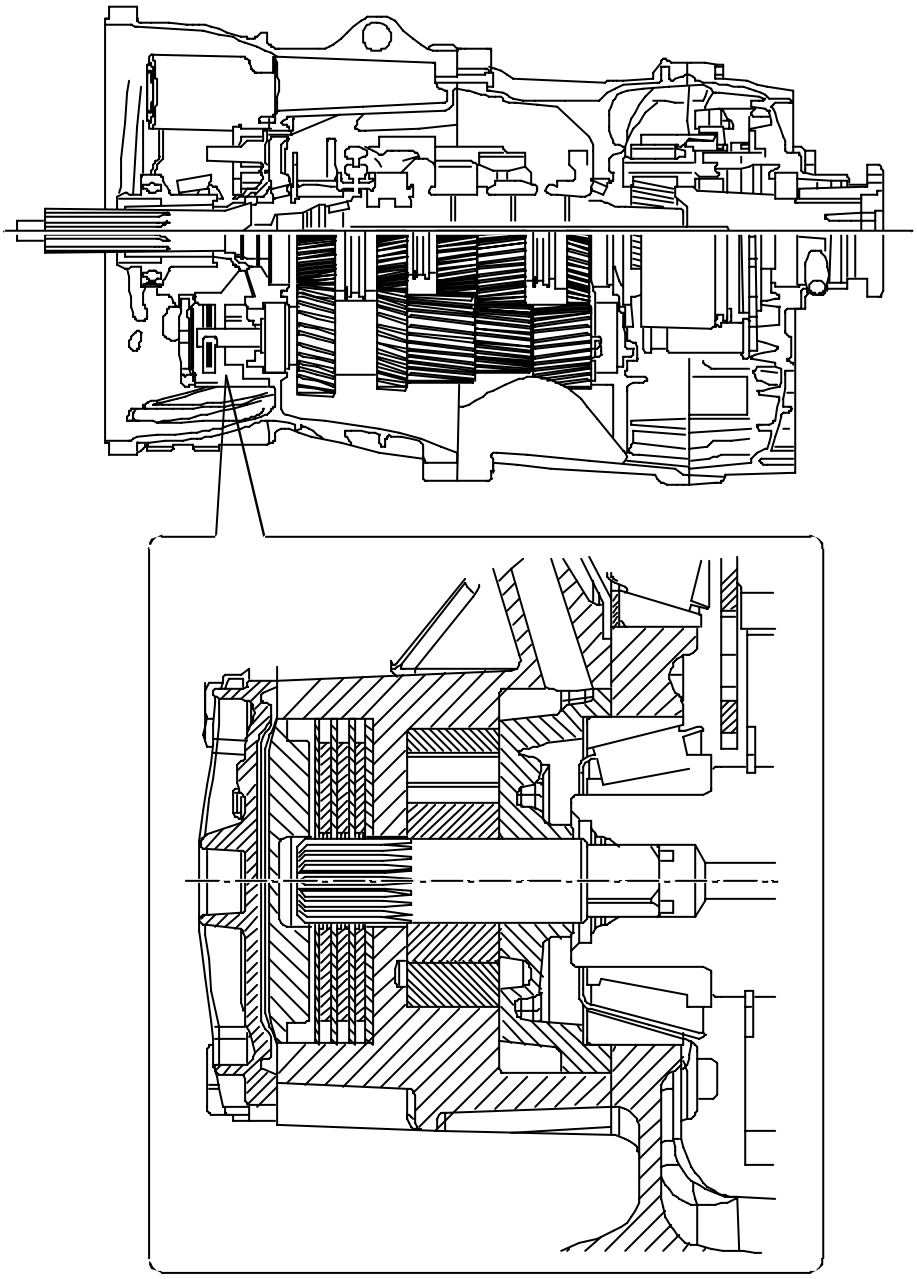

112211

A = Type of transmission
B = ZF drawing no.
C = Production sequence number
D = Spare part IVECO drawing no.
E = Transmission gear ratio
F = Tachometer gear ratio
G = Type of power take-off
H = Power take-off gear ratio
I = Replacement oil amount
L = ZF lubricant list name

P.T.O. = Power take-off

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Figure 2



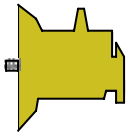
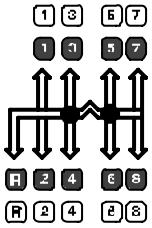
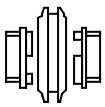
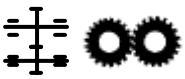
112212

LONGITUDINAL SECTION WITH INTEGRATED OVERRUN BRAKE AND OIL PUMP

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## MAIN DATA

| | | |
|---|---|---|
|  | GEARBOXES | EuroTronic Automated<br>12 AS 1420 T.D. |
| | Type | Mechanical |
| | Torque activated Nm | 1400 |
|  | Forward gears<br>Reverse gears | 12<br>2 |
| | Type of running control | electronically-operated semi-automatic |
|  | Rear power takeoff | optional |
|  | Gear engagement:<br>E.R.U.* and splitter engagement | by front engagement sleeves<br>free ring synchroniser |
|  | Gears | constantly engaged straight toothed |
|  | Gear ratios<br>1st<br>2nd<br>3rd<br>4th<br>5th<br>6th<br>7th<br>8th<br>9th<br>10th<br>11th<br>12th<br>1st reverse gear<br>2nd reverse gear | <br>12.384<br>10.369<br>8.428<br>6.487<br>5.176<br>4.182<br>3.009<br>2.480<br>1.920<br>1.951<br>1.238<br>1.000<br>13.072<br>10.561 |
|  | Type of oil<br>- 1st filling Litres<br>kg | Tutela Truck Fe-Gear<br>Tutela ZC 90<br>9.3<br>8.3 |

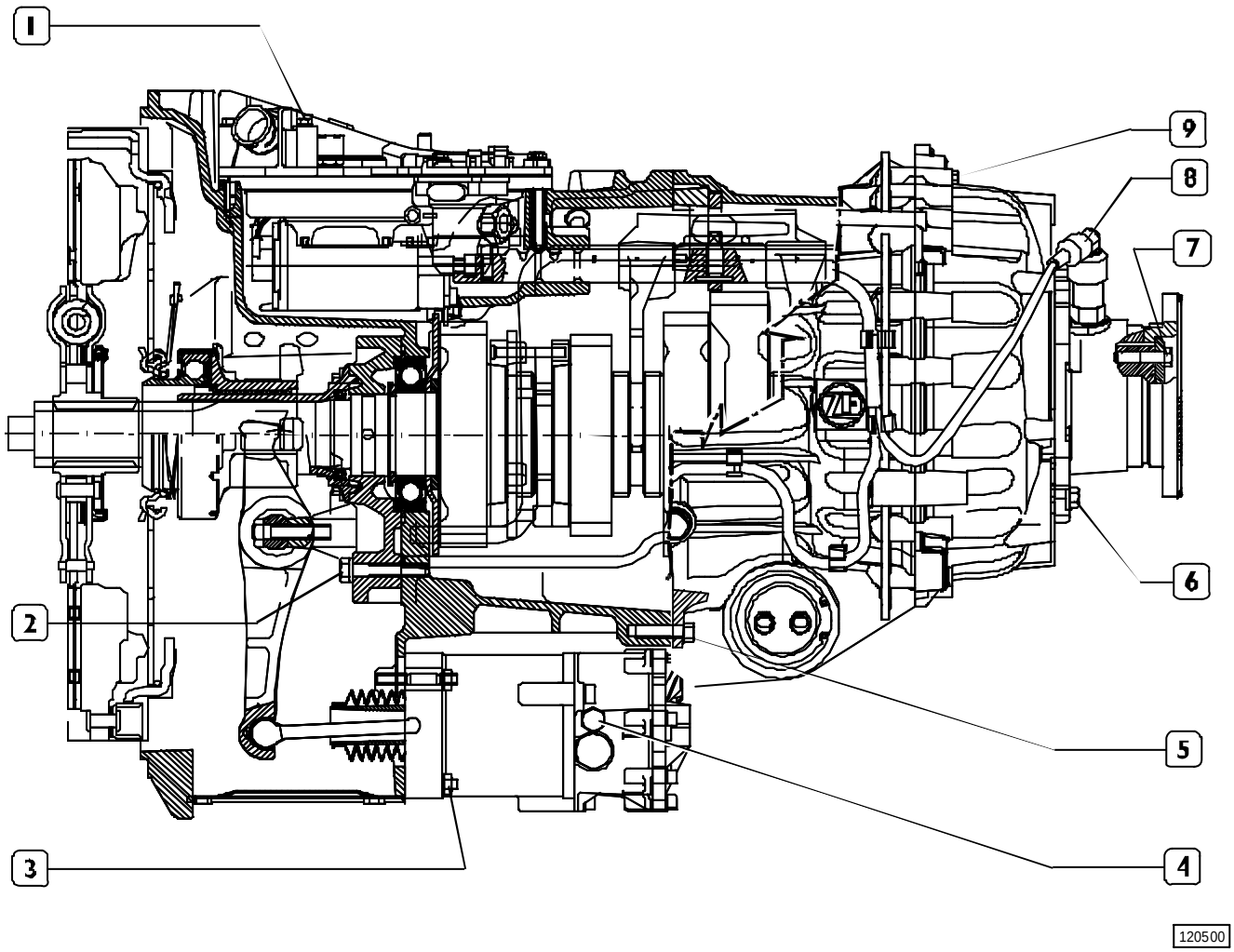
* ERG = Epicyclic reduction gear unit
T.D. = Truck Direct Drive


Base - November 2006
Revi - June 2007

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## TIGHTENING TORQUES

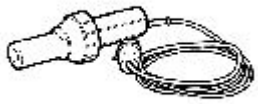
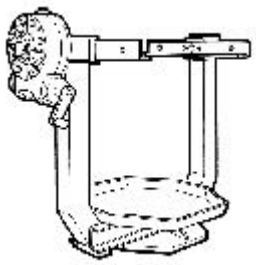
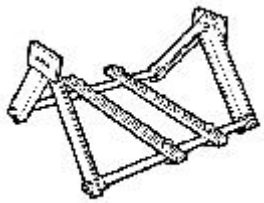
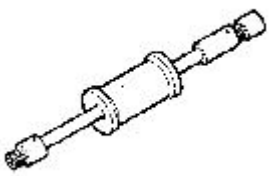
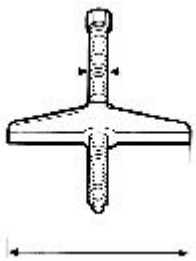
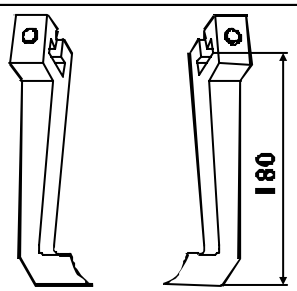
Figure 3




| | DESCRIPTION | TORQUE Nm | TORQUE kgm |
|---|---|---|---|
| 1 | Screws fixing gearbox actuator | 23 | 2.3 |
| 2 | Screws fixing cover | 46 | 7.9 |
| 3 | Screws fixing clutch actuator | 23 | 2.3 |
| 4 | Screw cap to discharge air from clutch actuator | 22 | 2.2 |
| 5 | Screws fixing rear box to middle box | 50 | 4.6 |
| 6 | Screws fixing rear cover | 46 | 4.6 |
| 7 | Screws fixing flange retaining plate | 79 | 7,9 |
| 8 | Speed sensor | 45 | 4.5 |
| 9 | Screws fixing middle box to front box | 50 | 5 |
| | Screw plug M 10x1 on rear box | 60 ± 6 | 1.5 |
| | Screw plug M 24x1 on rear box | 60 ± 6 | 6 ± 0,6 |

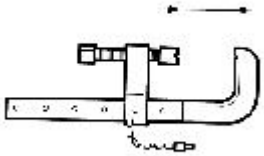
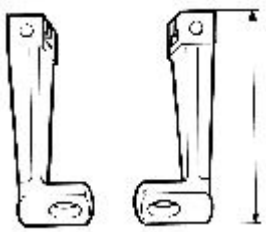
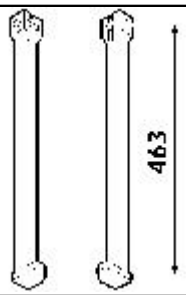
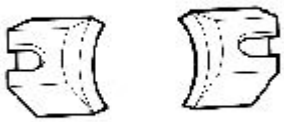
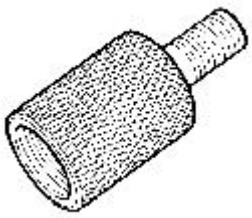
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## TOOLS

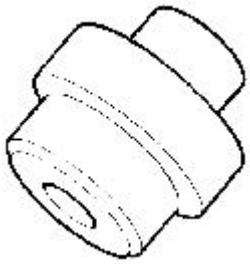
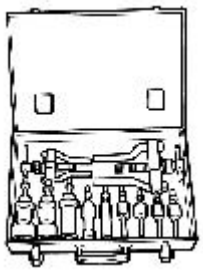
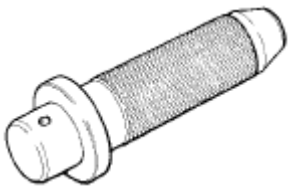
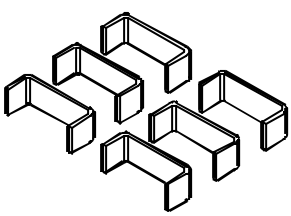
| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99305121** |  | Hot air device |
| **99322205** |  | Rotary stand for overhauling assemblies |
| **99322225** |  | Mount to support assemblies (to fit onto stand 99322205) |
| **99340205** |  | Percussion extractor |
| **99341003** |  | Single-acting bridge |
| **99341011** |   | Pair of brackets |

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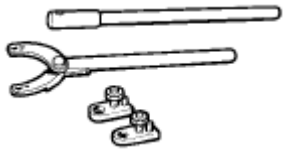
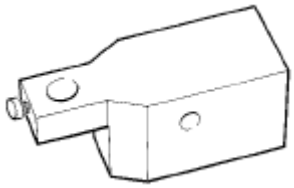
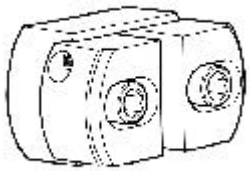
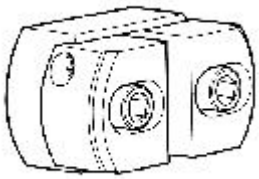
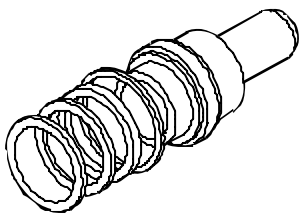
| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99341013** |  | Pair of brackets |
| **99341015** |  | Clamp |
| **99341017** |  | Pair of brackets with hole |
| **99341021** |  | Pair of tie rods with grips |
| **99341025** |  | Grips |
| **99342143** |  | Pin to extract gearbox front and rear centring pins (use with 99340205) |

Aquila Trucks Centres

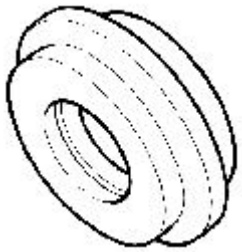
| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99345054** |  | Extractor reaction block |
| **99348004** |  | Universal puller for inner sides from 5 to 70 mm |
| **99366811** |  | Set of M10 eyebolts (3) to remove and refit gearboxes |
| **99370006** |  | Grip for interchangeable drifts |
| **99370007** |  | Grip for interchangeable drifts |
| **99370172** |  | Tools (6) to mount gearbox epicyclic reduction gear train synchronizer rings |

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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99370317** |  | Reaction lever with extension to fasten drive output flange |
| **99370415** |  | Dial gauge base to adjust transmission shaft bearings (use with 99395604) |
| **99370465** |  | Tool to notch safety plates |
| **99374092** |  | Drift to mount outer races of bearings (69 - 91) (use with 99370007) |
| **99374093** |  | Drift to mount external bearing races (Ø 91 ÷ 134 mm) (use with 99370007) |
| **99374221** |  | Driver to mount seals on back cover |

Aquila Trucks Centres

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99374336** |  | Driver to fit seals on the front cover of the gearbox (use with 99370006) |
| **99395604** |  | Dial gauge (0 - 10 mm) |

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# 530210 OVERHAULING THE GEARBOX

Before overhauling, wash the assembly accurately

The specific and/or generic equipment has to be used in the way it is designed for.

To make assembly easier, put away the disassembled components in the provided tray according to their disassembly order.

During assembly, the following components shall be always replaced with new ones: gaskets, sealing rings, plungers, safety plates and springs. Nuts and screws shall be tightened according to the preset torque and their threading shall be dry and degreased.

As regards lubricant and detergent disposal, see the specific standards.

During the overhaul, always use protective gloves to handle heated components.

## Checks

Gears, synchronizing rings, coupling bodies and sliding sleeves for coupling shall not to show failures or excessive wear of teeth.

The main shaft shall not have any notch, above all on the sliding surface of gear coupling and rotating sliding sleeves.

Pins of the reverse counter gear shall have a smooth and groove-free surface.
Gearboxes shall not have cracks and bearing seats shall not be damaged o worn out in order to prevent bearing outer rings from rotating in their seats.

Make sure that shoulder spacers are not worn out or damaged.

The gear coupling forks shall not show cracks and the related control rods have to slide freely, but without a significant clearance, in the guide seats.

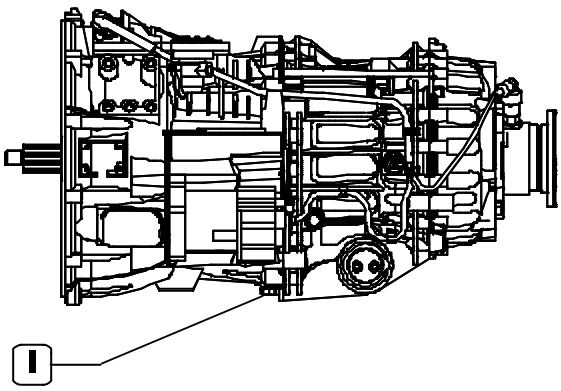
Make sure that control fork shoes are perfectly efficient.

Make sure that lubrication holes, grooves and pipes are not clogged by grease o foreign matters.

Make sure that bearings are not worn out, damaged or overheated.

## Preliminary works

Figure 4

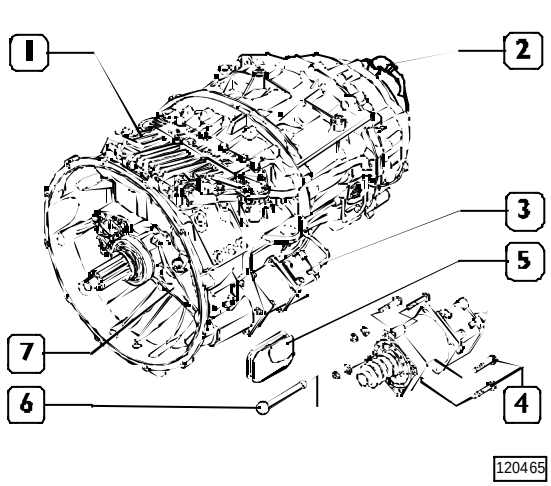



Unscrew the plug (1) and drain oil into a proper container.

## CLUTCH ACTUATOR

### Clutch actuator removal

Figure 5




Cut off connections of the electric wiring from the gearbox actuator (1) and from the output revs sensor (2).

Loosen the screws (4) before removing the hexagon nuts, complete with washers. Then remove the clutch actuator (3), complete with hexagon-head screws.

Remove the protective cover (5).

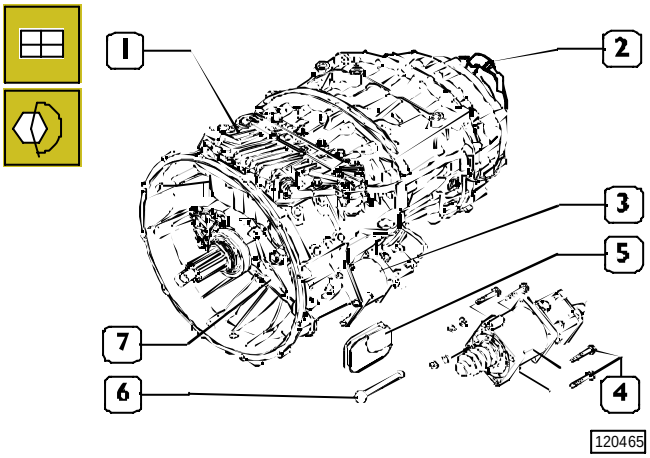
Remove the spherical push rod (6) from the disconnecting fork (7).

**NOTE** The adjustment of the push rod (6) is described in the clutch section of this manual

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## Clutch actuator reassembly

Figure 6




Assemble the clutch actuator (3) onto the gearbox. Make sure that connections are in the correct position.
Insert the screws into the (4) actuator and tighten the four hexagon nuts, complete with washers, according to the set torque (23 Nm).

Loosen the screw on the actuator and let the piston protrude. During this operation, check the correct housing of the push rod (6) in the disconnecting fork (7).
Tighten the screw according to the set torque (22 Nm).

Assemble the cover (5).

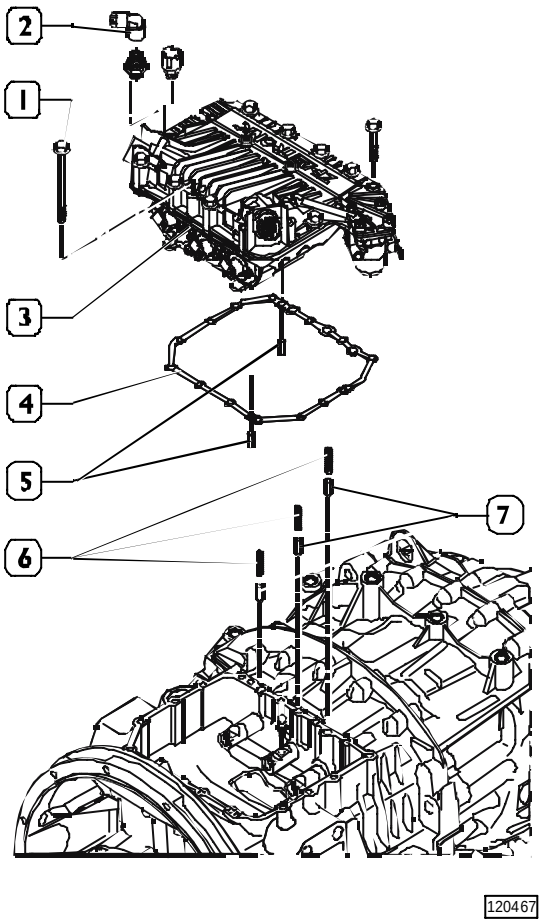
Connect the electric wiring to the clutch actuator (3), to the gearbox actuator (1) and to the output revs sensor (2).

Do not bend the cable and make sure that it is not too taut.
Avoid any friction point.
Make sure that connectors are inserted correctly.

## GEARBOX ACTUATOR

### Gearbox actuator removal

Figure 7




Remove the screws (1) and cut out the actuator (3) and the related gasket. (4)

Remove the compression springs (6) and the stop pins (7). Replace the two cylindrical pins (5), if damaged.

**NOTE** The electronic control unit is built-in in the actuator. These components cannot be overhauled.

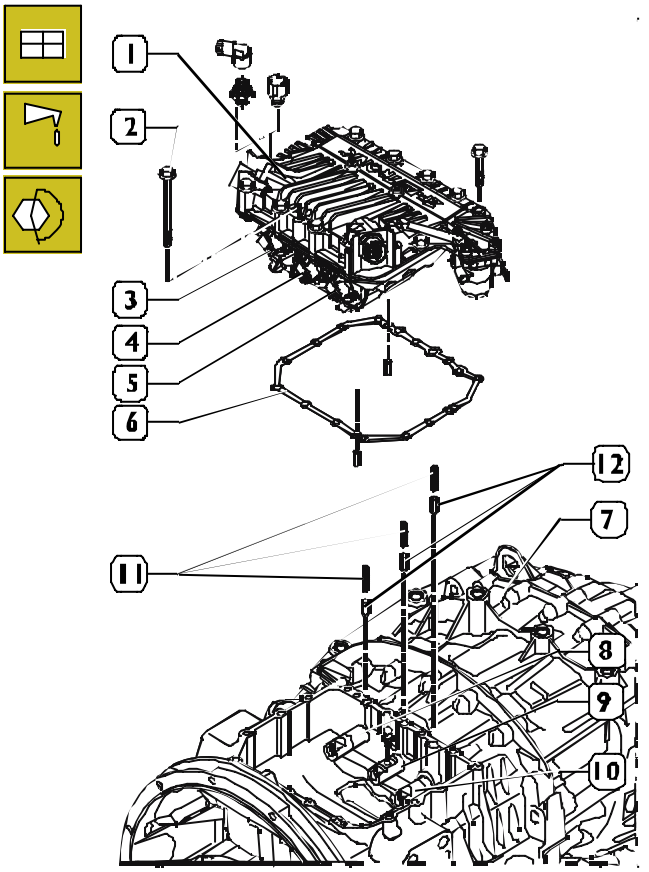
Make sure that the oil vapor breather (2) is not clogged, otherwise clean it.

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## Gearbox actuator reassembly

Figure 8




120468

Position a new gasket on the clutch casing (4).
Lubricate the solenoid valve stems (3-4-5) with silicone grease and set them to neutral position.
Position the rods (8-9-10) in neutral position.
Insert the stop pins (12) and the compression springs (11).

**NOTE** Compression springs (11) shall have the same length (abt. 50 mm).

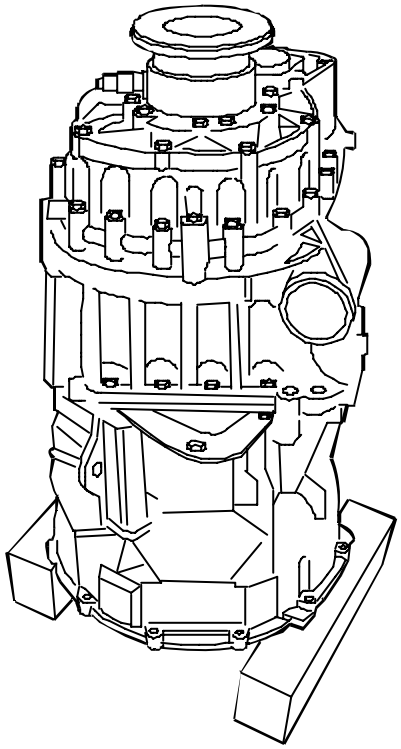
Assemble the actuator (1) onto the front box (7), making sure that the ends of the solenoid valve stems are exactly positioned in the rod seats (8-9-10). Tighten the fastening screws (2) according to the set torque (23 Nm).

## REAR BOX

### Rear box removal

**NOTE** Before cutting-out the rear box, disassemble the gearbox actuator and the idle switch, as described in the previous paragraphs.

Figure 9

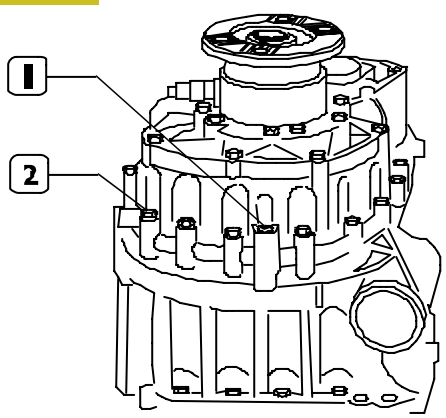


120469

Put the gearbox onto two square pieces of wood, from the friction housing side.

The gearbox has not to lay on the tang of the motion input shaft.

Figure 10

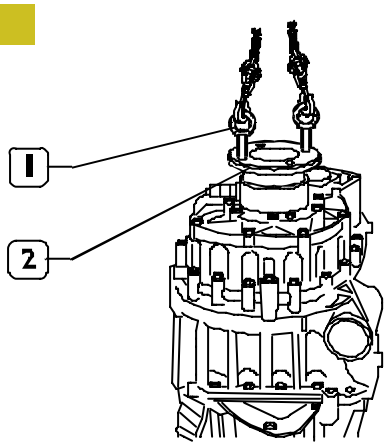



120470

With extractor 99340205 and pin 99342143 remove the centering pins (1).
Remove the hexagon-head screws (2) of the rear box.

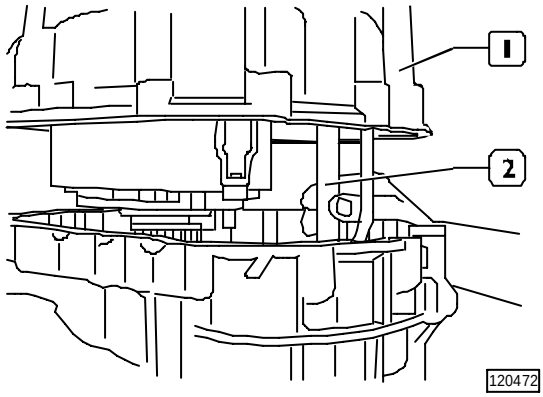
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Figure 11




Fasten the two eyebolts 99366811 (1) to the output flange (2).

Figure 12

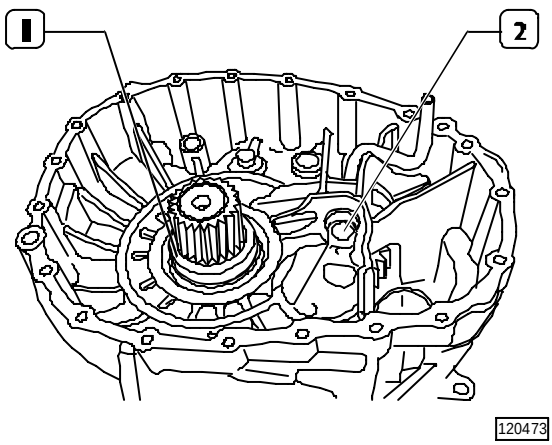



By means of special ropes and lift, remove carefully the rear box (1), completed with the epicyclical reduction gear assembly (GRE).
Hold the control rod (2).

The control rod (2) is not fastened to the control arm. If not held, it might fall.

Remove the control rod (2) from the control arm.

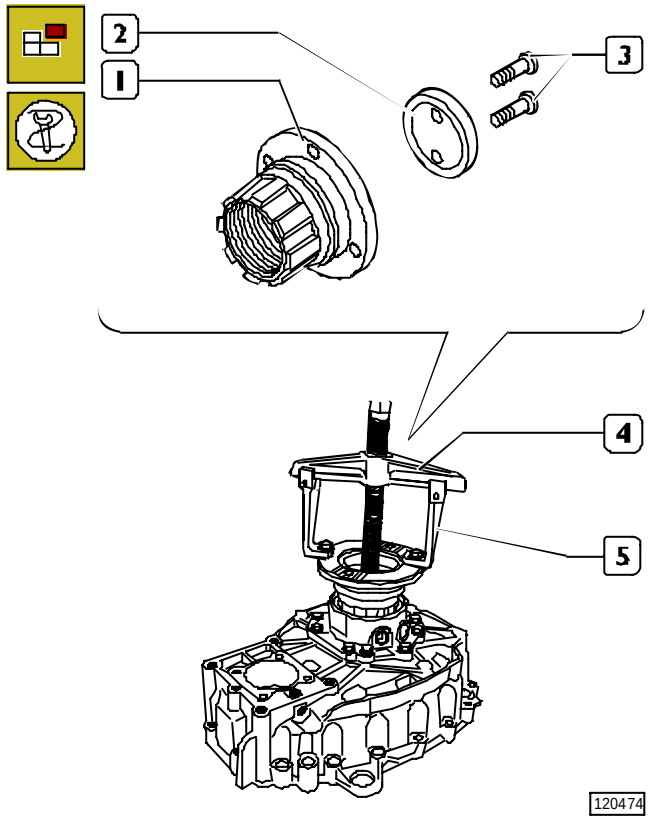
Figure 13




Remove the thrust washer (1).
Remove the magnet (2) and clean it.

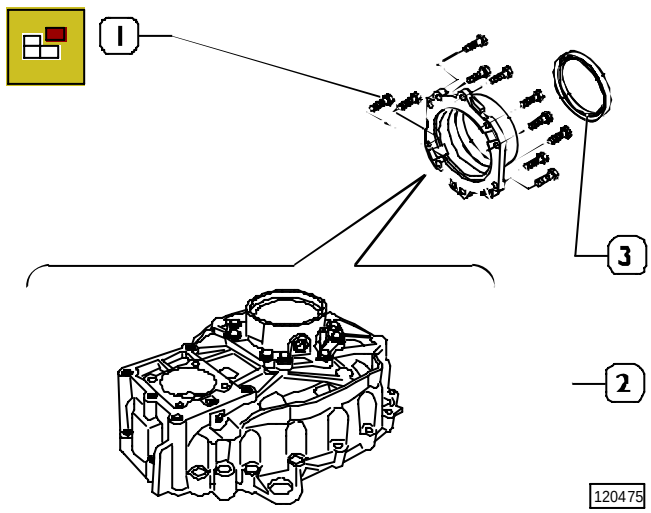
## Rear box disassembly

Figure 14




Remove the screws (3), the disc (2) and the flange (1) from the satellite holder shaft.
If removal is difficult, use the bridge 99341003 (4) and the brackets 99341017 (5), which are so applied as in the following figure.

Figure 15

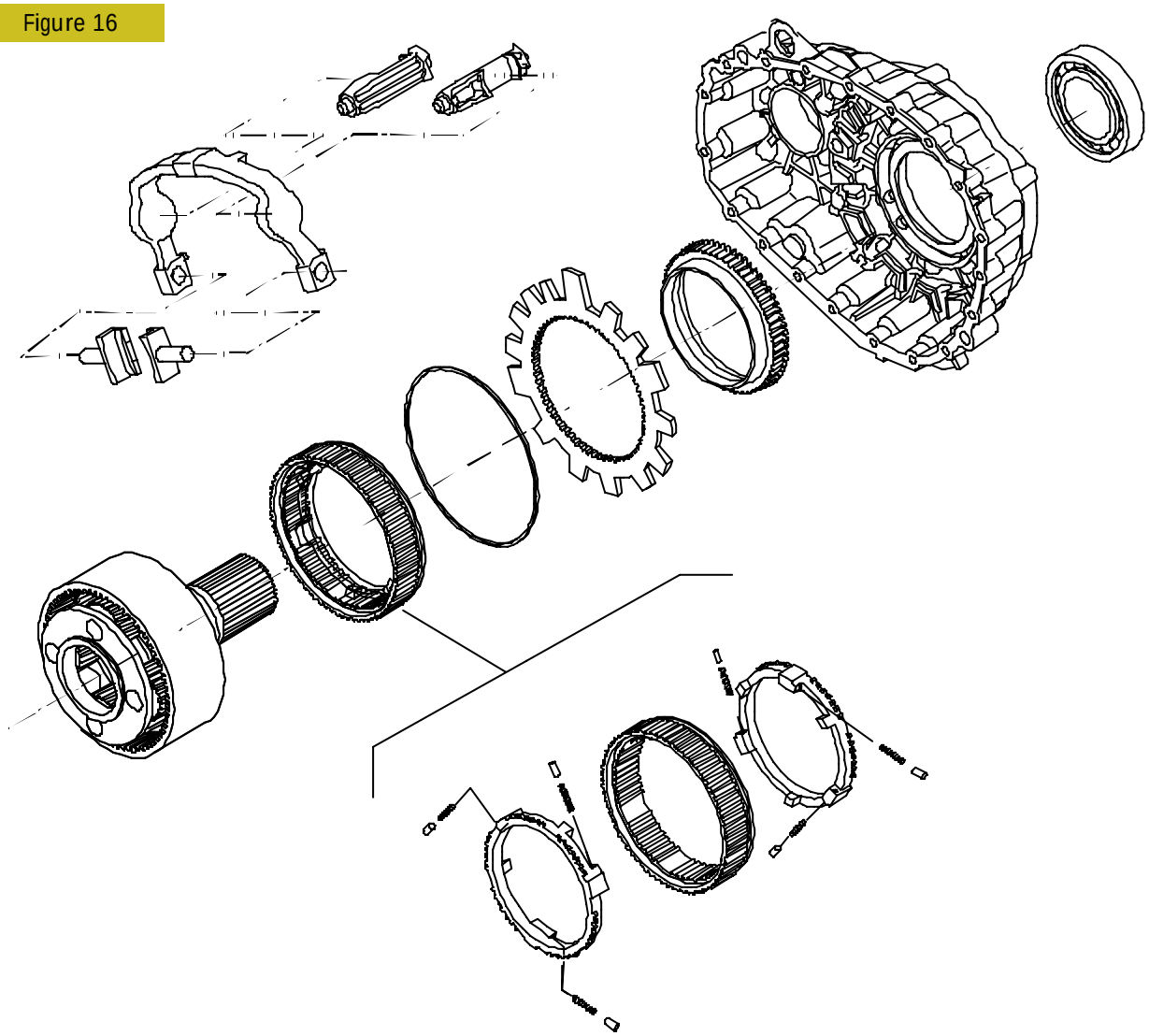



Remove the screws (1) and disconnect the output cover (2).
Remove the radial sealing ring (3) by means of a proper tool, without damaging the output cover.

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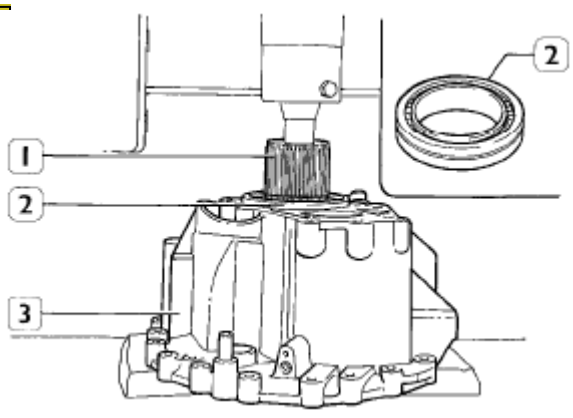
Figure 16



120476

COMPONENT PARTS OF THE REAR BOX

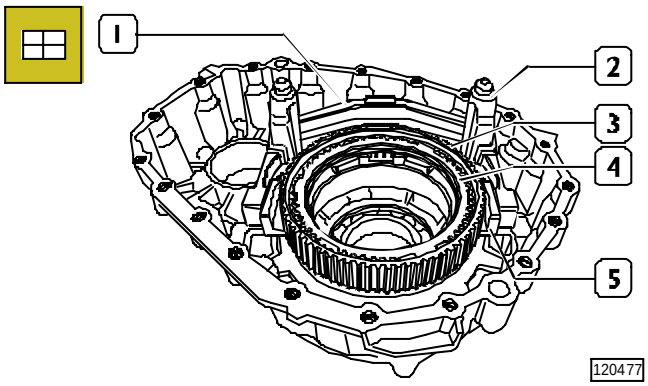
Figure 17




45946

With a press, remove the satellite holder shaft (1) from the supporting roll bearing (2). Turn the rear box (3) upside down.

Figure 18




120477

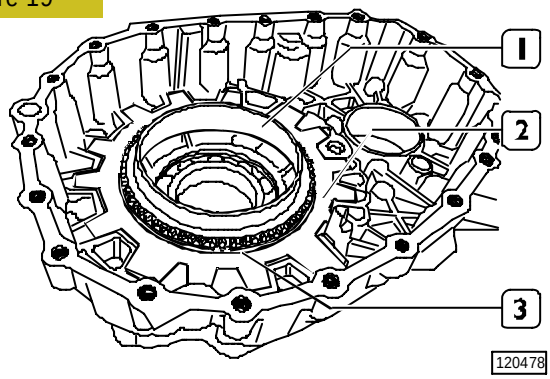
Push downwards the sliding sleeve (3) and the synchronizing ring (4) (to idle position).

**NOTE** During this operation, pawls and compression springs of the synchronizer might come out.

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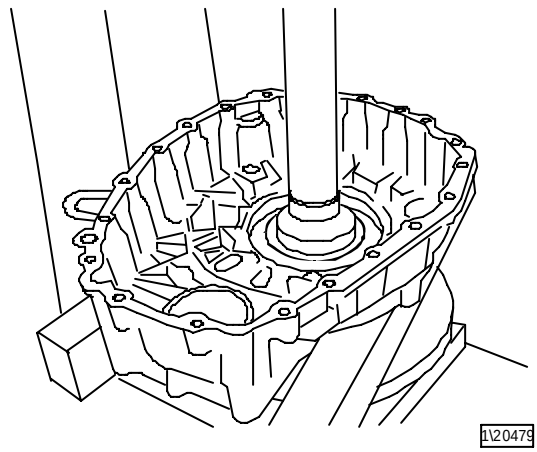
Disassemble supports (2) from the box.
Remove the shoes (5) from the sliding sleeve (3).
Remove the control arm (1) and the related supports.
Remove the shoes (5) from the control arm (1).

Figure 19




Remove the disc clutch (2) and the coupling hub (1) from the box.
Disassemble the safety ring (3), which is installed between the disc clutch (1) and the coupling hub (2).

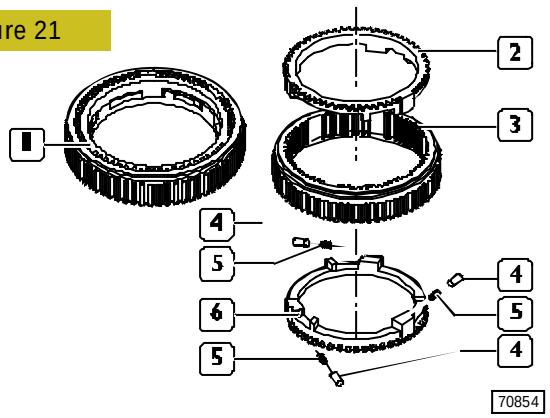
Figure 20




Under press, disassemble roll bearing from the rear box.

## Synchronizer disassembly

Figure 21

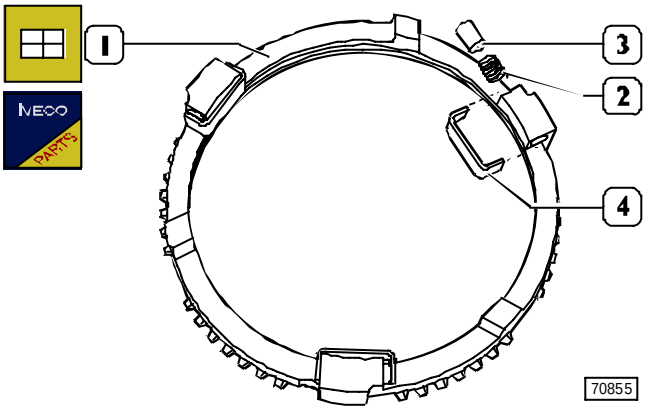



1. Synchronizer assembly - 2. Synchronizer ring - 3. Sliding sleeve - 4. Pawl - 5. Spring - 6. Synchronizing ring

Put a cloth onto the synchronizer assembly (1) so that, during its disassembly, springs (5) and pawls (4) are held while coming out from their seats.

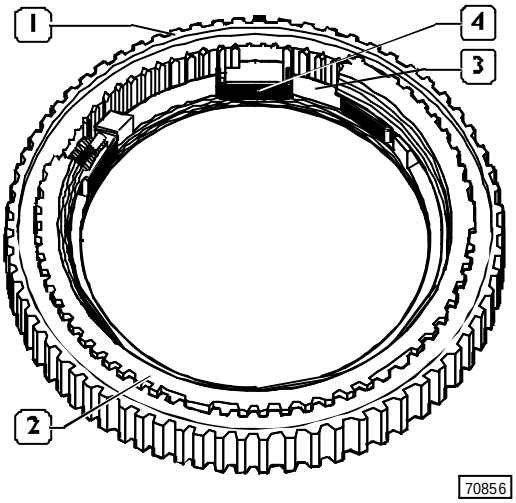
## Synchronizer assembly

Figure 22




Insert springs (2) and pawls (3) into the synchronizing ring seats (1) and fasten them with tools 99370172 (4).

Figure 23




Position the synchronizing ring (2) onto the synchronizing ring (3) so that they can be assembled onto the sliding sleeve (1). Assemble the synchronizer assembly (1) onto the coupling body with the annular groove (→) facing downwards.

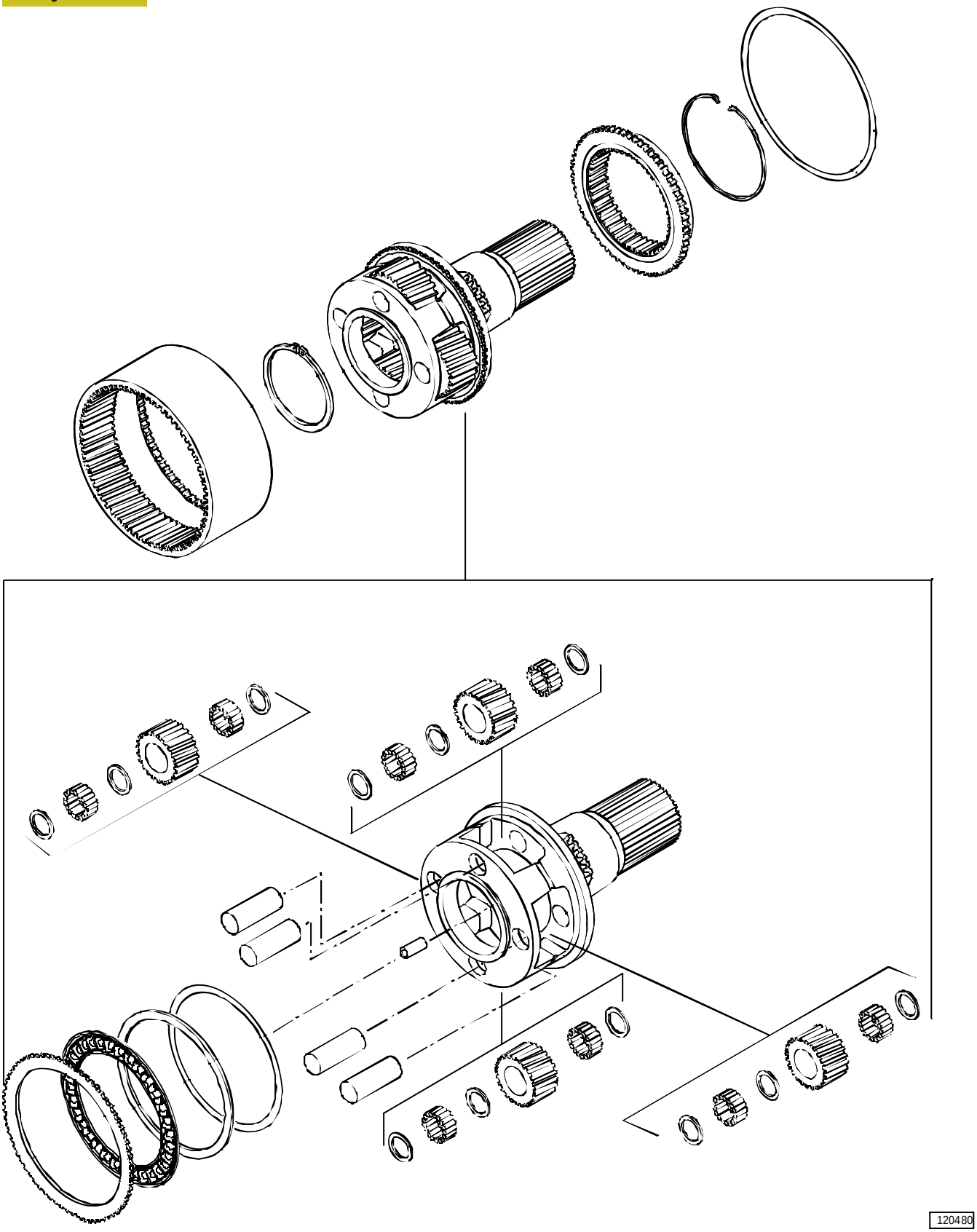
**NOTE** Remove the tools 99370172 (4) only when explicitly required by the assembly procedures in the following sections.

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## SATELLITE HOLDER SHAFT

Figure 24

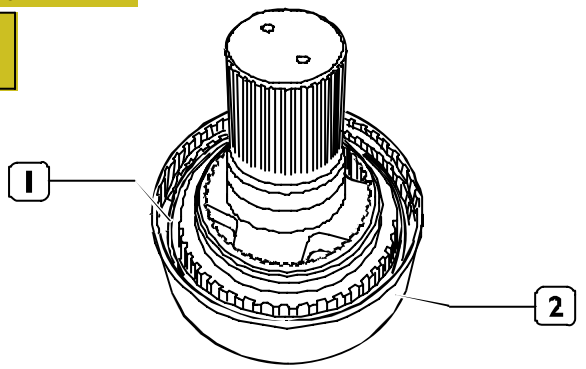



MAIN COMPONENTS OF THE SATELLITE HOLDER SHAFT

Aquila Trucks Centres

## Satellite holder shaft disassembly

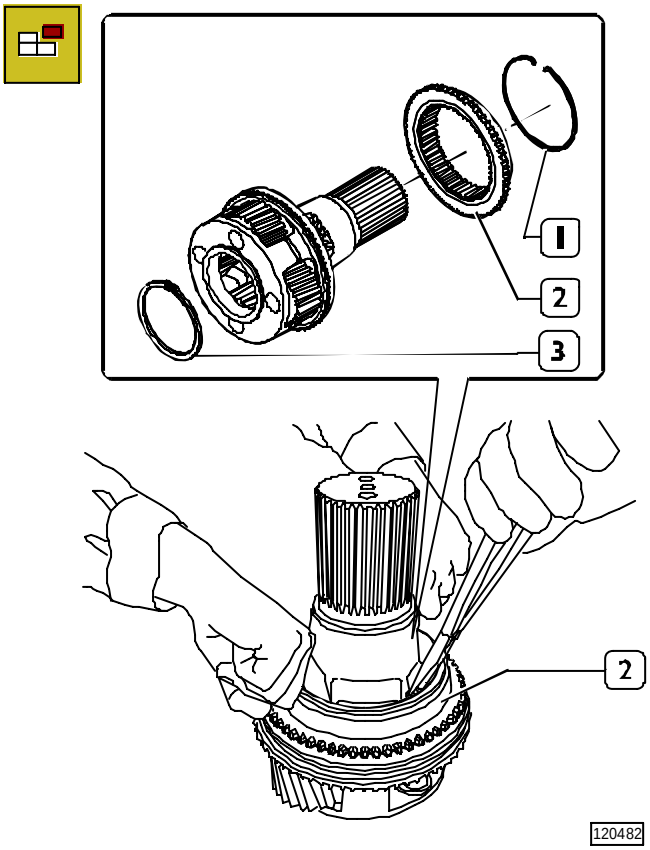
Figure 25




Remove the safety ring (1), for example by means of two small screwdrivers and remove the crown (2) as well.

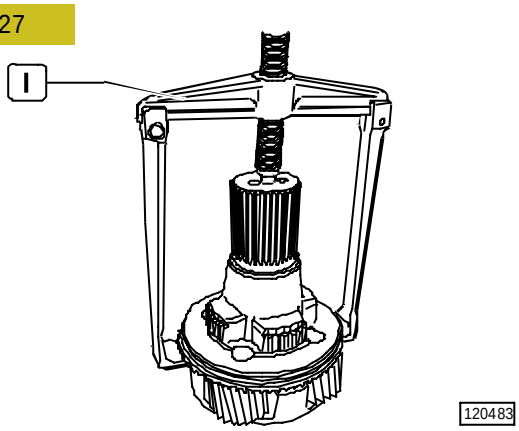
When disconnected, the crown (2) might fall.

Figure 26




Tighten the safety ring (1) with pliers. Remove the coupling hub (2) by lifting it from inside, as shown in the figure.
Remove the safety ring (3).

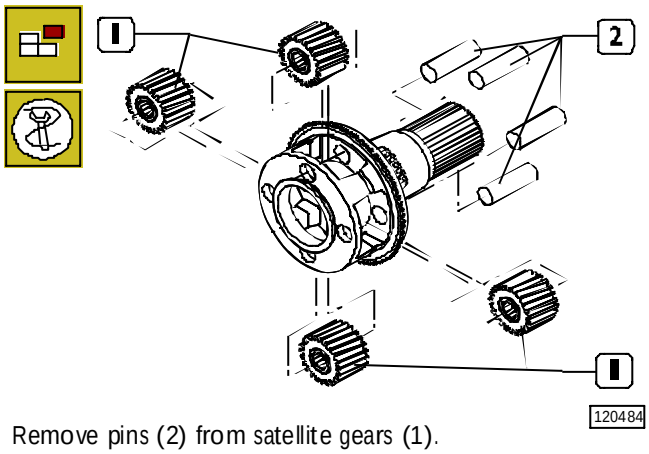
Figure 27




Pre-tighten the shoulder ring (4, Figure 29), the roll thrust bearing (3, Figure 29) and the Belleville spring (2, Figure 29) in two 180° shifted points.
Use the most suitable locking device (1) (an example is shown in the figure).

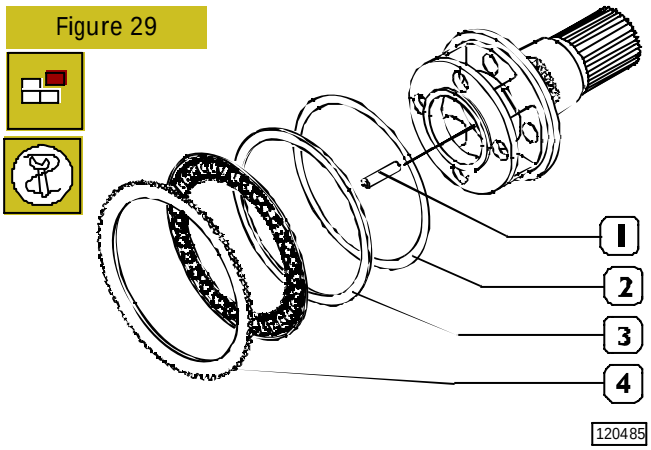
**NOTE** The locking is used to pre-load the Belleville spring and make the satellite gear disassembly easier (1, Figure 28).

Figure 28




Remove pins (2) from satellite gears (1).
Remove carefully the satellite gears (1), complete with rolls and washers.

Figure 29

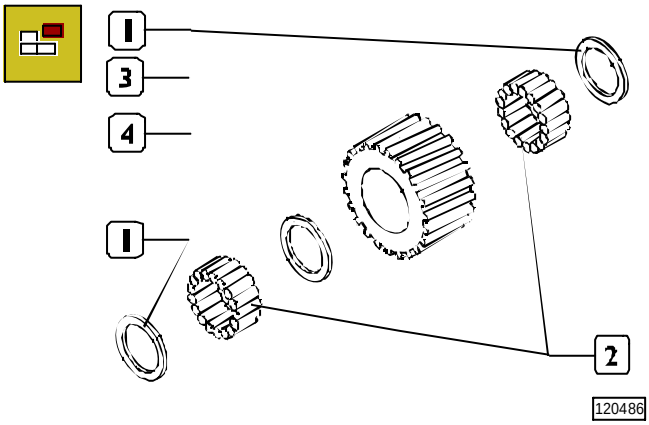



Remove the extractor (1, Figure 27), the shoulder ring (4), the roll thrust bearing (3) and the Belleville spring (2) from the satellite holder shaft.
Remove the oil pipe (1), if damaged.

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Figure 30



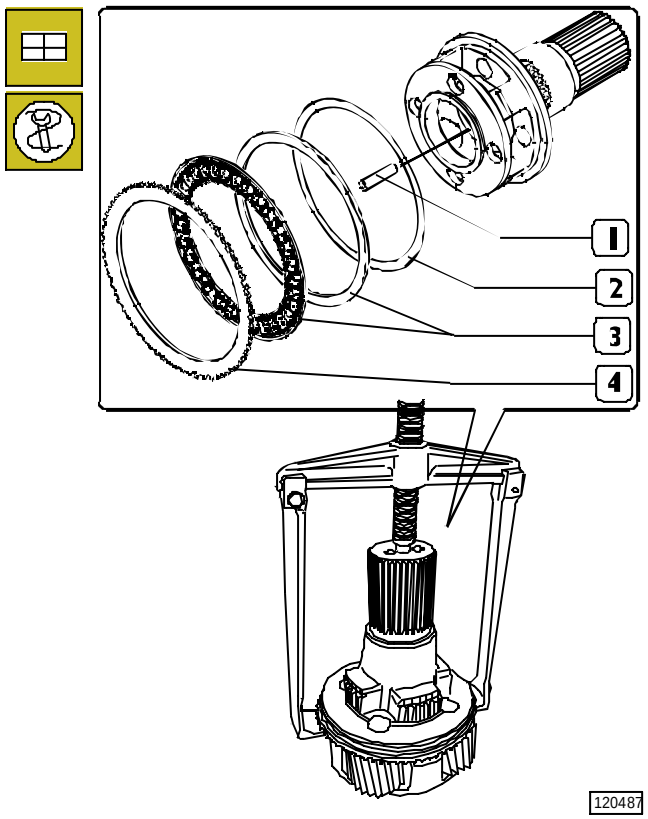

Remove washers (1 and 4) and washers and rollers (2) from the satellite gears (3).

**NOTE** The length of satellite gear, satellite holder shaft and the thickness of washers varies according to the gearbox type.

## Satellite holder shaft assembly

Spread grease on the satellite gear hole (3) and insert all rolls (2) with the related washers (1 and 4).

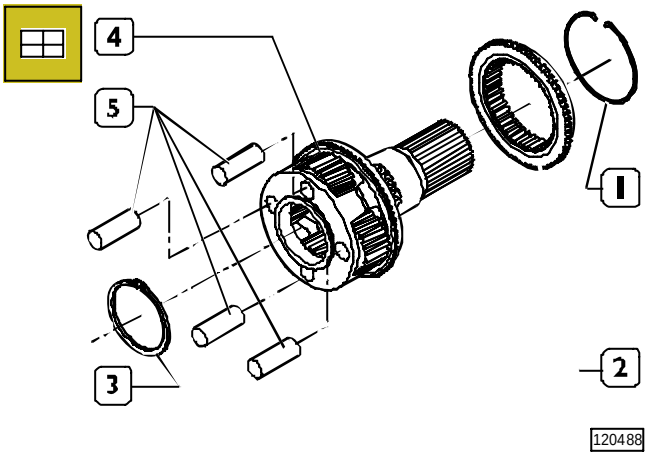
Figure 31




Assemble the Belleville spring (2), the roll thrust bearing (3) and the shoulder ring (4) on the satellite holder shaft, if damaged, and fasten then as described in disassembly.

**NOTE** Fastening is used to pre-load the Belleville spring and make the satellite gear assembly easier.

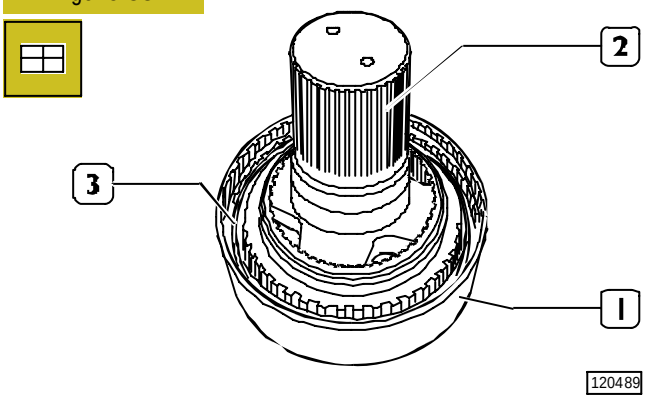
Figure 32




With pliers, tighten the ends of the snap ring (1) and assemble the coupling body (2) onto the G.R.E. shaft.
Insert carefully the pre-assembled satellite gears (4) into the satellite holder shaft.
Insert carefully leveled pins (5) into the respective holes of the satellite holder shaft.
Assemble the snap ring (3) making sure that it is correctly housed in the groove of the satellite holder shaft.

Remove the tool used for the pre-loading of the Belleville spring (2, fFigure 31).

Figure 33



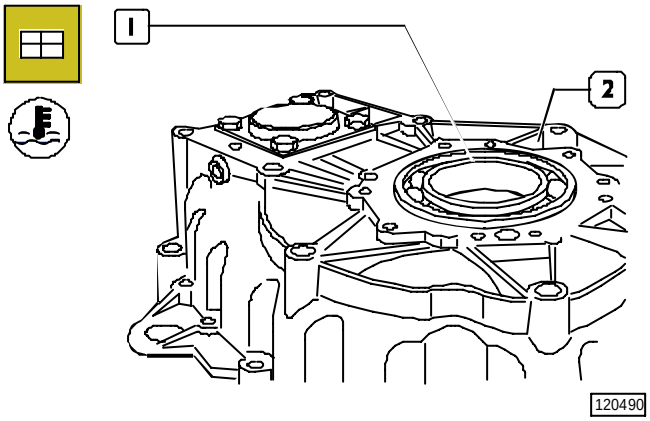

Put the crown (1) onto the support and assemble the satellite holder shaft (2)
Fasten the crown with the safety ring (3).

**NOTE** Make sure that the safety ring (3) is housed correctly in the groove provided in the crown bottom.

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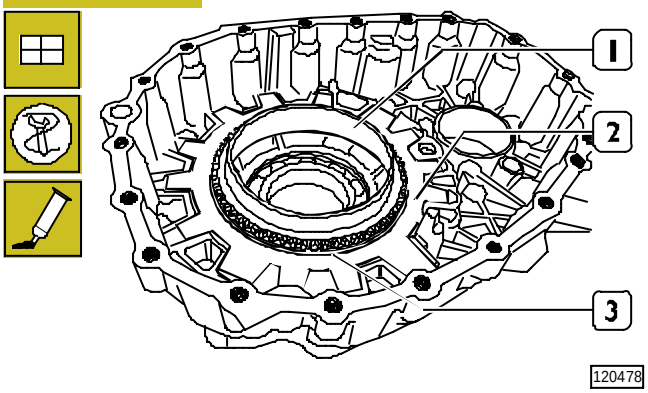
## Rear box assembly

Figure 34



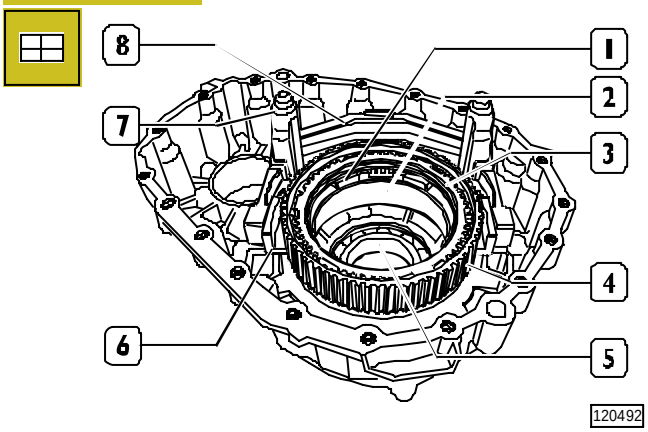

Heat the seat of the bearing (1) of the rear box (2) at 120 °C and assemble the bearing (1).

Figure 35




Rotate the rear box and put it on two supports.
Assemble the coupling hub (1) and the disc clutch (2) complete with safety ring (3) into rear box.

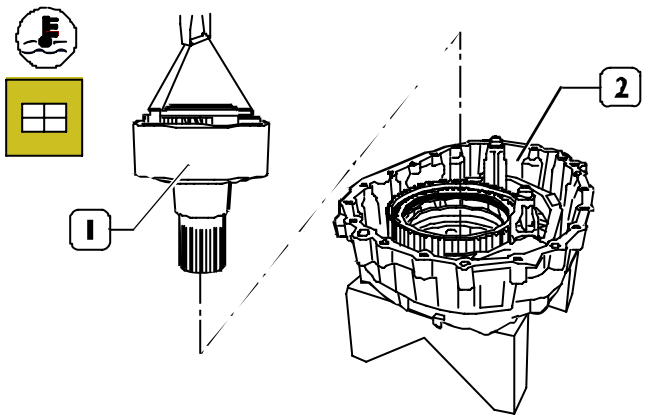
Figure 36




Assemble the previously assembled synchronizer set (3) onto the coupling body (2).
Remove the tools (1) 99370172.
Assemble the shoes (6) into the control arm (8) and insert them into the sliding sleeve (4).

**NOTE** To make assembly easier, stick supports (7) in the rear box with Loctite no. 241.

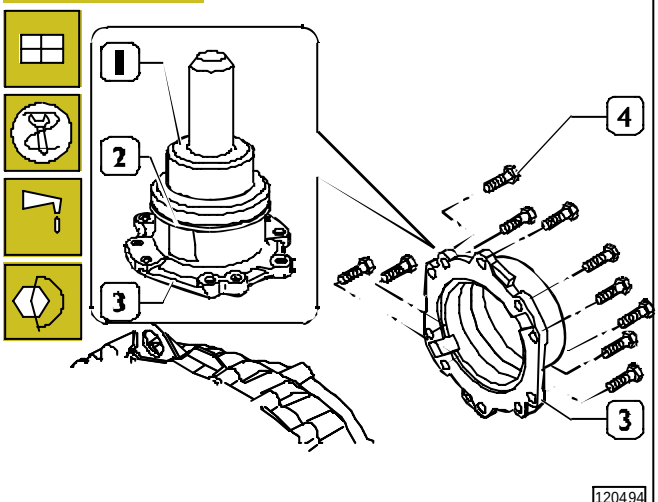
Figure 37




Heat the inner ring (5, figure 37) of the roll bearing at abt. 120 °C temperature.
Insert the satellite holder shaft (1) into the heated roll bearing, making sure that it reached the axial beat.
Turn the rear box (2) and assemble the remaining parts:

## Output cover assembly

Figure 38



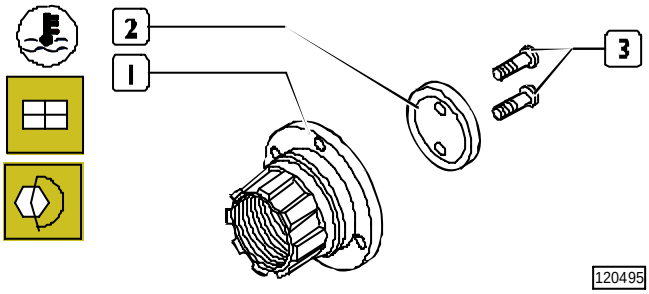

With locking set 99374221 (1), assemble the sealing ring (2) into the cover (3).
Fit the cover (3) on the rear box and fully tighten the hexagonal head screws (4).
Tightening torque = 46 Nm

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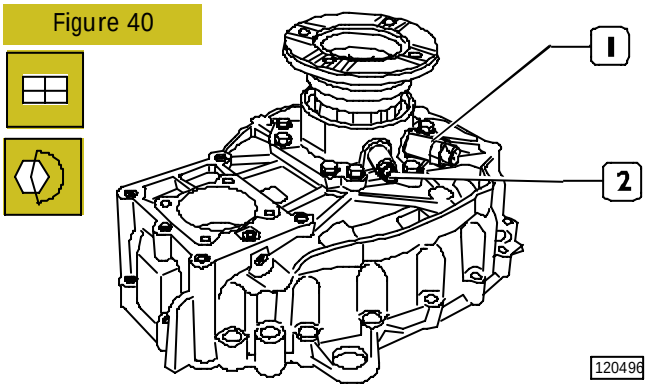
## Output flange assembly

Figure 39




Heat the output flange (1) at max. 160 °C temperature and push it onto the satellite holder shaft teeth to the axial contact.
Assemble the disc (2) and tighten the screws (3) according to the set torque.
Tightening torque = 79 Nm

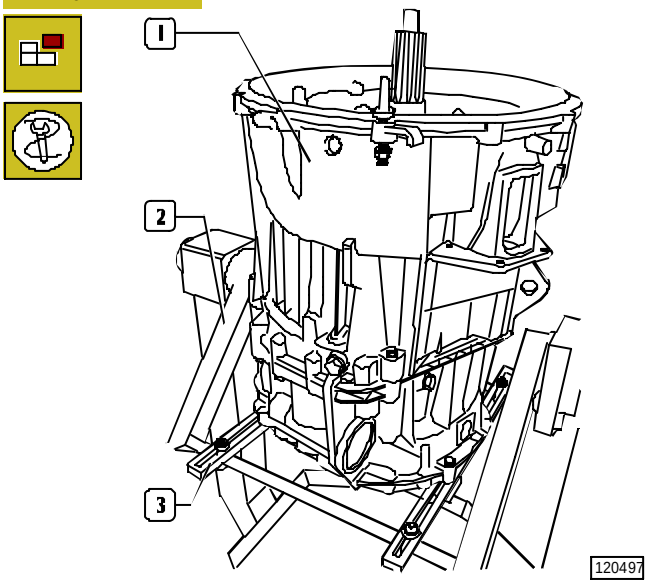
Figure 40




Screw the transmitters (1 and 2) according to the set torque.
Tightening torque = 45 Nm

## CLUTCH CASING

Figure 41

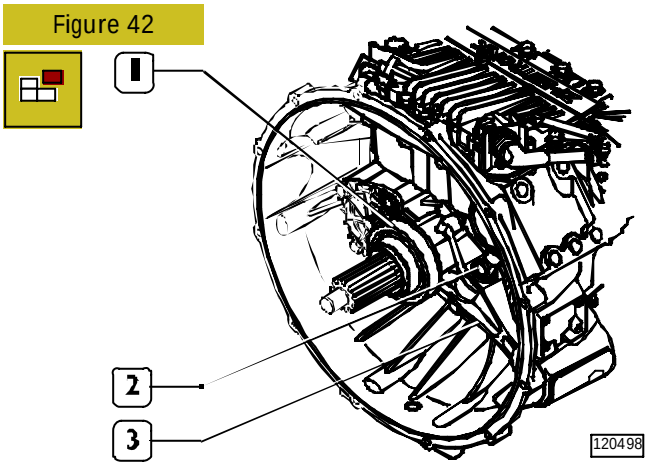



Fasten the gear transmission (1) to the support brackets 99322225 (3), which are arranged on the rotary stand 99322205 (2).

## DISCONNECTING FORK

### Disassembly

Figure 42



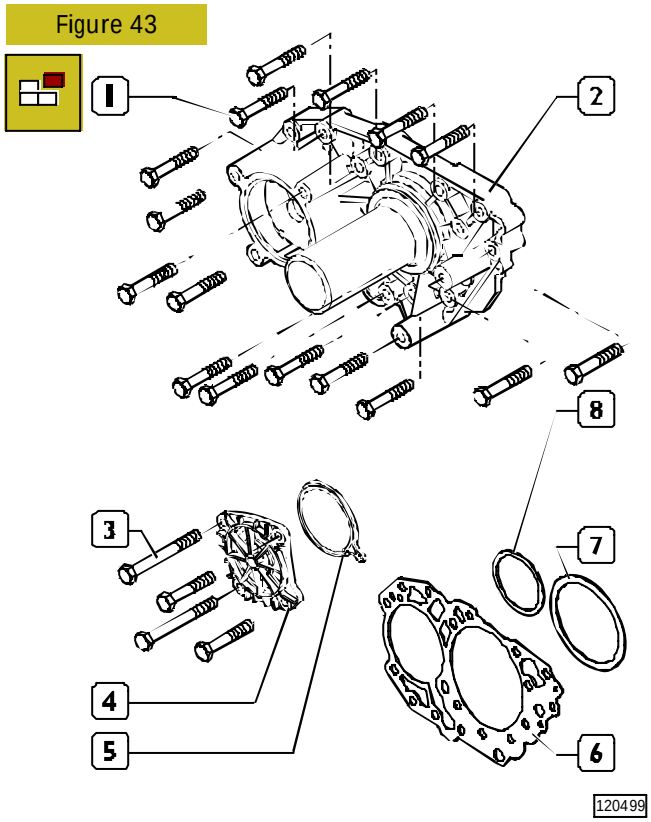

Remove the two hexagon head screws (2).
Remove the disconnecting bearing (1) and the disconnecting fork (3) from the motion input shaft.

### Assembly

Grease the bearing surfaces of the disconnecting bearing (1).
Assemble the bearing (1) and the disconnecting fork (3) so that it meshes the bearing.
Torque-tighten the screws (2).
Tightening torque = 115 Nm

### Disassembly of the front cover

Figure 43

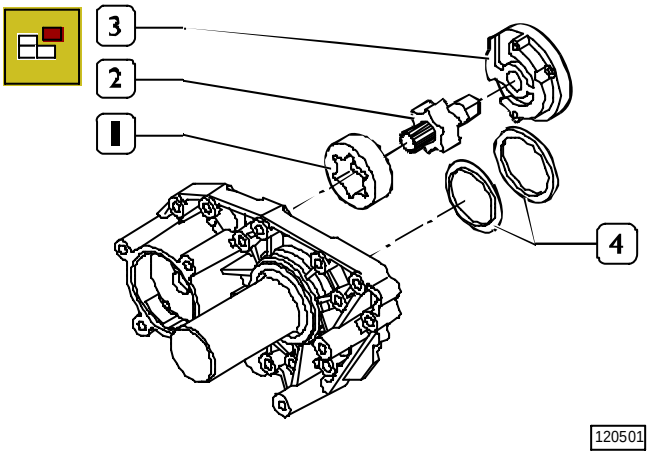



Remove the fastening screws (1 and 3) and remove the front cover (2), the cover (4) and the diaphragm (5).
Remove the adjusting rings (7, 8) and the gasket (6).

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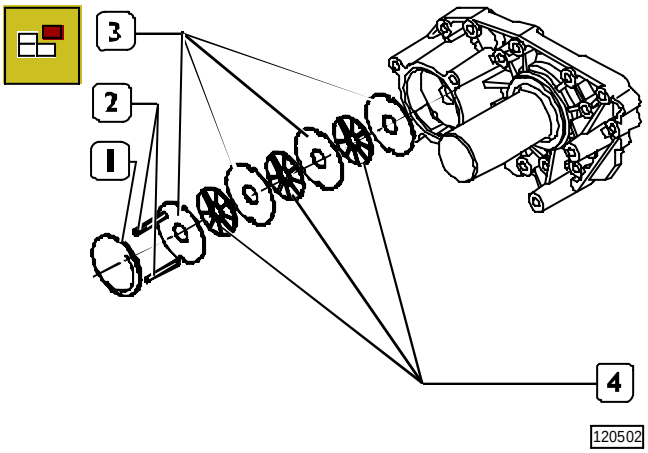
## Disassembly of the oil pump

Figure 44



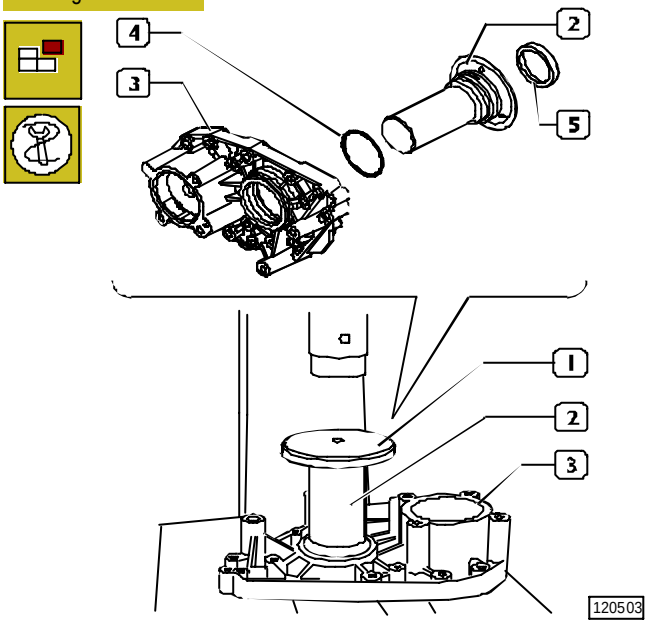

Remove the pump cover (3) and remove the shaft (2) and the rotor (1) from the connecting plate.
Remove the oil collecting discs (4) from the input shaft (2).

Figure 45




Remove the brake piston (1) and remove the discs (3 and 4), taking note of their arrangement.
Replace the cylindrical pins, if damaged (2).

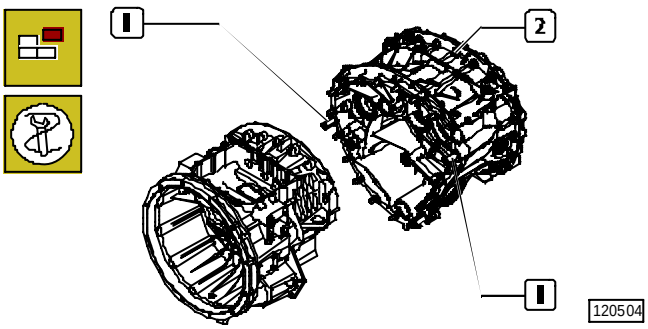
Figure 46




Put the front cover (3) onto two supports, as shown in figure.
Remove the pipe (2) under press using a suitable torque block. Remove the O-ring (4) and the sealing ring (5) from the pipe. (2).

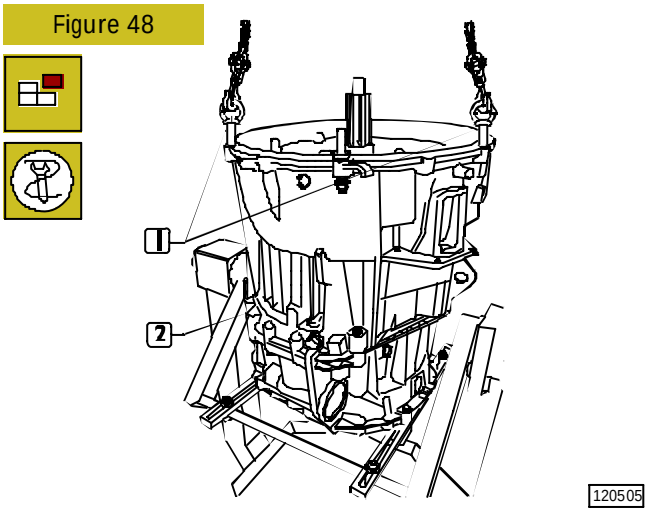
## Clutch casing removal

Figure 47




With extractor 99340205 and pin 99342143, remove the centering pins (1).
Remove the screws (2) fastening the clutch casing to the gearbox.

Figure 48

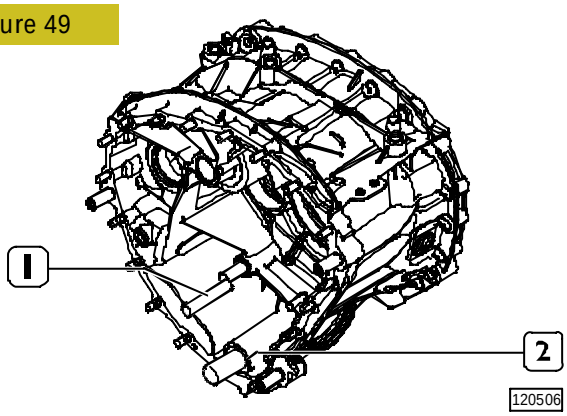



Fasten two eyebolts 99366811 (1) to the clutch casing. By means of special ropes and lift, carefully remove the clutch casing (2).

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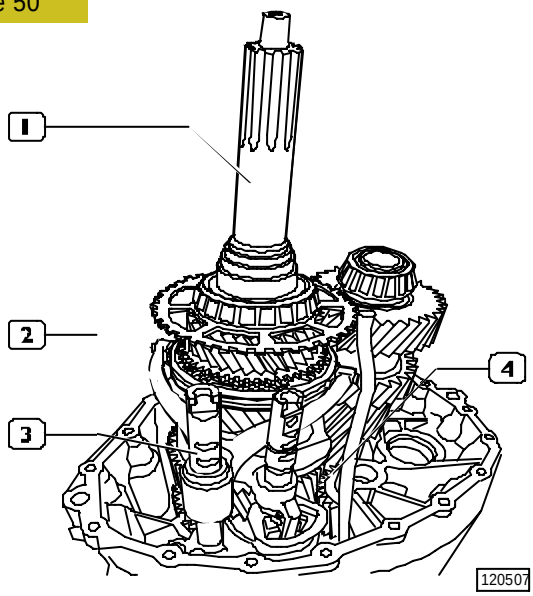
Figure 49




Remove the component (2) and the oil pipe (1), if damaged.

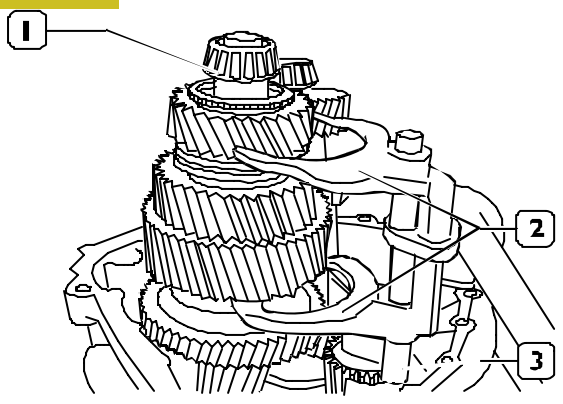
## Shaft removal

Figure 50



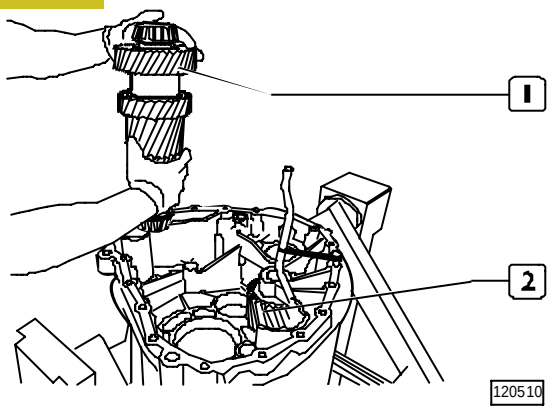

Move laterally the intermediate gear (4) of the reverse, so that it does not interfere with other gears.
Remove the motion input shaft (1) complete with fork (2) and splitter control rod (3).

Figure 51




By means of special ropes and lift, carefully remove the main shaft (1) complete with control rod (3) and forks (2), moving the secondary shaft laterally.

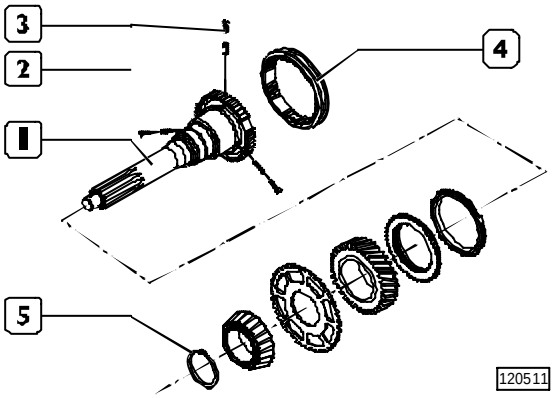
Figure 52




Remove the secondary shaft (1) from the gearbox.
Remove the reverse gear (2) complete with rolls.

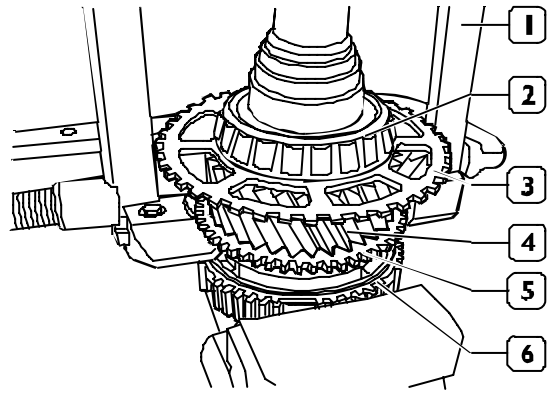
## Disassembly of the input shaft

Figure 53




Put a cloth onto the synchronizer assembly (1) so that, during disassembly, springs (2) and pawls (3) are held while coming out from their seats.
Disassemble the sliding sleeve (4).
Remove the safety ring (5).

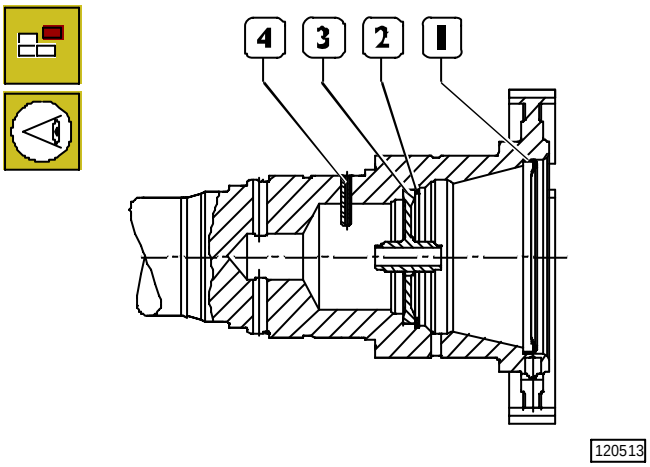
Figure 54




Insert holds 99341025 between the coupling hub (6) and the synchronizing ring (5). With the tools 99341021, 9934103 and 99341015, remove the conical roll bearing (2) and remove the motion input shaft, according to the following order: phonic wheel (3), helical gear (4), coupling hub (6) and synchronizing ring (5).

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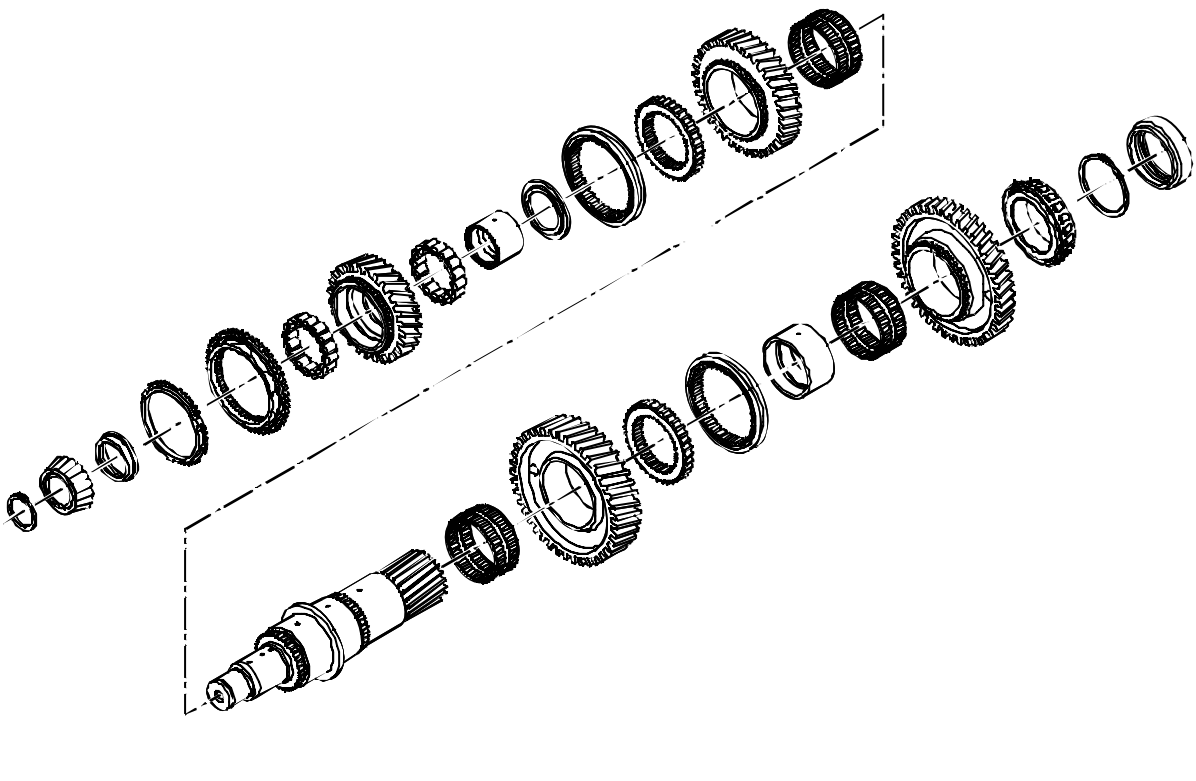
Figure 55




Make sure that the rubber edge of the oil collecting disc (1) is not damaged or spoiled. In this case, replace it.
If necessary, remove the safety ring (2) and the cover (3).
Make sure that the hole of the electric pin (4), used for oil feeding, is not clogged.

## Disassembly of the main shaft

Figure 56

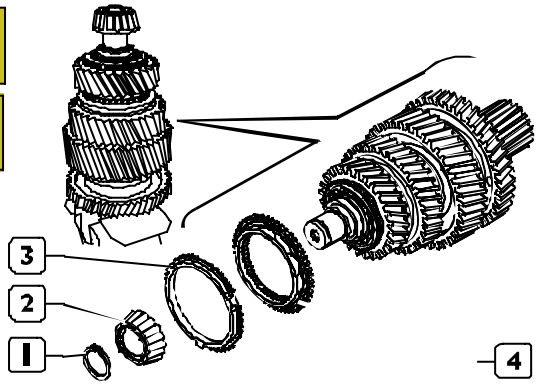



MAIN SHAFT MAJOR COMPONENTS

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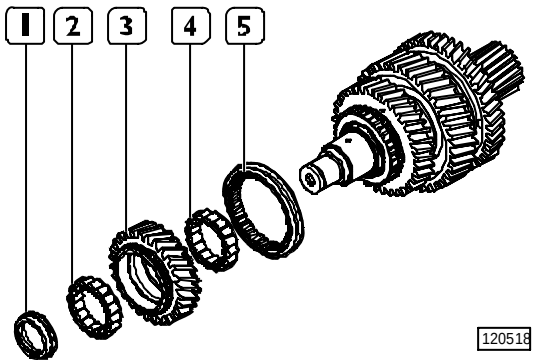

Aquila Trucks Centres

Figure 57



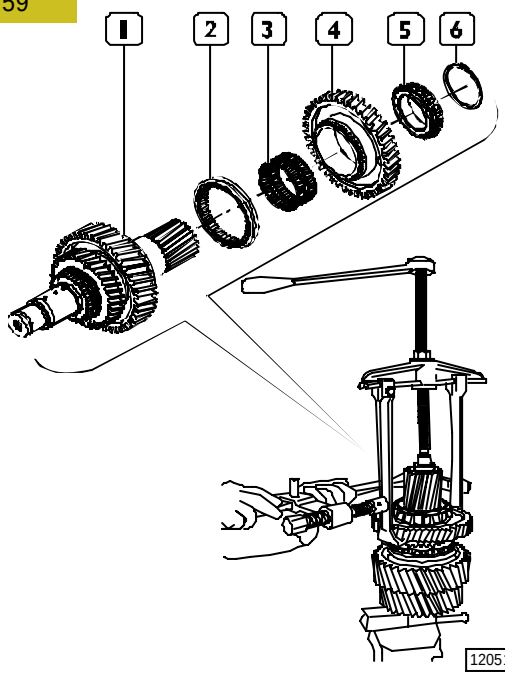

Vice tighten the main shaft.
Remove the safety ring (1) and coupling hub (4), complete with the synchronizing ring (3).
With the bridge 99341003, the brackets 99341011, the reaction block 99345054 and the tightener 99341015, remove the conical roller bearing (2).

Figure 58




Remove the shoulder ring (1), the third gear (3), complete with roll crowns, (2 and 4) and the sliding sleeve (5).

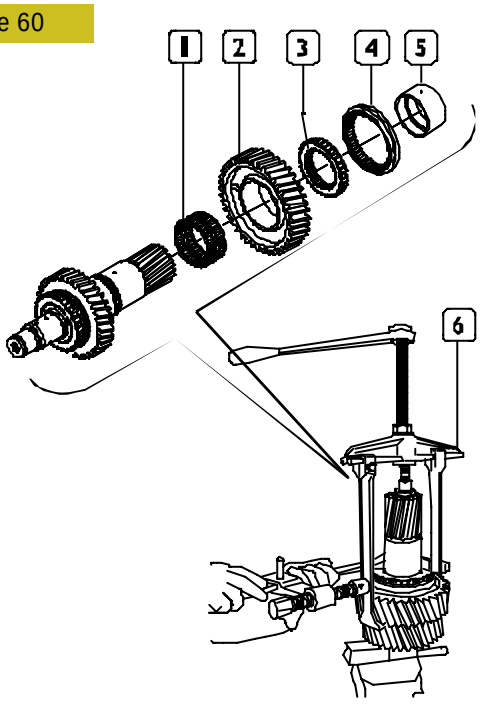
Figure 59




Rotate the main shaft (1) and vice tighten from the input side.
Remove the safety ring (5)

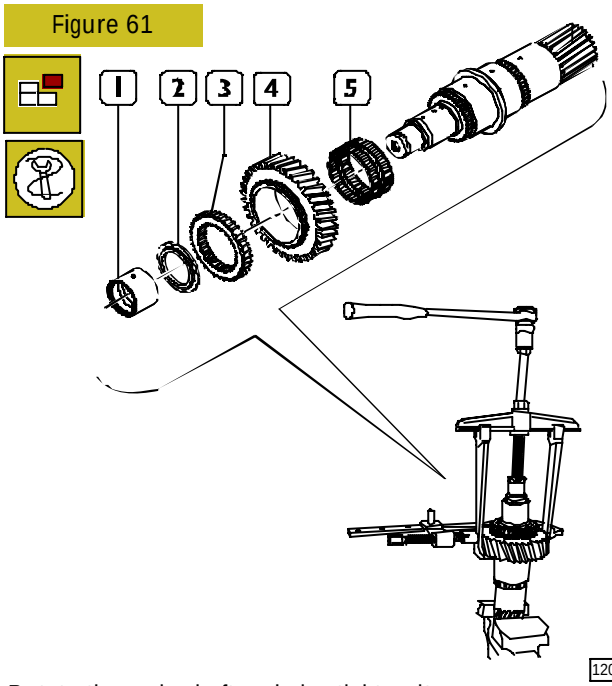
With the bridge 99341003, the brackets 99341013, the torque block 99345054 and the press 99341015 remove the reverse gear (4) with the bearing (5)
Remove the roll cage (3) and the sliding sleeve (2).

Figure 60




With the bridge 99341003, the brackets 99341013, the torque block 99345054 and the press 99341015 remove the first gear (2).
From the main shaft, remove the bushing (5), the sleeve holder (3) and the roll cage (1).

Figure 61

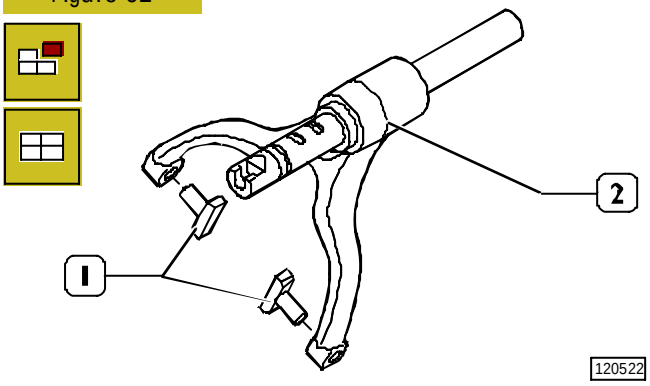



Rotate the main shaft and vice tighten it.
With brackets 99341017, bridge 99341003 and press 99341015, remove the second gear (4).
From the main shaft, remove the bushing (1), the disc (2), the sleeve holder (3) and the roll cage (5).

Aquila Trucks Centres

## SPLITTER CONTROL FORK
### Disassembly/Assembly

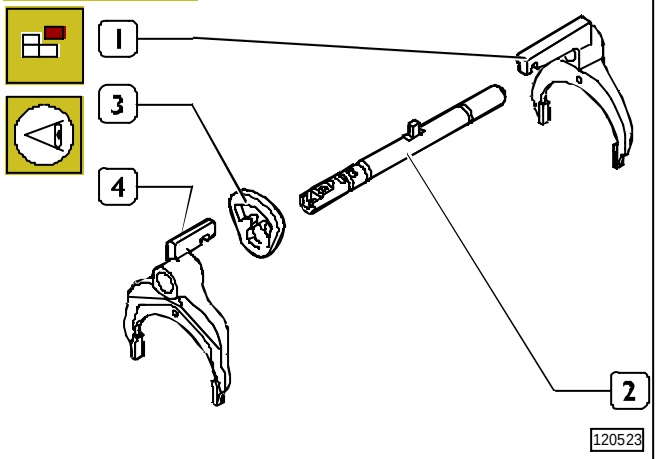
Figure 62




Remove the small block (2) from the splitter synchronizer connecting fork (1) and assemble the new small blocks.

## GEAR CONTROL FORKS
### Disassembly

Figure 63




Release and remove the control forks (1) and (4).

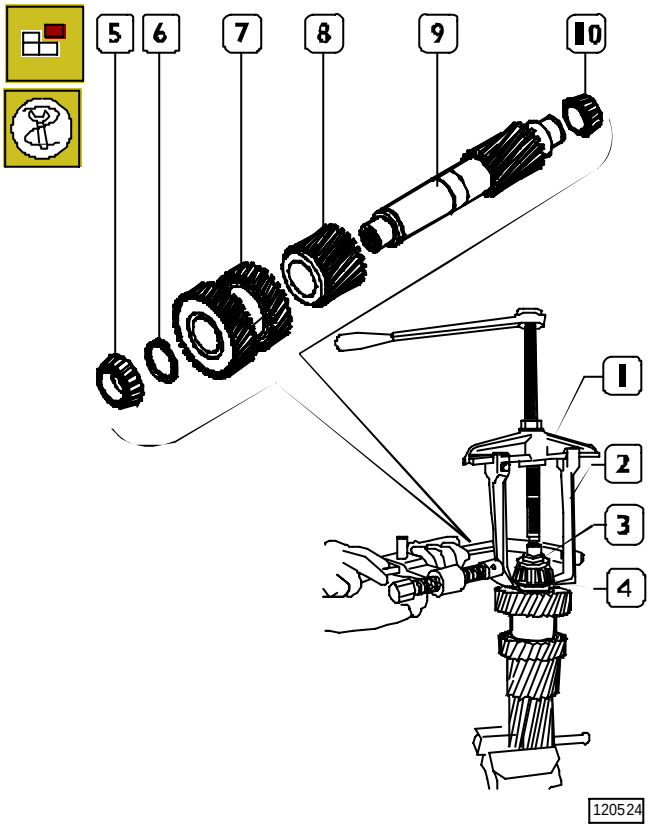
**NOTE** Do not change the control forks (1) and (4). If necessary, check the serial numbers of the packing list.

Remove the ring (3) hindering the simultaneous coupling of the control shaft (2).

Position the ring (3) onto the control shaft.
Insert the control forks (1 and 4) into the ring correct position.

## SECONDARY SHAFT
### Disassembly

Figure 64




Remove the inner rings (5 and 10) of the roller bearings from the secondary shaft (9), using the extractor 99347100 (1), the holds 99347132 (4), the insert 99345057 (10) and suitable brackets (2).
Remove the safety ring (6).
Remove under press the double gear (7) and the gear (8).

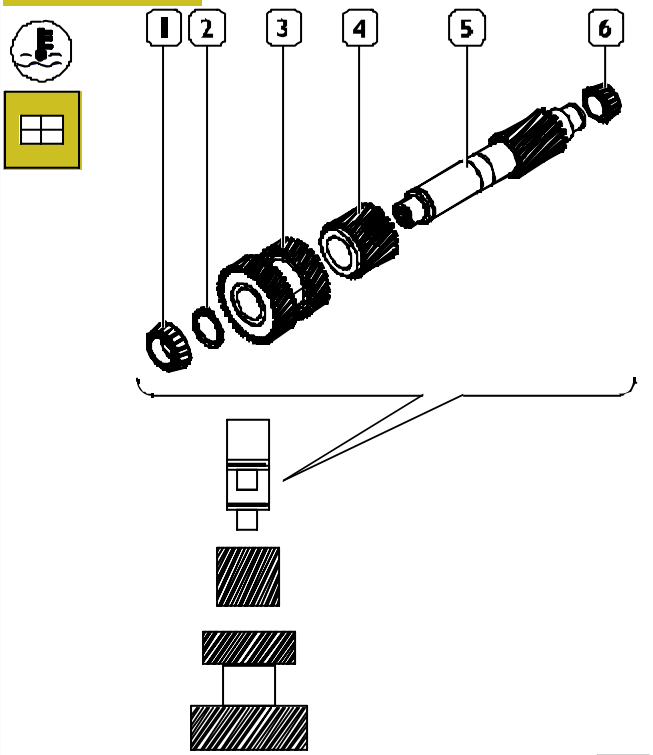
**NOTE** The removal force of each gear can reach 500 kN.

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## Assembly

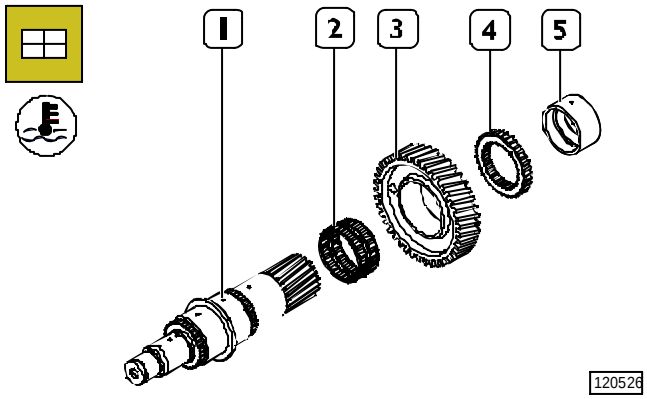
Figure 65




Heat the gears (3 and 4) at a maximum 170 °C temperature.
Put the heated gears one on another on a press and center them as shown in the figure.
Insert the secondary shaft (5) onto the heated gears and set it rapidly to axial beat.
Assemble the safety ring (2).
Heat the inner rings of the conical roll bearings (1 and 6) for 15 minutes at a maximum temperature ranging from 120 to 130 °C. Assemble them onto the secondary shaft checking the axial beat.

## Assembly of the main shaft

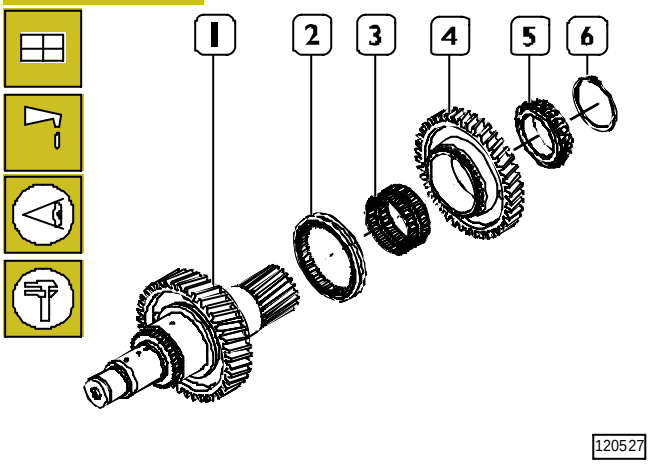
Figure 66




Vice tighten the main shaft (1).
Lubricate the roll cage (2) and push it on the shaft.
Assemble the gear of the first gear (3) making sure that its driving teeth are facing the motion output.

Heat the sleeve holder (4) at 120 °C temperature and push it onto the teeth of the main gear.
Heat the bushing (5) at 120 °C and assemble it on the main shaft.

Figure 67

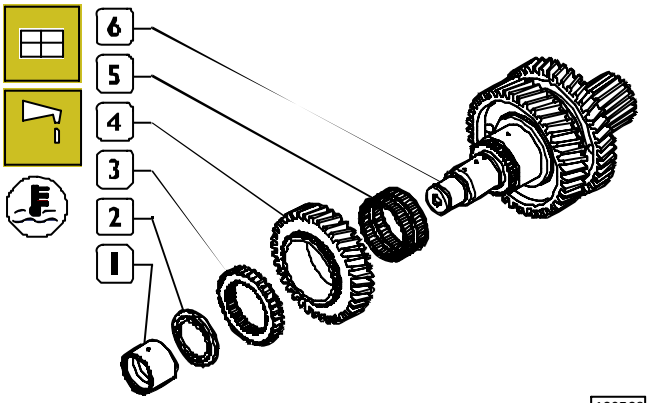



Insert the sliding sleeve (2) onto the sleeve holder (4, Figure 66)
Lubricate the roll cage (3) and push it onto the bushing (5, fFigure 66).
Assemble the reverse gear (4), inserting it onto the roll crown (3) and the main shaft, respectively. The driving teeth have to face the sleeve holder (4, Figure 66).

Heat the inner ring of the conical roll bearing (5) for max. 15 minutes at a temperature ranging from 120 to 130 °C and assemble it on the main shaft, making sure that it reached the axial beat.
By means of a thickness gauge, measure the safety ring thickness (6).
Choose the safety ring (6) in order to get an axial clearance ranging from 0 and 0,1 mm.
Assemble the chosen safety ring.
Rotate the main ring of 180°.

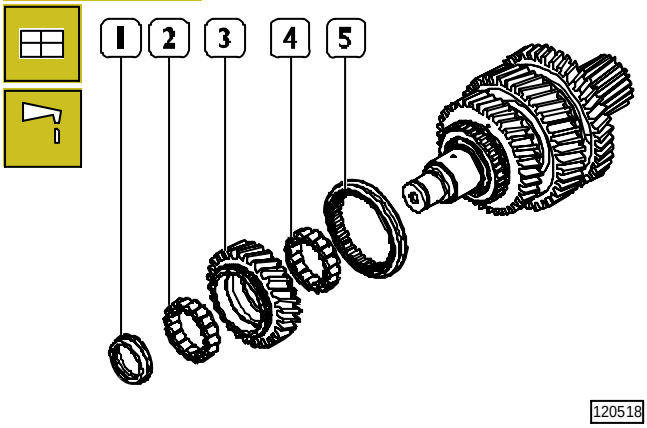
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Figure 68



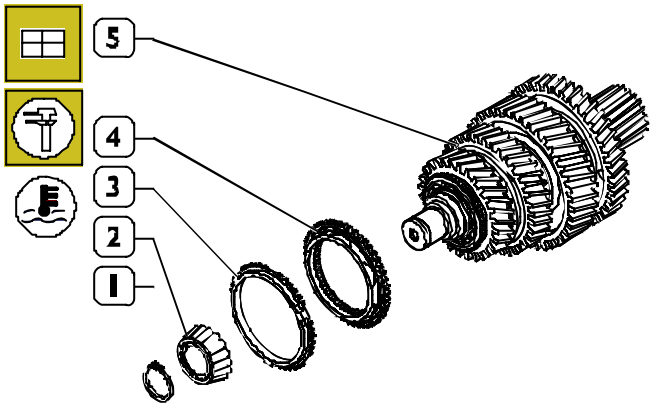

Lubricate the roll cage (5) and assemble it onto the main shaft.
Assemble the gear of the second gear (4) onto the main shaft.
Heat the sleeve holder (3) at abt. 120 °C temperature and push it onto the teeth of the main shaft until the axial contact is reached.
Heat the disk (2) and the bush (1) to a temperature of about 120 °C and push them on the shaft (6), until they reach the axle.

Figure 69




Assemble the sliding sleeve (5) onto the sleeve holder (3, Figure 68).
Lubricate the roll crowns (2 and 4) and insert them onto the gear (3).
Assemble the gear set, complete with roll crowns, onto the bushing (1, Figure 68).
Assemble the shoulder ring (1) onto the main shaft.

Figure 70

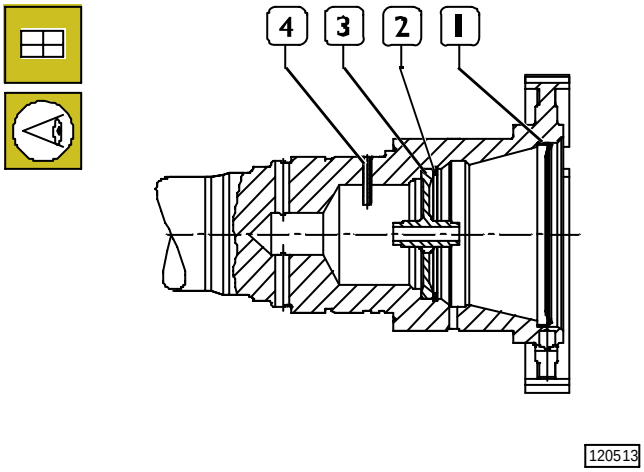



Heat the inner ring of the conical roll bearing (2) for max. 15 minutes at a temperature ranging from 120 and 130 °C and push in onto the main shaft until the axial contact is reached.

With a thickness gauge, measure the thickness of the safety ring (1).
Choose a safety ring allowing to get an axial clearance ranging from 0 to 0,1 mm.
Assemble the chosen safety ring.
Assemble the coupling hub (4) and the synchronizing ring (3) onto the shaft.

## Assembly of the motion input shaft

Figure 71

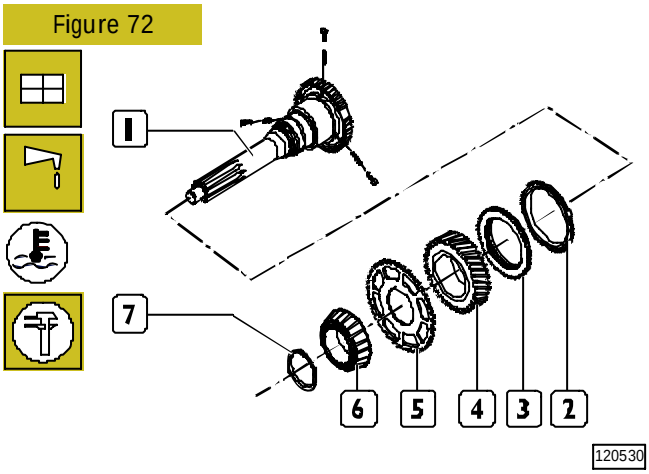



Make sure that the plunger (4) is assembled.
Assemble the cover (3) and the safety ring (2).
Insert the oil collecting disc (1) into the motion input shaft to the axial beat.

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Figure 72

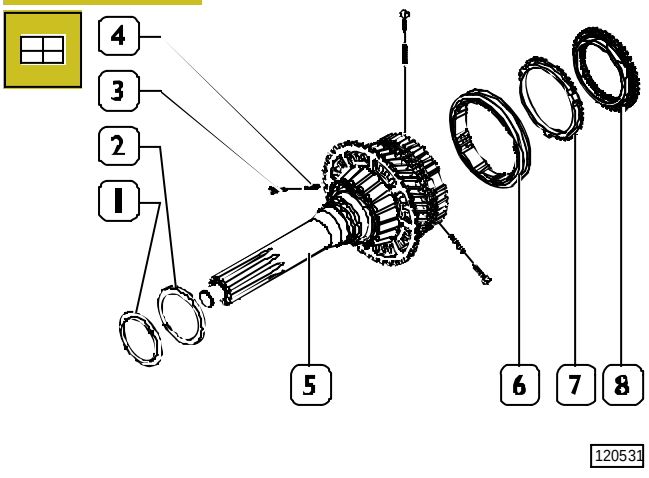



Assemble the synchronization ring (2) and the coupling hub (3) onto the shaft (1).

**NOTE** The projections of the synchronization ring face downwards and have to insert into the holes of the synchronizing hub.

Lubricate the gear inner track (4) and assemble the latter onto the input shaft.
The driving teeth face downwards and mesh the inner teeth of the coupling hub.
Assemble the phonic wheel (5).
Heat the inner ring of the conical roller bearing (6) at 120°C and assemble it onto the input shaft, making sure that it reached the axial beat.
With a thickness gauge, measure the thickness of the safety ring (7).
Choose a safety ring allowing to guarantee an axial clearance ranging from 0 to 0,1 mm and assemble it onto the motion input shaft (1).

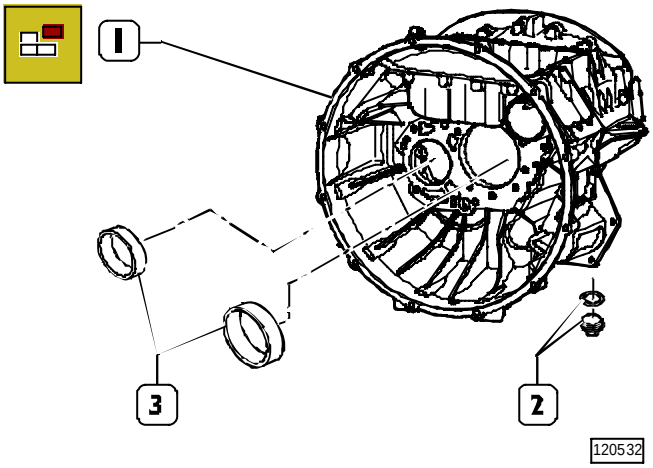
Figure 73




Assemble the sliding sleeve (6) onto the motion input shaft (5) and set it to beat.
Assemble the synchronizer as described in the specific chapter, complete with springs (4), pawls (3), ring (7), hub (8) and assemble it onto the shaft.
Set the sliding sleeve (6) to central position.
Assemble the oil collecting discs (1 and 2).

## Rear box disassembly

Figure 74



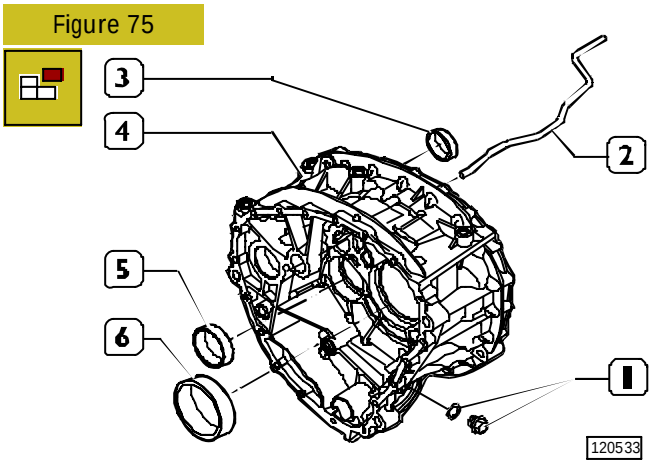

Remove the plug (2) from the clutch casing (1).
If bearings are replaced, remove the outer rings (3) by means of a suitable extractor.

## Rear box assembly

Screw the plug (2) with a new sealing ring and tighten it according to the set torque (60 Nm).
By means of a suitable tool, assemble the outer rings (3) of the bearings.
Re-assemble the cylindrical pins (4), if previously removed.

## GEARBOX CASING
## Disassembly

Figure 75




Remove the plug (1) from the gearbox (4).
In case of bearing replacement, remove the outer rings (3,5 and 6) by means of a suitable extractor.
Remove the oil pipe (2) by extracting it towards the output, taking note of its position for a following re-assembly.

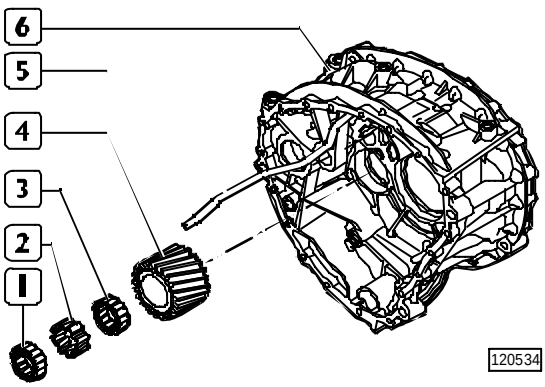
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## Assembly

Heat evenly the seat of the conical roll bearings (5) and (6) in the gearbox at 100°C.
Assemble the outer rings (5 and 6) in the related seats, by means of a suitable tool, to the axial beat.
Heat evenly the seat of the motion input shaft at 100 °C and, by means of a suitable tool, insert the outer ring (3) of the bearing to the axial beat.
Fasten the outer ring (3) caulking it in four equidistant points.
Assemble the oil pipe (2) inserting it from the output side, according to the position observed during disassembly. If necessary, replace the pipe O-rings. Grease properly the O-rings and their seats.
Screw the plug (1) with a new sealing ring and tighten it according to the set torque (60 Nm).

## Shaft reassembly

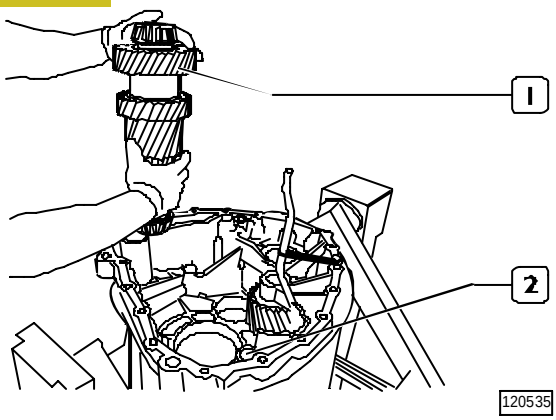
Figure 76




Insert the spacer (2) and the roll crowns (1 and 3) into the reverse gear (4).
Assemble the complete reverse gear into the gearbox (6) and push it laterally.

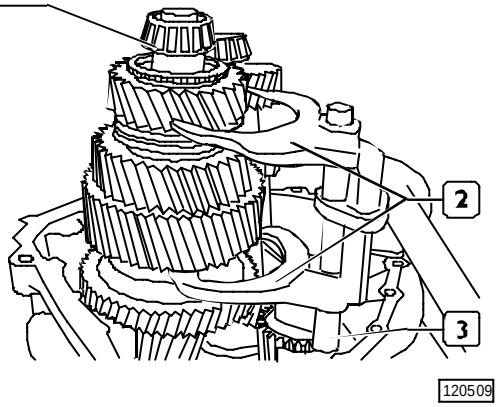
**NOTE** Make sure that the oil pipe (5) is assembled correctly in the gearbox.

Figure 77



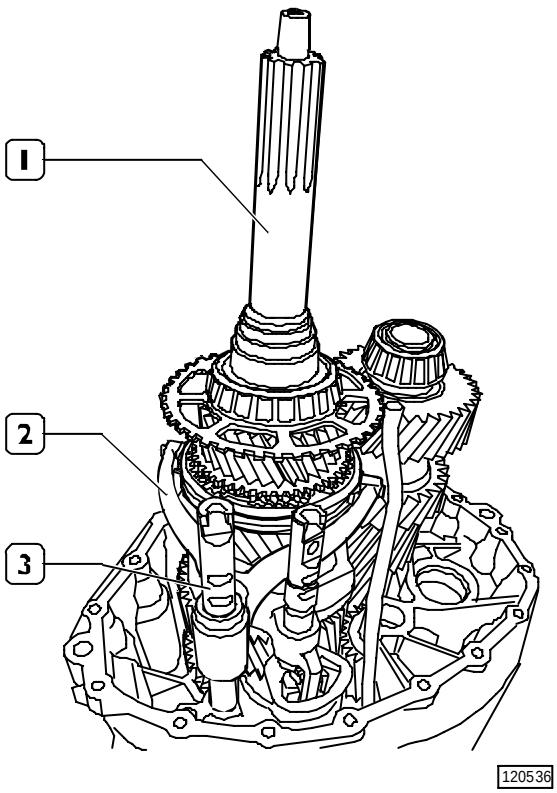

Assemble the secondary shaft (1) into the box (2).

Figure 78




Hook the main shaft (1) as shown in the figure and insert it into the box, complete with control rod (3), forks (2) and sleeves.
Move laterally the secondary shaft to make the input of the main shaft into the gearbox easier.
Make the reverse gear mesh the main and secondary shaft ones.

Figure 79



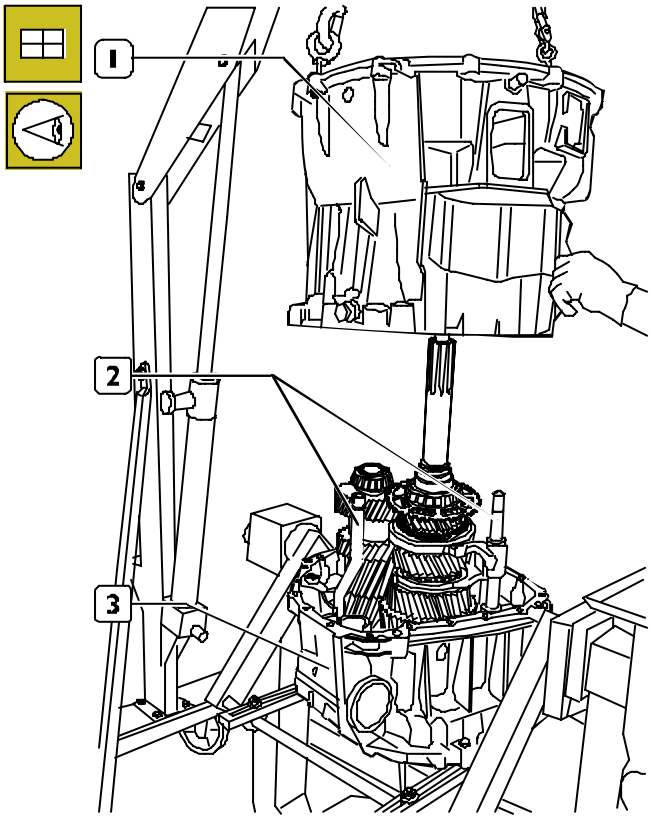

Assemble the motion input shaft (1), complete with fork (2) and control rod of the splitter (3).

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## Clutch casing reassembly

Figure 80

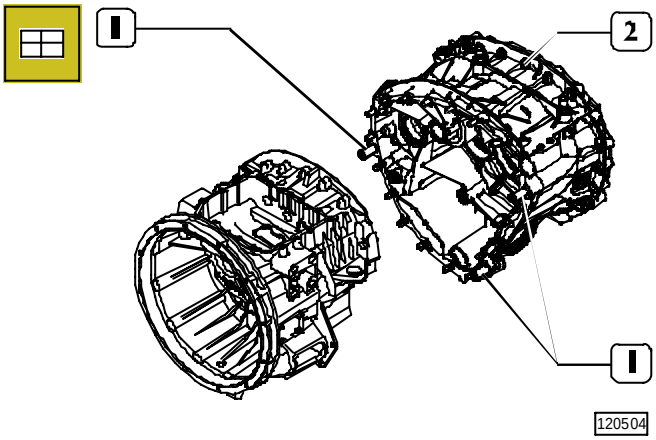



Apply two guides on the oil pipes (2) to make coupling between the clutch casing (1) and the gearbox (3) easier.
Clean the box sealing surfaces.

**NOTE** Sealing surfaces have to be clean and without oil and grease.

Spread the sealing surface of the gearbox (3) with Loctite no. 574.
Lay carefully the clutch casing (1) onto the gearbox (3). Use the oil pipe guide for centering.
Make sure that pipes (1 and 3) are correctly assembled in the clutch casing (leveled with the surface).

Figure 81

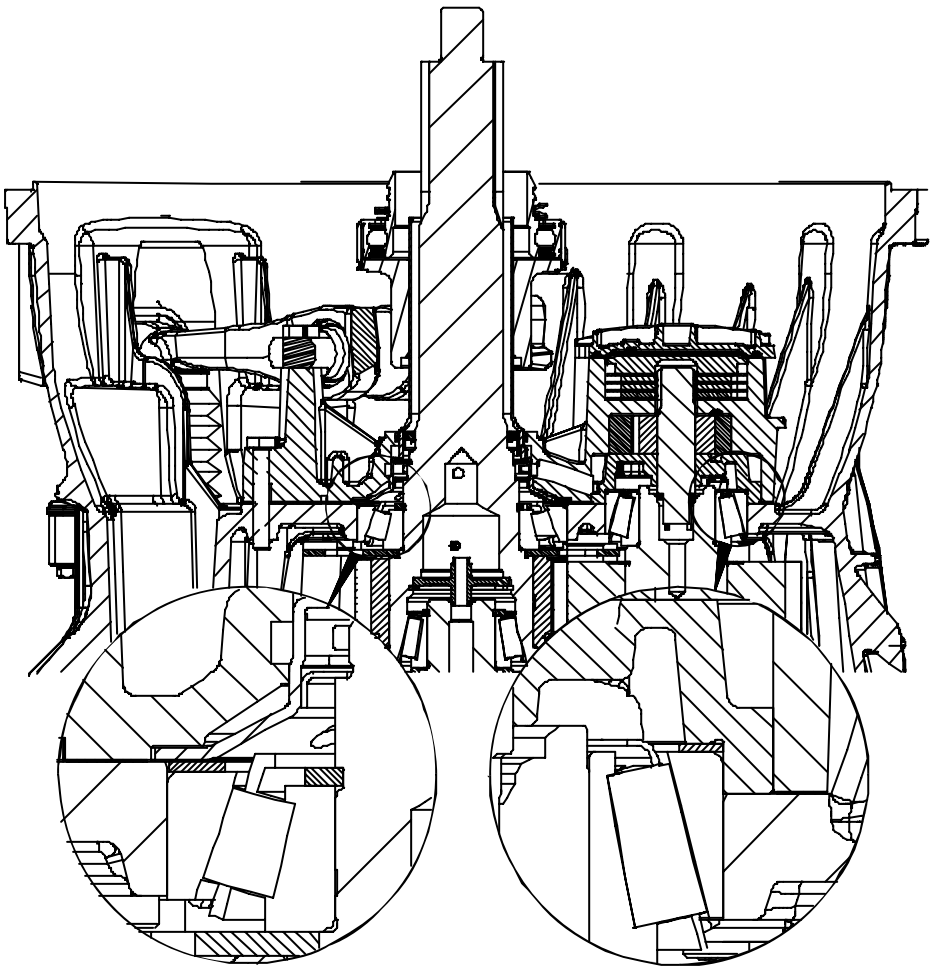



Insert partially the cylindrical pins (1) and torque-tighten the fastening screws of the clutch casing (50 Nm).
Complete the insertion of the cylindrical pins (1) to the axial beat.

Aquila Trucks Centres

## Adjustment of the axial clearance of bearings of the motion input shaft and of the secondary shaft

Figure 82



120538

Make the input shaft rotate forwards and backwards several times to align the conical rollers of the bearing and make the outer ring contact.
In order to carry out adjustments described in the following pages, an initial "null clearance" is required.
With a pin, make the outer rings of the bearings contact the conical rolls.
By means of a sharp object, make sure that bearing rolls do not move.

**NOTE** Clearance is null when the conical rolls are still, due to no pre-load.

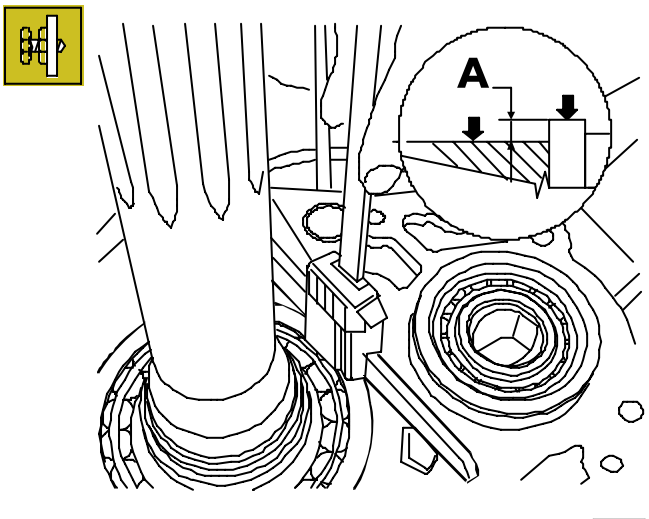
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## Adjustment of the axial clearance of the motion input shaft

**NOTE** The conical roll bearing of the motion input shaft is adjusted with a pre-load ranging from 0,25 to 0,35 mm.

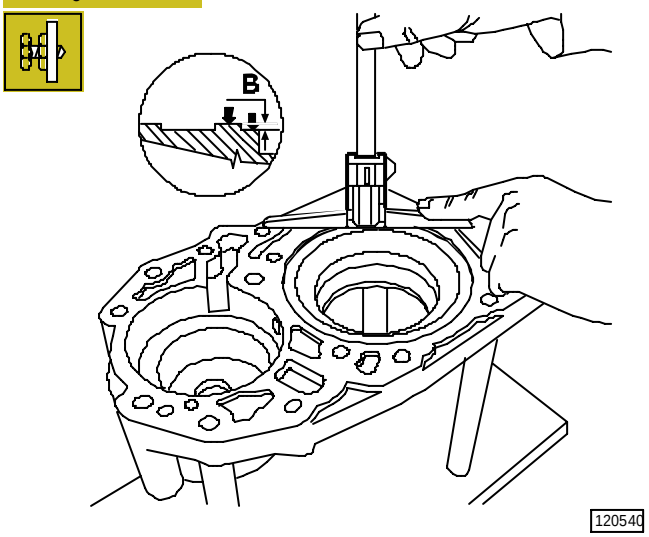
Figure 83




### Height A

With a thickness gauge, measure the distance between the box sealing surface and the upper edge of the bearing outer ring.

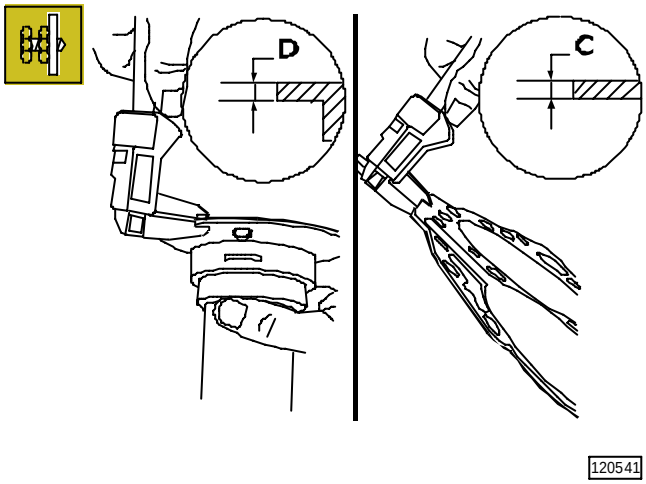
Figure 84




### Height B

With a depth gauge, measure the depth of the step in the front cover.

Figure 85




### Height C

Measure the gasket thickness.

### Height D

Measure the thickness of the tube plate.

### A + B + C - D = S

S = rated value with null clearance

### Example

A = 2,00 mm
B = 2,20 mm
C = 0,35 mm
D = 2,50 mm

2,00 + 2,20 + 0,35 - 2,50 = 2,05 mm

### Thickness with minimum pre-load:

S1 = 2,05 mm + 0,25 mm = 2,30 mm

### Thickness with maximum pre-load:

S2= 2,05 mm + 0,35 mm = 2,40 mm

The thickness **S** of the adjusting ring shall be chosen among the spare available ones in the interval of calculated thicknesses S1÷S2.

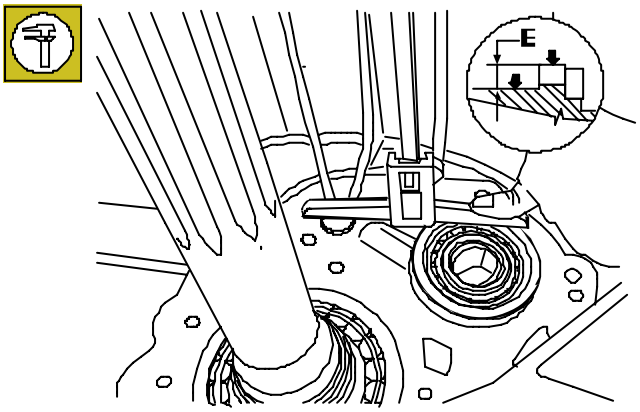
Assemble the chosen adjusting thickness.

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## Adjustment of the secondary shaft axial clearance

**NOTE** The conical roll bearing of the secondary shaft is adjusted with a pre-load ranging from 0,15 and 0,25 mm.

Figure 86

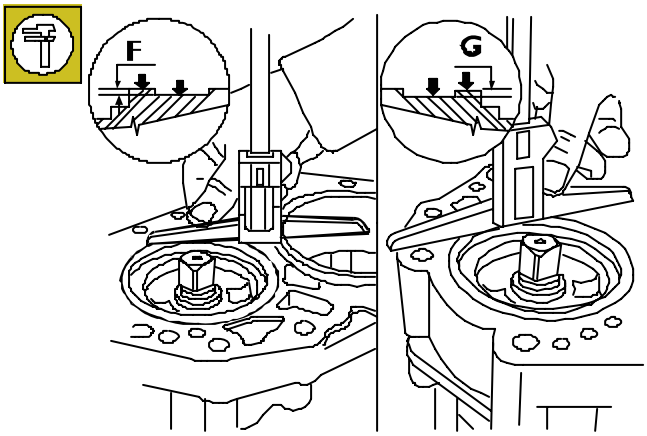



120542

### Height E

With a thickness gauge, measure the distance between the upper board of the bearing outer ring and the box sealing surface.

Figure 87




120543

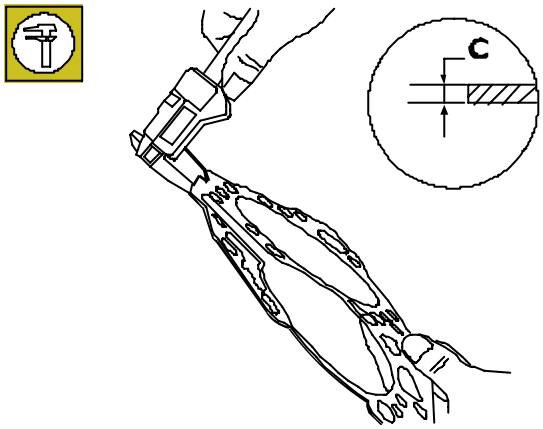
### Height F

Measure between the pump cover upper edge and the sealing surface of the front cover.

### Height G

Measure between the pump cover upper edge and the first step.

Figure 88




120544

### Height C

Measure the gasket thickness.

### G - F + C - E = S

S = rated value with null clearance

### Calculation example:

E = 6,80 mm
F = 0,20 mm
G = 7,55 mm
C = 0,35 mm

7,55 - 0,20 + 0,35 - 6,80 = 0,90 mm

### Thickness with minimum pre-load:

S1 = 0,90 mm + 0,15 mm = 1,05 mm

### Thickness with maximum pre-load:

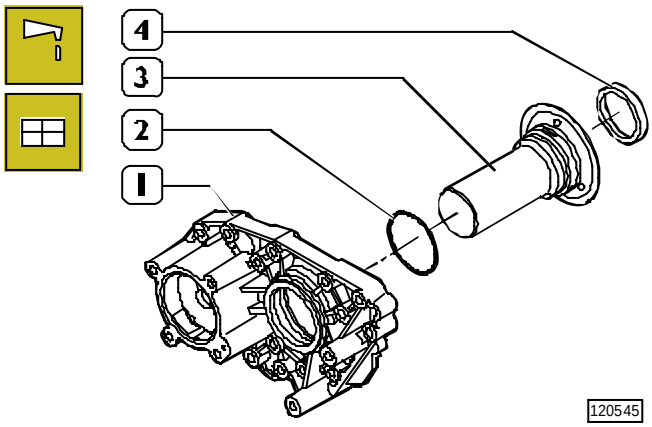
S2 = 0,90 mm + 0,25 mm = 1,15 mmm

The thickness **S** of the adjusting ring shall be chosen among the spare available ones in the interval of calculated thicknesses S1 S2.

Assemble the chosen adjusting thickness.ssemble the chosen adjusting thickness.

## Assembly of the front cover

Figure 89



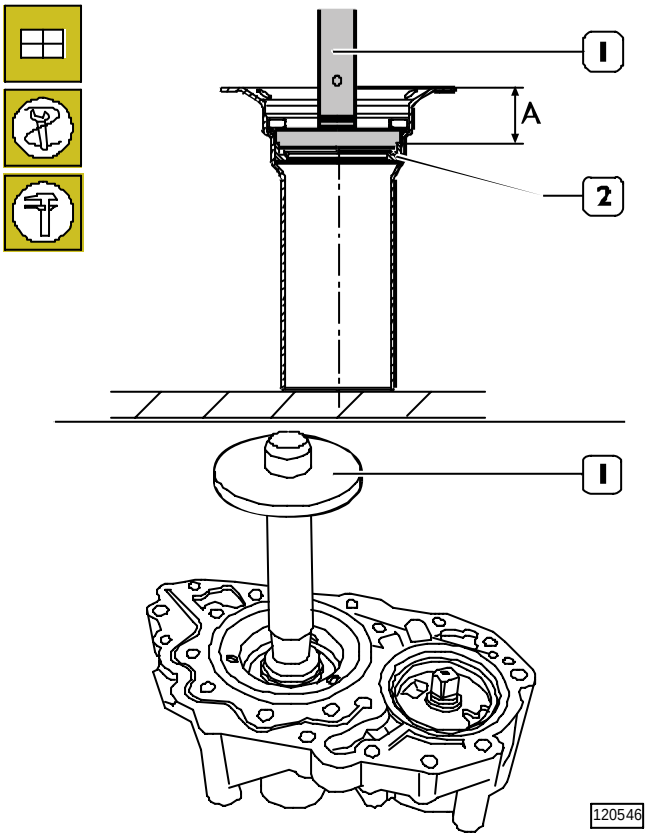

120545

Lightly grease the O-ring (2) and insert it on the front cover (1).

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Figure 90

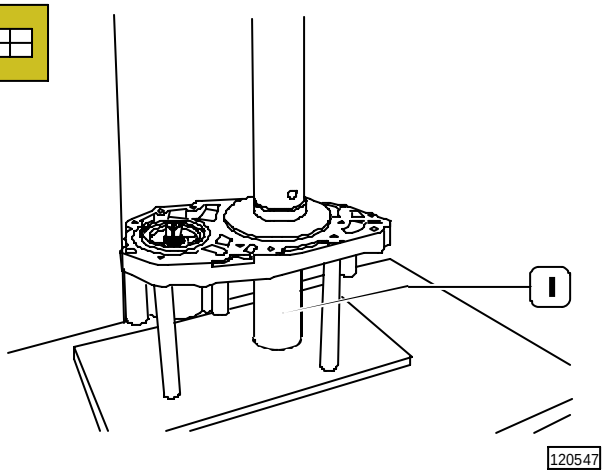



With locking set 99374336 (1), assemble the sealing ring (2).
Observe the overall height **A** = 31.50 mm ± 0.30 mm.

**NOTE**

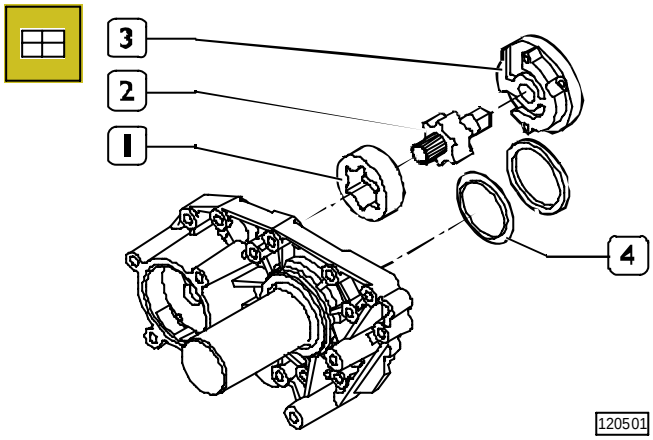
- Moisten with alcohol the outer circumference of the sealing ring.
- The ring sealing edge has to face outwards.
- Lightly grease the ring seal lip.

Figure 91



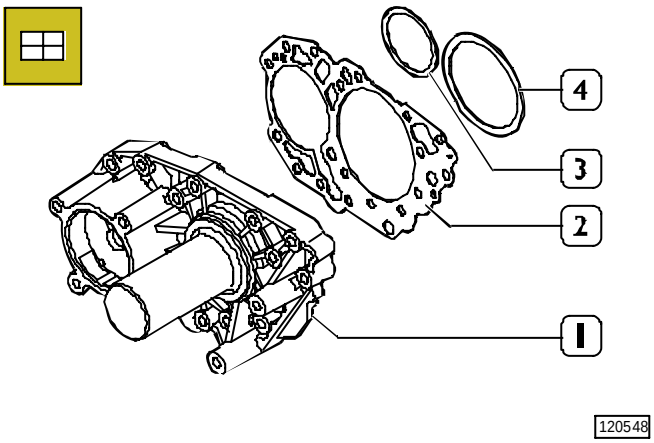

Assemble the pipe (1) under press.

Figure 92




Assemble onto the plate, the rotor (1), the pump shaft (2) and the pump cover (3).
Mount the oil collection disks (4).

Figure 93



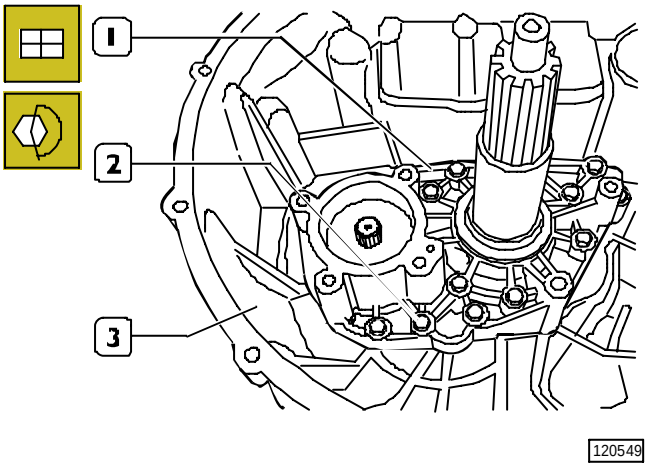

Clean the coupling surfaces of the front cover (1) and of the clutch casing.

**NOTE** All sealing surfaces and threaded holes M10 on the clutch casing have to be clean and without oil and grease.

Put the gasket (2) onto the clutch casing.
Assemble the previously set adjusting rings (3) and (4).

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Figure 94

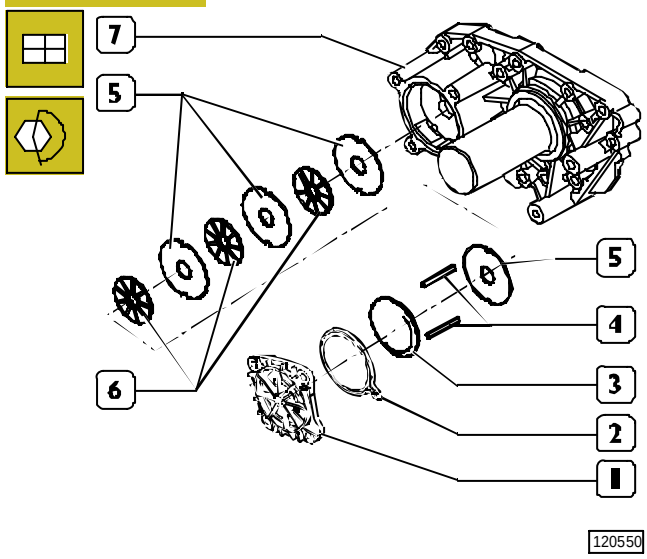



Assemble the front cover (1) onto the clutch casing (3).

**NOTE** Moisten the plate fastening screws (1) Loctite no. 241.

Tighten the fastening screws (2) according to the set torque (46 Nm).

Figure 95




Replace the cylindrical pins (4), if damaged (4).
Assemble the discs (5 e 6) according to the arrangement shown in the figure.
Assemble the brake piston (3), the diaphragm (2) and the brake cover (1).
Tighten the cover screws (1) according to the set torque (46 Nm).

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Aquila Trucks Centres

# Gearboxes EuroTronic Automated: - 12 AS 1930 T.D. - 12 AS 2330 T.O.


| | Page |
|---|---|
| DESCRIPTION | 49 |
| LOCATION OF GEARBOX DESCRIPTION PLATE | 49 |
| GEARBOX ELECTRONIC MANAGEMENT | 50 |
| MAIN DATA | 51 |
| TIGHTENING TORQUES | 52 |
| TOOLS | 53 |
| REMOVING-REFITTING GEARBOX | 55 |
| - Removal | 55 |
| - Refitting | 55 |
| OVERHAULING THE GEARBOX | 56/1 |
| - Checks | 56/1 |
| - Gearbox actuator | 56/1 |
| - Removal | 56/1 |
| - Refitting | 56/2 |
| - Removing the rear box | 56/2 |
| - Removing the rear box | 56/3 |
| - Removing the epicyclic reduction gear train (E.R.G.) | 56/4 |
| - Fitting the epicyclic reduction gear train (E.R.G.) | 56/6 |
| - Adjusting epicyclic reduction gear train bearing end float | 56/7 |
| - Adjusting main shaft end float | 56/8 |
| - Synchronizing device assembly for engaging normal or reduced gears | 56/10 |
| - Removal | 56/10 |
| - Fitting | 56/10 |
| - Removing the middle box | 56/13 |

https://truckmanualshub.com/
Aquila Trucks Centres

Page


- Removing the main shaft . . . . . 56/15
- Removing the drive input shaft . . . . . 56/17
- Removing the splitter synchronizing device . . . 56/18
- Fitting the splitter synchronizing device . . . . . 56/19
- Fitting the drive input shaft . . . . . 56/20
- Fitting the main shaft . . . . . 56/20
- Splitter control fork . . . . . 56/23
- Disassembly - Assembly . . . . . 56/23
- Gear control forks . . . . . 56/23
- Removal . . . . . 56/23
- Fitting . . . . . 56/23
- Fitting the middle box . . . . . 56/24
- Transmission shafts . . . . . 56/24
- Disassembly - Assembly . . . . . 56/24
- Fitting the front box . . . . . 56/27
- Front cover . . . . . 56/29
- Removal . . . . . 56/29
- Fitting the front cover . . . . . 56/29
- Adjusting drive input shaft bearing end float . . 56/29
- Adjusting transmission shaft bearing end float . 56/30
- Clutch release lever . . . . . 56/32

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## DESCRIPTION

Eurotronic Automated gearbox is an electrical-pneumatic drive mechanical type gearbox electronically managed by central unit. It has twelve forward gears and two reverse gears.

Gears selection and engagement functions are actuated by the help of an electronic central unit controlling clutch handling and engine rpm's during gear shift. A pneumatic device inside the gearbox decreases secondary shaft rpm's facilitating gear engagement.

All gearbox functions are managed by an electronic central unit, which receives signals from various electrical and electronic systems aboard via CAN line and controls various components optimising manoeuvres and managing manoeuvres safety.

The driver can choose whether to actuate gear selection manually or in semiautomatic mode, or to use completely automatic management.

With semiautomatic operation, the driver engages the various gears very easily by driving the selector lever, without needing to release accelerator pedal.

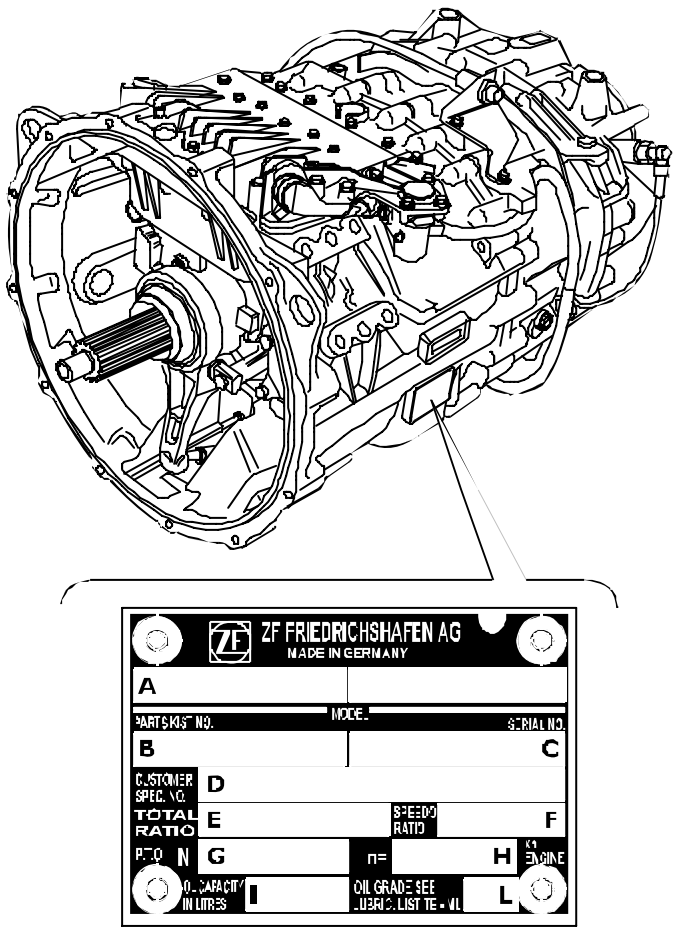
With automatic operation, the driver only drives accelerator or brake pedal; the gears are engaged automatically.

The gears are selected with finely shifted ratios and can be entered successively. Positioned in gearbox rear side is G.R.E. (Epicycloidal Reducer), that can be inserted by a sliding sleeve shift. The sliding sleeve allows to double front box ratios number. Such number can be further multiplied via "Splitter" engagement. Each single ratio consequently results to be split into an either slow or fast ratio. The engagements of G.R.E. and "Splitter" are synchronised.

A display unit on instrument panel warns about each system operation, as well as any operation faults.

## LOCATION OF GEARBOX DESCRIPTION PLATE

Figure 1



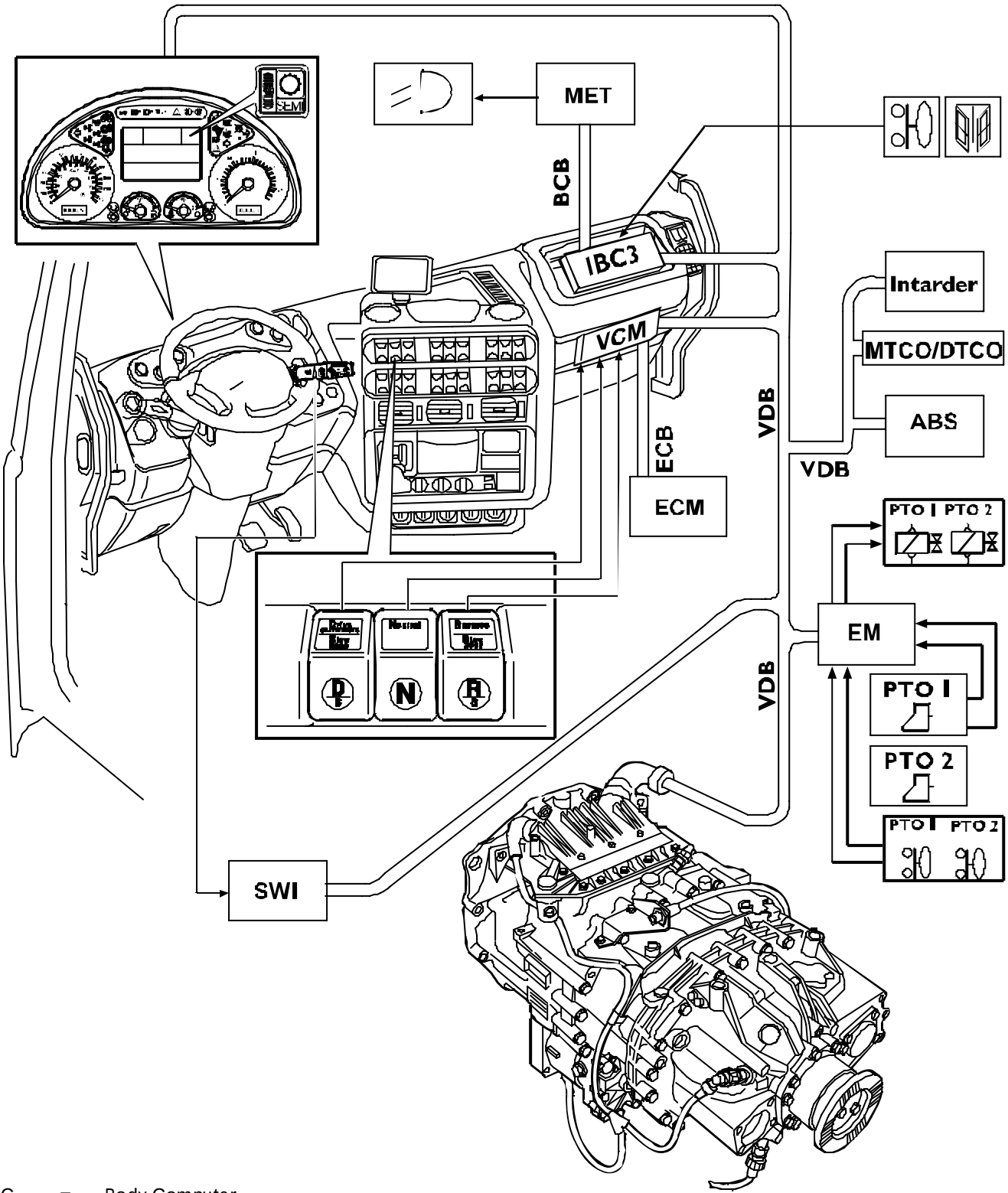

A = Type of transmission
B = ZF drawing no.
C = Production sequence number
D = Spare part IVECO drawing no.
E = Transmission gear ratio
F = Tachometer gear ratio
G = Type of power take-off
H = Power take-off gear ratio
I = Replacement oil amount
L = ZF lubricant list name

P.T.O. = Power take-off

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## GEARBOX ELECTRONIC MANAGEMENT
### Theoretical scheme

Figure 2

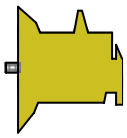
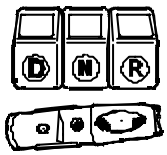
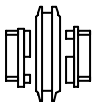
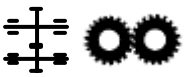



BC = Body Computer
ICB = Instrument Cluster Bus
VDB = Vehicle Data Frame
ECM = Engine Control Module
ECB = Engine Control Bus
EM = Expansion Module
MET = Electronic Chassis Module

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## MAIN DATA

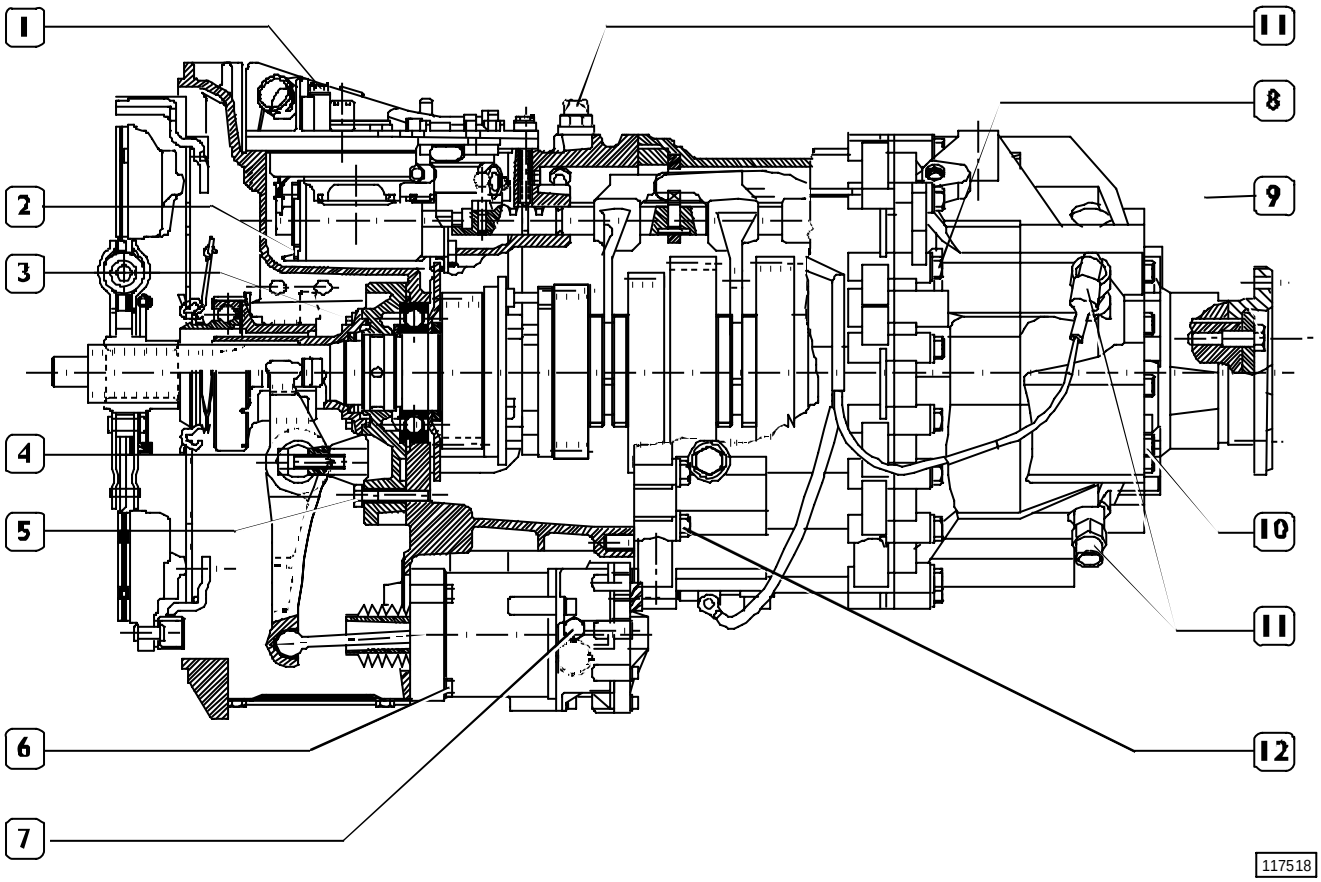
| | GEARBOXES | EuroTronic | |
|---|---|---|---|
|  | Type | 12 AS 1930 T.D. | 12 AS 2330 T.O. |
| | | Mechanical | |
| | Torque activated Nm | 1900 | 2300 |
|  | Forward gears | 12 | 12 |
| | Reverse gears | 2 | 2 |
| | Type of running control | semiautomatic/automatic with electronic management | |
|  | Side and/or rear power take-off | optional | |
|  | Gear clutch : Splitter and G.R.E clutch.* | through synchroniser frontal clutch sleeves with free ring | |
|  | Gears | with epicyclic teeth constantly meshing | |
|  | Gear ratios | | |
| | 1st | 15.86 | 12.33 |
| | 2nd | 12.33 | 9.59 |
| | 3rd | 9.57 | 7.44 |
| | 4th | 7.44 | 5.78 |
| | 5th | 5.87 | 4.57 |
| | 6th | 4.57 | 3.55 |
| | 7th | 3.47 | 2.70 |
| | 8th | 2.70 | 2.10 |
| | 9th | 2.10 | 1.63 |
| | 10th | 1.63 | 1.27 |
| | 11th | 1.29 | 1.00 |
| | 1st reverse gear | 1.00 | 0.78 |
| | 2nd reverse gear | 14.68 | 11.41 |
| | | 11.41 | 8.88 |
|  | Type of oil | Tutela Truck Fe-Gear Tutela ZC 90 | |
| | - 1st filling Litres | 12 | |
| | kg | 11 | |

* ERG = Epicyclic reduction gear unit
T.D. = Truck Direct Drive
T.O. = Truck Over Drive (Multiplied)

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## TIGHTENING TORQUES

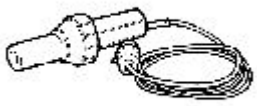
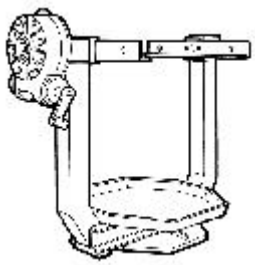
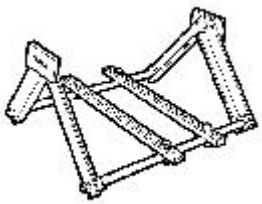
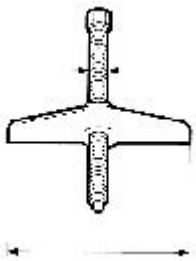
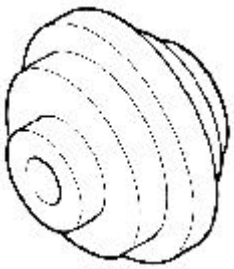
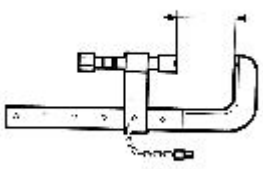
Figure 3



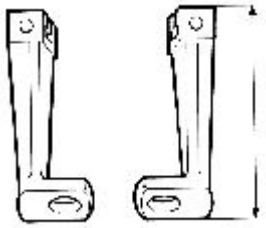
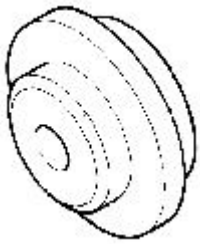
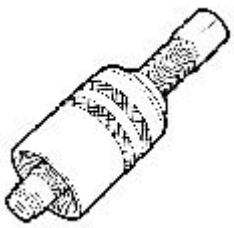
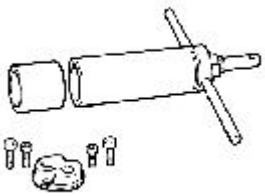
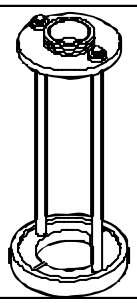
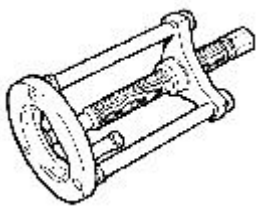

| DESCRIPTION | | TORQUE | |
|---|---|---|---|
| | | Nm | kgm |
| 1 | Screws fixing gearbox actuator | 23 | 2.3 |
| 2 | Screw fixing oil pump | 10 | 1 |
| 3 | Screws fixing drive input shaft cover | 23 | 2.3 |
| 4 | Screw fixing clutch uncoupling lever control pin:<br>- M 12 8.8<br>- M 12 10.9 | <br>79<br>115 | <br>7.9<br>11.5 |
| 5 | Screws fixing cover (spread LOCTITE 241 on the thread) | 79 | 7.9 |
| 6 | Screws fixing clutch actuator | 23 | 2.3 |
| 7 | Screw cap to discharge air from clutch actuator | 22 | 2.2 |
| 8 | Screws fixing rear box to middle box | 46 | 4.6 |
| 9 | Screws fixing flange retaining plate | 120 | 12 |
| 10 | Screws fixing rear cover | 5 | 4.6 |
| 11 | Speed sensor | 45 | 4.5 |
| 12 | Screws fixing middle box to front box | 50 | 5 |
| | Pin on rod (spread LOCTITE 262 on the thread) | 23 | 2.3 |
| | Oil vapour vent | 10 | 1 |
| | Screw plug M 10x1 on rear box | 15 | 1.5 |
| | Screw plug M 24x1 on rear box | 60 | 6 |
| | Screw M12 fixing power take-off bay cover | 79 | 7.9 |
| | Screw plug M 24x1.5 on middle box | 60 | 6 |
| | Screw fixing plates retaining fork joint pins on rear box | 23 | 2.3 |

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## TOOLS

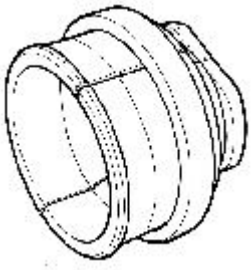
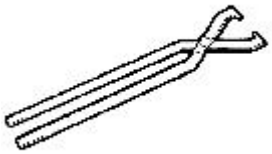
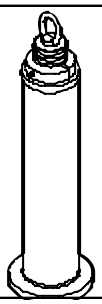
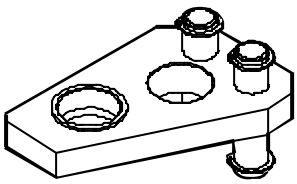
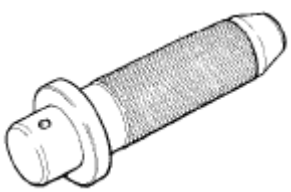
| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99305121** |  | Hot air device |
| **99322205** |  | Rotary stand for overhauling assemblies |
| **99322225** |  | Mount to support assemblies (to fit onto stand 99322205) |
| **99341003** |  | Single-acting bridge |
| **99341013** |  | Reaction block |
| **99341015** |  | Clamp |

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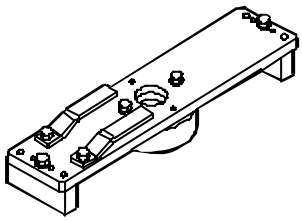
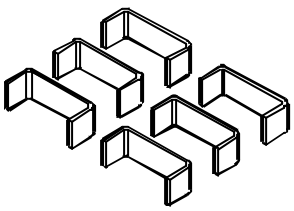
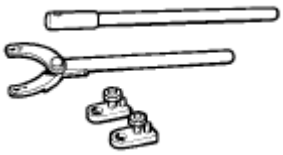
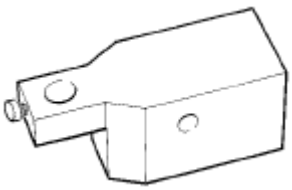
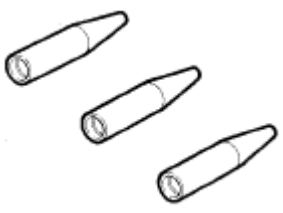
| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99341018** |  | Pair of brackets with hole |
| **99345057** |  | Extractor reaction block |
| **99345078** |  | Extractor to remove drive input shaft bearing (use with 99345105) |
| **993450998** |  | Inserter to fit bearing on main shaft, rear side and to insert rear flange of gearbox |
| **99345105** |  | Extractor for gearbox drive input shaft bearing (use with 99345078) |
| **99347100** |  | Small extractor (use with specific rings with 99347132) |

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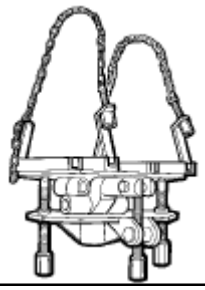
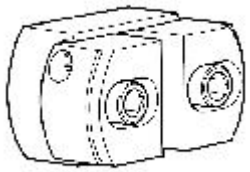
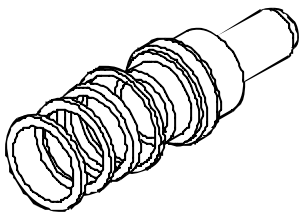
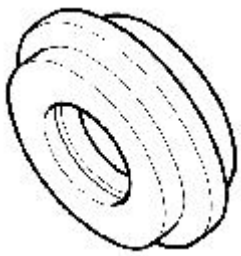
## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99347132** |  | Ring grips to extract gearbox transmission shaft bearings (use with 99345057 - 99347100) |
| **99360323** |  | Tool to turn drive input shaft when refitting the gearbox to the engine |
| **99360526** |  | Tool to extract and insert main shaft (use with 99360527) and to drive in gearbox drive input shaft bearing (use with 99345098) |
| **99360527** |  | Tool retaining gearbox main shaft forks (use with 99360526) |
| **99366811** |  | Set of M10 eyebolts (3) to remove and refit gearboxes |
| **99370006** |  | Grip for interchangeable drifts |

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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99370007** |  | Grip for interchangeable drifts |
| **99370153** |  | Tool for positioning main shaft when removing the transmission shafts and for retaining gearbox reverse gear pins |
| **99370172** |  | Tools (6) to mount gearbox epicyclic reduction gear train synchronizer rings |
| **99370317** |  | Reaction lever with extension to fasten drive output flange |
| **99370415** |  | Dial gauge base to adjust transmission shaft bearings (use with 99395604) |
| **99370499** |  | Guides (no. 3) to mount Splitter synchronizing device assembly |

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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99370629** |  | Mount to support gearbox when removing and fitting it back on the vehicle |
| **99374092** |  | Drift to mount outer races of bearings (69 - 91) (use with 99370007) |
| **99374221** |  | Driver to mount seals on back cover |
| **99374336** |  | Driver to fit seals on the front cover of the gearbox (use with 99370006) |
| **99395604** |  | Dial gauge (0 - 10 mm) |

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# 530210 REMOVING-REFITTING GEARBOX

## Removal

**NOTE** There follows a description of the operations for removing-refitting a gearbox with Intarder that, barring the asterisked operations, hold for the gearbox without intarder too.

To remove the gearbox, proceed as follows:

- set the vehicle over a pit or on a lift;
- disconnect the battery cables to avoid any possible short-circuiting;
- remove any sound-proofing guards that may be fitted on the engine and the entry boards;
- drain engine coolant;
- disconnect the wiring via the connectors (→) and disengage it from any clamps;
- disconnect the electrical connections (3) and (18) on the electronic control unit;
- disconnect the air supply pipe (19);
- * disengage the water delivery and return pipes (4 and 12) from the sleeves (1) on the engine;
- * disconnect the water delivery pipe (4) via the sleeve (13) and disengage it from any clamps on the gearbox;
- * disconnect the water return pipe (12) via the sleeve (16) (det. C) and disengage it from any clamps on the gearbox; remove the air pipe (17) too;
- disconnect the air pipe (7) of the servo-clutch cylinder (8) (det. A);
- remove the fasteners (9) (det. A) of the servo-clutch cylinder and extract it from the gearbox;
- disconnect the drier air discharge pipe (10) from the discharge pipe (11) (det. B);
- remove the outlet pipe (11) disconnecting it from the associated collars on the silencer and turbine and disengaging it from the fastener on the chassis frame;
- put a hydraulic jack fitted with the mount 99370629 under the gearbox and sling the gearbox mount;
- remove the screws (6) (det. A) fixing the crosspiece (5) to the chassis frame and remove the crosspiece;
- disconnect the propeller shaft (15) using the screws (14) and fasten it to the vehicle's chassis frame so it won't interfere with the removal of the gearbox;
- take out the screws (2) fixing the gearbox to the engine;
- take the gearbox out of its seat.

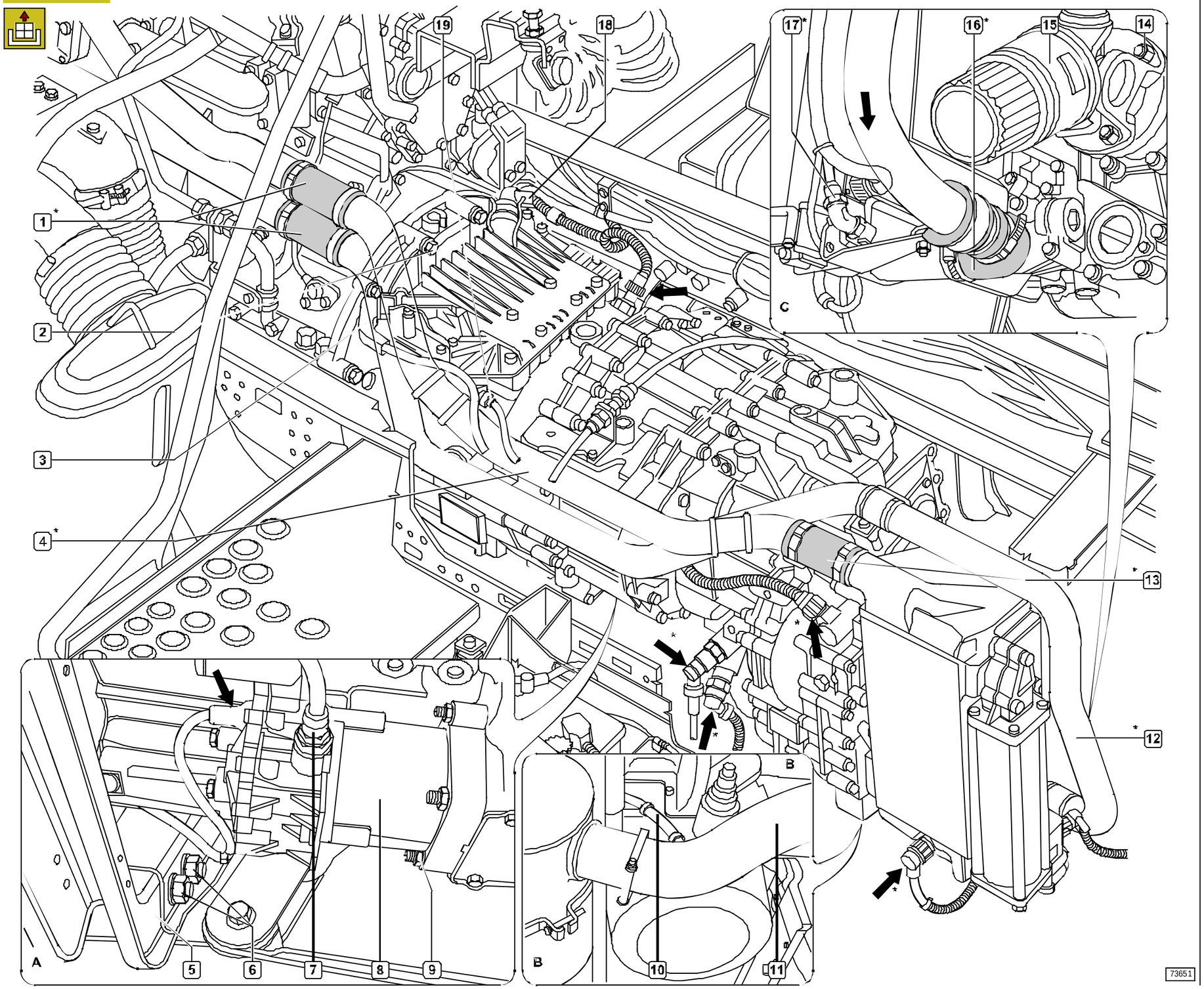
**NOTE** If the cross member of the chassis frame prevents you from removing the gearbox, you need to drain off the oil from the intarder; take out the nuts and screws fixing the heat exchanger to the intarder, remove the stud bolts and detach the heat exchanger.

## Refitting

Carry out the operations described for removal in reverse order and tighten the fixing nuts and screws to the required torque.

**NOTE** For gearboxes with intarder, proceed as follows: apply LOCTITE 510 onto the thread of the stud bolts fixing the heat exchanger and screw then onto the gearbox; connect the refrigerant fluid pipes to the heat exchanger and replenish the gearbox with the required amount of oil; fill the engine cooling system as described in Section 2 Engine.

Figure 4



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## 530210 OVERHAULING THE GEARBOX

Wash the assembly thoroughly before overhauling.

The specific and/or general tools must be used in the way for which they were designed.

To facilitate assembly, put the removed parts away on the specific tray in their order of removal.

Upon assembly, the following must always be replaced with new parts: the gaskets and seals, spring pins, safety plates and springs. Nuts and screws must be tightened to the prescribed torque with their thread dry and degreased.

Keep to the specific regulations when disposing of lubricant and detergents.

### Checks

The gears, synchronizer rings, coupling bodies and sliding couplings must show no sign of failure or excessive toothing wear.

The main shaft must have no indentation, especially on the sliding surfaces of the gear rotation and coupling sleeves.

The reverse idle gear shafts must have a polished surface free from scoring.
The gearboxes must show no sign of cracking and the bearing seats must be neither damaged nor worn, so as to prevent the outer rings of the bearings from turning in their seats.

Check the shoulder spacers are neither worn nor damaged.

The gear coupling forks must show no sign of cracking and the relevant control rods must slide freely, but without any appreciable play, in their guide seats.

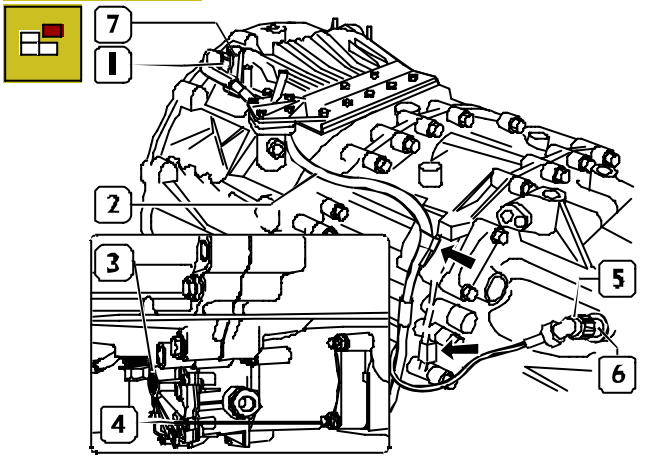
Check that the shoes of the drive forks are fully efficient.

Check that the holes, grooves and lubrication pipes are not obstructed by grease or foreign bodies.

Check the bearings are not worn, damaged or overheated.

## 530520 Gearbox actuator Removal

Figure 4/1

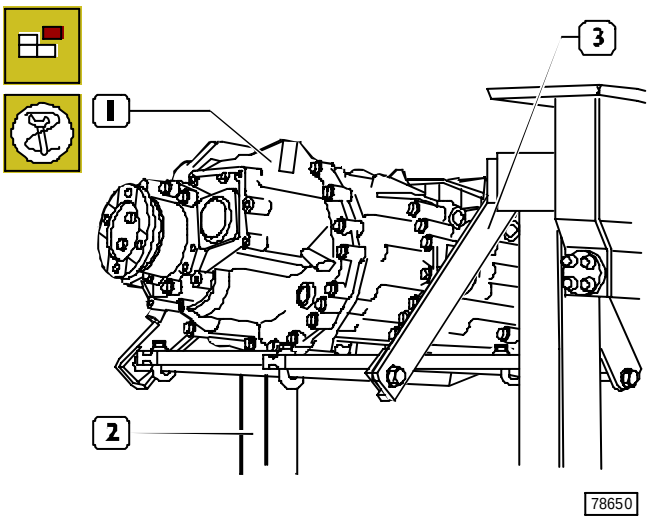



Unscrew the ring nut (1 and 5) and disconnect the electric wiring (2) from the speed sensor (6 and 7).

Detach the wiring (2) from the clips (→) securing it to the middle box.

Remove the nuts (4) and detach the actuator (3) from the front box.

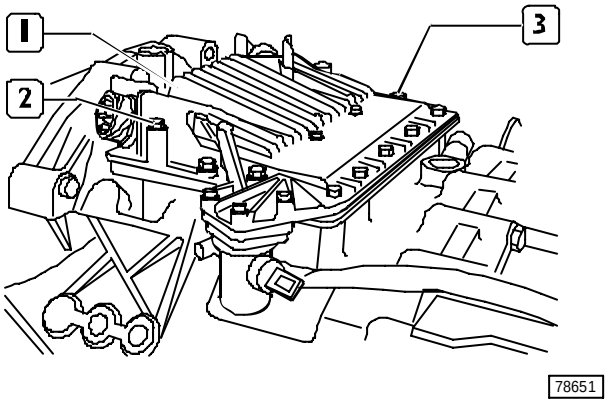
Figure 4/2




Fasten the gearbox (1) to brackets 99322225 (3) on the rotating stand 99322205 (2).
Remove the plug and bleed the lubrication oil.

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Figure 4/3




78651

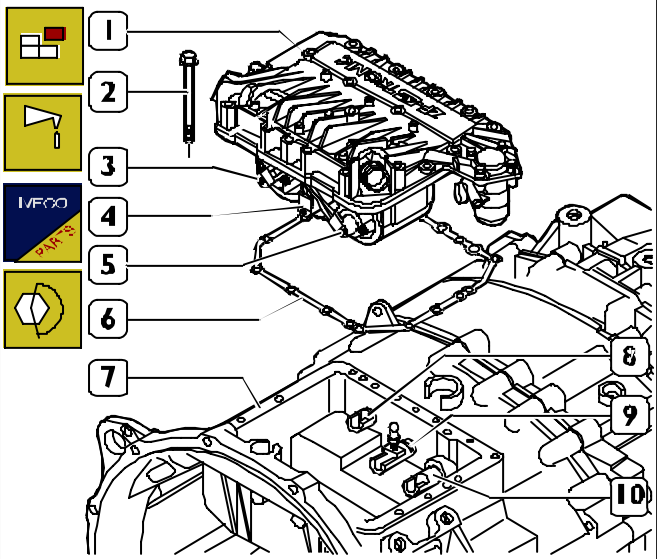
Take out the screws (2) and detach the actuator (1) with its gasket.

The electronic control unit is integrated in the actuator and these cannot be overhauled. See under the diagnosis heading for the check.

Check that the oil vapour vent (3) is not clogged; if it is, clean it.

## Refitting

Figure 4/4



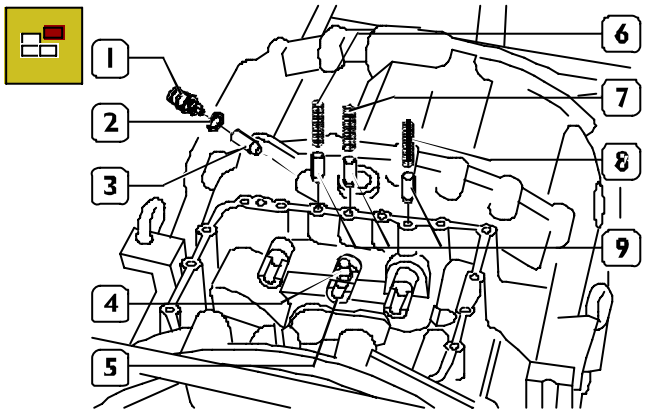

70828

Set a new gasket (6) on the front case (7).

Lubricate the stems of the solenoid valves (3-4-5) with silicone grease and put them into a neutral position. Put the rods (8-9-10) into a neutral position. Fit the actuator (1) on the front box (7) verifying that the end of the stems of the solenoid valves is correctly positioned in the seats of the rods (8-9-10). Tighten the fixing screws (2) to the prescribed torque. After removing the gearbox from the stand used for overhaul, refit the clutch actuator (3, Figure 4/1) and make sure the wiring (2, Figure 4/1) is not damaged.

## Removing the rear box

Figure 4/5




70863

Disconnect speed actuators (1) as described in the relevant chapter.

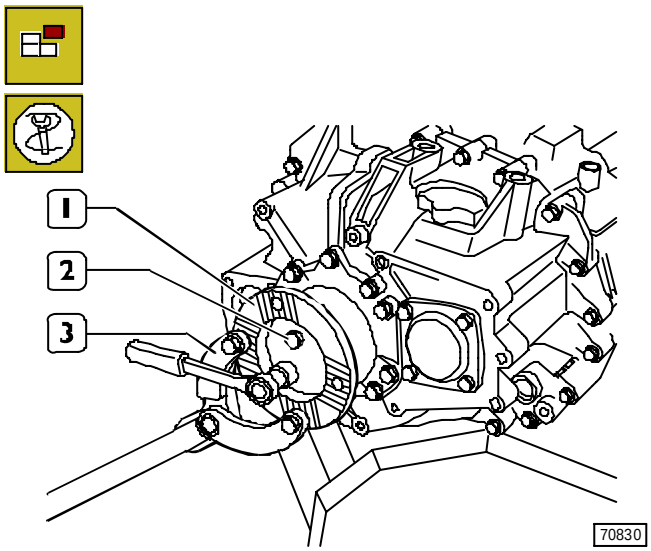
Extract the springs (6-7-8) and the pawls (6).

The springs (7 and 8) are of equal length, the spring (6) is larger.

Remove the pin (4) from the rod (5).

Remove the switch (1) together with the gasket (2) and extract the cap (3).

Figure 4/6

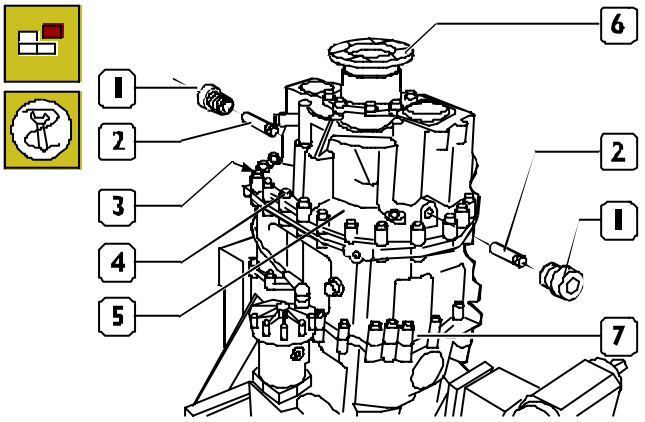



70830

Block rotation of the sleeve (1) by applying the lever 99370317 (3) and slightly loosen the screws (2).

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Figure 4/7



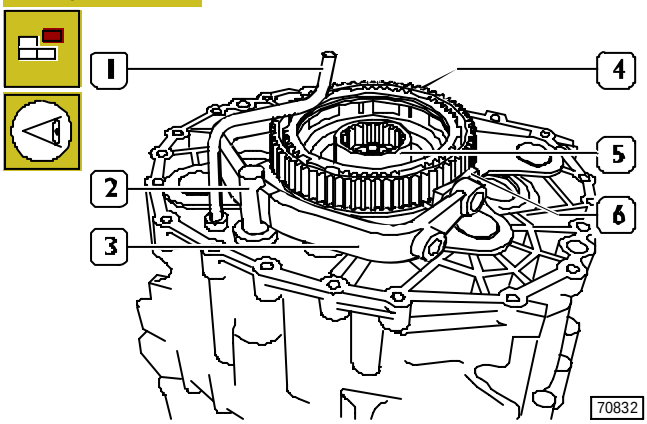

117521

Remove the screws (1) fixing the plates (2) fastening the pins (4) and extract these together with the seal (3) from the rear box (7).

Extract the two centring pins (5). Remove the screws (6).

Fit the eyebolt 99366811 to the sleeve (8) and, using special ropes and lifter, detach the rear box (7) from the middle one (9).

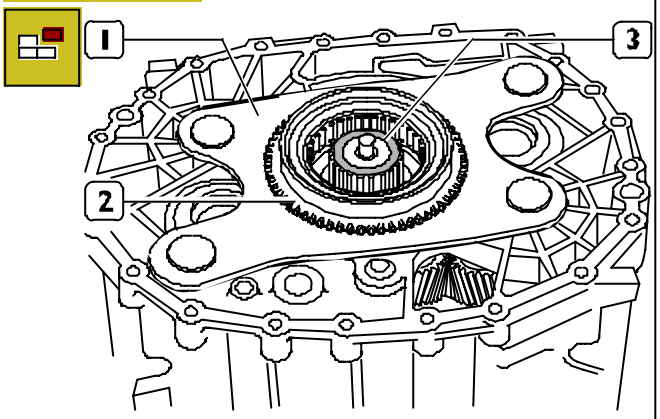
Figure 4/8




70832

Remove the oil pipe (1). Note down the assembly position of the fork (3) and plugs (6) and remove them. Remove: the rod (2), synchronizing device assembly (4) and connecting sleeve (5).

Figure 4/9

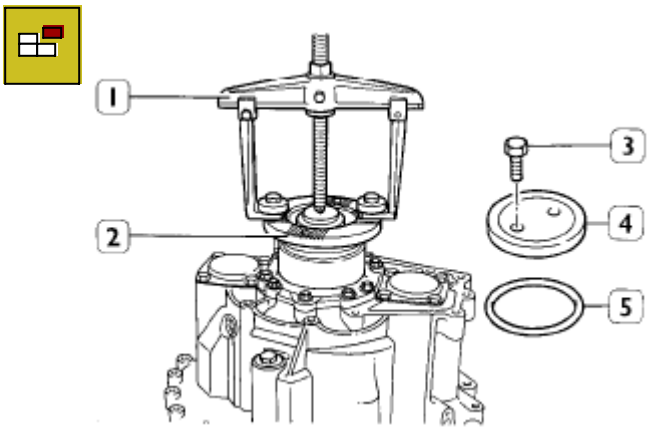



70833

Remove the adjustment ring (3) and the plate (1) together with the coupling body (2).

## Removing the rear box

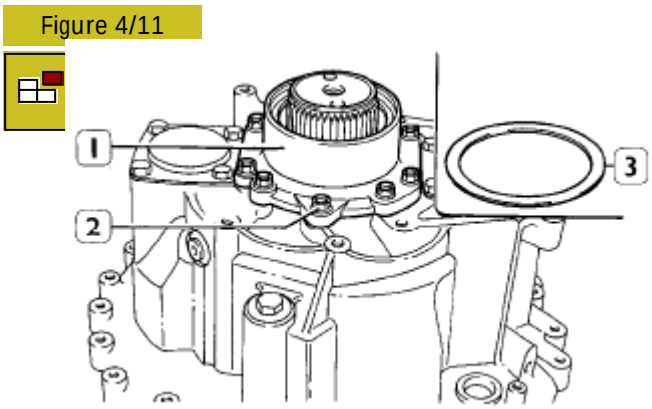
Figure 4/10




70834

Remove the screws (3), disc (4) and seal (5) and extract the sleeve (2) from the spider shaft. Should extraction prove difficult, use an extractor (1) applied as illustrated in the figure.

Figure 4/11

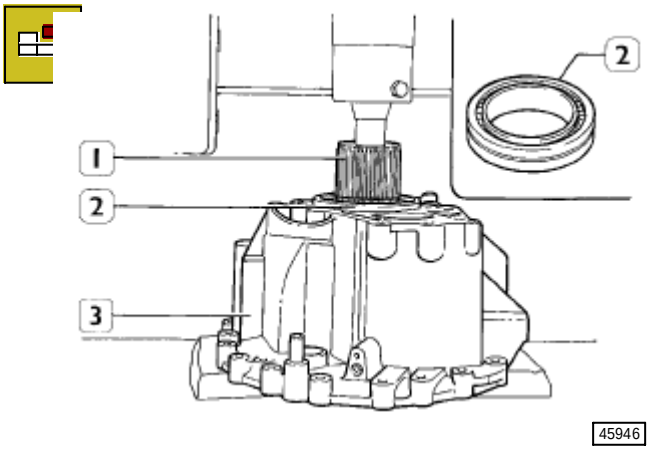



70835

Remove the screws (2) and take off the cover (1). Remove the spider shaft bearing end float adjustment ring (3).

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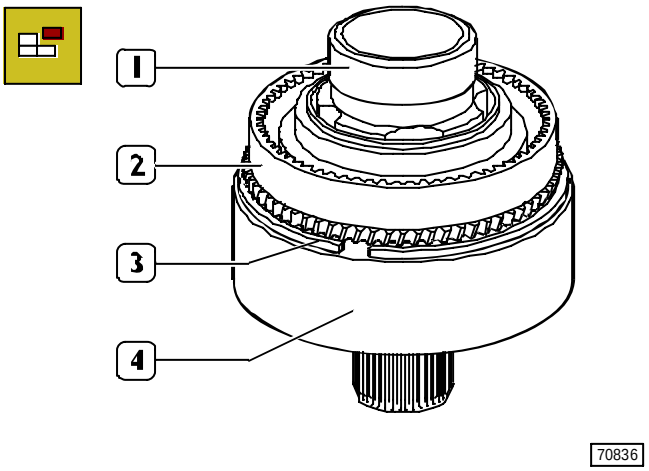
Figure 4/12




Using a press, extract the spider shaft (1) from the supporting roller bearing (2). Turn the rear box (3) upside-down and extract the roller bearing (2).

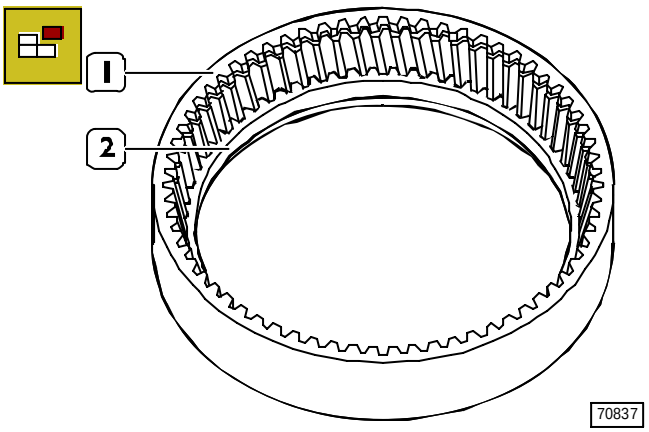
## Removing the epicyclic reduction gear train (E.R.G.)

Figure 4/13



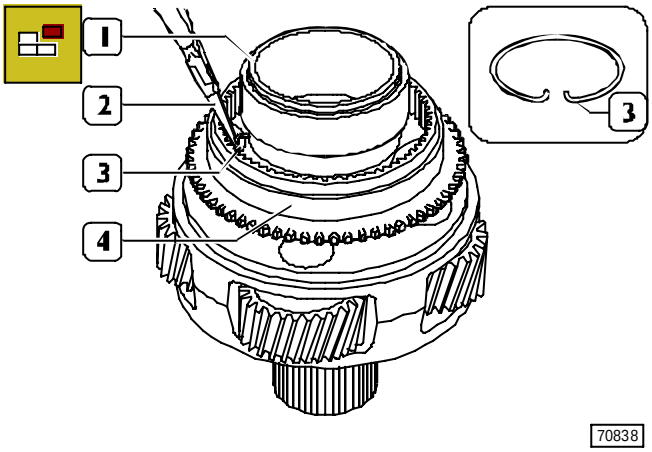

Using a screwdriver, remove the circlip (3) fastening the ring gear with internal toothing (4) to the ring gear with external toothing (2) and remove them from the E.R.G. (1).

Figure 4/14



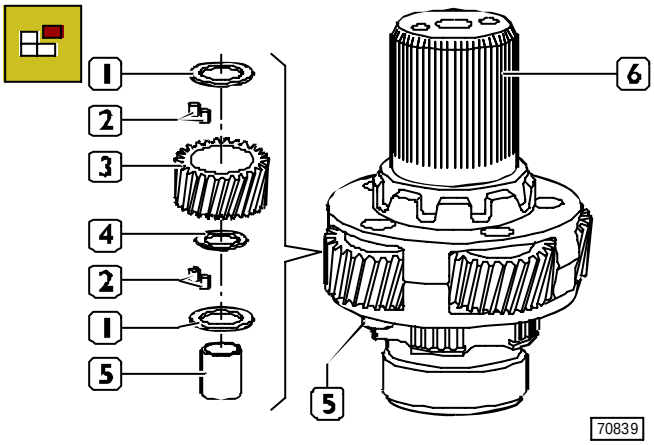

Extract the toothed ring (2) from the ring gear with internal toothing (1).

Figure 4/15




Using pliers (2), tighten the ends of the circlip (3) and remove the coupling body (4) from the E.R.G. shaft (1).

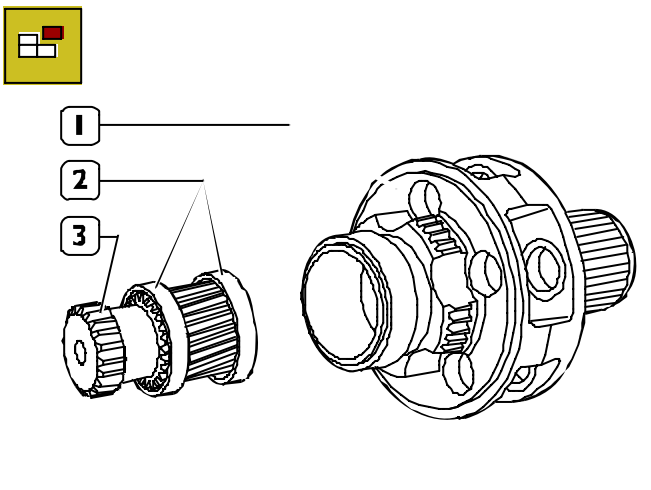
Figure 4/16




Using a punch, extract the pins (5) from the spider shaft (6).

Remove the planetary gears (3) from the spider shaft (6), together with the rollers (2) and shim adjustment rings (1 and 4).

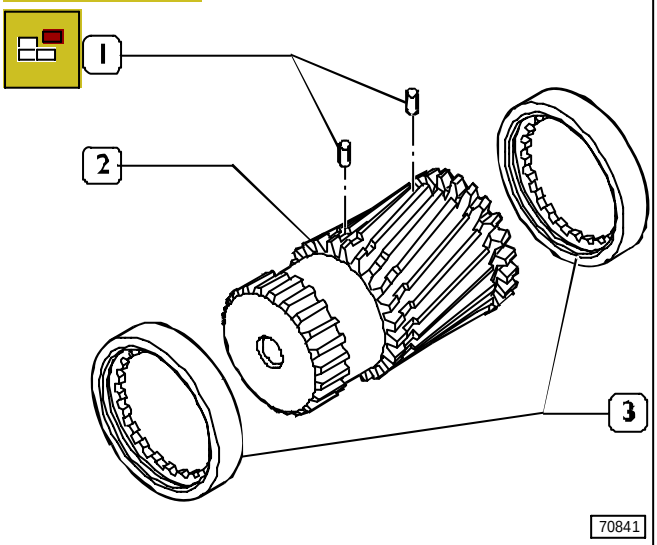
Figure 4/17




Extract the toothed shaft (3) from the spider shaft (1) together with the rings (2).

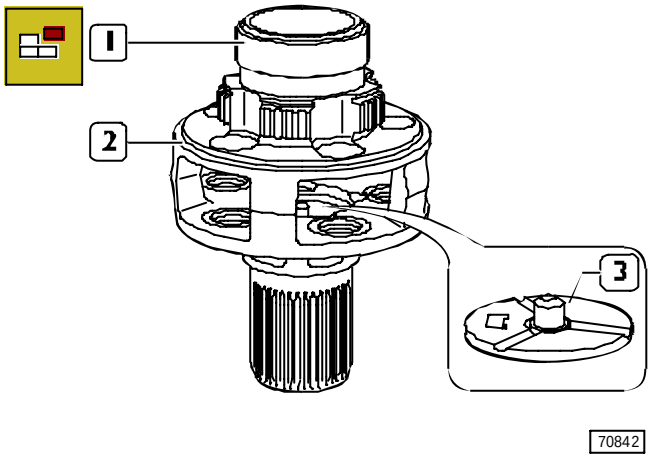
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Figure 4/18




Extract one of the pins (1) from the toothed shaft (2) and extract the rings (3) from this.

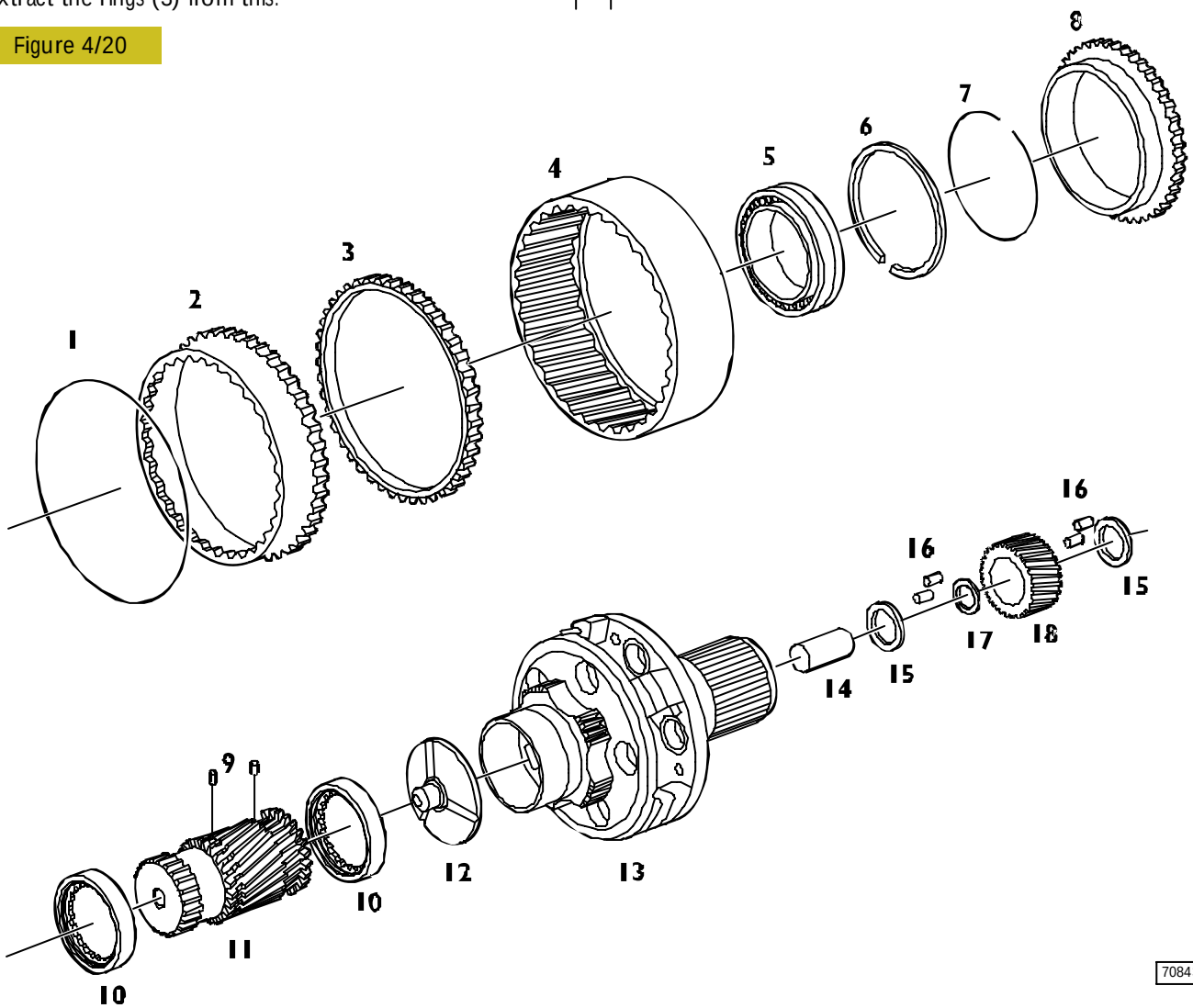
Figure 4/19




Using a suitable extractor, remove the roller bearing ring (1) from the spider shaft (2).

Using a punch, extract the disc (3) from the inside of the spider shaft (2).

Figure 4/20



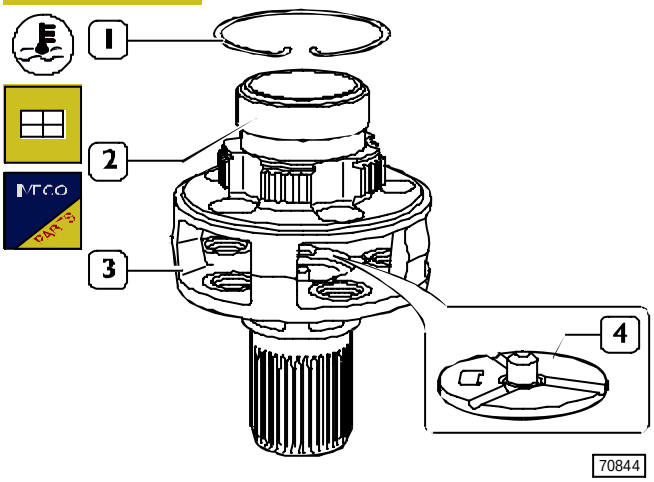

PARTS COMPRISING THE E.R.G.

1. Circlip - 2. Ring gear with external toothing - 3. Toothed ring - 4. Ring gear with internal toothing - 5. Bearing - 6. Circlip - 7. Circlip - 8. Coupling body - 9. Pins - 10. Ring - 11. Toothed spindle - 12. Disc - 13. Spider shaft - 14. Pin - 15. Shim adjustment ring - 16. Rollers - 17. Shim adjustment ring - 18. Planetary gear.

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## Fitting the epicyclic reduction gear train (E.R.G.)

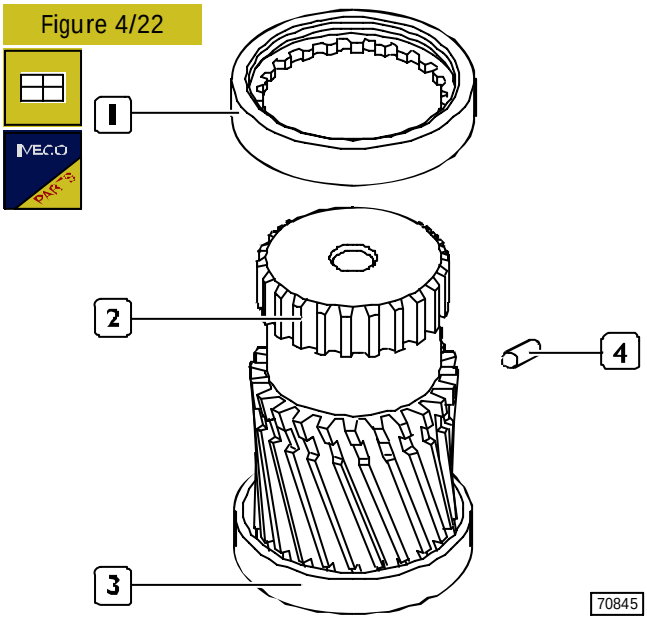
Figure 4/21




Heat the inside ring (2) of the roller bearing to 120°C and fit it on the spider shaft (3).

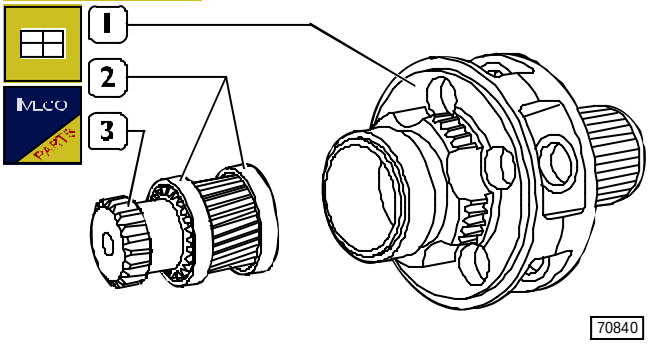
Fit on the circlip (1). Fit on the disc (4).

Figure 4/22



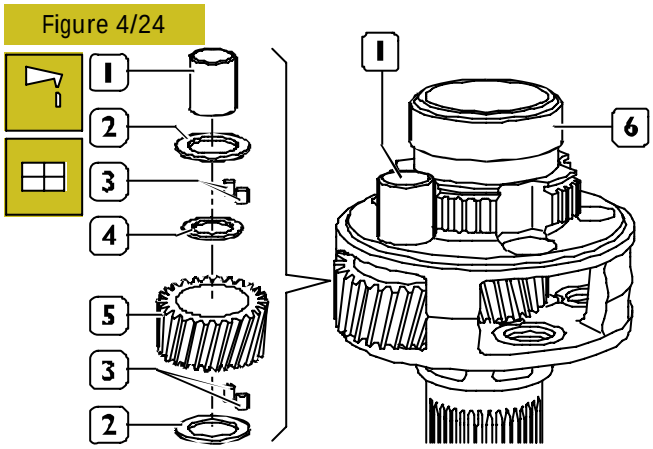

Drive the rings (1 and 3) onto the toothed spindle (2) and fit on the pin (4).

Figure 4/23



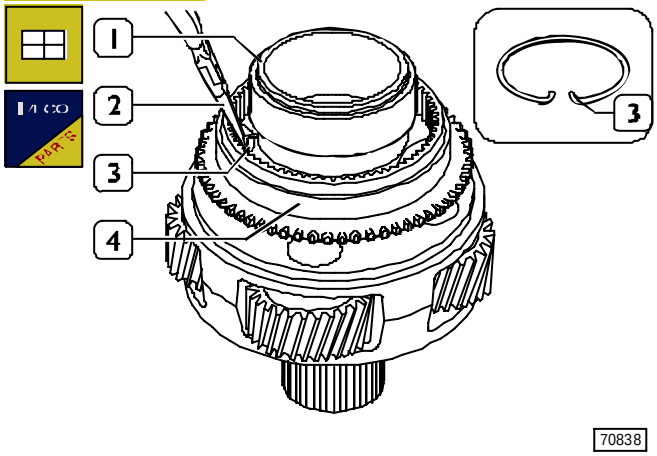

Insert the spindle (3) together with the rings (2) onto the spider shaft (1).

Figure 4/24



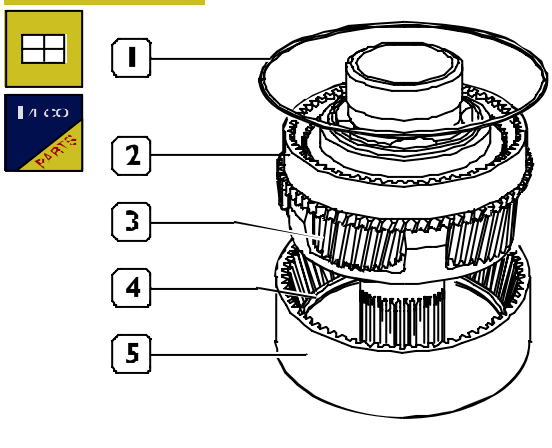

Smear grease into the hole of the planetary gear (5) and insert the rollers (3) with the associated shim adjustment rings (2 and 4). Fit the planetary gears (5) onto the spider shaft (6), fastening them to it with the pins (1).

Figure 4/25




Using pliers (2), tighten the ends of the circlip (3) and fit the coupling body (4) onto the E.R.G. shaft (1).

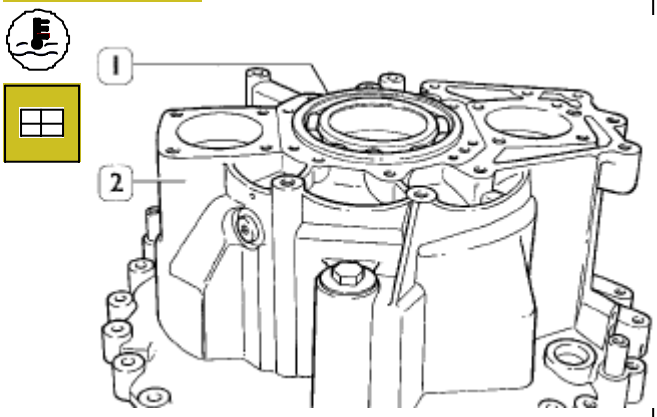
Figure 4/26




Fit the ring gear with internal toothing (5) onto the spider shaft (3) together with the toothed ring (4), and the ring gear with external toothing (2) and fasten the two ring gears with the circlip (1).

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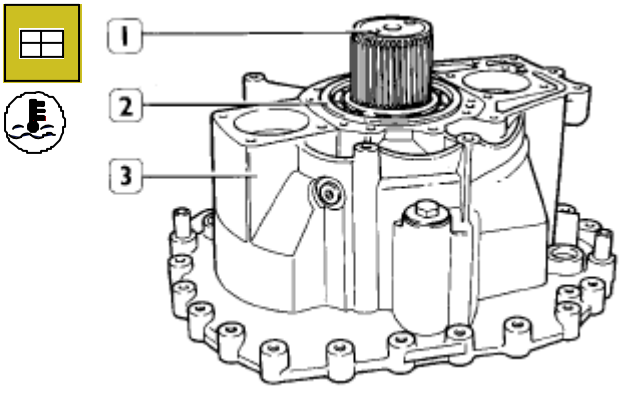
Figure 4/27




45951

Heat the seat of the bearing (1) of the rear box (2) to 120°C and mount the bearing (1).

Figure 4/28



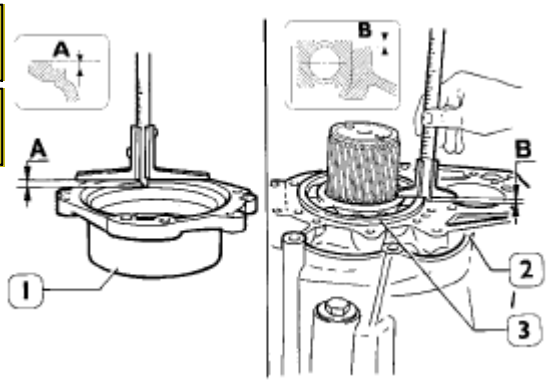

45943

Rest the spider shaft (1) on an appropriate spacer.

Heat the inside ring of the bearing (2) to 120°C and drive it together with the rear box (3) onto the spider shaft (1).

## Adjusting epicyclic reduction gear train bearing end float

Figure 4/29




70847

Determine the ball bearing end float adjustment thickness (3) by proceeding as follows:

- measure the depth of the seat on the cover (1) of the bearing (3), distance A;
- measure the protrusion of the bearing (3) from the surface of the rear box (2), distance B.

The thickness S of the adjustment ring is determined by the following equation:

$$S = (A - B) - C$$

Where:

A and B = measurements

C = end float 0÷0.1 mm

For example:

A = 5.4 mm

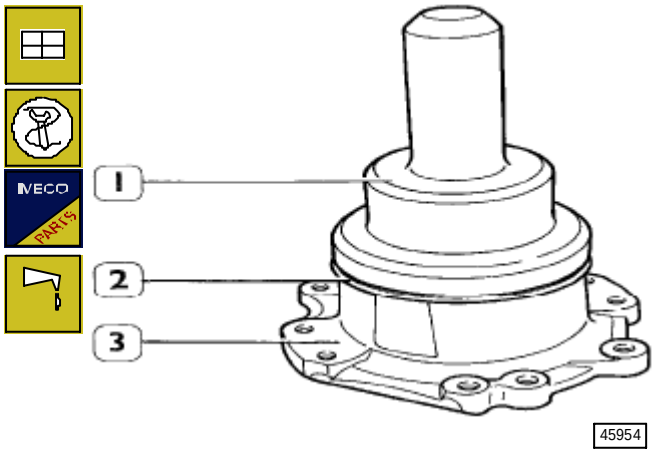
B = 5 mm

C = 0÷0.1 mm

S = (5.4 - 5) - (0÷0.1 mm) = 0.3 ÷ 0.4 mm

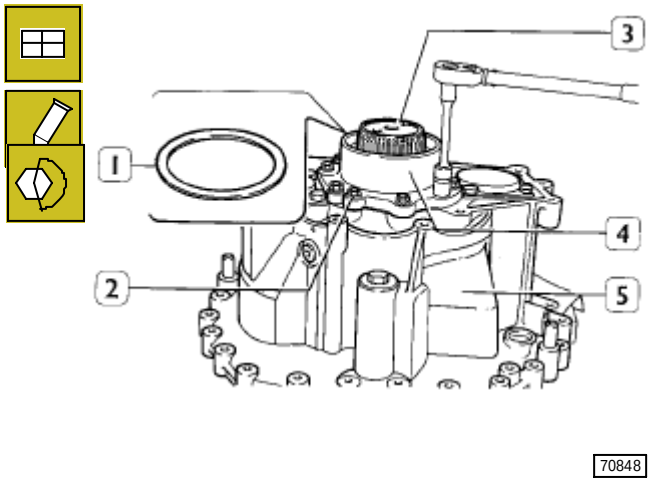
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Figure 4/30




Using the driver 99374221 (1), fit the seal (2) in the cover (3).

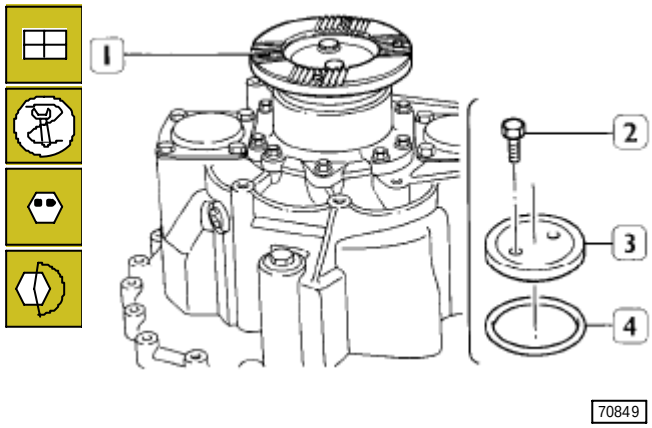
Figure 4/31




Mount the adjustment ring (1), of the thickness determined in the preceding measurement, on the bearing (2, Figure 4/28) of the spider shaft (3).

Spread IVECO sealant 1905685 on the mating surface of the cover (4) with the box (5) and fit it onto the box, tightening the screws (2) to the prescribed torque.

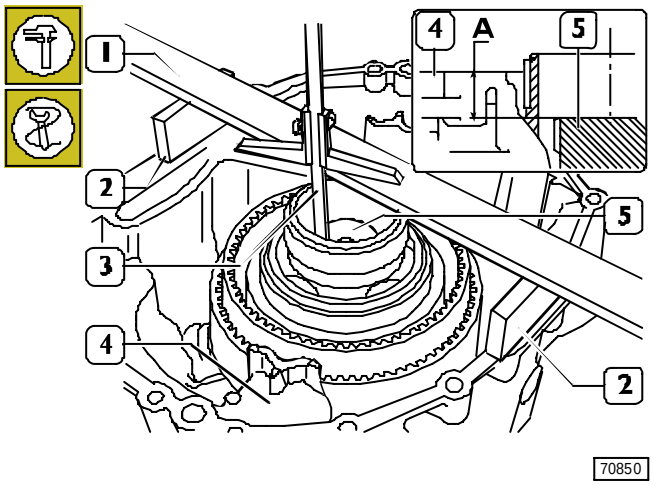
Figure 4/32




Heat the sleeve (1) to 90 °C and fit it onto the spider shaft (1). Fit on a new seal (4), the disc (3) and screws (2) and tighten them to the prescribed torque.

## Adjusting main shaft end float

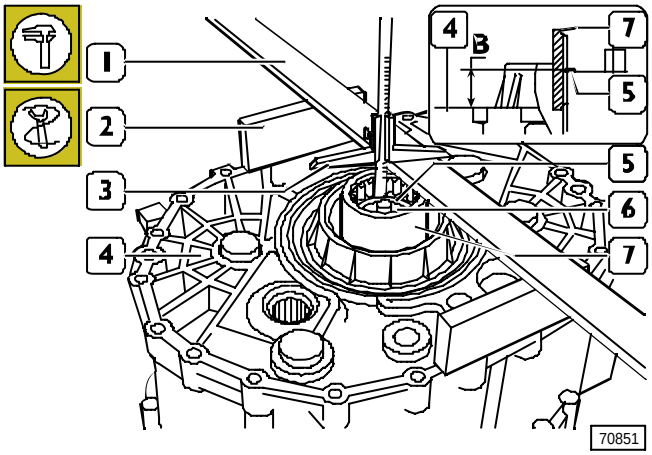
Figure 4/33




Position two calibrated blocks (2) on the rear box (4). Place a calibrated rule (1) on them and, using a depth gauge (3), measure the distance between the top side of the rule and the end of the spider shaft (5), distance A.

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Figure 4/34




Fit the connecting sleeve (7) together with the circlip (5) on the main shaft (6).

Position two calibrated blocks (2) on the middle box (4) and place a calibrated rule (1) on them.

The calibrated blocks and rule must be the same ones used in the preceding measurement.

Using a depth gauge (3), measure the distance between the top end of the circlip (5) and the top side of the calibrated rule, distance B.

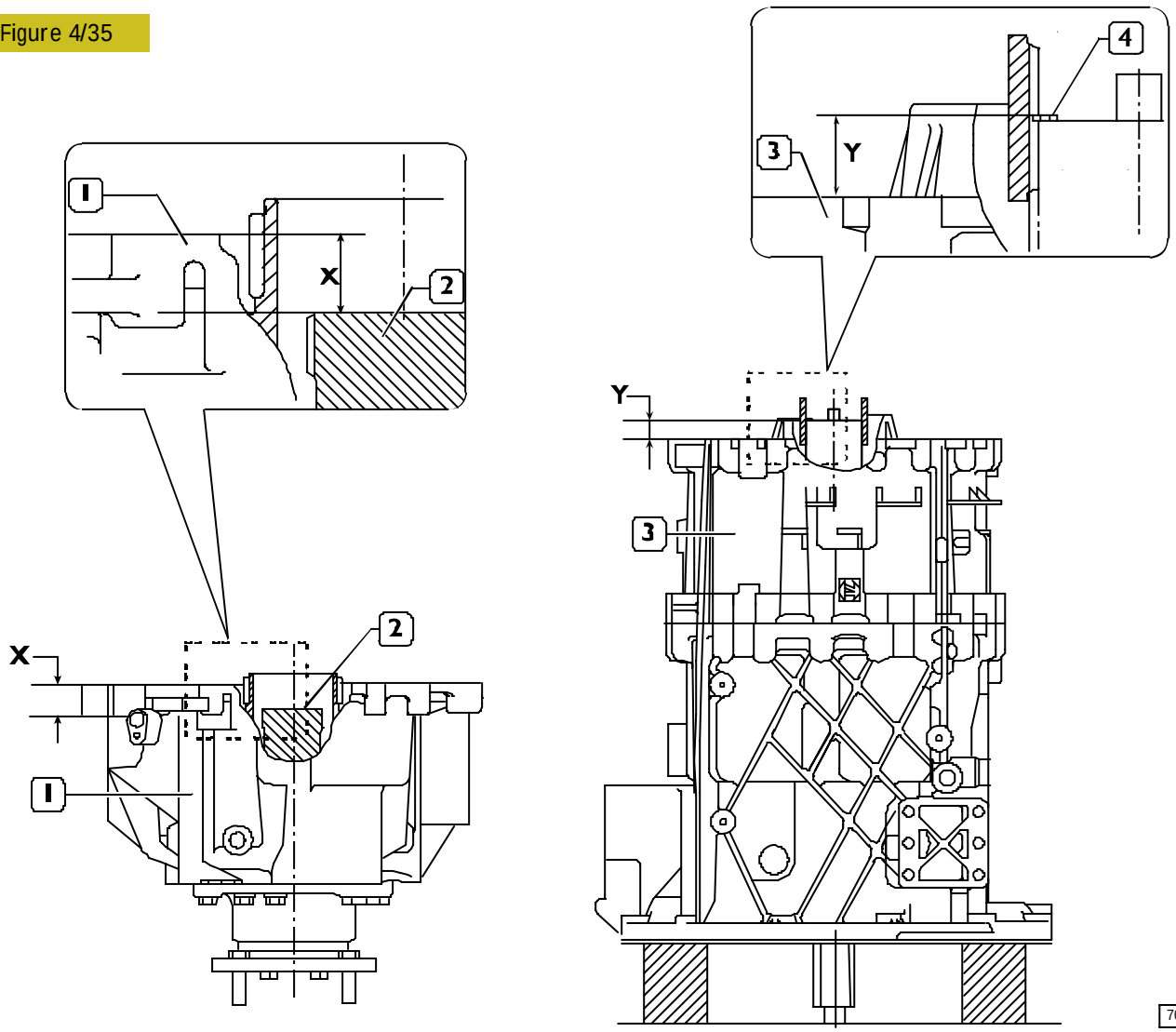
The thickness S of the main shaft end float adjustment ring is determined by the following equation:

$$S = (A - B) - 2$$

For your information (see Figure 4/36), subtracting the thickness of the calibrated blocks and rule:

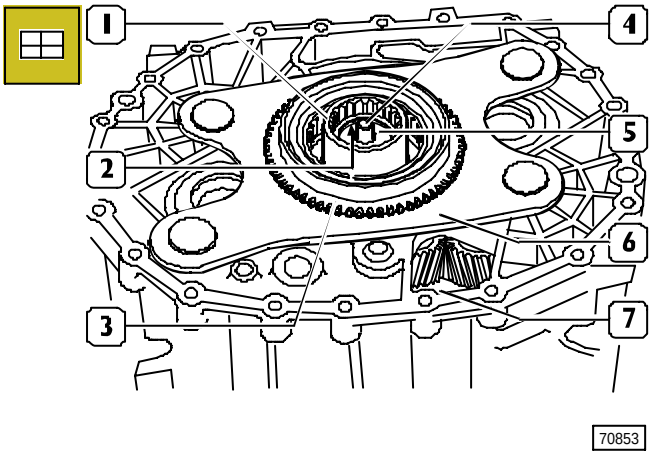
- from the distance A gives the distance X corresponding to the distance between the end of the spider shaft (2) from the mating surface of the rear box (1).
- from the distance B gives the distance Y corresponding to the distance between the circlip (4) and the mating surface of the middle box (3).

Figure 4/35



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Figure 4/36



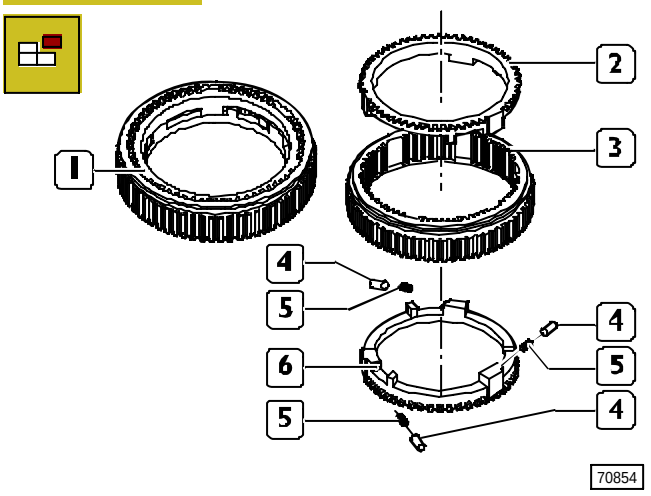

Position the adjustment ring (2) (of the thickness determined in the preceding measurements) on the main shaft (5). Mount the connecting sleeve (1) and the tube (4).

Mount the plate (6) together with the coupling body (3).

## Synchronizing device assembly for engaging normal or reduced gears

### Removal

Figure 4/37

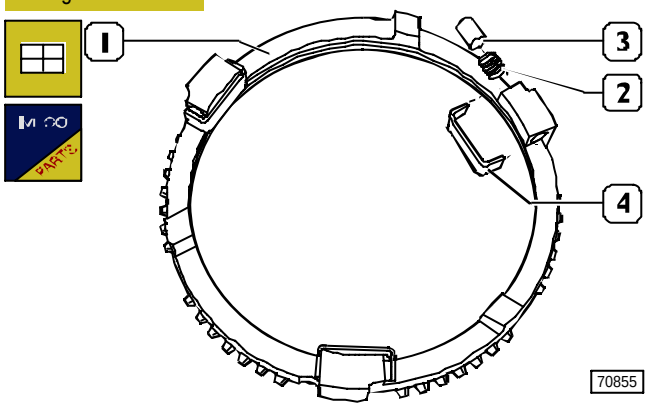



1. Synchronizing device assembly - 2. Synchronizing device ring - 3. Sliding sleeve - 4. Pawl - 5. Spring - 6. Synchronizing device ring.

Put a cloth on the synchronizing device assembly (1) so that, when dismantling it, the springs (5) and pawls (4) are held back as they come out of their seats.

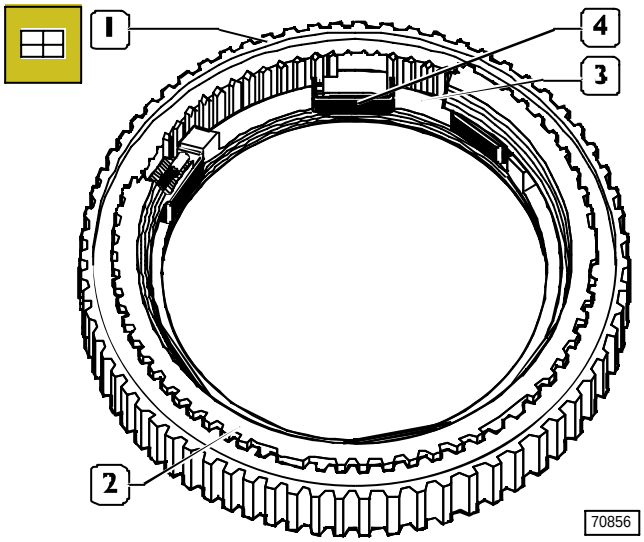
### Fitting

Figure 4/38



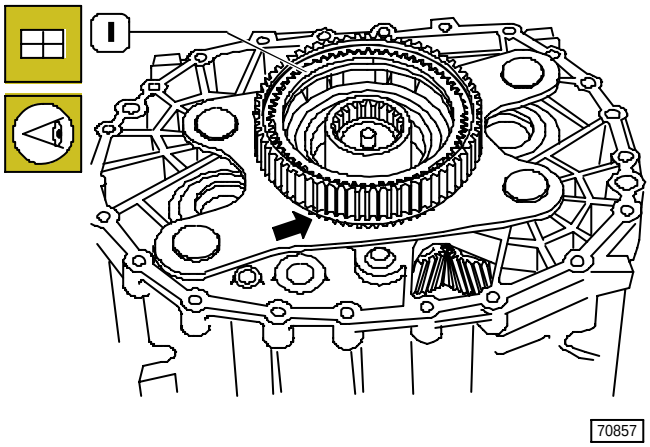

Put the springs (2) and pawls (3) into the seats of the synchronizing device rings (1) and fasten them with the tools 99370172 (4).

Figure 4/39




Position the synchronizing device ring (2) on the synchronizing device ring (3) so that it is possible to fit the sliding sleeve (1) onto them. On completing assembly, remove the tools 99370172 (4).

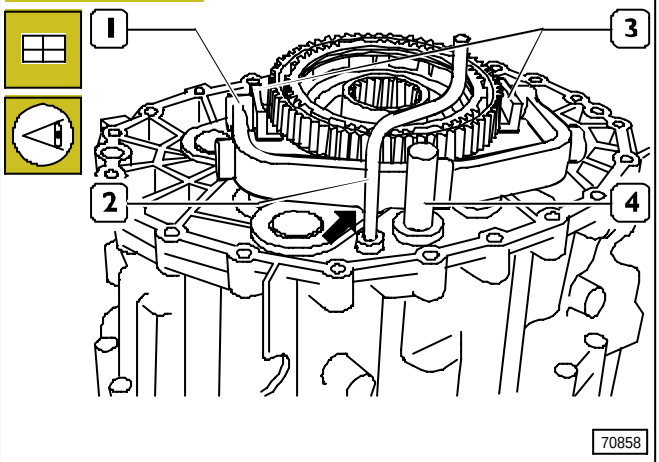
Figure 4/40




Fit the synchronizing device assembly (1) on the coupling body (3, Figure 4/36) with the ring groove (→) facing downwards.

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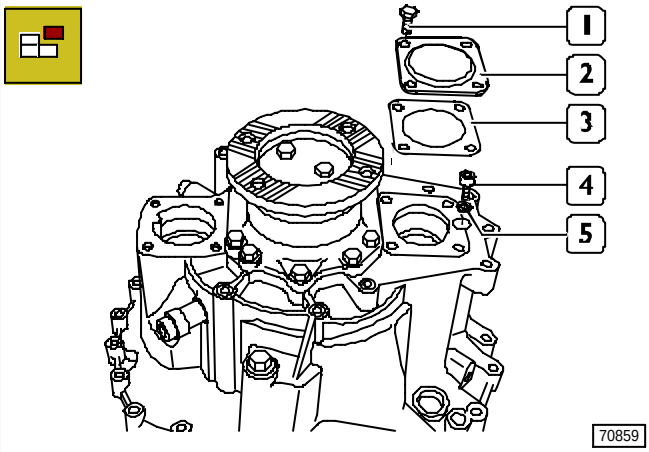
Figure 4/41




Position the fork (1) with the plugs (3) and the reliefs ( ' ) facing as illustrated in the figure.

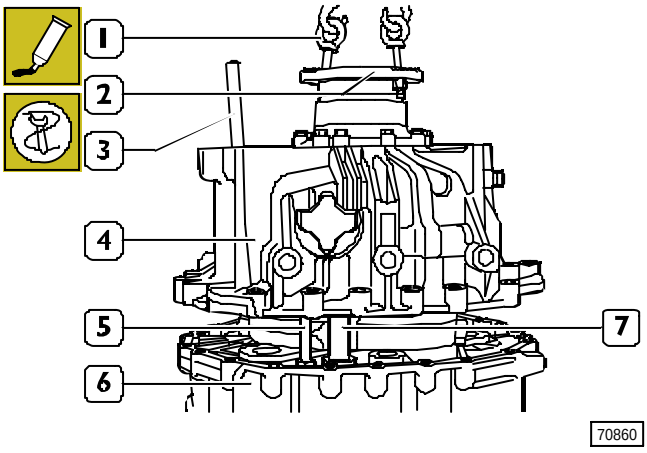
Fit on the rod (4) and connect it to the fork (1). Fit on the oil pipe (2).

Figure 4/42




Take out the screws (1) and remove the cover (2) with its seal (3). Remove the screw (4) with the washer (5).

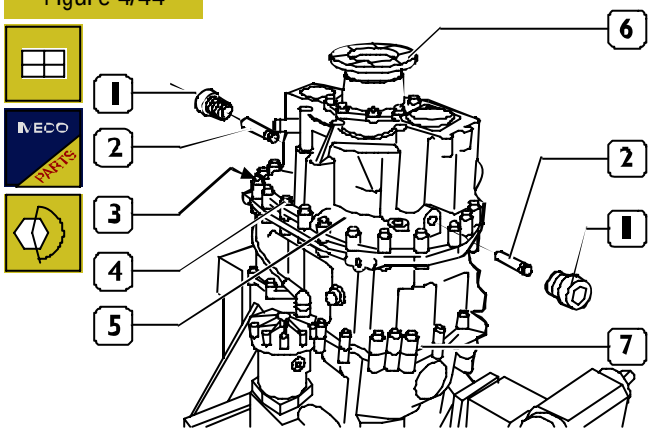
Figure 4/43




Spread IVECO sealant 1905685 onto the mating surface of the middle box (6). Fit the eyebolts 99368811 (1) to the sleeve (2). Using ropes and a lifter, position the rear box (4) coaxially to the middle one (6).

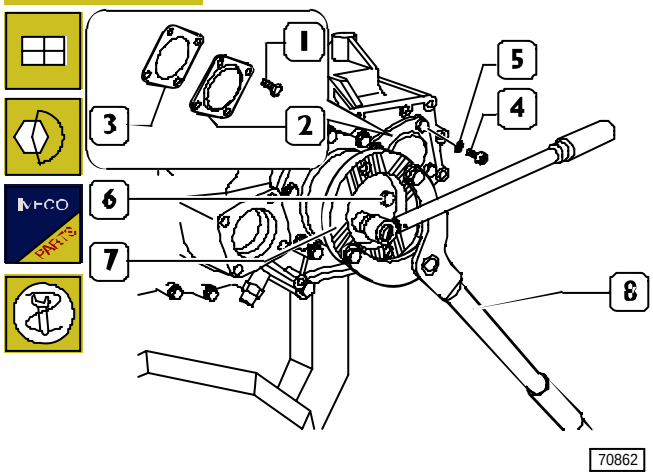
Insert the rod (3) of appropriate diameter in the hole for the screw (4, Figure 4/42) and in the oil pipe (5) to guide this into its seat, while lowering the rear box (4). Lower the rear box (4), paying attention that the spider shaft, oil pipe (5) and rod (7) go into their seat correctly.

Figure 4/44




Screw down the screws (6) without tightening them; insert the centring pins (5) and tighten the screws (6) to the prescribed torque.
Fit the fork joint pins (4) with fresh seals (3) and tighten the screws (1) fixing the fastening plates (2) to the prescribed torque.

Figure 4/45



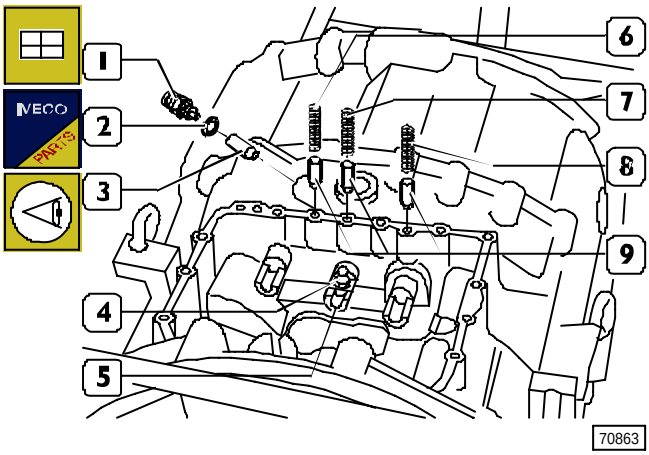

Fit: the screw (4) with a new washer (5) and tighten it to the prescribed torque.

Fit the cover (2) with a fresh seal (3) and tighten the fixing screws (1) to the prescribed torque.

Block rotation of the sleeve (7) by applying the lever 99370317 (8) and tighten the fixing screws (6) to the prescribed torque.

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Figure 4/46

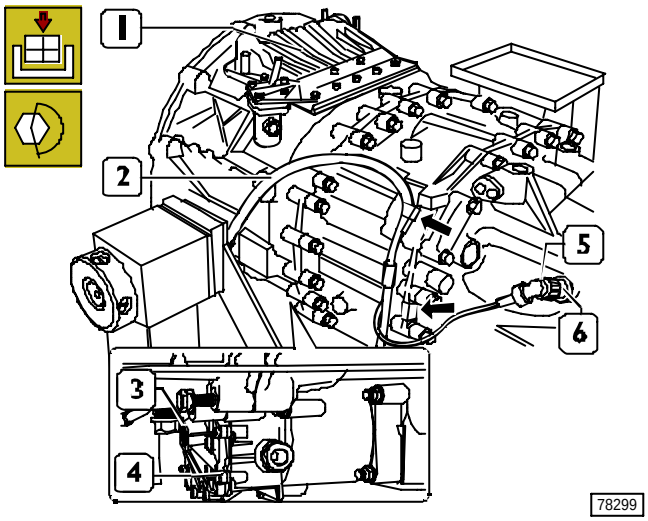



Fit the cap (3) and the switch (1) with a new gasket (2). Spread LOCTITE 262 onto the thread of the pin (4), screw it onto the rod (5) and tighten them to the prescribed torque.

Fit the pawls (9) and the springs (6-7-8).

The springs (7 - 8) are of equal length, the spring (6) is larger.

Figure 4/47

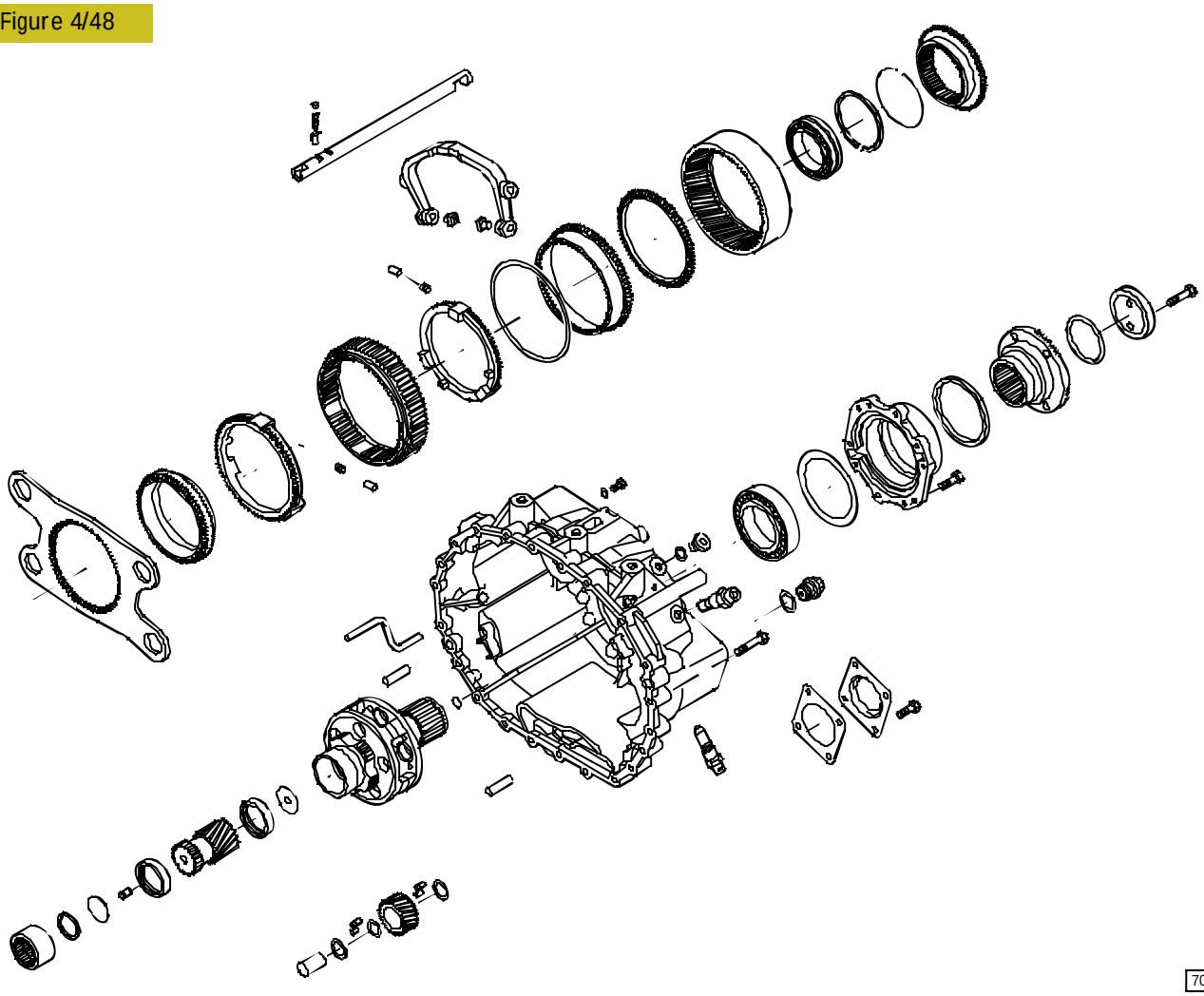



Refit the gear actuator (1) as described under the relevant heading.

Connect the electric wiring (2) to the speed sensor (6), tighten the fixing ring nut (5) and secure the wiring (2) to the box by inserting it in the clips (→).

Refit the clutch actuator (3) and tighten the nuts (4) to the prescribed torque.

Figure 4/48

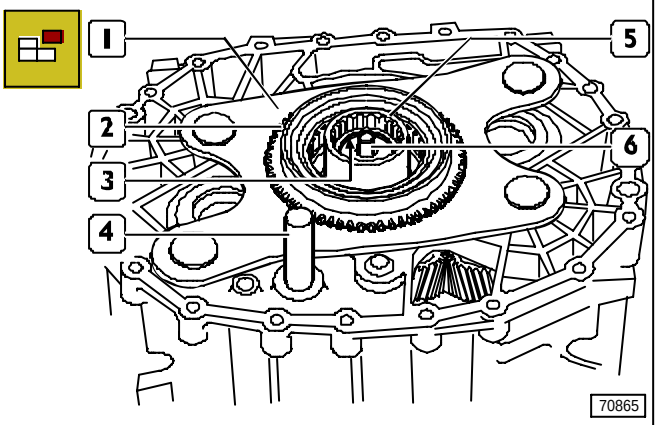



COMPONENT PARTS OF THE REAR BOX OF THE EPICYCLIC REDUCTION GEAR TRAIN

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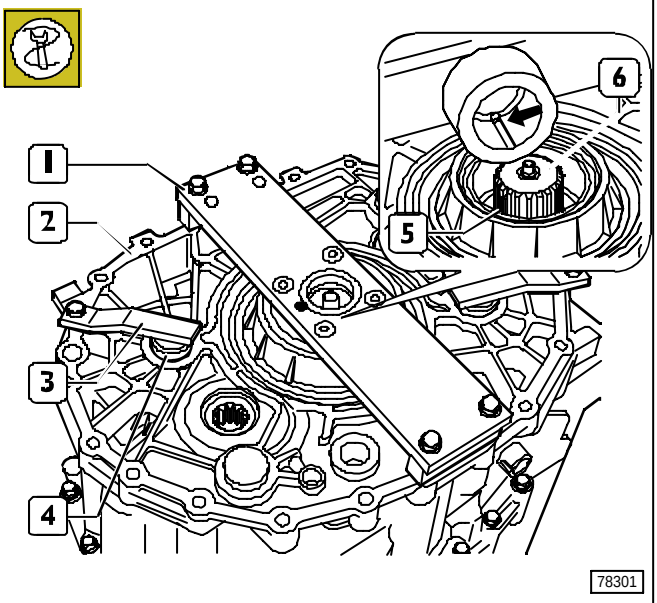
## Removing the middle box

Figure 4/49




Detach the gear actuator and the rear box as described under the relevant headings. Remove the E.R.G. drive rod (4), connecting sleeve (5), adjustment ring (3) and the plate (1) together with the coupling body (2). Remove the small pipe (6).

Figure 4/50

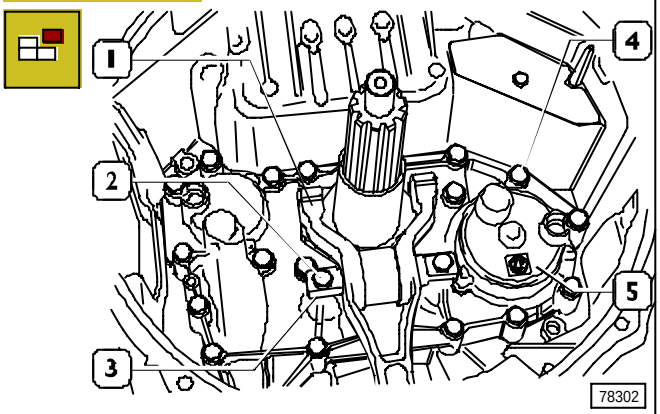



Fit the plate 99370153 (1) to the middle box (2) so that the groove inside the plate coincides with the key (5) of the main shaft (6).

Fasten the pins (4) by fitting the brackets (3) of the plate 99370153 to the middle box (2).

Turn the gearbox through 180°.

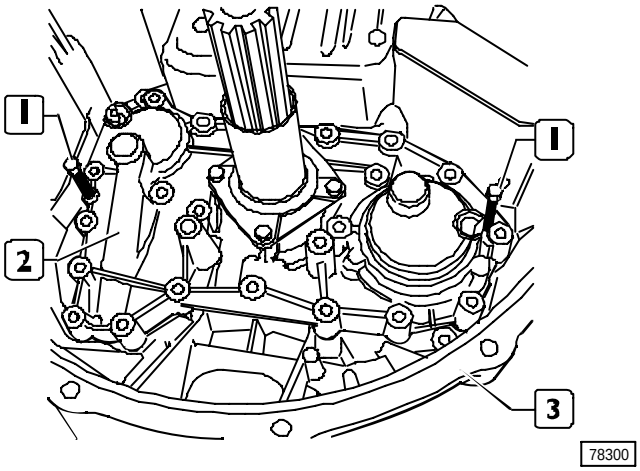
Figure 4/51




Take out the screws (2) and remove the pin (3) in the joint of the clutch uncoupling lever (1) with this lever.

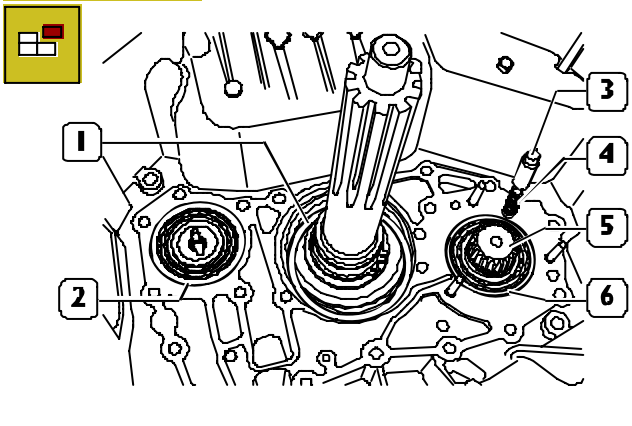
Remove the screws (4) fixing the front cover (5) to the front box.

Figure 4/52




Screw down two screws (1) into the front cover (2) and detach this from the front box (3).

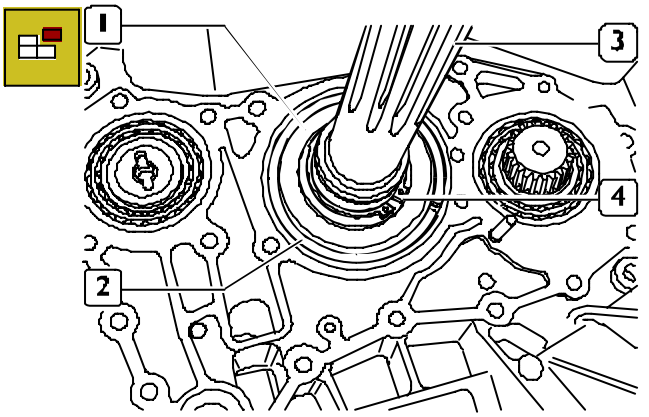
Figure 4/53




Remove the cap (3), the spring (4) from the transmission shaft (5) and the adjustment rings (1-2-6 -).

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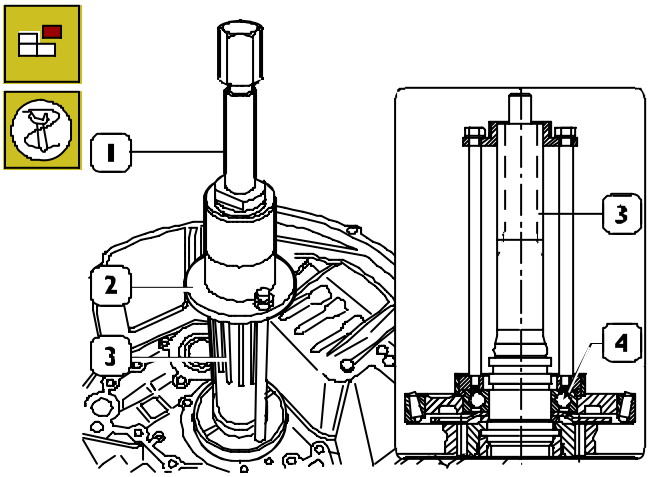
Figure 4/54




70871

Remove the circlip (4) fastening the bearing (1) to the drive input shaft (3). Remove the circlip (2) from the bearing (1).

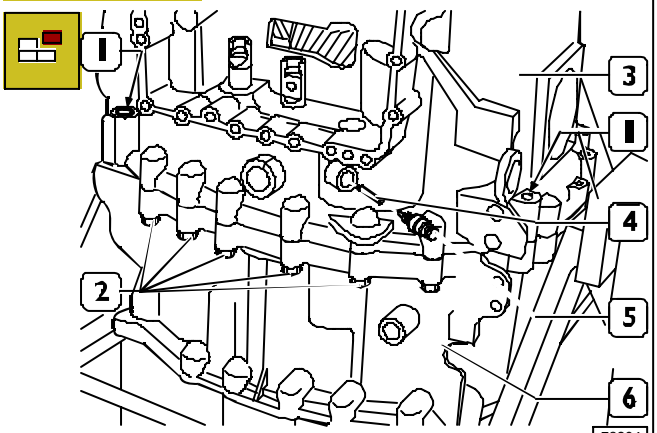
Figure 4/55




78303

Using the extractors 99345078 (1) and 99345105 (2), extract the ball bearing (4) from the drive input shaft (3).

Figure 4/56



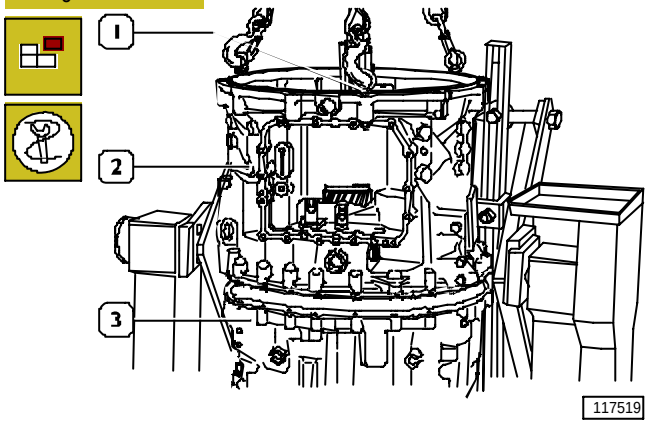

78304

Remove the speed sensor (5) and the cap (4) beneath.

Take out the four centring pins (1).

Remove the screws (2) fixing the middle box (6) to the front box (3).

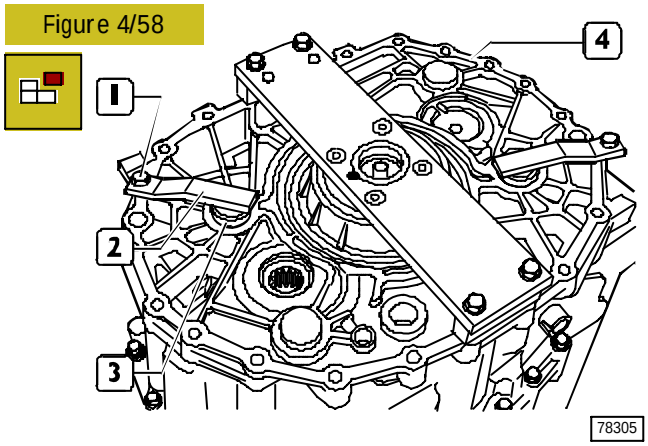
Figure 4/57




117519

Fit the eyebolt 99366811 (1) onto the front box (2). Using special ropes and a hoist, detach the front box (2) from the middle one (3). Remove the metal seal included.

Figure 4/58

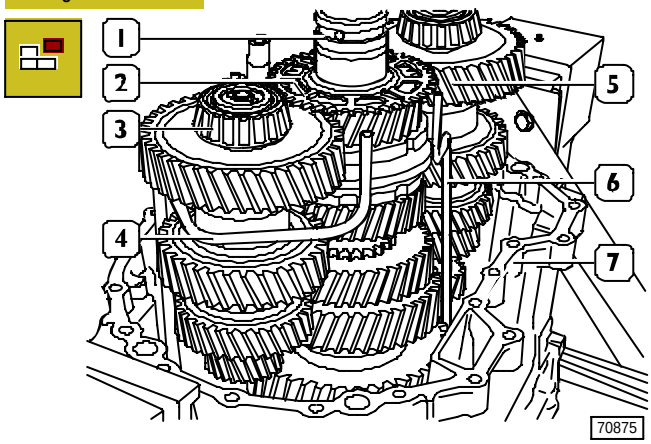



78305

To perform the following operations, the gearbox must be positioned as shown in Figure 4/59 in order to avoid any chance of the transmission shafts falling.

Take out the screws (1) and remove the brackets (2) of the plate 99370153. Extract the reverse gear pins (3) from the middle box (4).

Figure 4/59

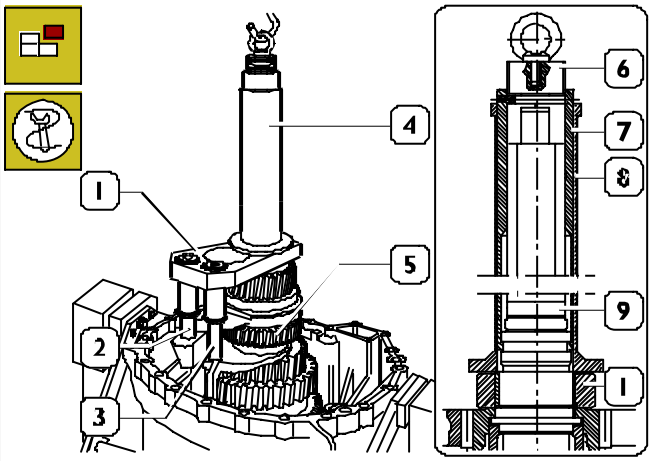



70875

Remove the phonic wheel (2) from the drive input shaft (1). Extract the oil pipes (4-6) from the middle box (7).
Spread apart the transmission shafts (3-5) and remove them from the middle box (7).

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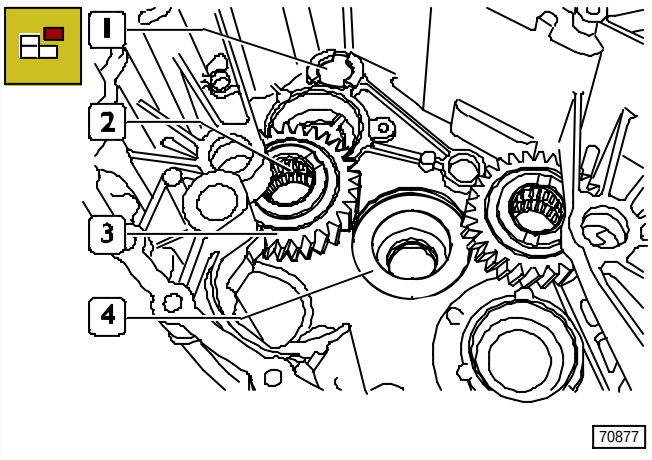
Figure 4/60




Fit tool 99360527 (1) onto the drive input shaft (9) and the rods (2 and 3); fit parts (6-7 and 8) of tool 99360526 (4) onto the drive input shaft (9).

Hook tool 99360526 (4) onto the lifter and extract the main shaft (5) together with the drive input shaft (9) and rods (2 and 3) from the supporting bearing.

Figure 4/61



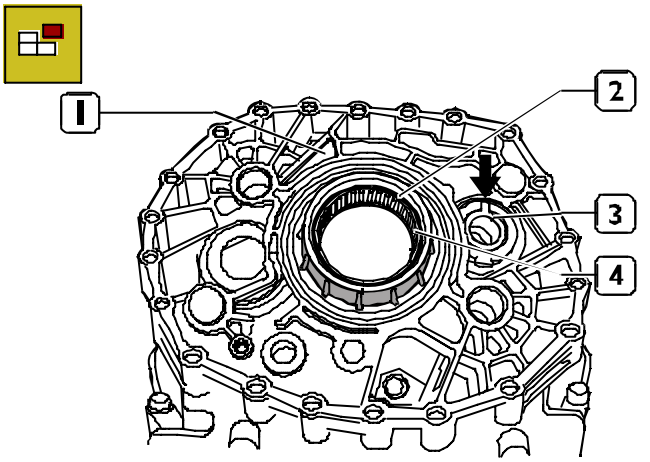

Remove the reverse gears (3) together with the roller bearings (2).

Remove the plate 99370153 (4).

If replacement is necessary, remove the centring pins (1).

Before removing the pins (1) heat the seats of the box to ~ 90°C.

Figure 4/62

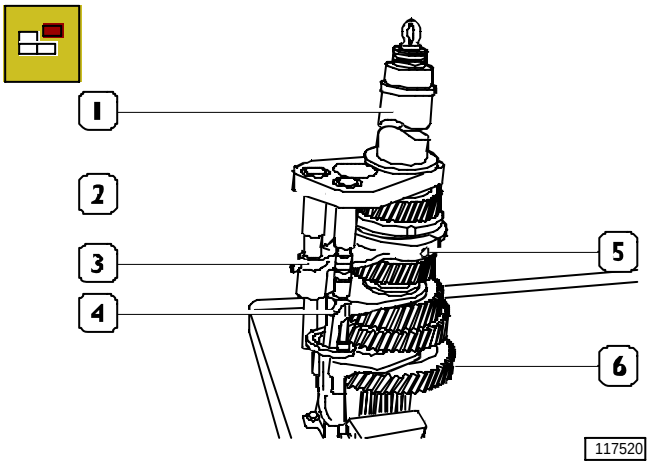



Turn the middle box (1) upside-down, remove the circlip (2) and, working from inside the box, remove the roller bearing (4).

Using a punch, and operating through the openings (→) of the middle box (1), remove the external rings (3) of the tapered roller bearings for transmission shafts.

## Removing the main shaft

Figure 4/63



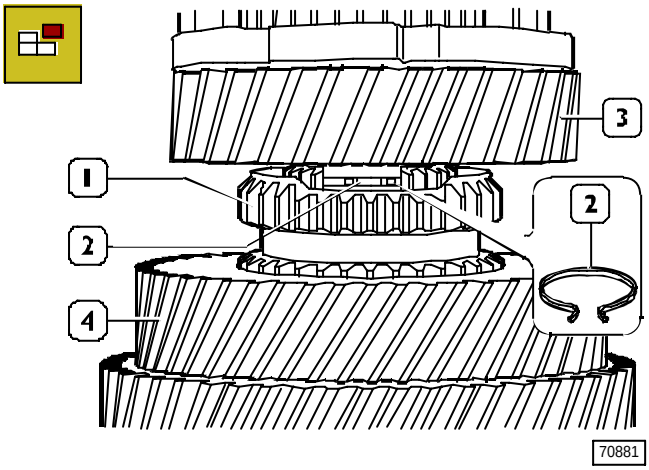

Clamp the main shaft (6) in a vice and remove tool 99360526 (1) and 99360527 (2).

Remove the rods (3 and 4) with the relevant forks.

To remove the fork (5), the ring of the synchronizing device has to be in the middle position.

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Figure 4/64




Through the bay of the coupling sleeve (1), using suitable pliers, tighten the ends of the circlip (2) and remove the drive input shaft (3) from the main shaft (4), see Figure 4/65.

Remove the coupling sleeve (1) and the tube (2) from the main shaft (3).

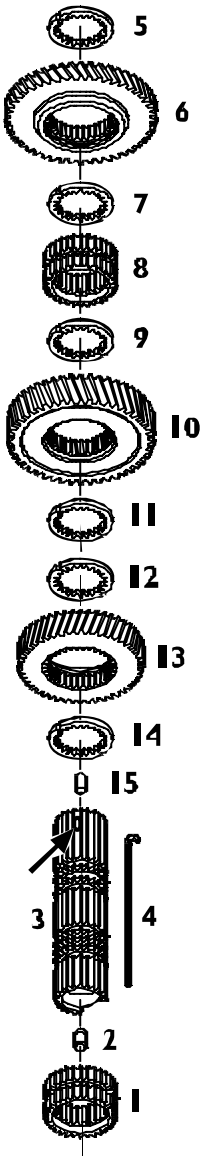
Turn the main shaft (3) upside-down and remove the coupling sleeve (4) from it; remove the key (5) from the hole (→) in the shaft (3) and extract it.

To extract the shoulder spacers (5 - 7 - 9 - 11 - 12 - 14) it is necessary to turn them so that their toothing is with the grooves of the shaft (3).

Extract:

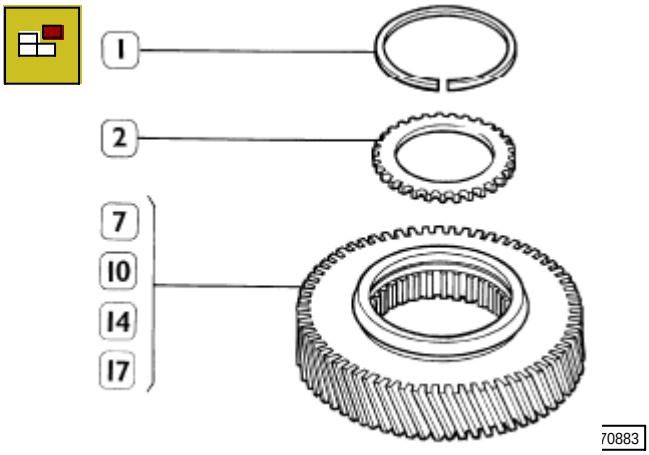
- spacer (5);
- reverse gear (6);
- spacer (7);
- coupling sleeve (8);
- spacer (9);
- 2nd gear (10);
- spacers (11 and 12);
- gear (13);
- spacer (14);
- tube (15).

Figure 4/65



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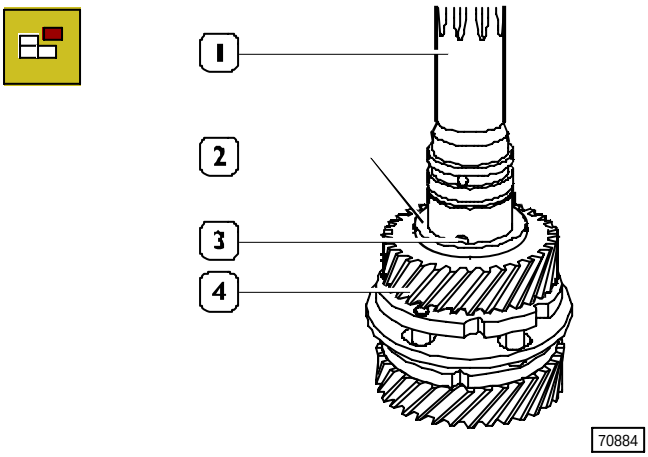
Figure 4/66




If necessary, remove the circlips (1) from the gears (7 - 10 - 14 - 17, Figure 4/65) and extract the toothed ring (2).

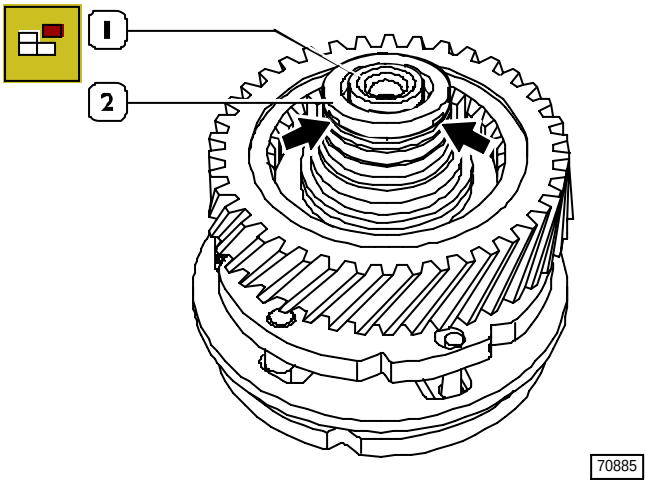
## Removing the drive input shaft

Figure 4/67



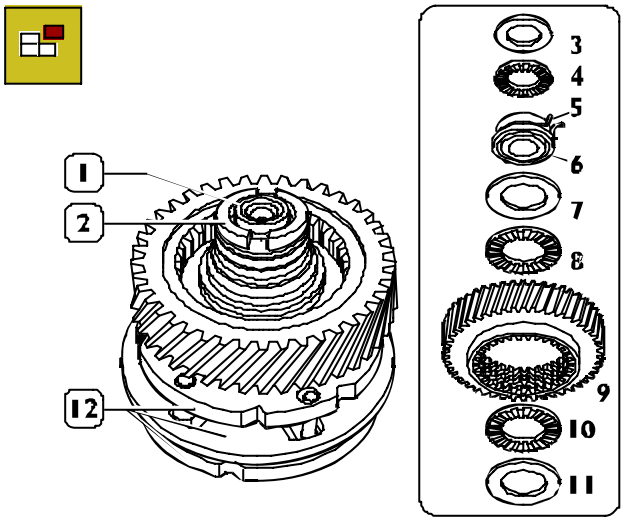

Extract the ring (2), key (3) and gear (4) from the drive input shaft (1).

Figure 4/68




Turn the drive input shaft (1) upside-down, lift the notches (→) of the safety cover (2) and take it off.

Figure 4/69

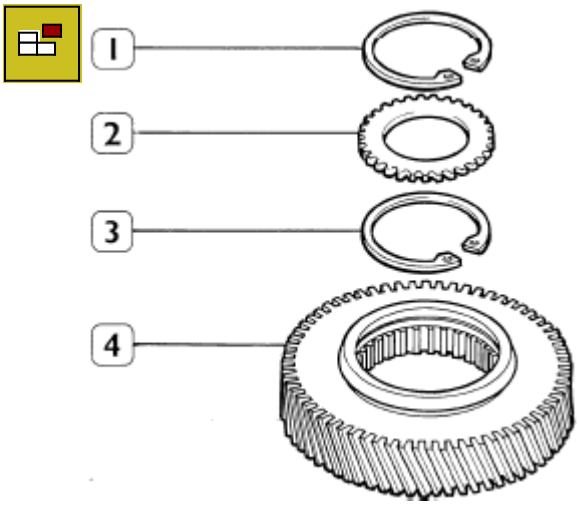



Remove the half rings (2) from the drive input shaft (1) and extract from it:

- thrust washer (3);
- thrust bearing (4);
- bushing (6) together with circlip (5);
- thrust washer (7);
- thrust bearing (8);
- gear (9);
- thrust bearing (10);
- thrust washer (11);
- synchronizing device assembly (12).

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Figure 4/70

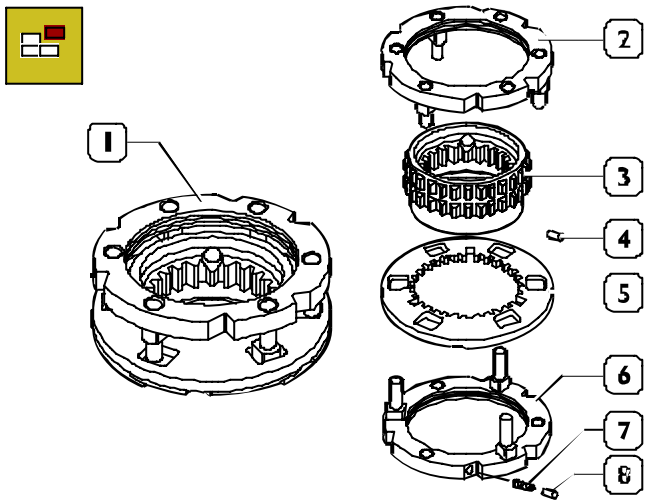



70887

If necessary, remove the circlips (1-3) from the gear (4) and extract the toothed ring (2).

## Removing the splitter synchronizing device

Figure 4/71



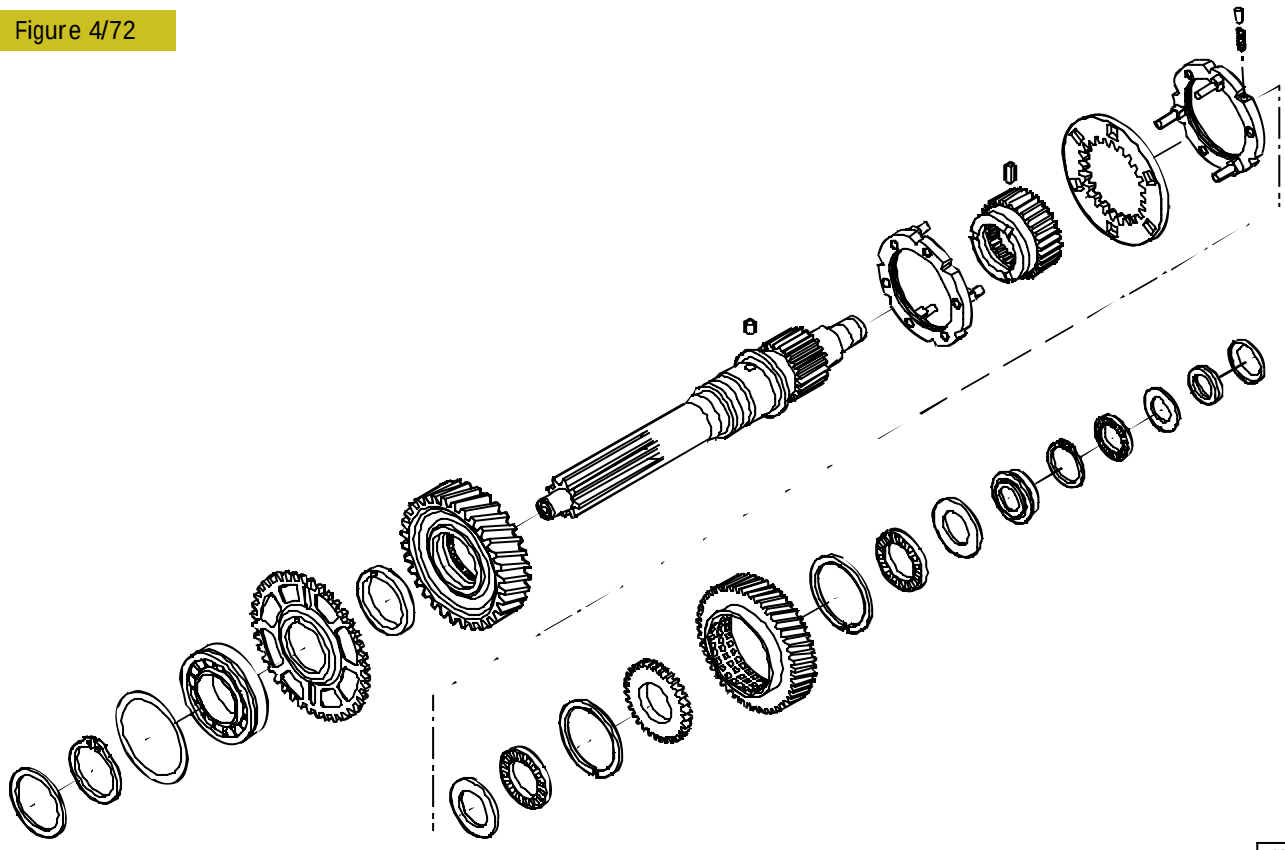

70889

Put the synchronizing device assembly (1) on the workbench, cover it with a cloth to prevent the pins (8) and springs (7) getting lost during subsequent dismantling.

Holding back the synchronizing device ring (6), lift the synchronizing device ring (2); these will get freed: toothed ring (5), three clips (7) and three pins (8).

Remove the key (4) and extract the toothed sleeve (3) from the toothed ring (5).

Figure 4/72



70888

COMPONENT PARTS OF THE DRIVE INPUT SHAFT

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## Fitting the splitter synchronizing device

Insert the three springs (6) and three pins (7) in the synchronizing device ring (1) and keep them in their seat with the centring pins 99370499 (2).

Position the toothed ring (3) on the synchronizing device ring (5). Fit the synchronizing device ring (1) in the toothed ring (3) and on the synchronizing device ring (6) so that the centring pins 99370499 (2) drive onto the pins (4) of the synchronizing device ring (5). Press on the synchronizing device ring (1) uniformly so that the components of the assembly fit together correctly. Take out the centring pins (2).

Figure 4/74

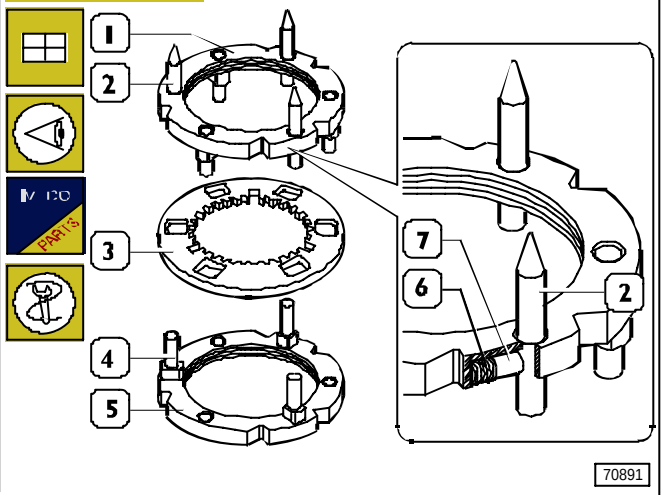
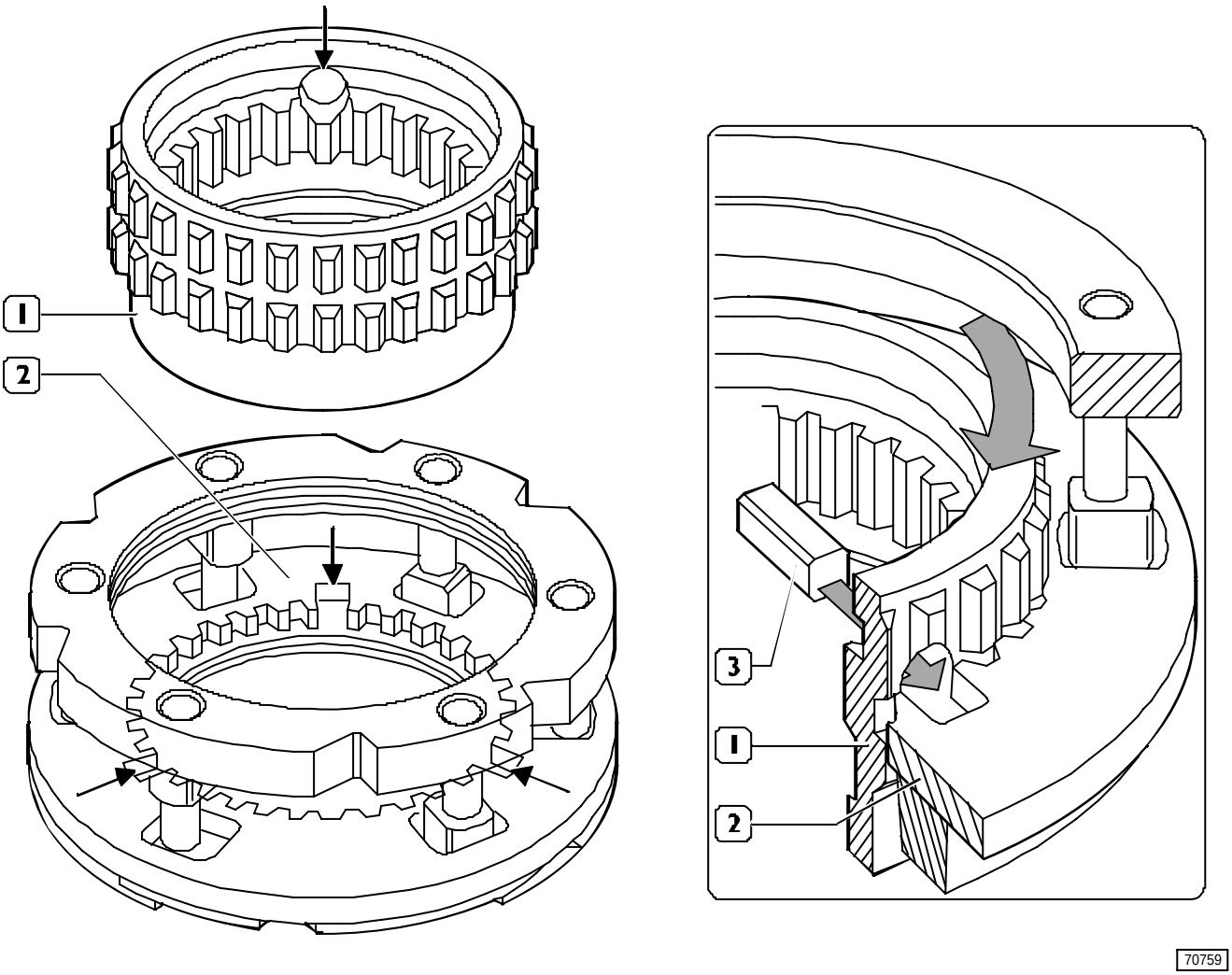



Figure 4/73




Insert the toothed sleeve (1) in the toothed ring (2) so that the race between the two toothings corresponds to the inside toothing of the ring (2) and allows it to rotate.

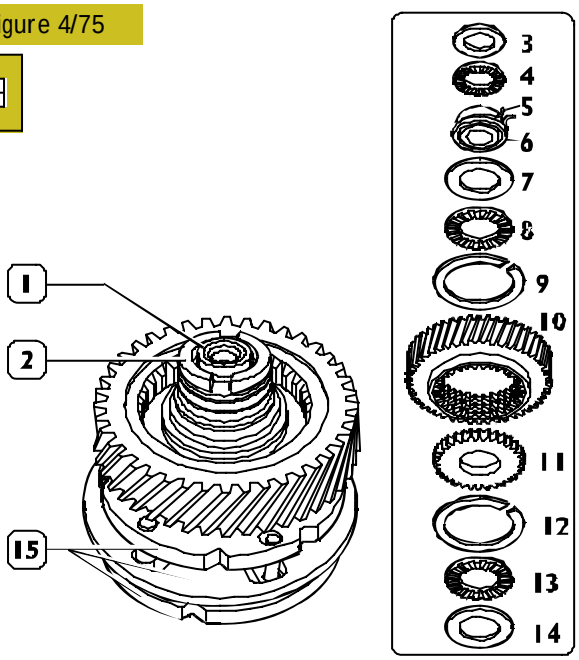
Turn the sleeve (1) so that the hole in it coincides with one of the three bays (→) of the toothed ring (1).

Then insert the key (3) as shown in the figure.

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## Fitting the main shaft

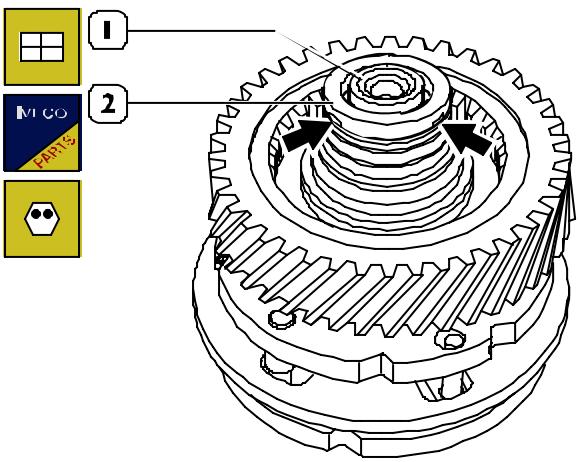
Figure 4/75




On the drive input shaft (1), fit:

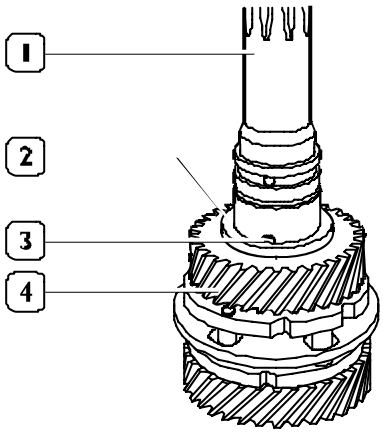
- synchronizing device assembly (15);
- thrust washer (14);
- thrust bearing (13);
- gear (10) together with circlips (9 and 12) and toothed ring (11);
- thrust bearing (8);
- thrust washer (7);
- bushing (6) with circlip (5);
- thrust bearing (4);
- thrust washer (3).
- half rings (2).

Figure 4/76




Fit on a new safety cover (2) and notch it (→) at three/four equidistant points. Turn over the drive input shaft (1).

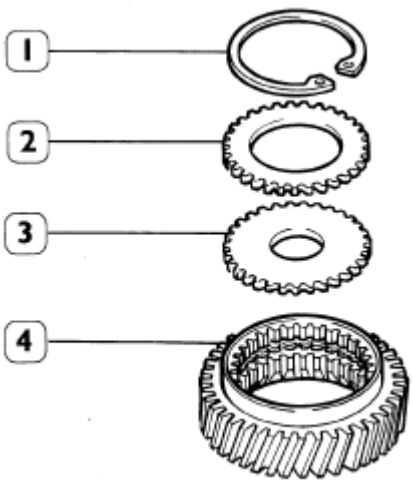
Figure 4/77




On the drive input shaft (1), fit: gear (4), key (3) and thrust washer (2).

## Fitting the drive input shaft

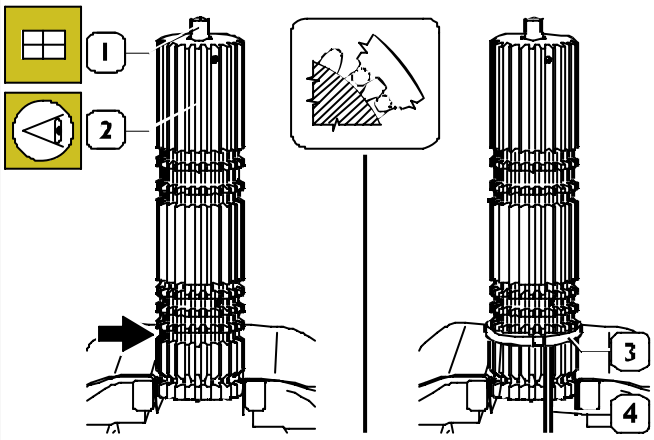
Figure 4/78




In the gears (4), fit: Reverse – 1st – 2nd gears and toothed rings (2) and fasten them to the gears with the circlips (1 and 3).

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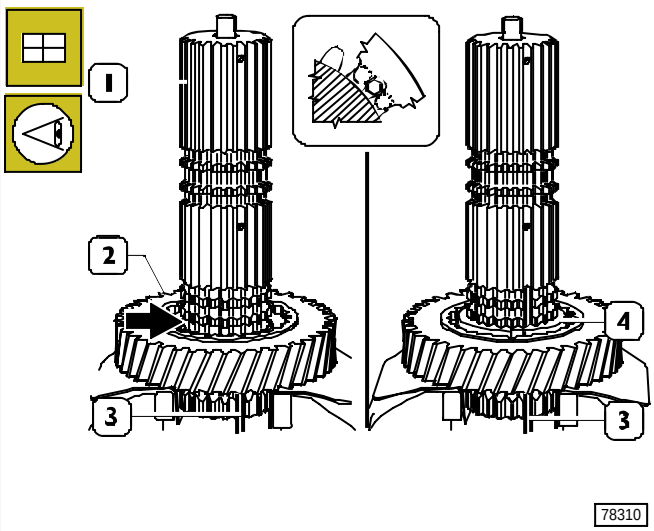
Figure 4/79




Clamp the main shaft (2) in a vice. Fit on the tube (1). Put the shoulder spacer (3) in the ring groove (→). Turn the spacer (3) so that its internal toothing rests on that of the main shaft (2).

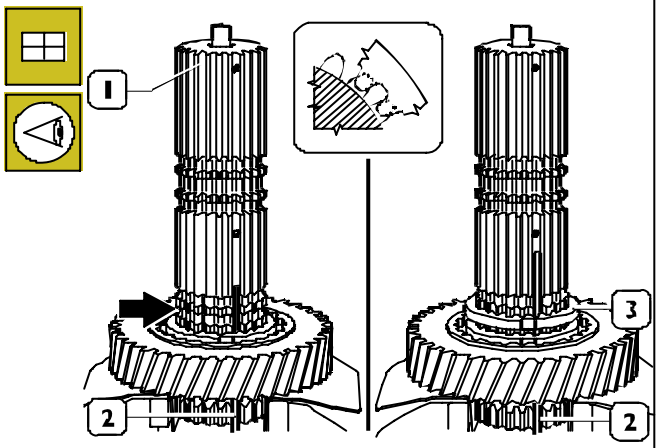
Insert the key (4) in the spacer (3) so as to prevent rotation and keep it in position.

Figure 4/80



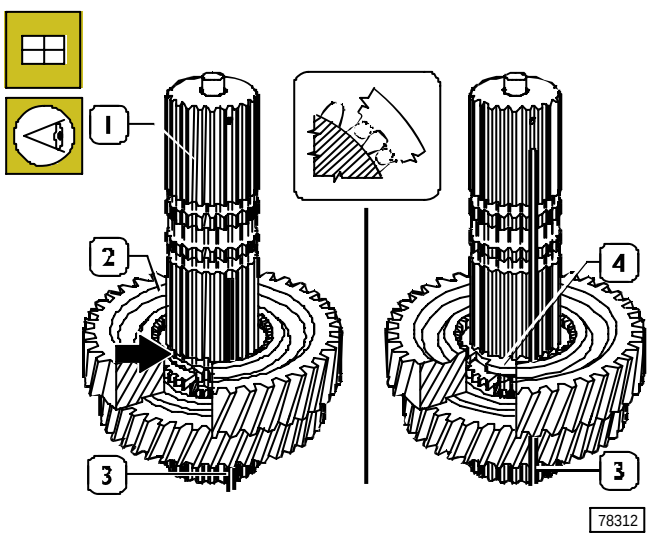

Mount the 2nd speed gear (2), put the spacer (4) in the ring groove (→). Turn the spacer (4) so that its internal toothing rests on that of the main shaft (1). Insert the key (3) in the spacer (4) and keep it in position.

Figure 4/81




Put the spacer (3) in the ring groove (→). Turn the spacer (3) so that its internal toothing rests on that of the main shaft (1). Insert the key (2) in the spacer and keep it in position.

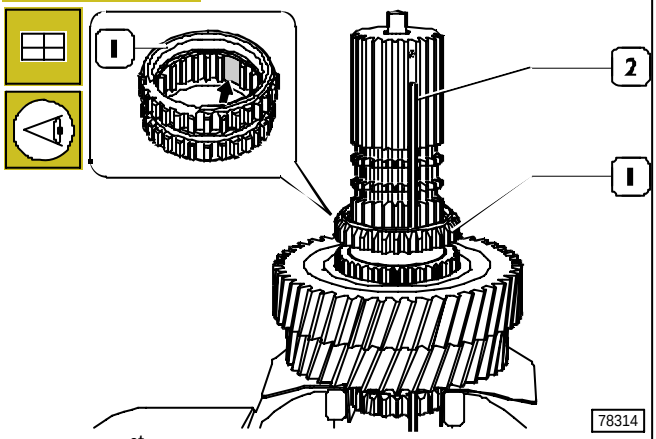
Figure 4/82




Mount the 1st speed gear (2), put the spacer (4) in the ring groove (→). Turn the spacer (4) so that its internal toothing rests on that of the main shaft (1). Insert the key (3) in the spacer (4) and keep it in position.

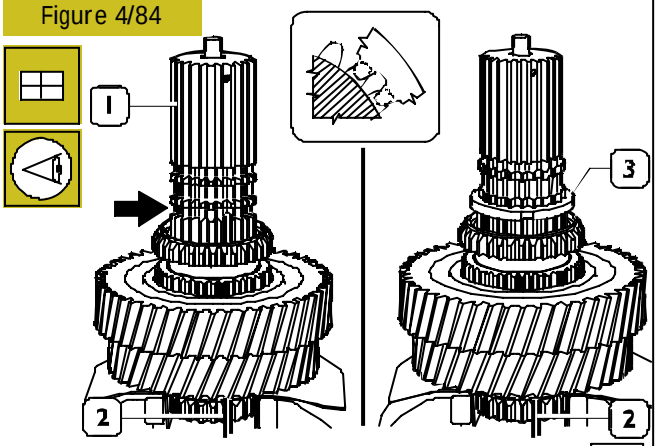
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Figure 4/83



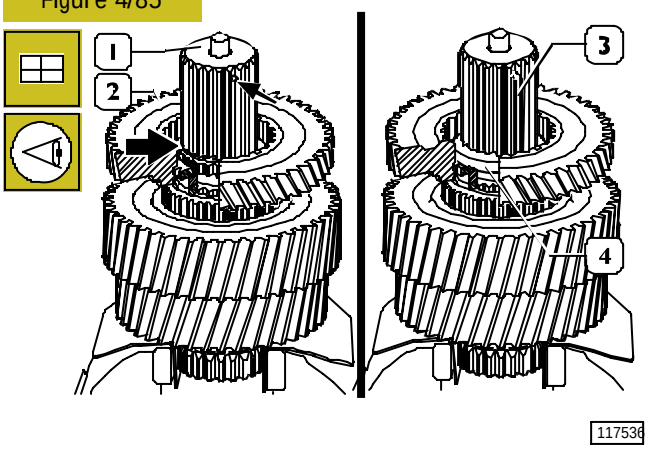

Fit on the 1st/Reverse gear coupling sleeve (1) with the larger internal groove (→) turned to the side of the key (2).

Figure 4/84



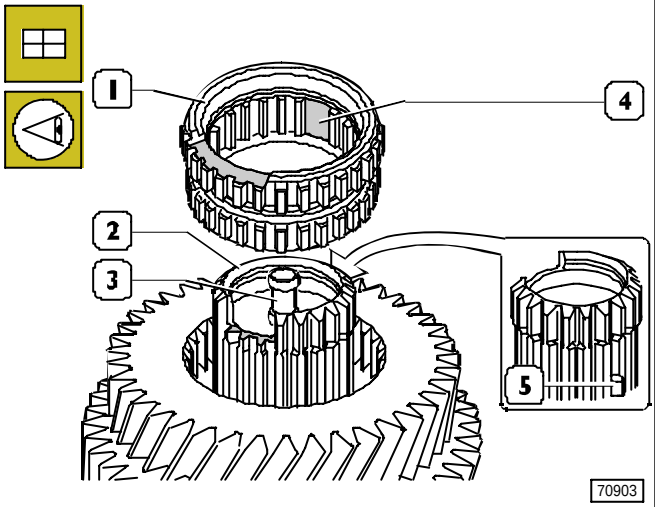

Put the spacer (3) in the ring groove (→). Turn the spacer (3) so that its internal toothing rests on that of the main shaft (1). Insert the key (2) in the spacer (3) and keep it in position.

Figure 4/85




Fit on the gear (2). Put the spacer (4) in the ring groove (→) so that its internal toothing rests on that of the main shaft (1). Slide out the key (3) and insert it from the upper side of the shaft into its keyway and in all the spacers so that the bent part inters into the hole (→) of the shaft (1).

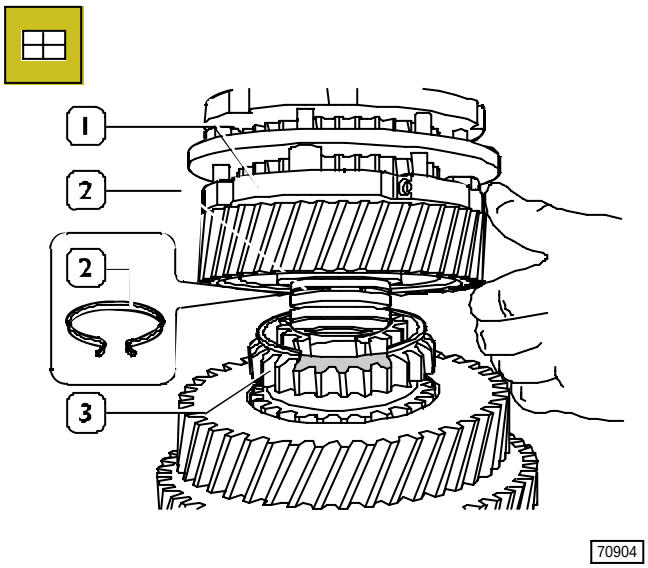
Figure 4/86




Turn over the main shaft (2) and fit on the sleeve (1) with the bay (4) coinciding with the key (5).

Fit on the tube (3).

Figure 4/87



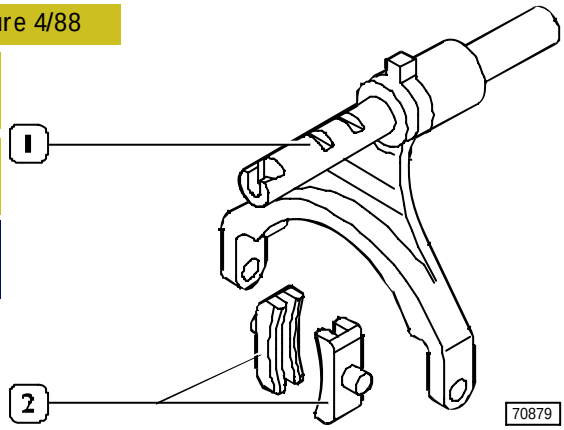

Using suitable pliers, tighten the ends of the circlip (2) and fit the drive input shaft (1) onto the main shaft (3).

Make sure that the circlip (2) gets correctly positioned in the seat of the main shaft (3).

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## Splitter control fork Disassembly - Assembly

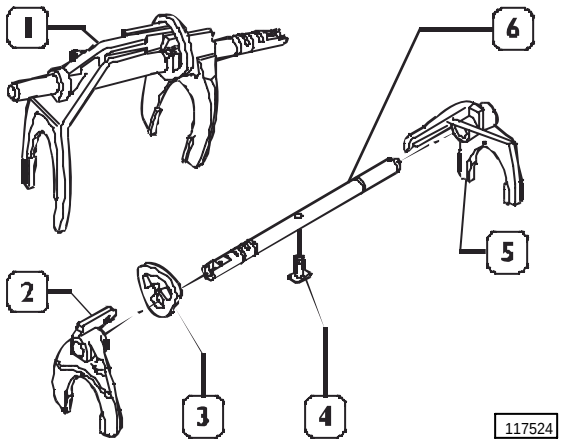
Figure 4/88




Extract the plugs (2) from the splitter synchronizing device coupling fork (1) and fit on the new plugs.

## Gear control forks Removal

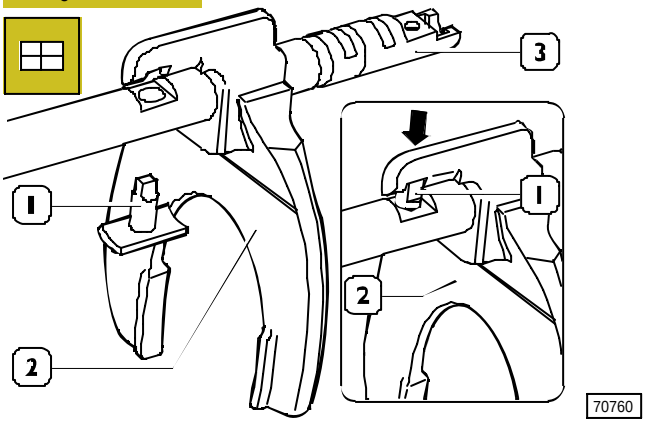
Figure 4/89




Dismantle the gear control fork assembly (1), suitably adjusting the ring (3) to prevent the gears simultaneously coupling and extracting from the rod (6): the coupling fork (5)*, pin (4), fork (2) and ring (3).

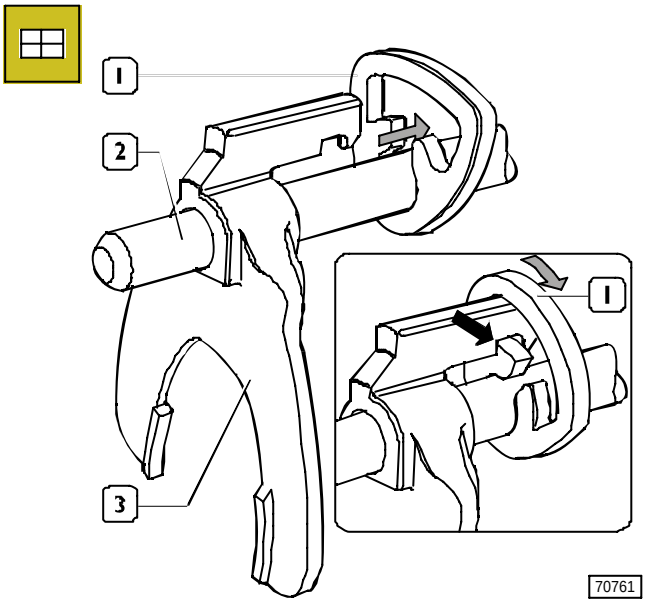
## Fitting

Figure 4/90



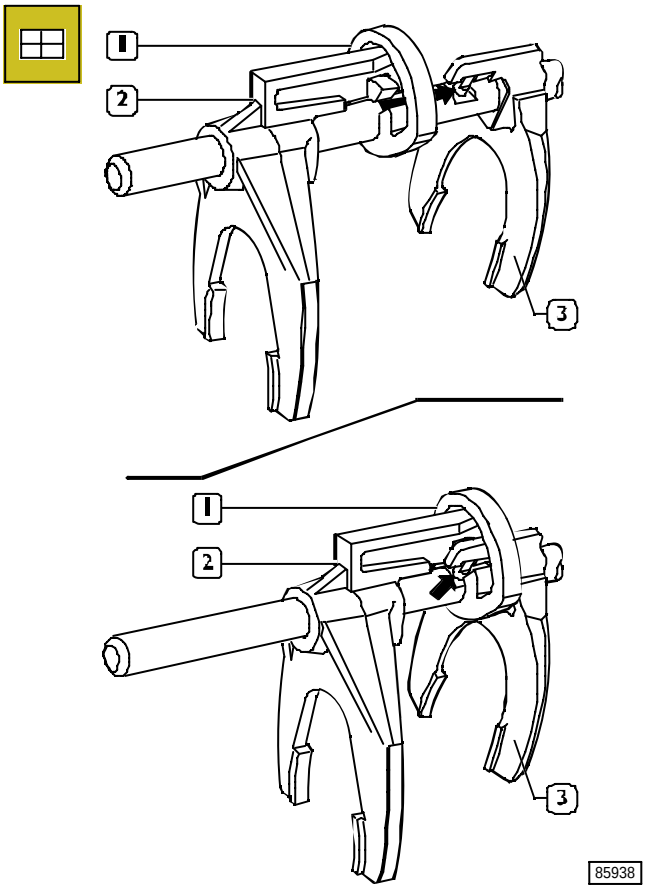

Insert the pin (1) in the seat on the rod (3). Drive the reverse/1st gear coupling fork (2) onto the rod (3), adjusting it so that the pin (1) gets positioned in the bay (→) of the fork (2).

Figure 4/91




Drive the ring (1) and the 2nd/3rd gear coupling fork (3) onto the rod (2). Position the fork (3) in the ring (1) so that on turning it the bay (→) of the fork (3) is inserted in the ring (1).

Figure 4/92

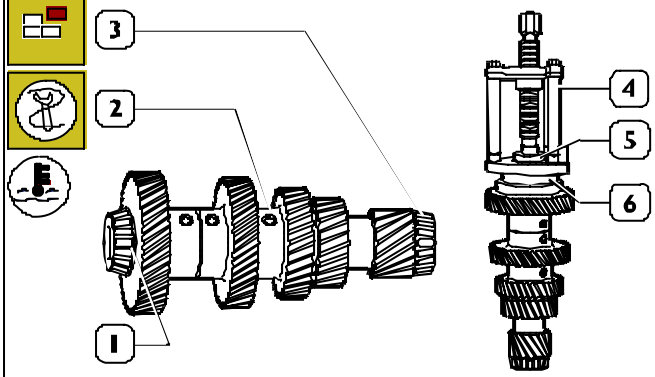



Position the fork (2) and the ring (1) assembled together as indicated so that the compartment (→) of the fork (3) engages reverse/ 1st gear engages into the ring (1).

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## Transmission shafts Disassembly - Assembly

Figure 4/93



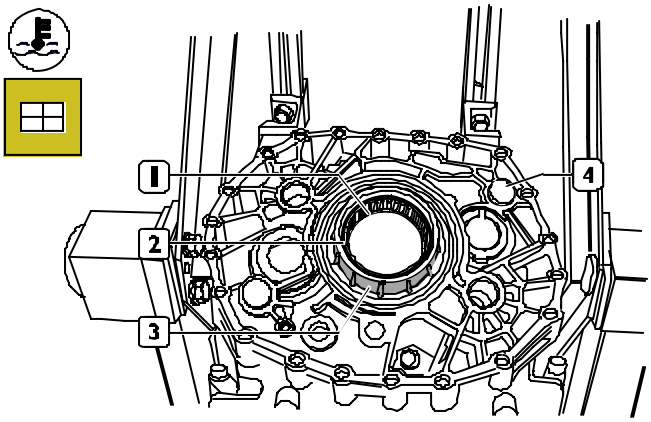

117525

Remove the inside rings (1-3) of the roller bearings from the transmission shaft (2), using the extractor 99347100 (4), grips (6) and plug 99345057 (5).

To fit the rings (1 - 3) on the shaft (2) it is necessary to first heat them to 120°C.

## Fitting the middle box

Figure 4/94

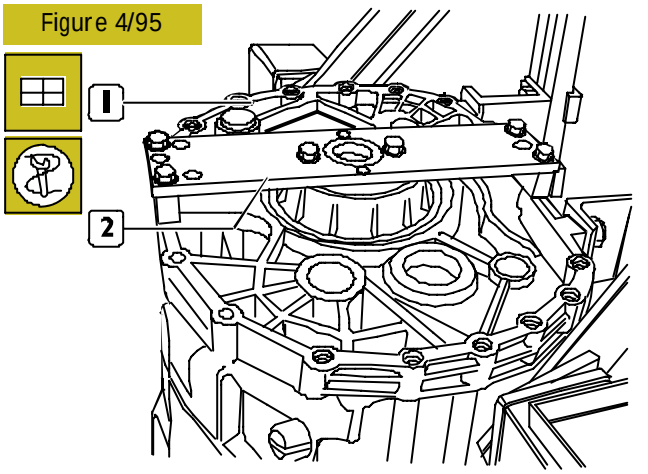



78318

Heat the seat (3) of the cylindrical roller bearing (1) to ~ 90°C, fit this and fasten it to the middle box with the circlip (2).

If removed, refit the centring pins (4) after heating the seats of the box to ~ 90°C.

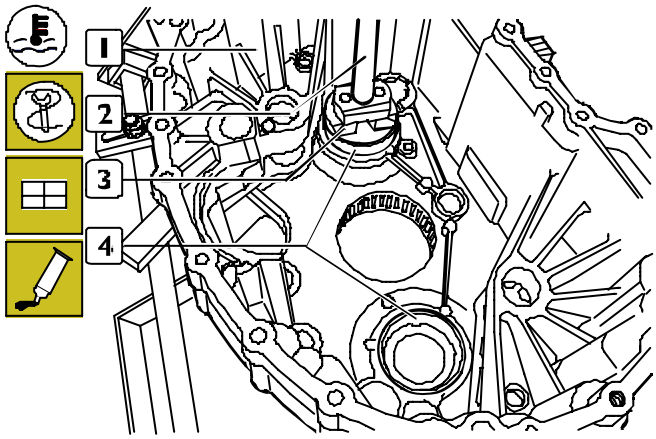
Figure 4/95




78319

Fit the plate 99370153 (2) onto the middle box (1).

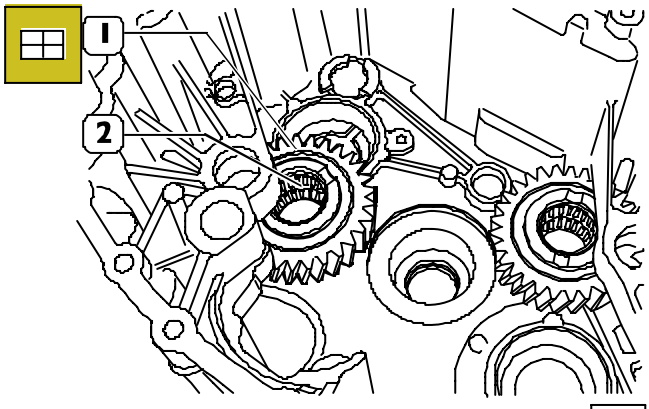
Figure 4/96




70909

From inside the box (1), heat the seats of the rings (4) to ~ 90°C, transmission shaft bearings. Fit on the rings (4) with driver 99370092 (3) and grip 99370007 (2).

Figure 4/97

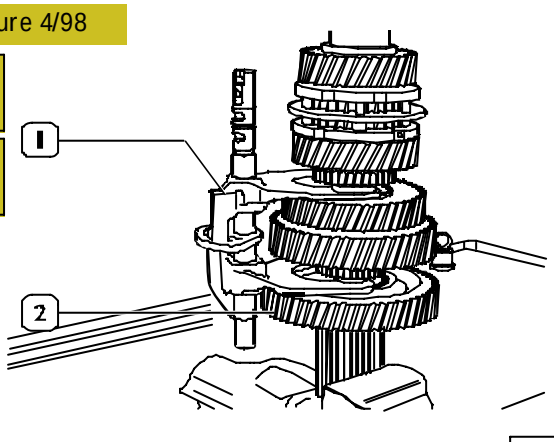



70910

Place the reverse gears (1) together with the roller bearings (2) in the middle box.

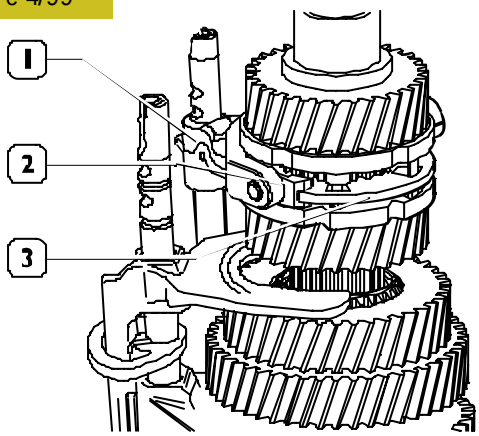
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Figure 4/98



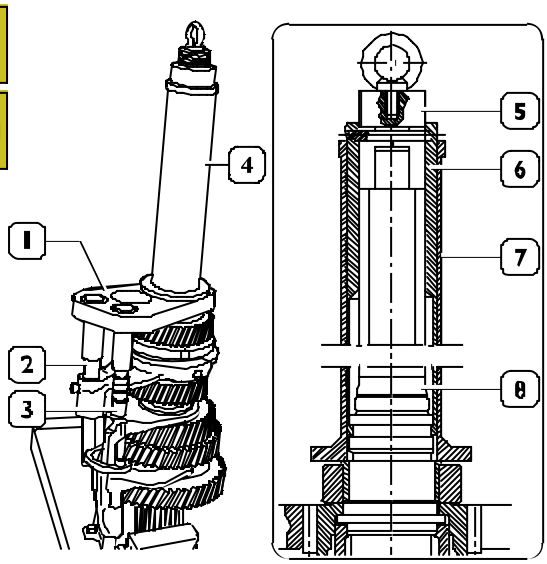

Fit the fork assembly (1) onto the main shaft (2), verifying that the forks are correctly positioned on their respective coupling sleeves.

Figure 4/99



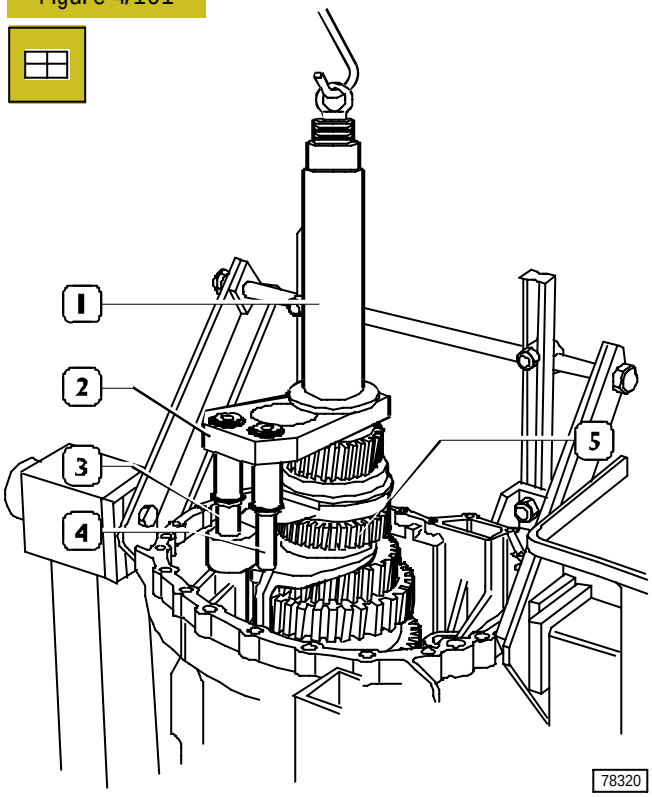

Mount the splitter coupling fork (1) positioning the plugs (2) on the toothed coupling ring (3).

Figure 4/100




Fit tool 99360527 (1) onto the drive input shaft (8) and the rods (2 and 3). Fit parts (5-6-7) of tool 99360526 (4) onto the drive input shaft (8).

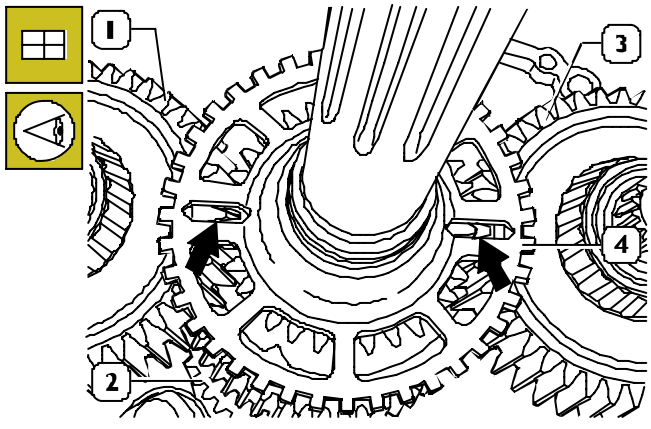
Figure 4/101




Hook the tool 99360526 (1) onto the lifter and fit the main shaft assembly (5) in the gearbox, verifying that the shaft (5) and the rods (3 and 4) get correctly inserted in their seats.

Remove the tools 99360526 (1) and 99360527 (2).

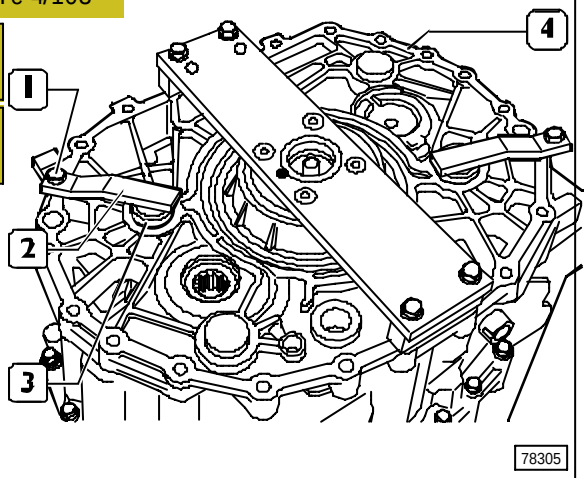
Figure 4/102




Mount the transmission shafts (1 and 3) so that on joining them to the main shaft (2) the marks stamped on them are aligned. Use the slots (→) of the phonic wheel (4) to check this.

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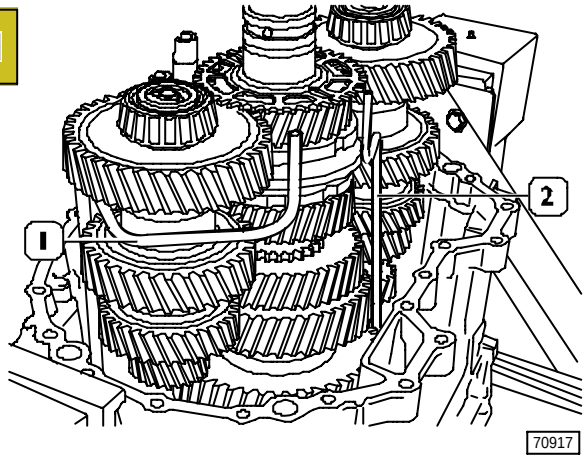
Figure 4/103




To perform the following operations, the gearbox must be positioned as shown in Figure 4/104 in order to avoid any chance of the reverse gears falling.

Insert the pins (3) in the middle box (4) and in the reverse gears (1, Figure 4/98), fastening them to the box (4) with the brackets (2) of plate 99370153 and the screws (1).

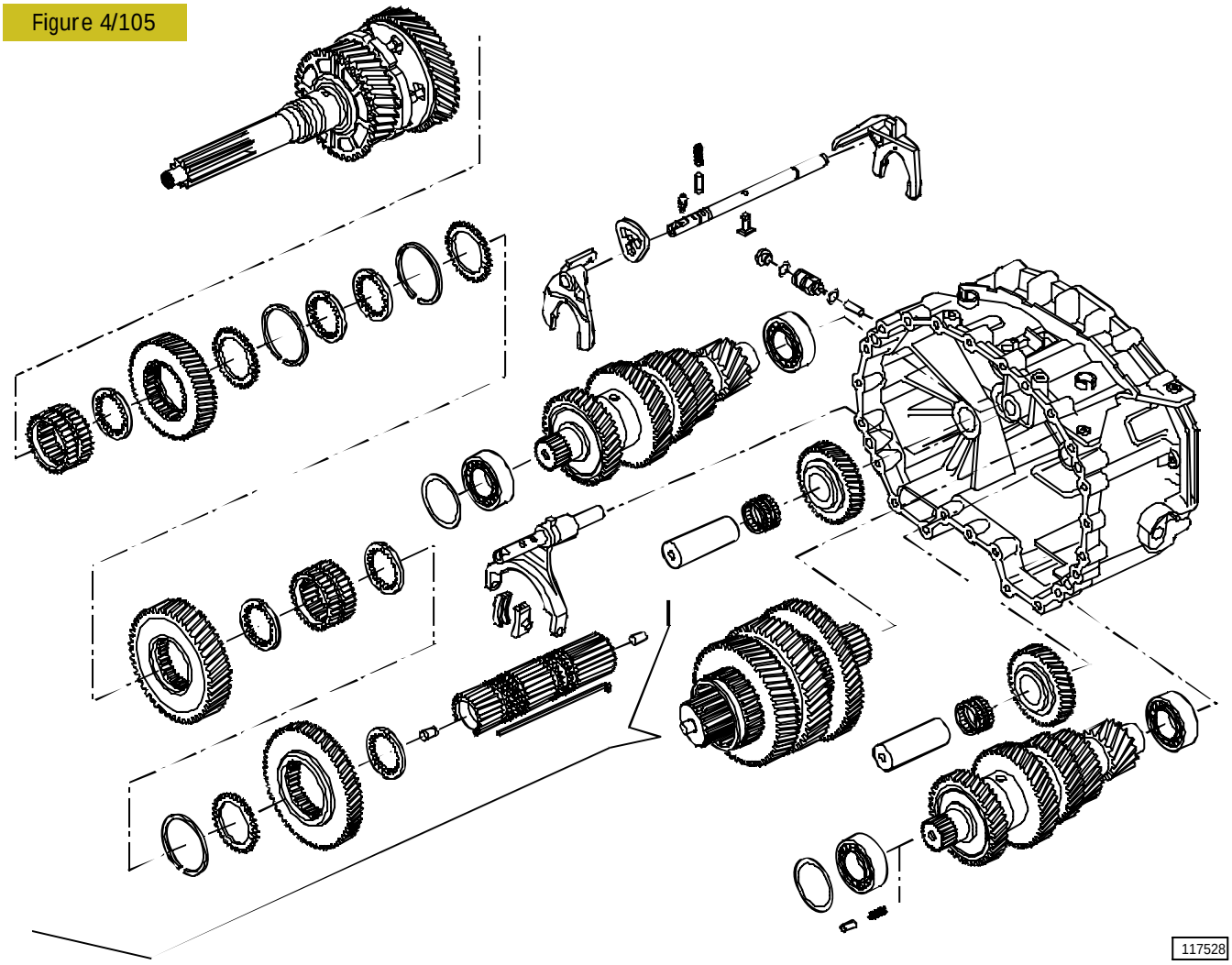
Figure 4/104




With no gears engaged, the shafts must turn freely, otherwise the alignment of the marks (see Figure 4/102) will not be correct.

Fit on the oil pipes (1 and 2).

Figure 4/105

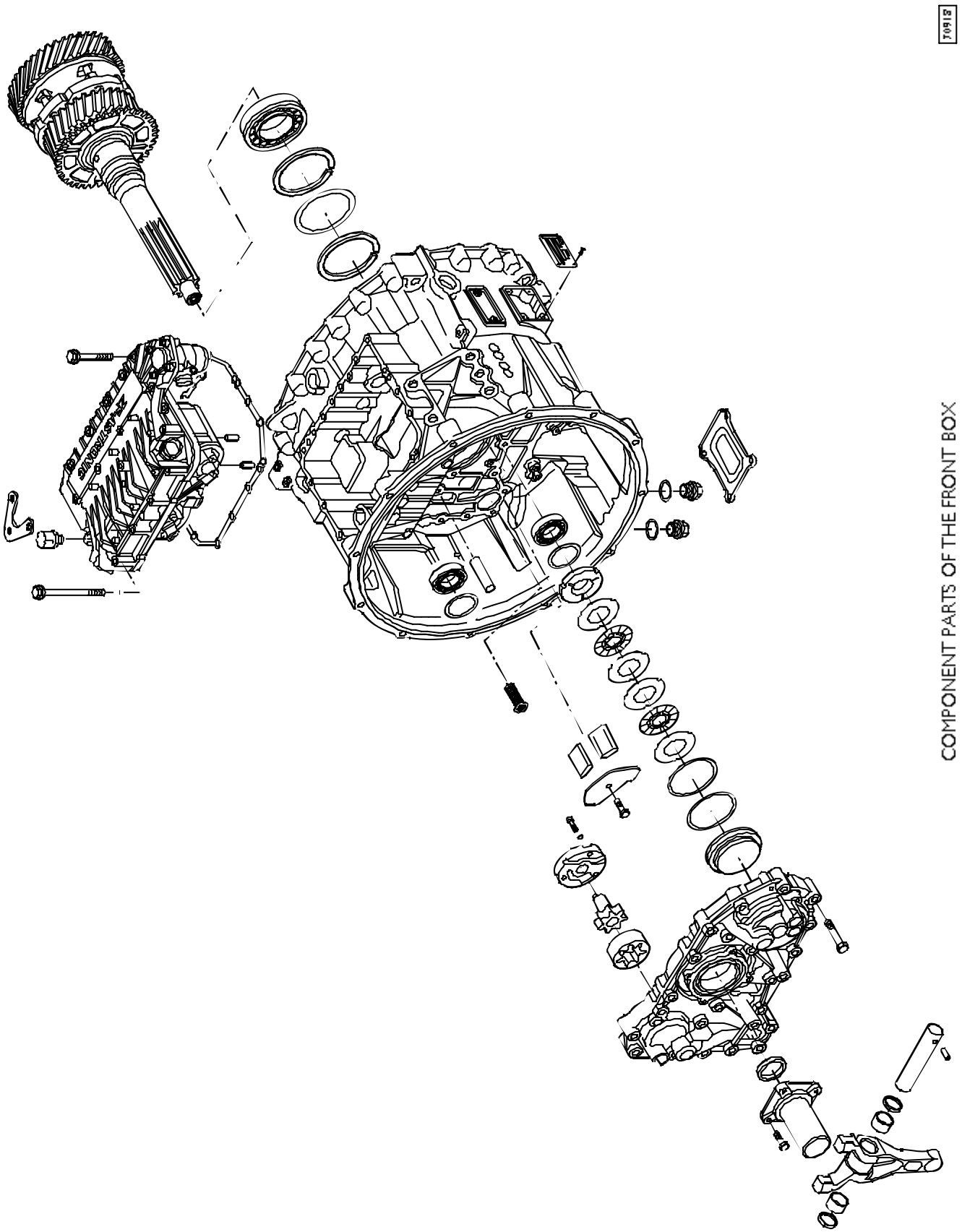



COMPONENT PARTS OF THE MIDDLE BOX

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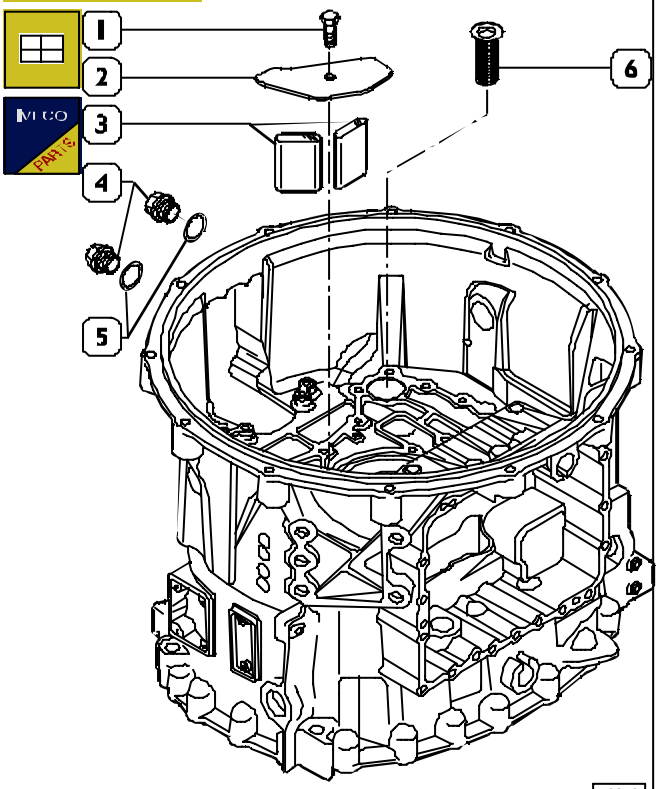
## Fitting the front box

Figure 4/106



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Figure 4/107




70819

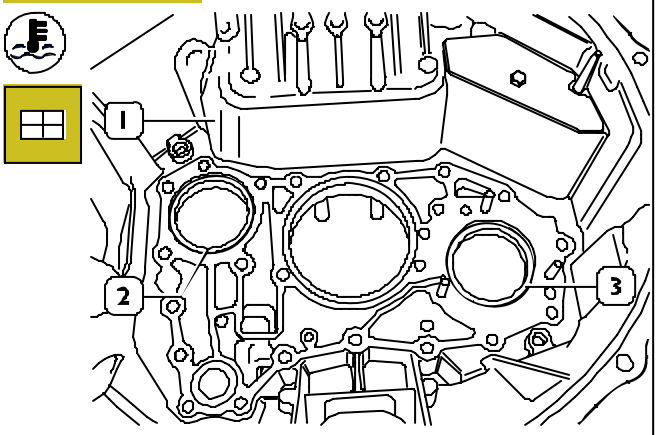
Remove the screw (1), lift the cover (2), remove the vents (3) and clean them or replace them.

Then reassemble the parts.

Carefully clean the oil filter (6) and fit it back in its seat.

If the plugs (4) have been removed, it is necessary to fit them back on with new seals (5).

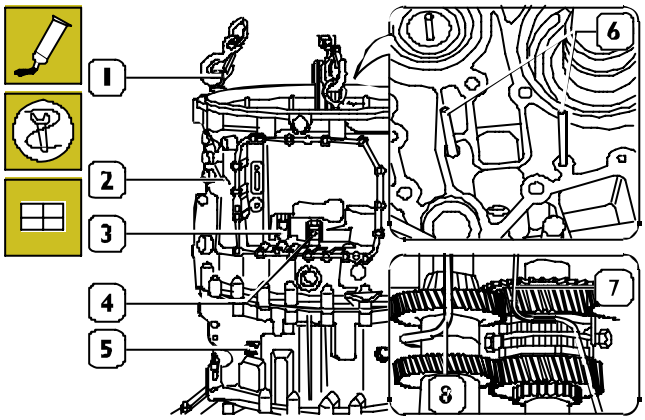
Figure 4/108




70920

Heat the front box (1) to 90°C in correspondence with the seats for the external rings (2 - 3) of the tapered roller bearings and fit these on.

Figure 4/109




70921

Spread IVECO sealant 1905685 onto the mating surface of the middle box (5).

Fit the eyebolt 99368811 (1) onto the front box (2).

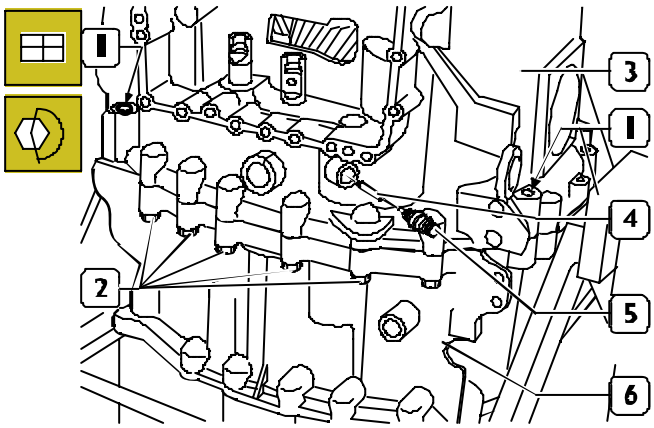
Using ropes and a hoist, lift the box (2) and position it coaxially to the middle box (5).

Insert the rods (6), of suitable diameter, into the seats in the front box (2) of the oil pipes (7 and 8) and into these too.

Lower the box (2) checking that the rods (3 and 4) and the oil pipes (7 and 8) are correctly inserted in their seat.

Remove the eyebolt (1) and the guide rods (6).

Figure 4/110



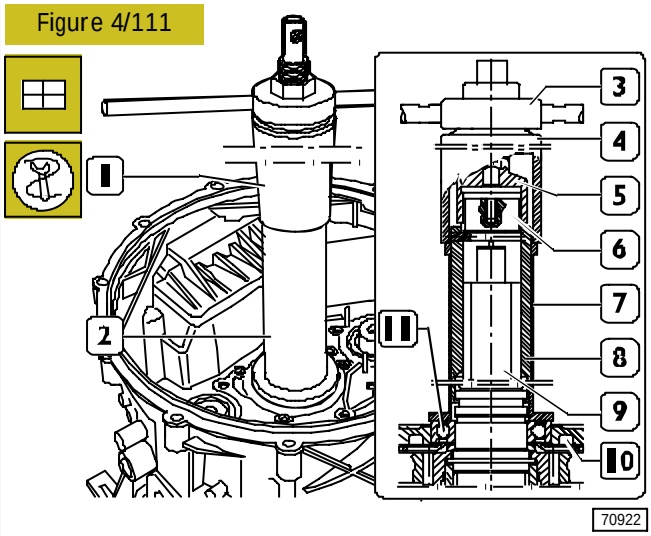

78304

Screw down the screws (2) fixing the front box (3) to the middle box (6). Insert the centring pins (1) and tighten the screws (2) to the prescribed torque.

Mount the cap (4) and the speed sensor (5), tightening it to the prescribed torque.

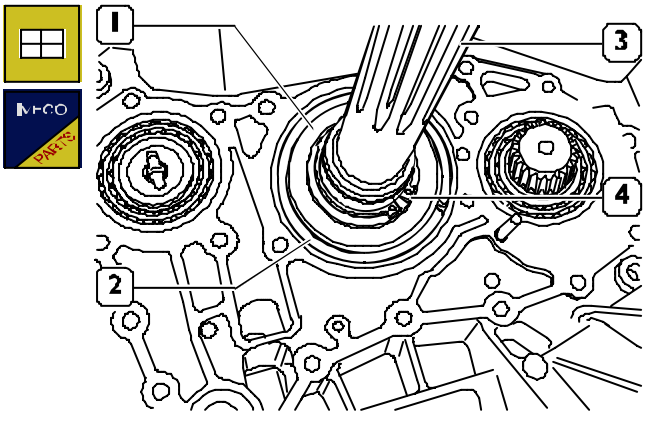
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Figure 4/111




Using the tools 99345098 (1) comprising parts (3-4 and 5) and 99360526 comprising parts (6 - 7 - 8), fit the ball bearing (11) on the drive input shaft (9) and in the front box (10).

Figure 4/112

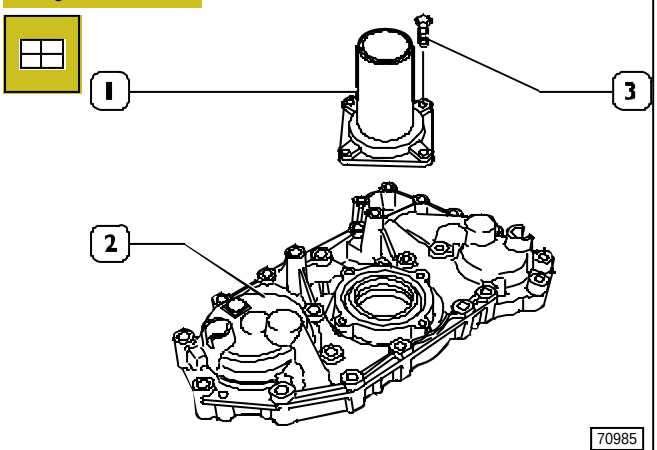



Fit the circlip (4) fastening the bearing (1) to the drive input shaft (3).

Fit the circlip (2) onto the bearing (1).

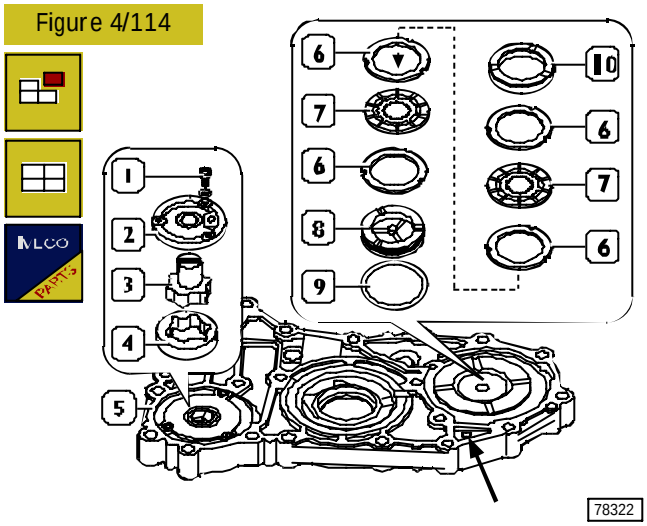
## Front cover Removal

Figure 4/113




Remove the screws (3) and take off the drive input shaft cover (1) from the front cover (2).

Figure 4/114




Take out the screws (1) and, through the front cover (5), take out the oil pump comprising: cover (2), rotor (3) and stator (4).

Introduce compressed air through the hole (→) and expel through the front cover (5): the overrun brake piston (8) comprehensive of gasket (9), clutch plates with external toothing (6), clutch plates with internal toothing (7) and supporting ring (10).

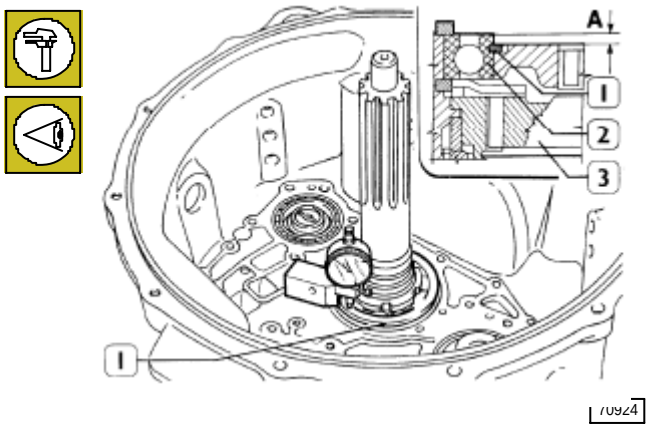
## Fitting the front cover

Recompose the front cover (5) by reversing the operations described for removal, without parts (6 - 7 - 8).

The gasket (9) must always be replaced.

## Adjusting drive input shaft bearing end float

Figure 4/115

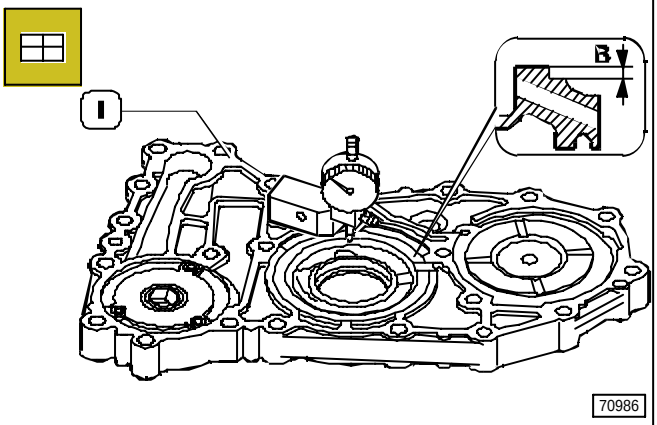



Determine the thickness S of the drive input shaft bearing adjustment ring by proceeding in the following way:

- check that the circlip (1) of the bearing (2) rests in its seat;
- measure the protrusion of the bearing (2) from the surface of the front box (3), distance A.

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Figure 4/116




- measure the depth of the seat on the front cover (1) of the bearing (2, Figure 4/115), distance B.

The thickness S of the adjustment ring is determined by the following equation:

$$S = (A - B) - C$$

Where:

A-B = measurements

C = end float 0 ÷ 0.1 mm

For example:

A = 5.50 mm

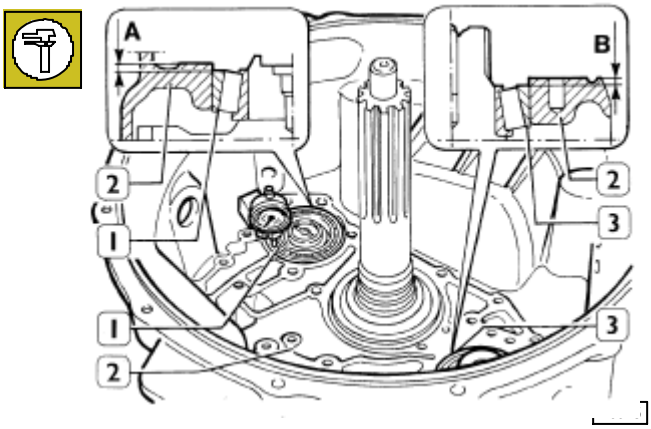
B = 3.90 mm

C = 0 ÷ 0.1 mm

S = (5.50 -3.90) - 0 ÷ 0.1 = 1.59 – 1.60 mm

## Adjusting transmission shaft bearing end float

Figure 4/117



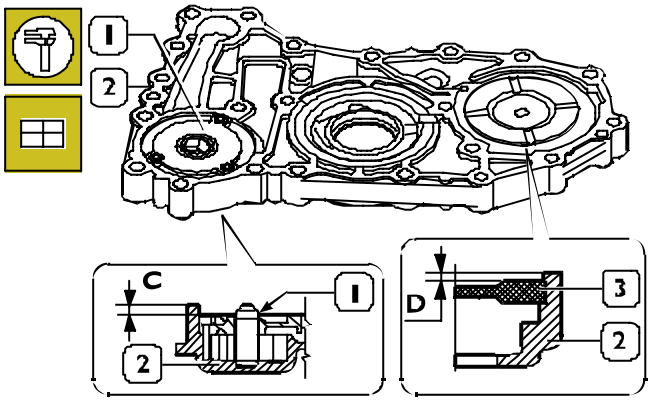

Determine the thickness S of the transmission shaft bearing end float adjustment rings by proceeding in the following way:

- turn the shafts and check that the external rings (1 -3) of the bearings rest with no play on the rollers of the bearings;
- measure the distance between the surface of the front box (2) and the external rings (1 - 3);

D external ring (1) pump side, distance A.

D external ring (3) overrun brake side, distance B

Figure 4/118




- measure the distance between the surface of the front cover (2) and the oil pump (1), distance C;
- mount the overrun brake disc supporting ring (3) in the seat on the front cover (2) and measure the distance between this and the surface of the cover (2), distance D.

The thickness S of the adjustment rings is determined by the following equation:

D oil pump side $S = A + C + F$

A - C = measurements

F = end float ± 0.05

For example:

S = 2 + 0.05 (± 0.05) = 2 – 2.1

D overrun brake side $S = B + D + F$

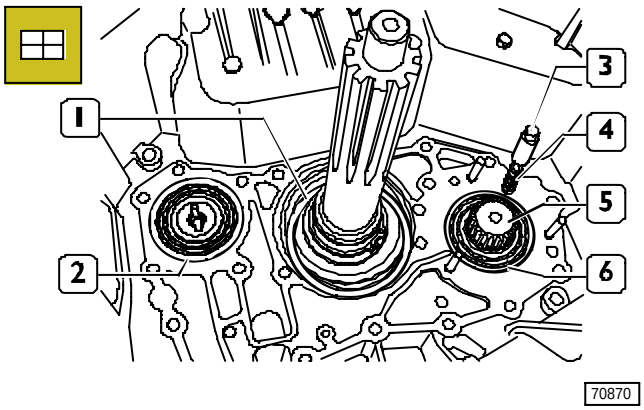
B - C = measurements

F = end float ± 0.05

For example:

S = 1.95 + 0.15 (± 0.05) = 2.05 – 2.15

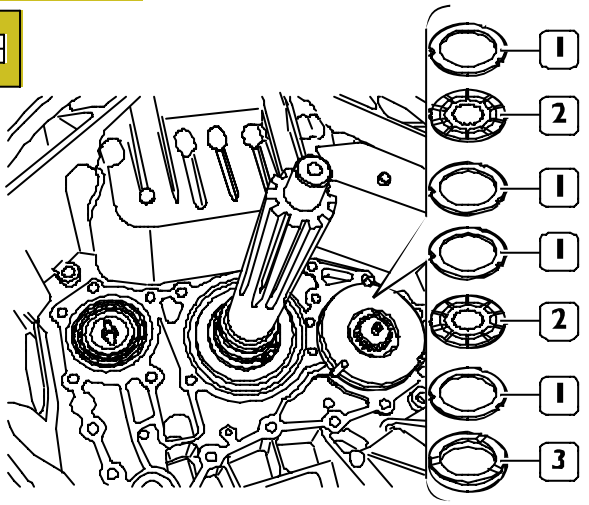
Figure 4/119




On the external rings of the bearings supporting the drive input and transmission shafts, mount the end float adjustment rings (1 - 2 and 6) of the thickness determined in the preceding measurements. Insert the spring (4) and the cap (3) in the transmission shaft (5).

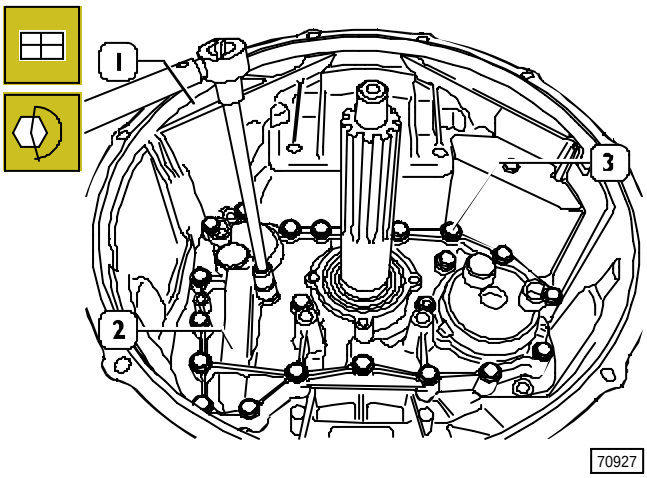
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Figure 4/120



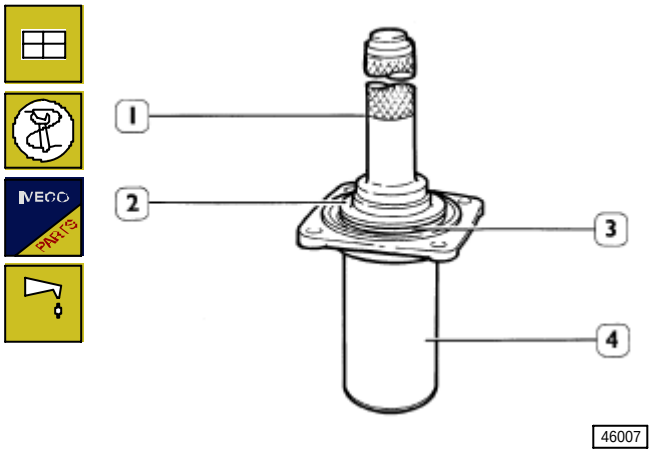

In the sequence shown in the figure, position: the supporting ring (3), clutch plates with internal toothing (2) and clutch plates with external toothing (1).

Figure 4/121



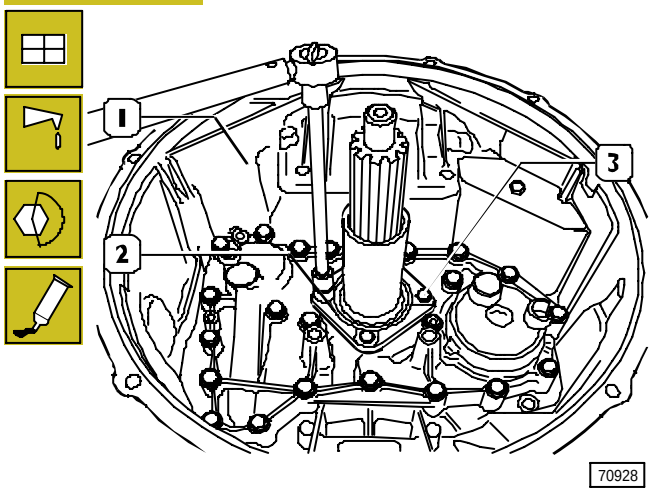

Spread IVECO sealant 1905685 onto the surface of the front box (1) mating with the cover (2). Adjust the key of the oil pump shaft so that it coincides with the coupling milling of the transmission shaft. Fit on the cover (2) and tighten the screws (3) to the prescribed torque.

Figure 4/122




Using the driver 99374336 (2) and grip 99370007 (1), fit the seal (3) in the drive input shaft cover (4).

Figure 4/123



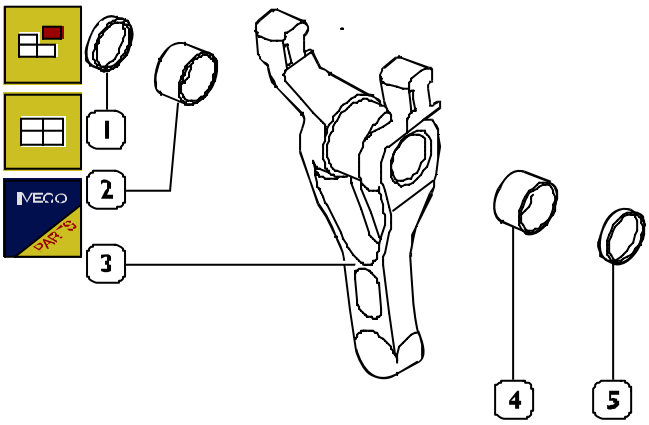

Lubricate the sealing surface of the seal with Unisilikon.

Spread IVECO sealant 1905285 onto the surface of the front box (1) mating with the cover (2). Mount the cover (2). Spread LOCTITE 241 onto the thread of the screws (3) and tighten them to the prescribed torque.

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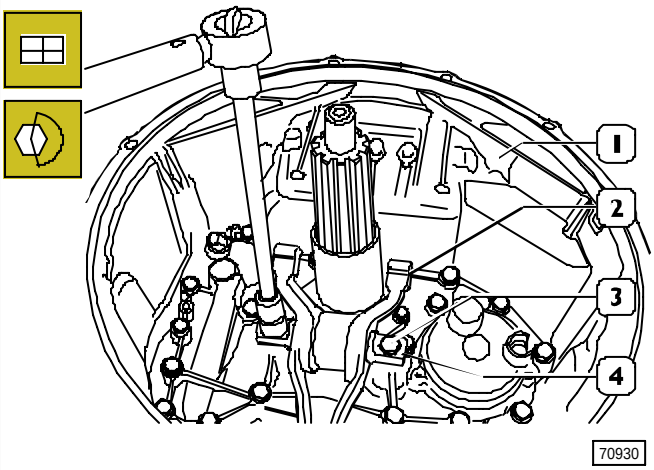
## Clutch release lever

Figure 4/124



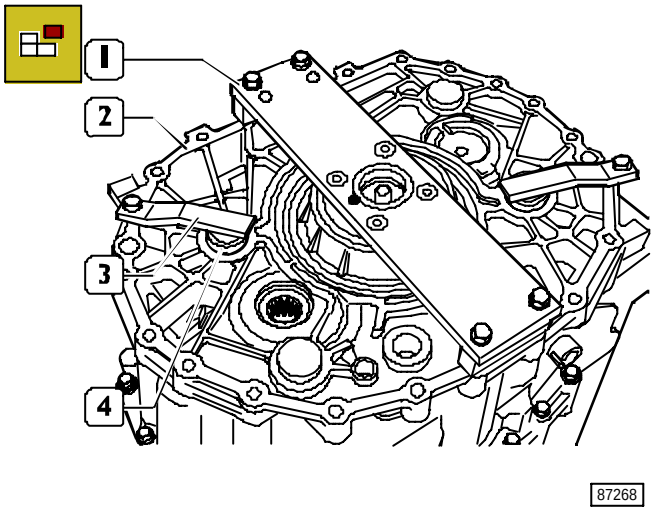

The bushings (2 and 4) and seals (1 and 5) of the lever (3) are changed by using a suitable drift for removing – fitting new parts.

Figure 4/125




Insert the joint pin (4) into the lever (2) and tighten the screws (3), fixing it to the front box (1), to the prescribed torque.

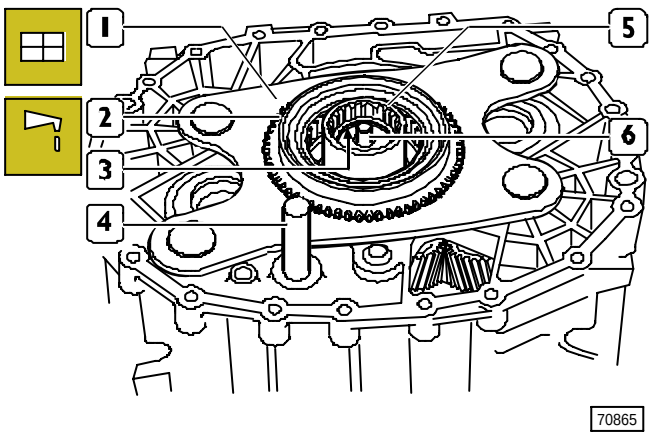
Figure 4/126




Turn over the gearbox.

Remove the plate 99370153 (1) and the brackets (3) fastening the pins (4) from the middle box (2).

Figure 4/127




Fit: the plate (1) together with the coupling body (2), adjustment ring (3), connecting sleeve (5) and rod (4).

Fit the small pipe (6). Complete assembly of the gearbox by refitting the rear box and the speed actuator as described under the relevant headings.

On completing assembly, replenish the gearbox with the prescribed grade and quantity of lubricating oil.

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Aquila Trucks Centres

# Gearboxes
# EuroTronic Automated with Intarder
# - 12 AS 1931 T.D.
# - 12 AS 2331 T.D./T.O.


| | Page |
|---|---|
| MAIN DATA | 59 |
| TOOLS | 60 |
| EXPERIMENTAL TOOLS | 61 |
| OVERHAULING THE GEARBOX | 62 |
| - Removing the hydraulic retarder | 62 |
| - Refitting the hydraulic retarder | 63 |
| - Adjusting epicyclic reduction gear train bearing end float | 63 |
| - Adjusting stator end float | 64 |
| - Removing the rear box | 66 |
| - Disassembling the E.R.G. | 66 |
| - Assembling the E.R.G. | 68 |

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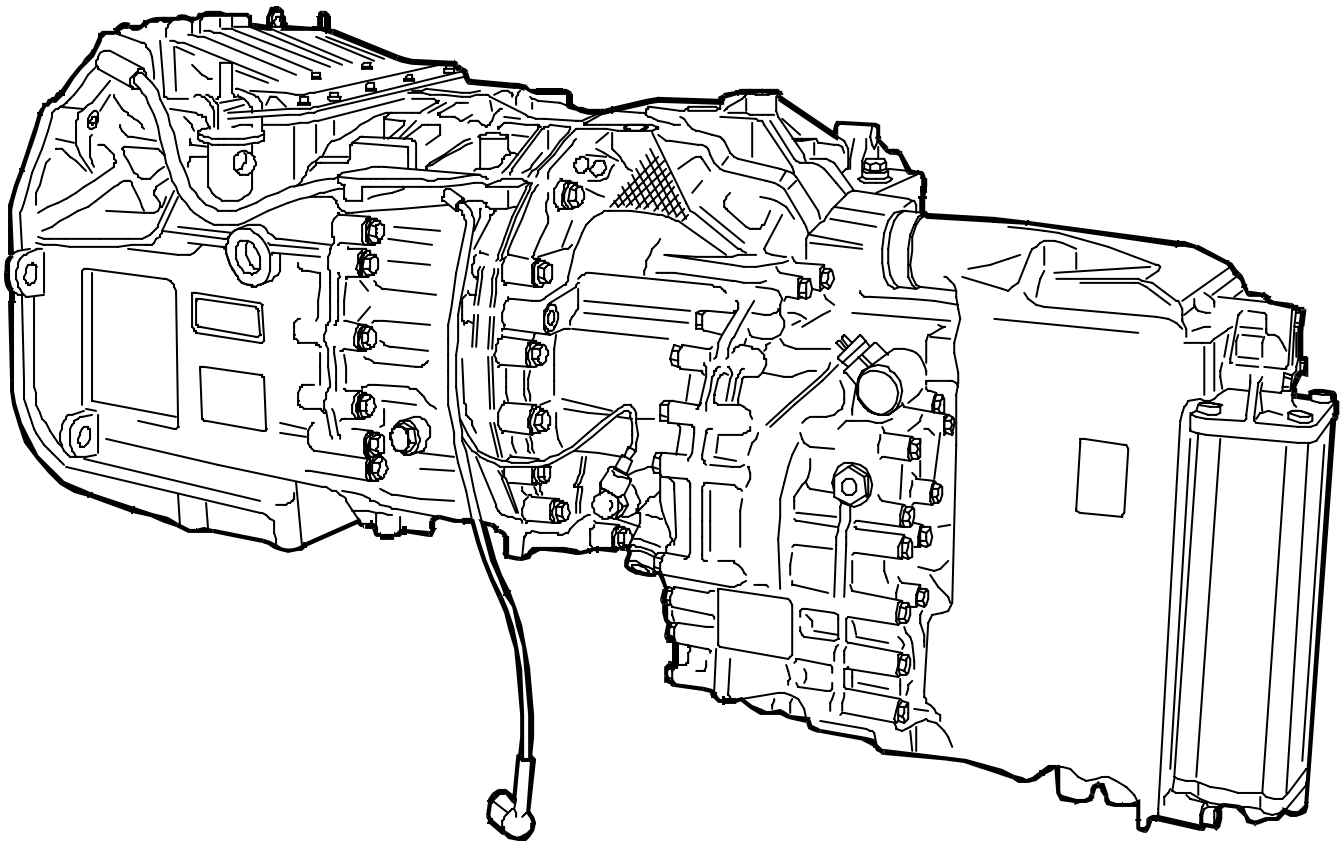
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**NOTE** This differs from the 12 AS 1930 T.D. - 12 AS 2330 T.D./T.O. gearbox in the following:

## MAIN DATA

| | | |
|---|---|---|
| | GEARBOXES | 12 AS 1931 T.D.<br>12 AS 2331 T.D./T.O. |
| | Maximum braking torque Nm | 3200 |
| | Braking capacity Kw | 500 |
| | Type of oil | Tutela Truck Fe - Gear<br>Tutela ZC 90 |
| | Quantity after overhauling gearbox and retarder drained completely litres | 21 |
| | kg | 18.9 |

Figure 1

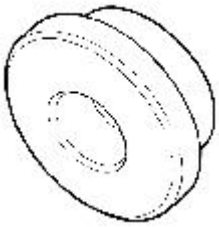
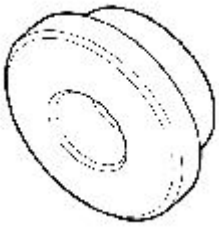
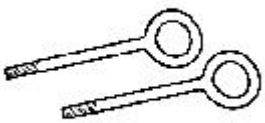


T.D.= Truck Direct Drive
T.O. = Truck Over Drive (Multiplied)

70831

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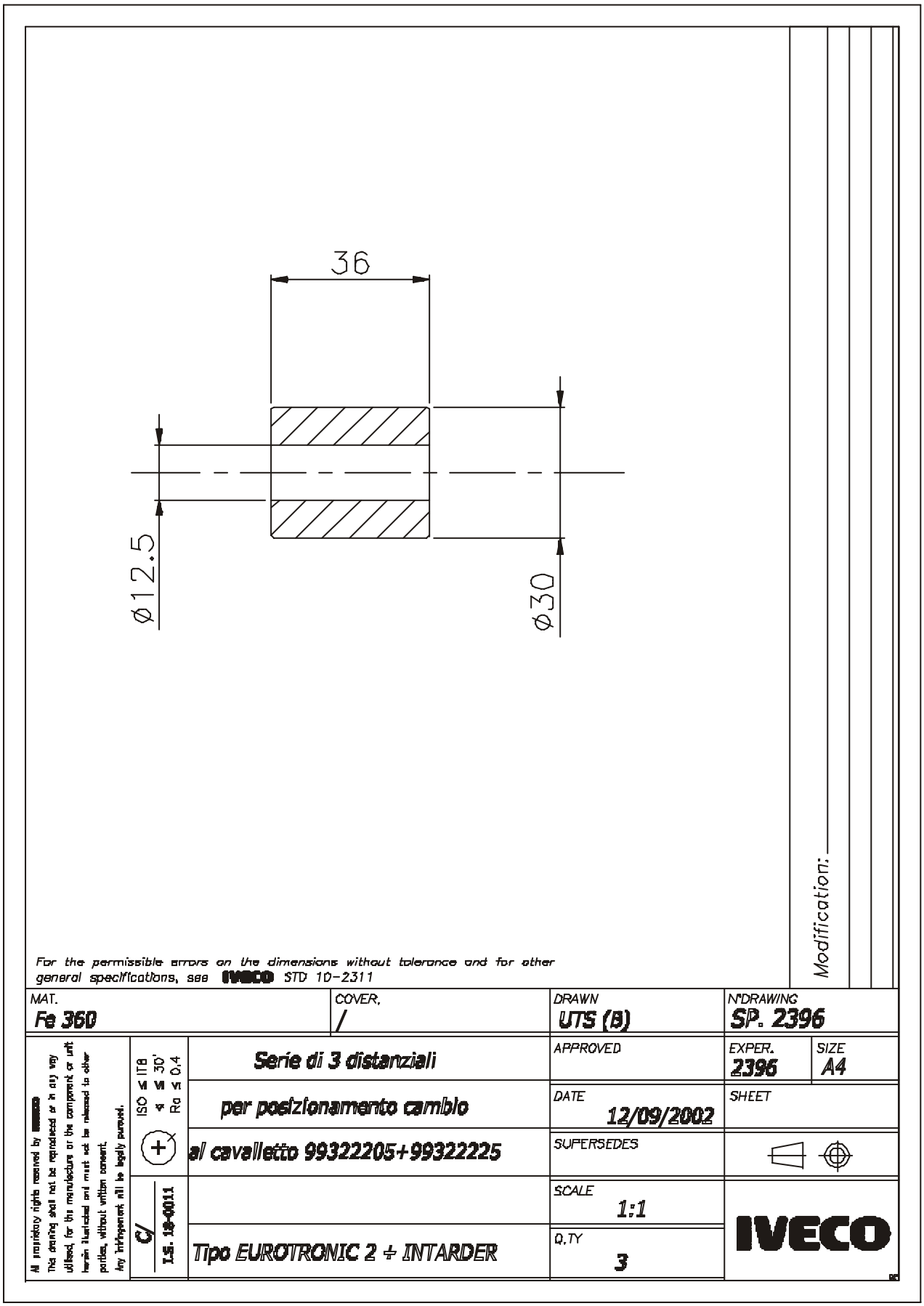
## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99345056** |  | Reaction block for extractors |
| **99345058** |  | Reaction block for extractors |
| **99370565** |  | M10 eyebolts (2) for lifting various assemblies |

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## EXPERIMENTAL TOOLS

This heading covers the working drawing for the experimental tool (S.P. 2396) used when overhauling the gearbox described in this section, which can be made by the repair shop.

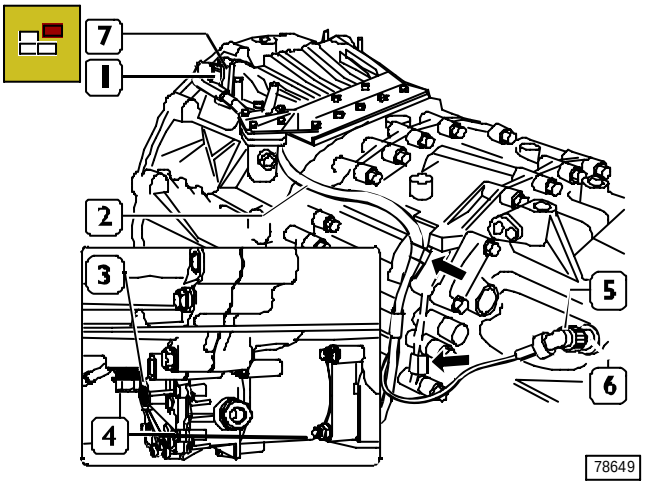


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## 530210 OVERHAULING THE GEARBOX

### Removing the hydraulic retarder

Figure 2

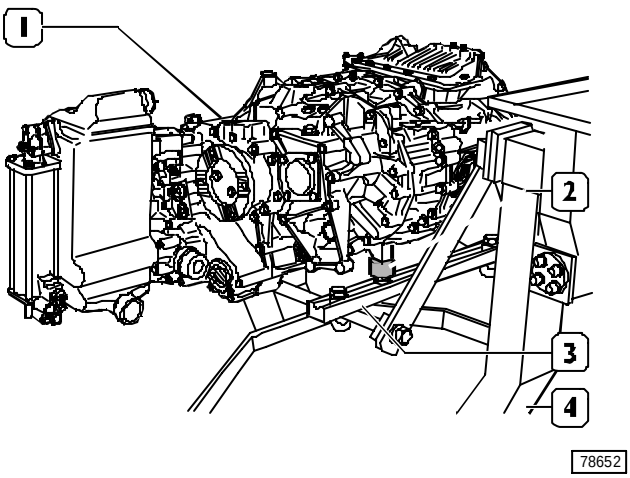



Unscrew the ring nut (1 and 5) and disconnect the electric wiring (2) from the speed sensor (6 and 7).

Detach the wiring (2) from the clips (→) securing it to the middle box.

Remove the nuts (4) and detach the actuator (3) from the front box.

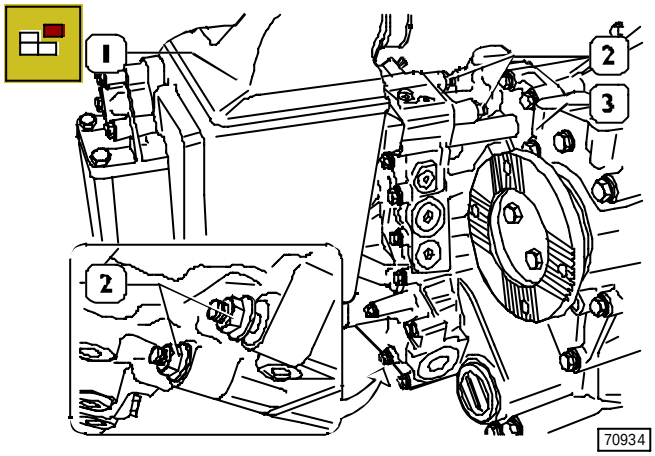
Figure 3




Fir spacers SP. 2396 (2) and fasten the gearbox (1) to brackets 99322225 (3) on the rotating stand 99322205 (4).

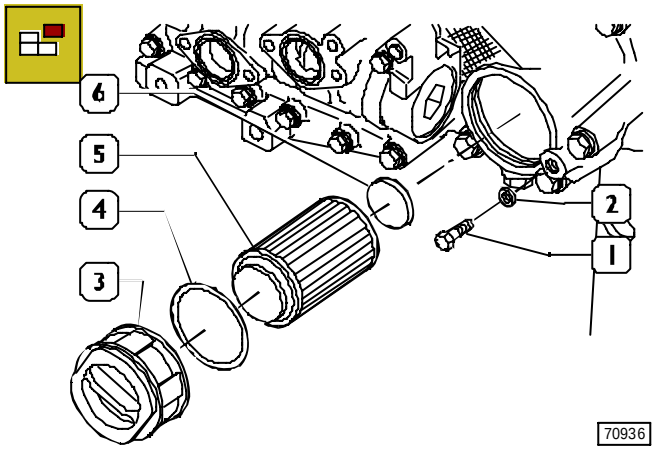
Drain off the lubricating oil by removing the plugs from the Intarder and from the gearbox.

Figure 4



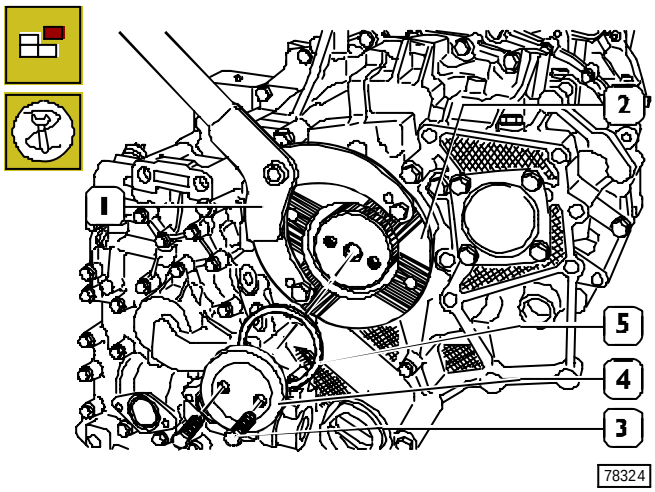

If applicable, remove the four nuts (2) fixing the heat exchanger (1) to the hydraulic retarder (3) and detach the heat exchanger (1).

Figure 5




Remove the screw (1) and the washer (2) beneath. Extract the plug (3) with the seal (4), oil filter (5) and magnet (6).

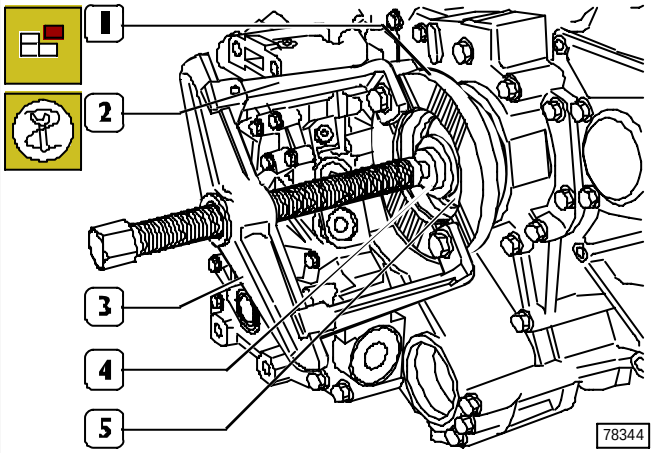
Figure 6




Block rotation of the sleeve (2) by applying the lever 99370317 (1) to it and remove the screws (3), disc (4) and underlying seal (5).

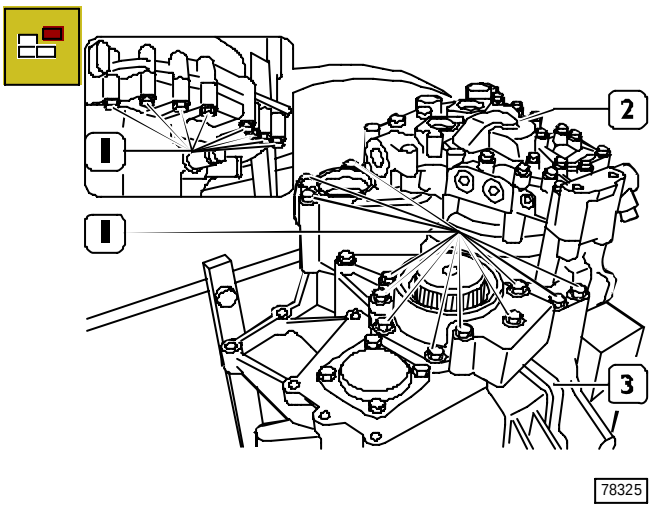
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Figure 7



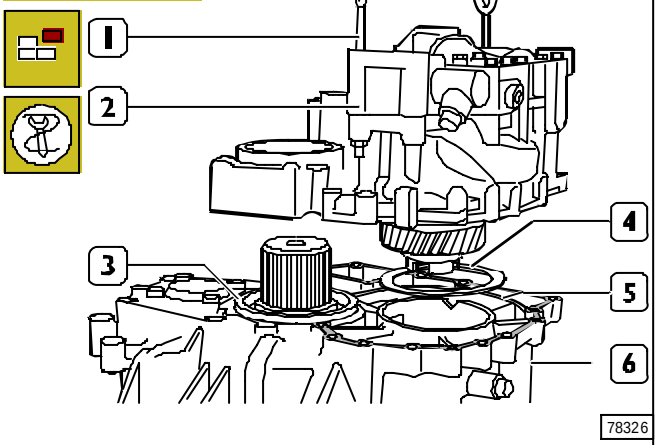

Using an extractor composed of the bridge 99341003 (3), brackets 99341018 (2) and reaction block 993410134 (4), remove the sleeve (1) from the shaft (5).

Figure 8




Remove the screws (1) fixing the hydraulic retarder (2) to the rear box (3).

Figure 9




Fit the eyebolt 99370565 (1) to the hydraulic retarder (2). With special ropes and lifter, detach the hydraulic retarder (2) from the rear box (5).

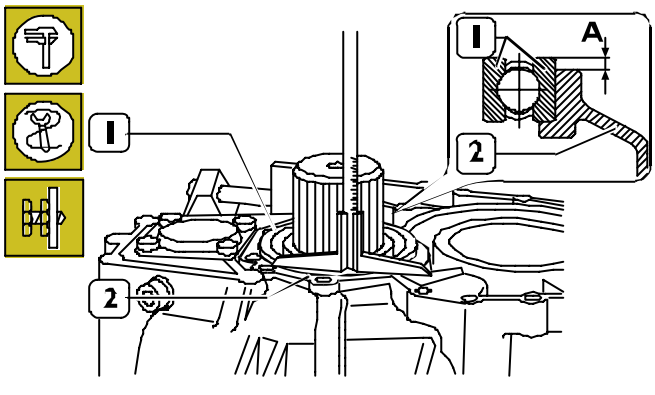
Remove the adjustment rings (3 and 4) and the gasket (6).

## Refitting the hydraulic retarder

Before refitting, determine the thickness of the adjustment rings (3 and 4, Figure 9) as follows:

## Adjusting epicyclic reduction gear train bearing end float

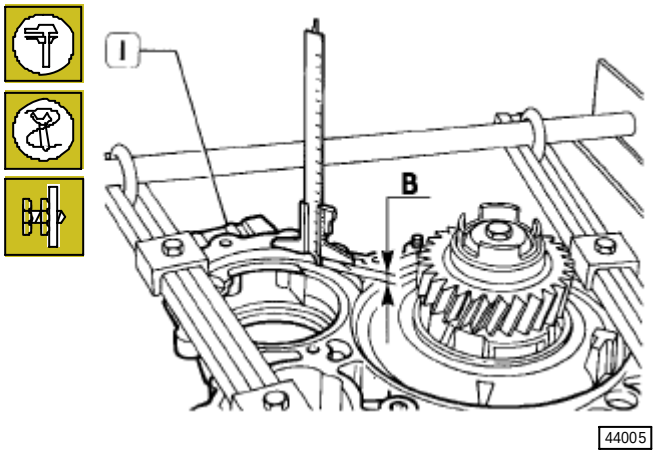
Figure 10




Determine the ball bearing end float adjustment thickness (1) by proceeding as follows:

- measure the protrusion of the bearing (1) from the surface of the rear box (2): distance A;

Figure 11




- measure the distance between the sealing surface (1) of the half box of the retarder and the supporting surface of the bearing (1, Figure 10): distance B;
- measure the thickness of the gasket between the retarder and gearbox: distance C.

The thickness S of the adjustment ring is given by the following equation:

$$S = [ B + C - A ] - G$$

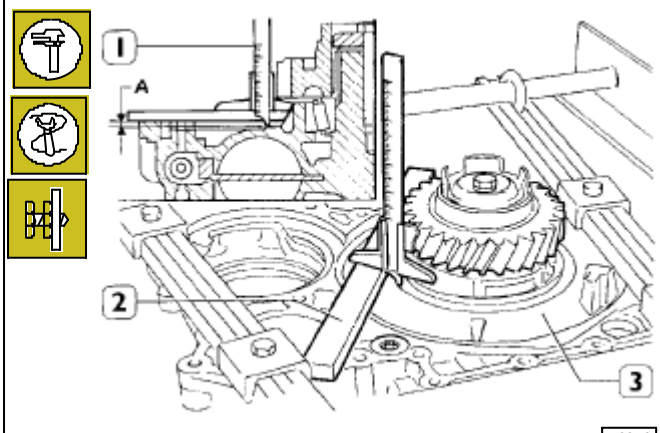
where:

- B - C - A = measurements
- G = 0.1 mm: end float of the ball bearing (1 Figure 10) (0 ÷ 0.1 mm)

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## Adjusting stator end float

Figure 12

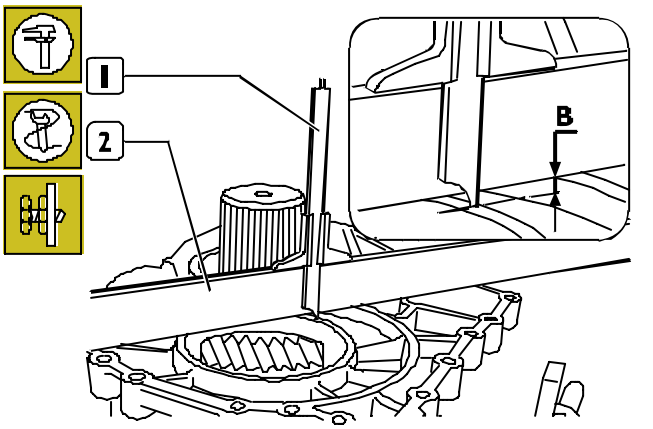



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Determine the thickness S of the stator end float adjustment ring:

- using a depth gauge (1) and calibrated rule (2), measure the distance between the sealing surface of the half boxes and the supporting surface of the stator (3): distance A;

Figure 13



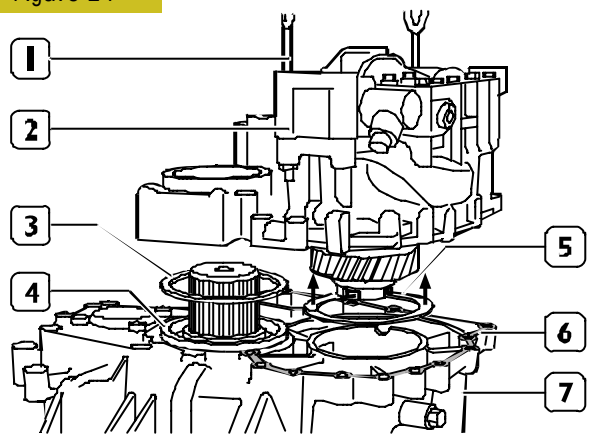

106403

- with depth gauge (1) and calibrated ruler (2), measure distance B between adjusting ring (5, ) rest surface and hydraulic decelerator rest surface;
- measure the thickness of the gasket between the retarder and gearbox: distance C.

The thickness S of the stator end flo at adjustment ring is given by the following sum: S = A+B+C+D

- A, B and C = measurements
- D = 0.05 mm: stator end float adjustment ring pre-load. (- 0.05 ÷ 0.05 mm)

Figure 14




78327

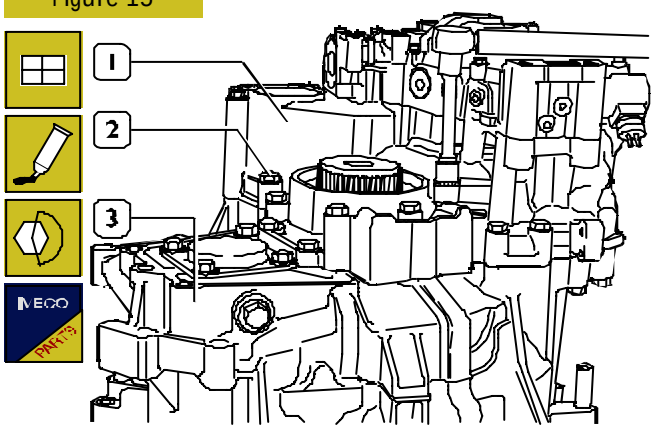
Fit the eyebolt 99370565 (1) to the hydraulic retarder (2) and lift it with a hoist.

Position the adjustment rings (3 and 5) of the thickness determined in the preceding measurements on the bearing (4) and on the seat (→) of the stator.

Fit a new gasket (6) on the rear box.

Mount the hydraulic retarder (2) on the rear box (7) making sure that the gasket (6) gets positioned correctly.

Figure 15

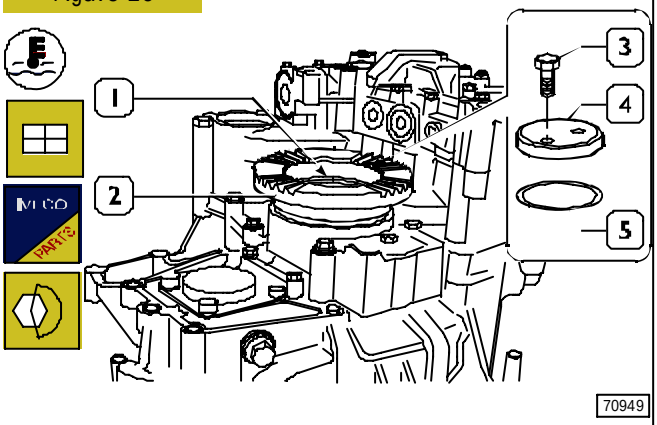



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Screw down the screws (2) fixing the hydraulic retarder (1) to the rear box (3) and tighten them to the prescribed torque.

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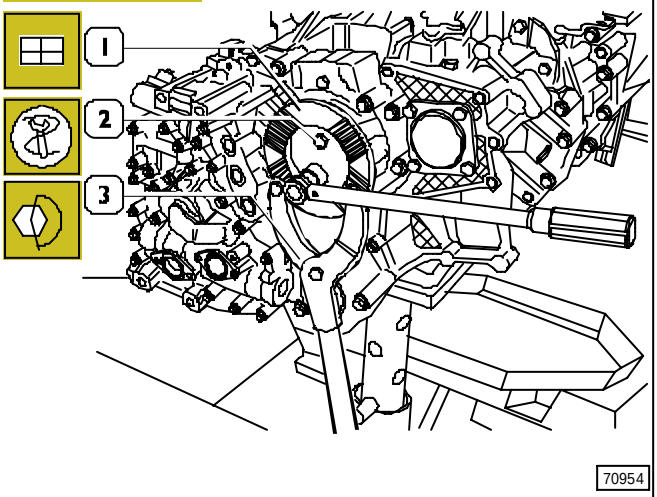
Figure 16




Heat the flange (2) to approx. 80°C and fit it onto the spider shaft (1).

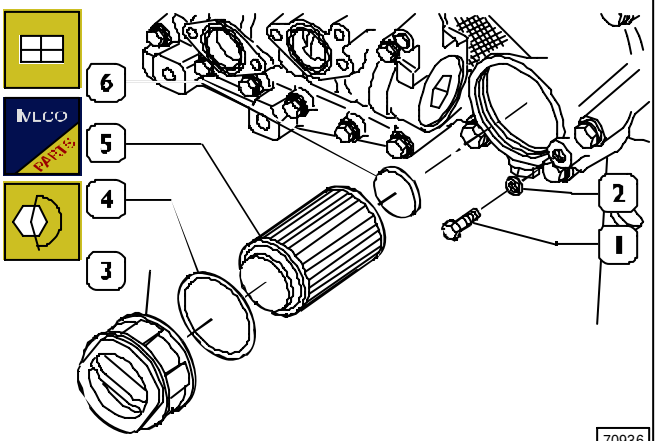
Fit on a new seal (5), the disc (4), screw down the screws (3) and tighten them to the prescribed torque.

Figure 17




Block rotation of the sleeve (1) by applying the lever 99370317 (3) and tighten the fixing screws (2) to the prescribed torque.

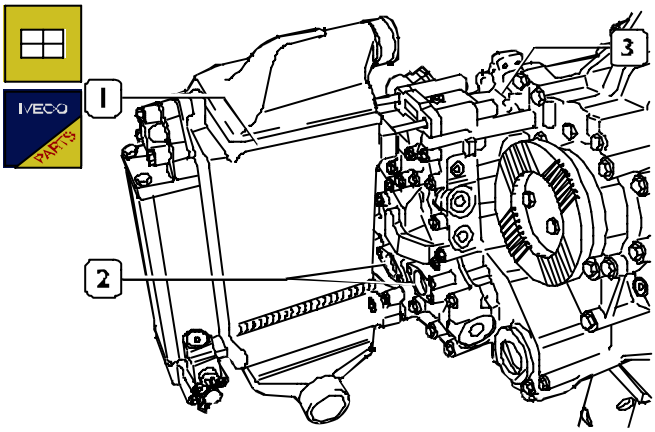
Figure 18




Position the magnet (6) on the filter (5) and insert this into the hydraulic retarder. Fit the plug (3) with a new seal (4).

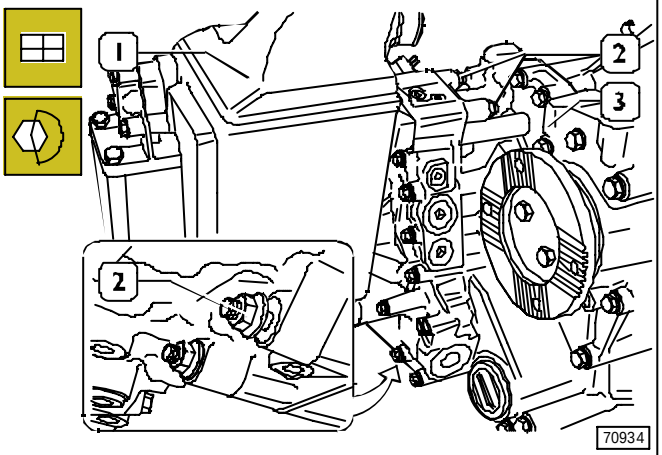
Screw down the fastening screw (1) with the washer (2).

Figure 19



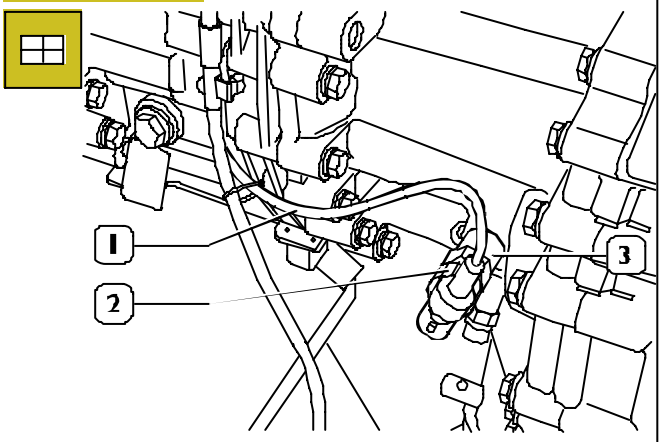

Fit two new seals (2) on the hydraulic retarder (3) and mount the heat exchanger (1) (if applicable).

Figure 20




Screw down the four nuts (2) fixing the heat exchanger (1) to the hydraulic retarder (3) and tighten them to the prescribed torque.

Figure 21

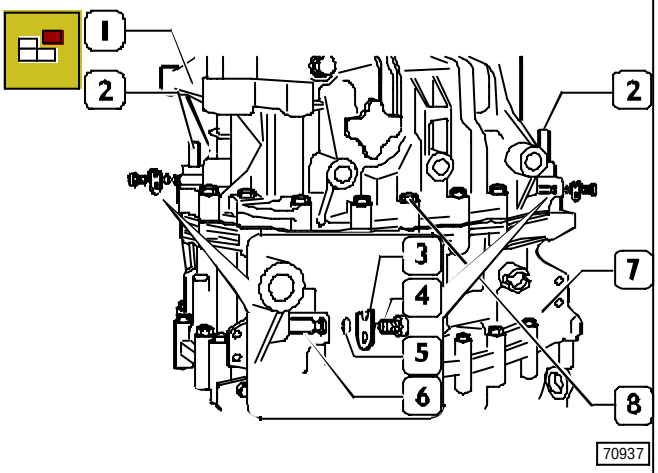



Connect the electric wiring (1) to the speed sensor (3) and tighten the ring nut (2).
Replenish the gearbox with the prescribed grade and quantity of lubricating oil.

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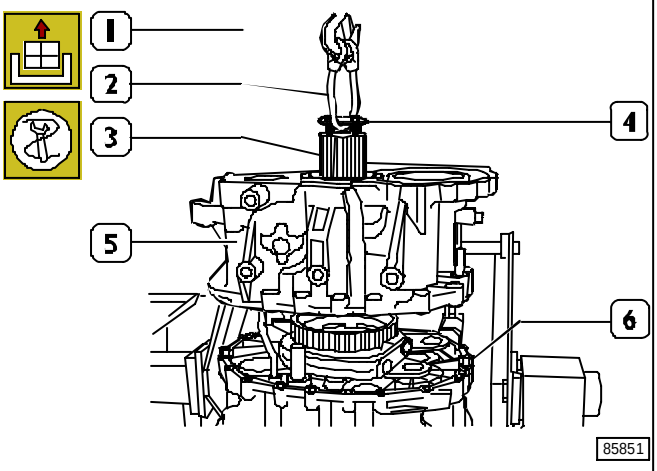
## Removing the rear box

Figure 22




Disconnect the gear actuator, as described in the respective chapter.
Remove the hydraulic retarder as described under the relevant heading.
Remove the fastening screws (4) of the plates (3) retaining the pins (6) and remove the pins with the O-rings (5) from the central case (7).
Take off the locating pins (2) and remove the rear case (1) fastening screws (8).

Figure 23

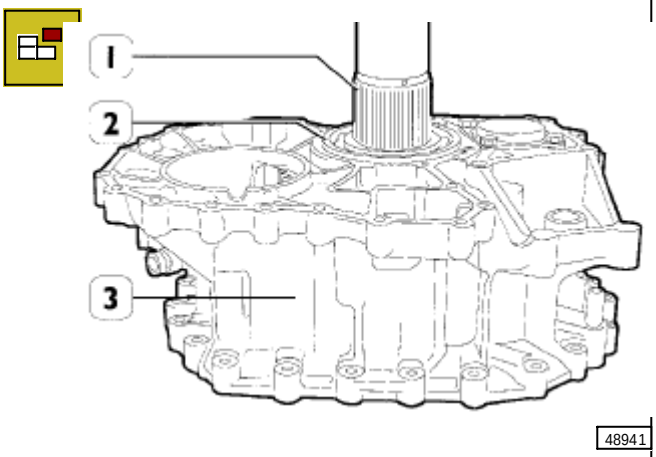



Apply the flange fastening plate (4) on the planetary gear shaft (3) and leave enough clearance to let the rope (2) pass through.

Hook the rope to a hoist (1) and remove the rear case (5) from the central case (6).

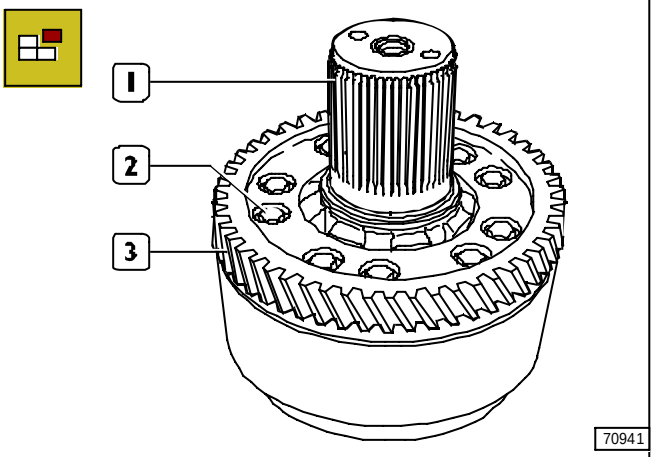
## Disassembling the E.R.G.

Figure 24



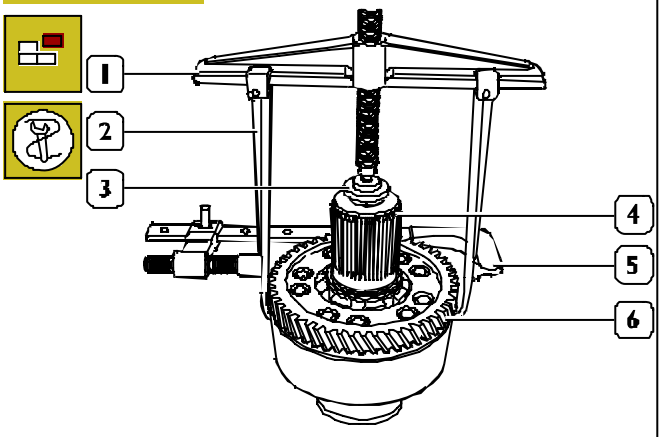

Using a press, extract the E.R.G. spider shaft (1) from the supporting ball bearing (2). Turn the rear box (3) upside-down and extract the ball bearing (2).

Figure 25




Remove the screws (2) securing the gear (3) to the spider shaft (1).

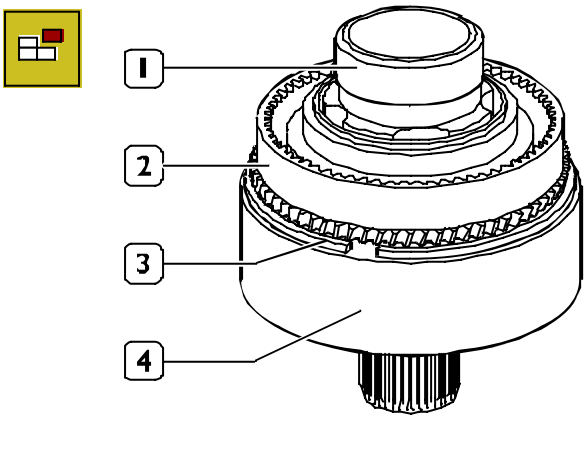
Figure 26




Using an extractor composed of: bridge 99341004 (1), stays 99341012 (2), reaction block 99345056 (3) and clamp 99341015 (5), extract the gear (6) from the spider shaft (4).

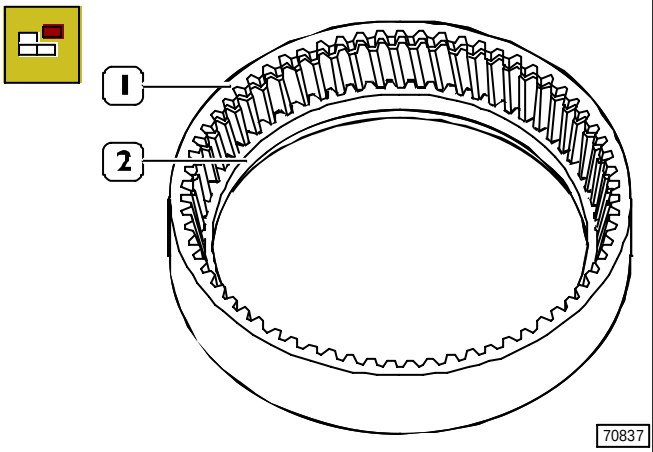
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Figure 27



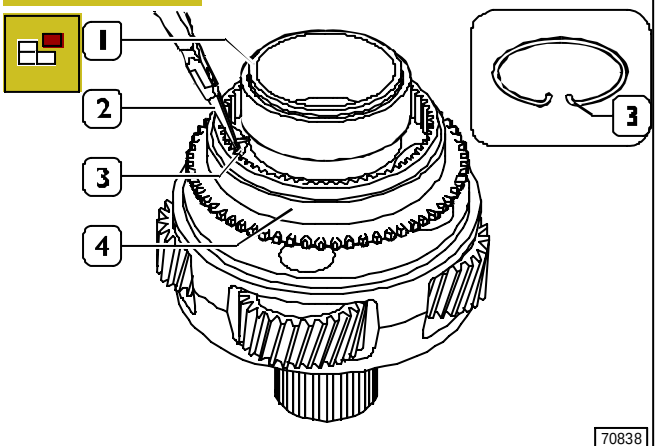

Using a screwdriver, remove the seeger ring (3) fastening the ring gear with internal toothing (4) to the ring gear with external toothing (2) and remove them from the E.R.G. (1).

Figure 28



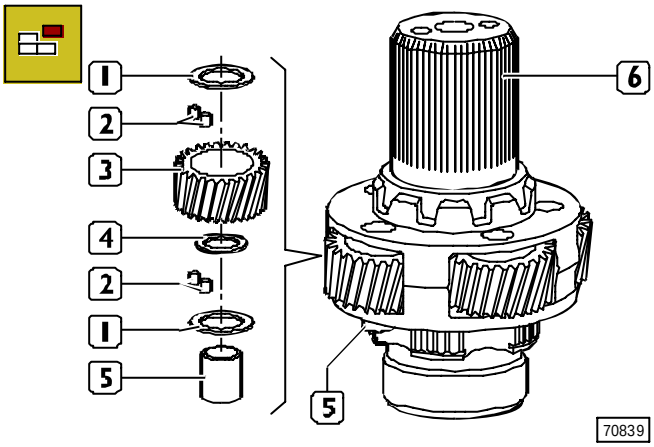

Extract the toothed ring (2) from the ring gear with internal toothing (1).

Figure 29



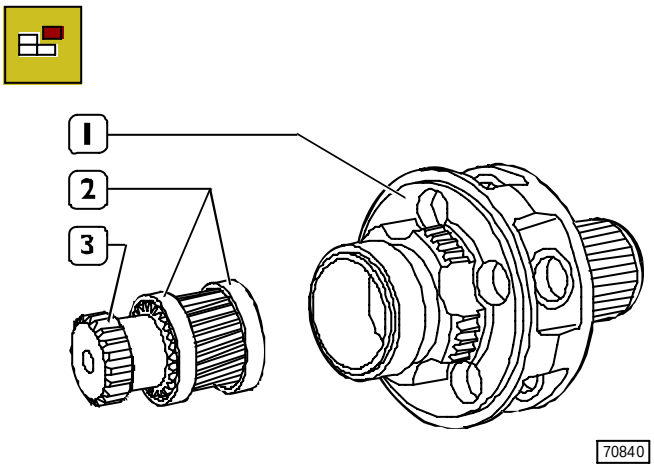

Using pliers (2), tighten the ends of the seeger ring (3) and remove the coupling body (4) from the E.R.G. shaft (1).

Figure 30



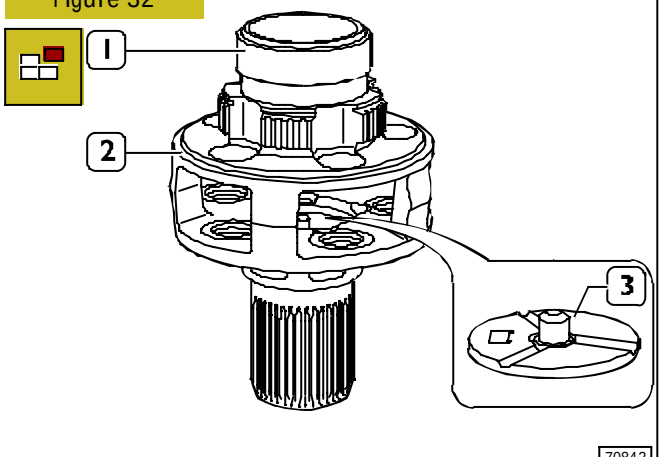

Using a punch, extract the pins (5) from the spider shaft (6). Remove the planetary gears (3) from the spider shaft (6), together with the rollers (2) and shim adjustment rings (1 and 4).

Figure 31




Extract the toothed spindle (3) from the spider shaft (1) together with the rings (2).

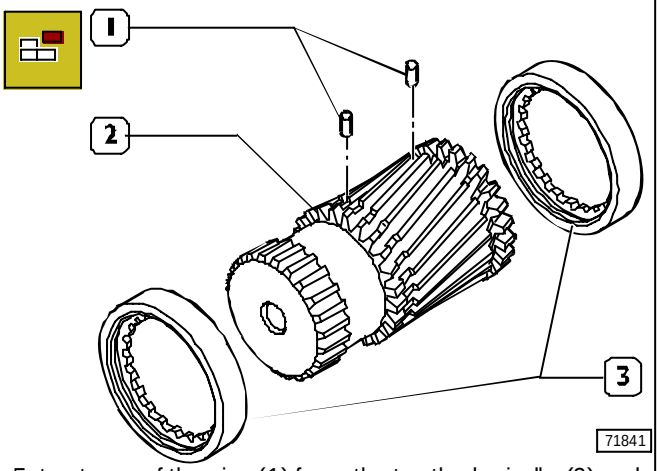
Figure 32




Using a suitable extractor, remove the roller bearing ring (1) from the spider shaft (2). Using a punch, extract the disc (3) from the inside of the spider shaft (2).

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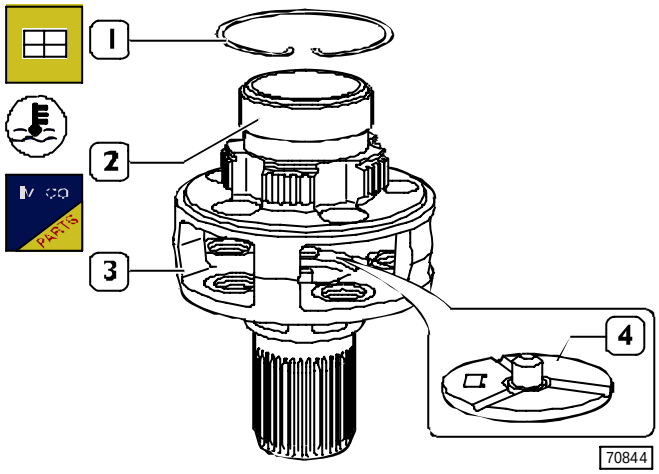
Figure 33




Extract one of the pins (1) from the toothed spindle (2) and extract the rings (3) from this.

## Assembling the E.R.G.

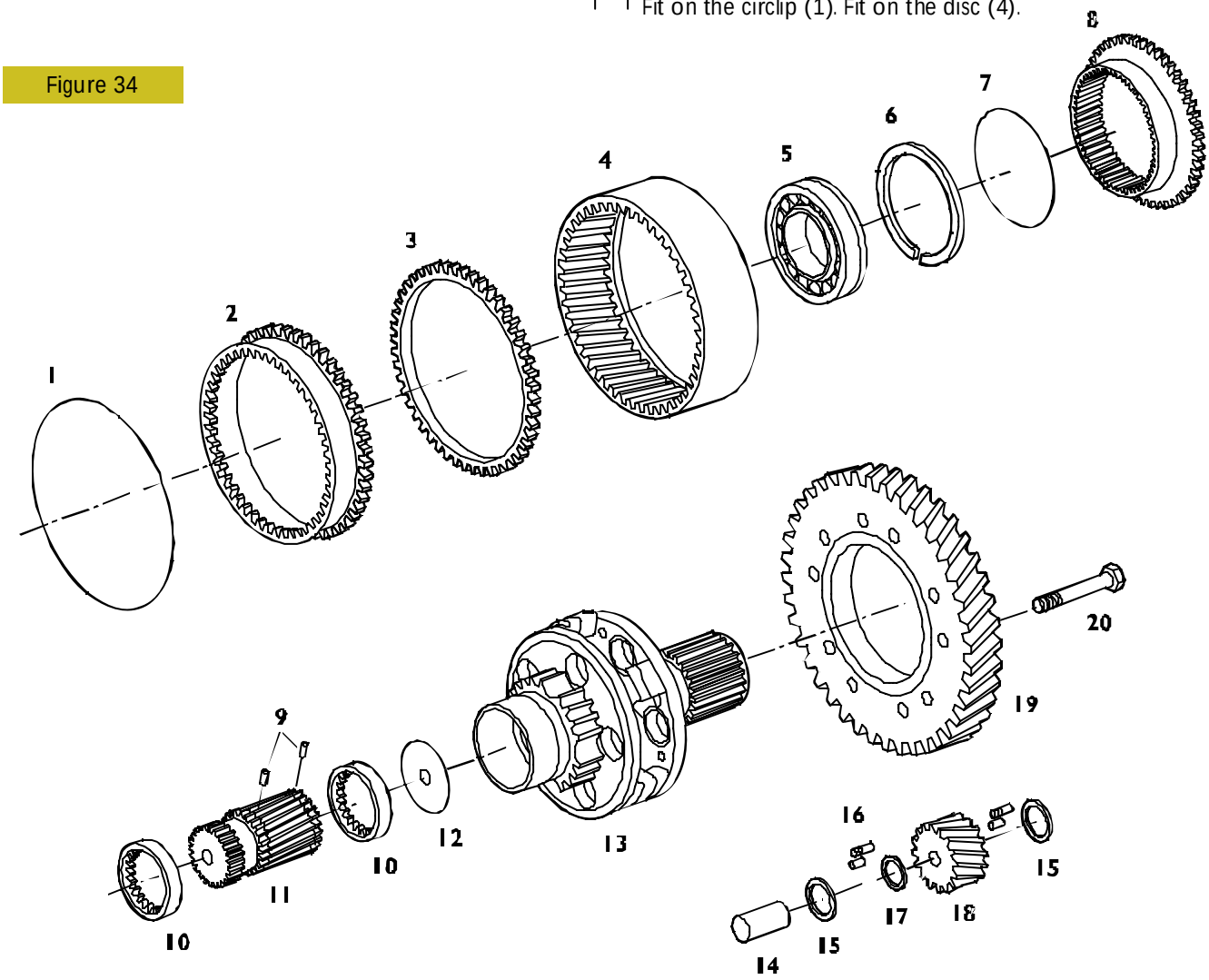
Figure 35




Heat the inside ring (2) of the roller bearing to and fit it on the spider shaft (3).

Fit on the circlip (1). Fit on the disc (4).

Figure 34

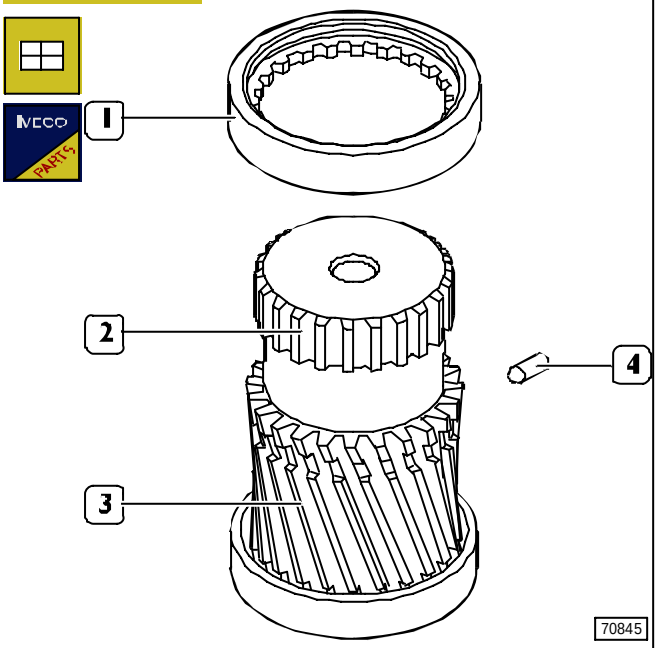



PARTS COMPRISING THE E.R.G.

1. Circlip - 2. Ring gear with external toothing - 3. Toothed ring - 4. Ring gear with internal toothing - 5. Bearing - 6. Circlip - 7. Circlip - 8. Coupling body - 9. Pins - 10. Ring - 11. Toothed spindle - 12. Disc - 13. Spider shaft - 14. Pin - 15. Shim adjustment ring - 16. Rollers - 17. Shim adjustment ring - 18. Planetary gear - 19. Gear - 20. Screw.

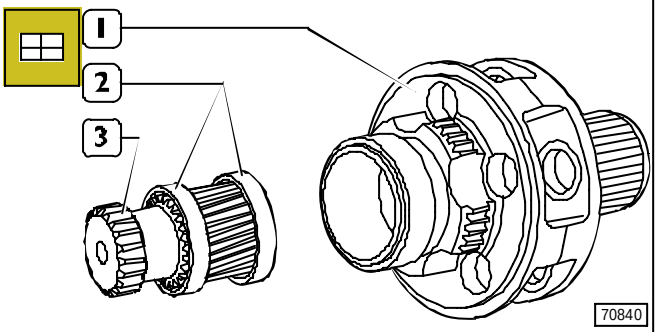
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Figure 36



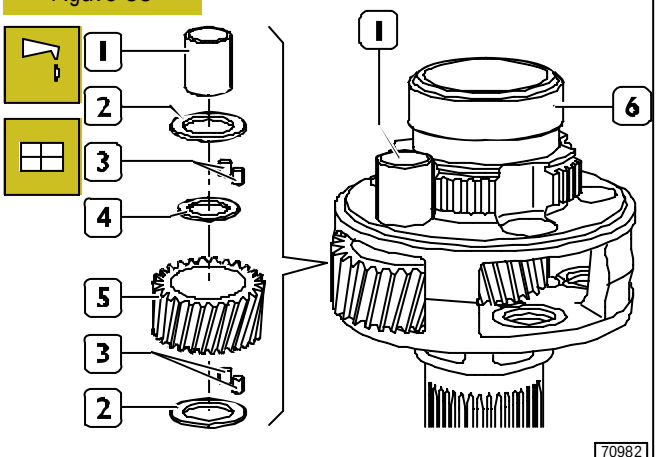

Drive the rings (1 and 3) onto the toothed spindle (2) and fit on the pin (4).

Figure 37



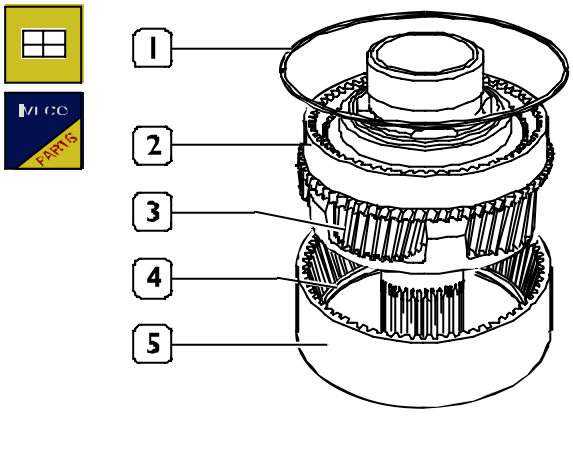

Insert the spindle (3) together with the rings (2) onto the spider shaft (1).

Figure 38



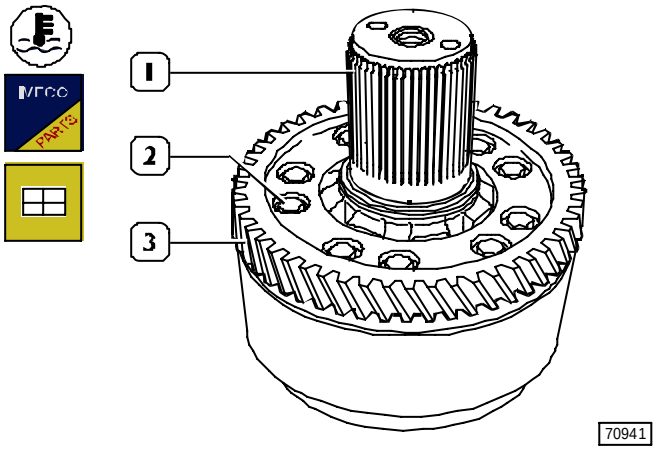

Smear grease into the hole of the planetary gear (5) and insert the rollers (3) with the associated shim adjustment rings (2 and 4).
Fit the planetary gears (5) onto the spider shaft (6), fastening them to it with the pins (1).

Figure 39



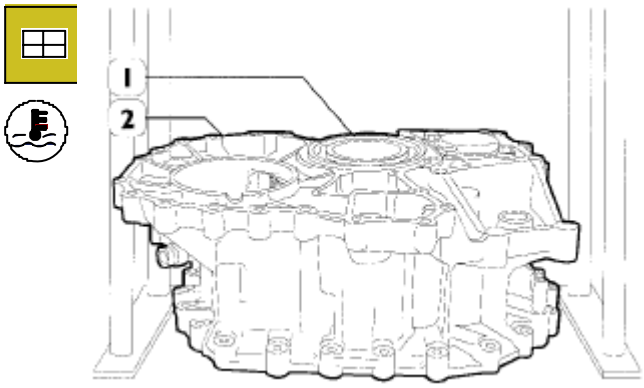

On the spider shaft (3), fit: the ring gear with internal toothing (5) together with the toothed ring (4), and the ring gear with external toothing (2) and fasten the two ring gears with the circlip (1).

Figure 40




Heat the gear (3) to 120°C ÷ 130°C and fit it onto the spider shaft (1). Screw down the fixing screws (2) and tighten them to the prescribed torque.

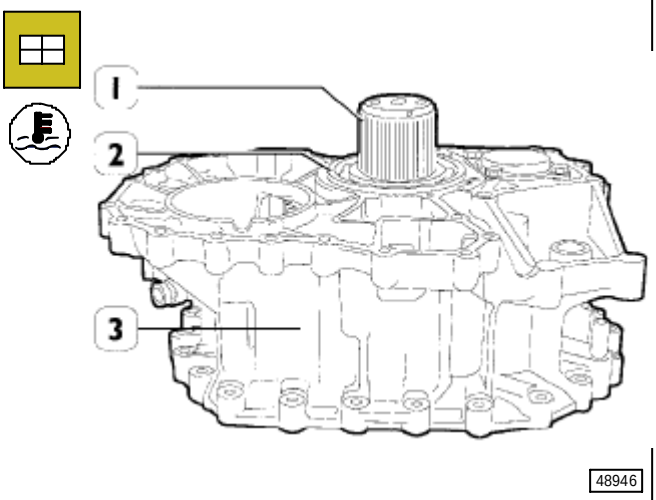
Figure 41




Heat the seat of the bearing (1) of the rear box (2) to 90°C and mount the bearing (1).

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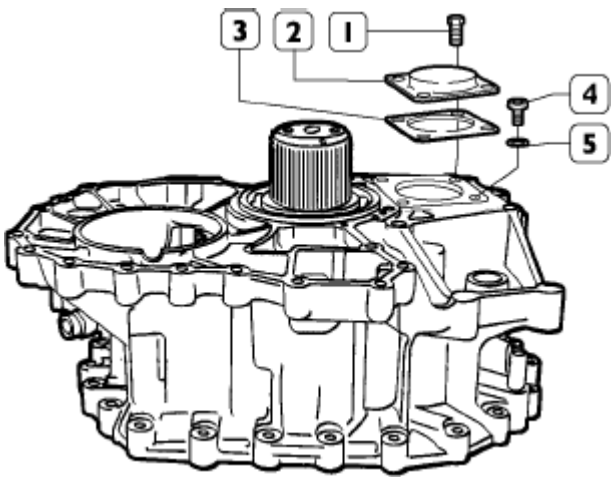
Figure 42




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Rest the spider shaft (1) on an appropriate spacer. Heat the inside ring of the bearing (2) to approx. 100°C and drive it together with the rear box (3) onto the spider shaft (1).

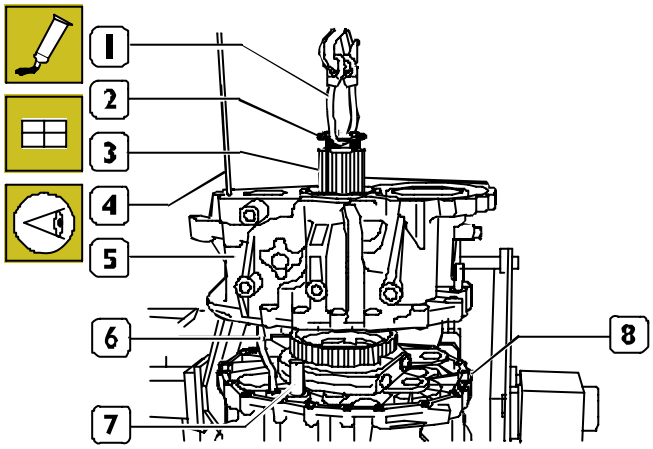
Figure 43




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Take out the screws (1) and remove the cover (2) with its seal (3). Remove the screw (4) with the washer (5).

Figure 44




85852

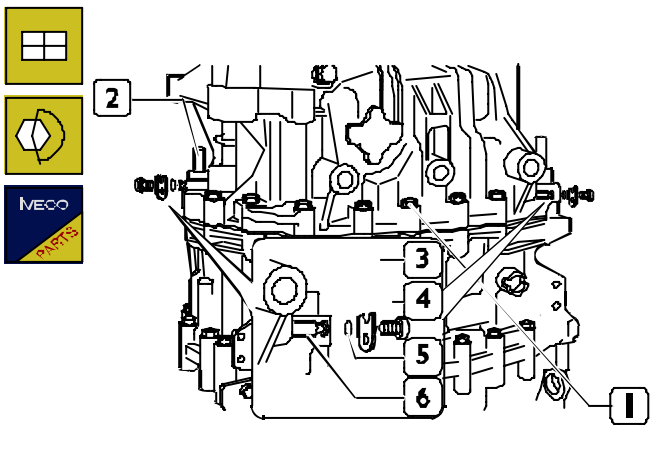
Apply sealer IVECO 1905685 on the central case (8) mating surface. Apply the shaft (3), the planetary gear shaft (3) fastening plate (2) leaving enough clearance to let the rope (1) pass through.

Hook the rope to a hoist and position the rear case (5) coaxially compared to the central case (8).

Fit a reinforcement (4) having the suitable diameter in the screw hole (1, Figure 45) and in the oil pipe (6) in order to lead the pipe into its seat when the rear case is lowered.

Lower the rear case (5) and make sure the planetary gear shaft, the oil pipe (6) and the bar (7) are fitted correctly in the respective seats.

Figure 45



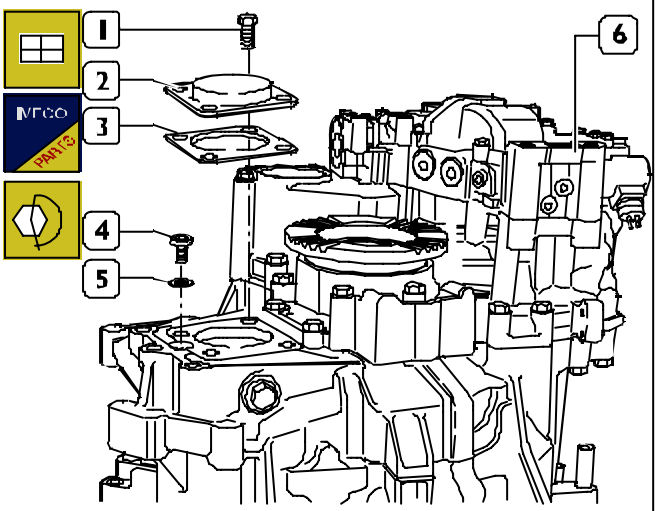

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Screw down the screws (1) without tightening them; insert the centring pins (2) and tighten the screws (1) to the prescribed torque.

Fit the fork joint pins (6) with fresh seals (5) and tighten the screws (4) fixing the fastening plates (3) to the prescribed torque.

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Figure 46




70950

Fit: the screw (4) with a new washer (5) and tighten it to the prescribed torque.

Fit the cover (2) with a fresh seal (3) and tighten the fixing screws (1) to the prescribed torque.

Then refit the hydraulic retarder (6) as described under the relevant heading.

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## EuroTronic Gearboxes Diagnostic

Page

FAULT DIAGNOSIS . . . . . 75

- Diagnosis Instruments . . . . . 75
- Cluster Diagnosis . . . . . 77
- DTC-FMI error codes . . . . . 78

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## FAULT DIAGNOSIS

EUROTRONIC troubleshooting can be performed with the Cluster or Modus, E.A.SY. and IT 2000 diagnosis instruments.

Diagnosis via cluster makes it possible to estimate the fault situation in the system in advance, while the fault-diagnosis instruments are essential to make a thorough diagnosis and operate correctly on the single faults.

For each single instrument it displays the diagnosis and repair help.

### Diagnosis Instruments

MODUS (Maintenance and Diagnostic System)

A computerized fault-diagnosis station dedicated to diagnosing the brake systems, air suspensions, engines and systems controlled electronically.

The station is equipped with auxiliary functions, such as: programming electronic control units, consulting the spare parts catalogue and service time schedules.

The vehicle has a 30-pin diagnosis socket to interface with the instrument.

IT 2000 (IVECO Electronic Tester)

This makes it possible to take immediate action on the vehicle, identifying it with the chassis number.

It saves the results of diagnostics actions performed.

It can be used as a portable Personal Computer, too, being fitted for remote diagnosis.

By using MODUS as the mother station it is possible to update and configure the IT 2000.

IT 2000 interfaces with the vehicle via a 30-pin diagnosis socket.

E.A.SY.

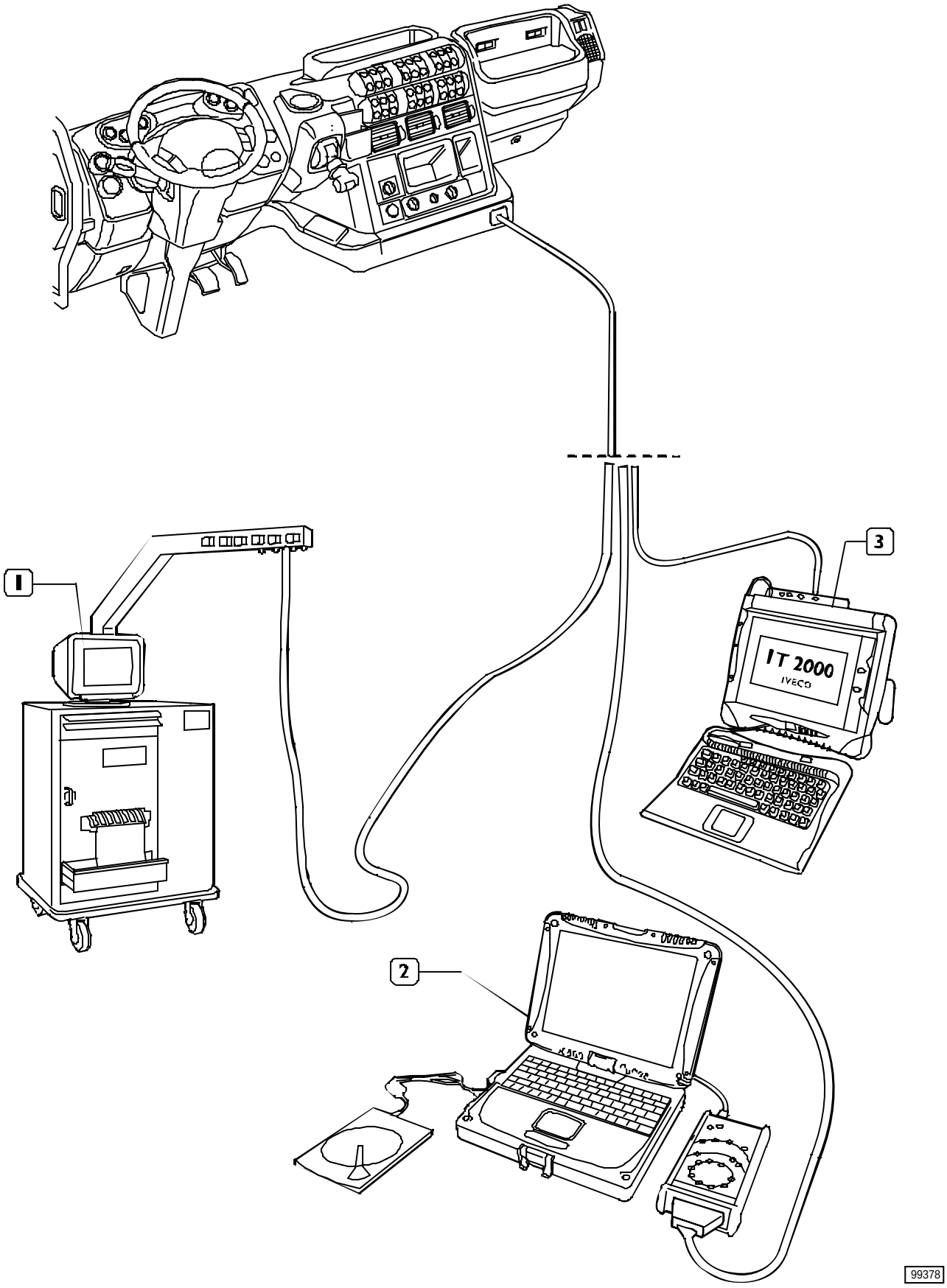
E.A.SY. system allows to simply make the diagnosis and programming of the various electronic central units aboard the vehicle.

E.A.SY. system is made up of ECI module communicating with the electronic central units and of a Panasonic PC.

ECI module, exploiting the Panasonic PC, also allows easy on the road interventions: in particular, thanks to Panasonic PC wireless technologies (e.g. GPRS), diagnostic interventions can be assisted by a remote expert centre.

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Figure 1



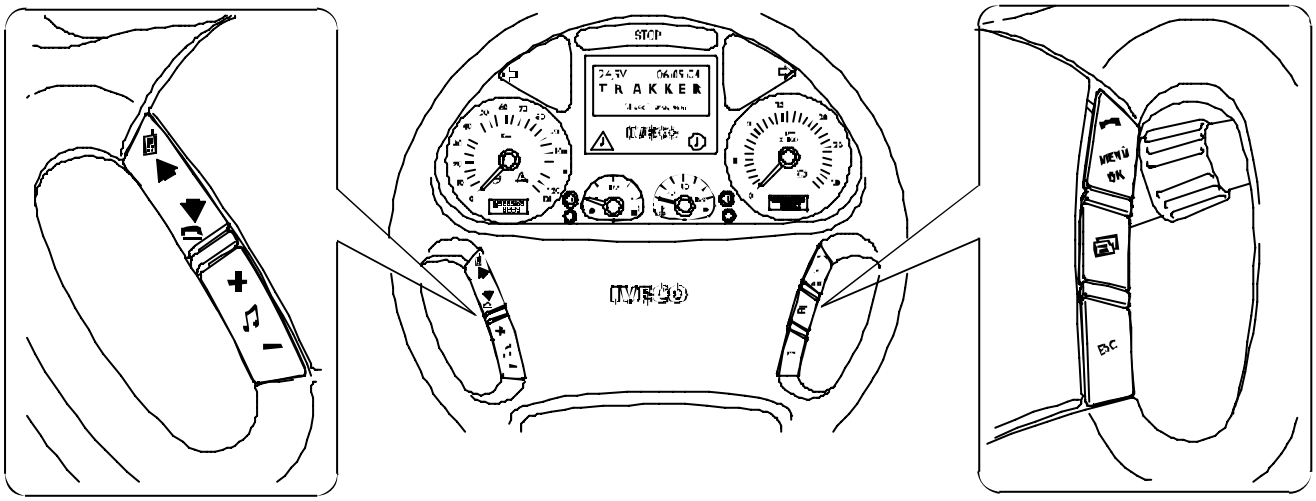

1. E.A.SY. - 2. IT 2000 - 3. Modus

Aquila Trucks Centres

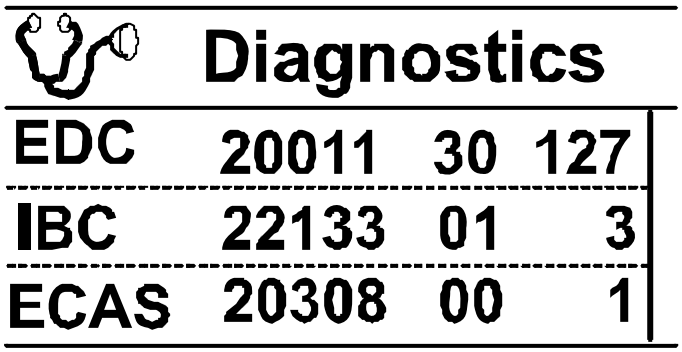
## Diagnosis on Cluster

Access to diagnostic screen is possible through "page" or " y " " b " keys.

Figure 2




98888




98885

Diagnosis information on the cluster is split into 4 columns:

- First column = central unit.
- Second column = central unit address plus fault order number.
- Third column = failure type.
- Fourth column = failure frequency.

The screen shows three error messages at most, but can store up to eight error messages. For displaying any further messages, just operate " y " and " b " keys.

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | SENSORS -TRANS-MISSION OUTPUT SPEED | WRONG SIGNAL | | | Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit) | | | | Gear actuator replacement (control unit) |
| | | SIGNALS - SENSOR - TACHO-GRAPH SENSOR | WRONG SIGNAL | Other errors 91,100,177 present. | Short circuit to ground to pin 8 - CAN H possible. | Check vehicle CAN. | Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | |
| | | SIGNALS - SENSOR - TACHO-GRAPH+OUTPUT SHAFT SPEED SENSOR | BOTH SPEED SENSORS FAULTY | If the output speed signal 1 is available, there are no restrictions on the system. | | Check vehicle-end wiring. Check and replace defective output sensor. | | | | Error 99,101 set; Output speed > 2500 rpm; Vehicle speed too high. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | CAN LINE - ENGINE - REQUESTED ENGINE TORQUE | WRONG SIGNAL | Vehicle moving:<br>No calculation of vehicle weight and gear resistance possible.<br>Impossible to calculate starting gear.<br>The driver's request will be substituted by the information on the throttle pedal position.<br>Once coupling is over, an amount of fuel equivalent to the throttle pedal value will be released.<br>The clutch coupling quality could be reduced.<br>During cruise control operation it is not possible to release any amount of fuel because the throttle pedal value is 0.<br>After the clutch has engaged, the amount of fuel will be released by the EDC.<br>Poor coupling quality after changing gear.<br>Vehicle stationary:<br>Starting is possible.<br>On reaching the stop, the average starting gear will be engaged.<br>No additional functional restrictions. | | Check accelerator/accelerator wiring.<br>Replace/repair accelerator/periphery. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | CAN LINE - ENGINE - LOW IDLE SWITCH | WRONG SIGNAL | Further errors saved in EDC. | | Please make also a diagnosis check on EDC system. | | | | |
| | | CAN LINE - ENGINE - CONTROL MESSAGE | TIMEOUT | | | Check fuse box fuses. | | | | |
| | | CAN LINE - ENGINE - CONTROL MESSAGE | TIMEOUT | | In the EEC1 message timeout at the following signals:<br>- Idling switch<br>- Kickdown switch<br>- Accelerator pedal position<br>- Engine torque ratio calculation | Please make also a diagnosis check on EDC system. | | | | |
| | | CAN LINE - ENGINE - NUMBER OF ENGINE REVS. | WRONG SIGNAL | | | Check vehicle CAN. | Measure type: Resistance (Ohm)<br>Measure point 1: Connector (vehicle side)<br>Pin: 8<br>Measure point 2: Connector (vehicle side)<br>Pin: 12 | Connector Connected;<br>Key +15 OFF; | Typical Value: 60 Ohm; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 02 | 05 | SHIFTING ACTUATOR - SOLENOID VALVE (Y2) SPLITTER | SHORT CIRCUIT TO GROUND | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 03 | 05 | SHIFTING ACTUATOR - SOLENOID VALVE (Y3) SPLITTER | SHORT CIRCUIT TO GROUND | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 04 | 05 | SHIFTING ACTUATOR - (Y4) SOLENOID VALVE GEAR SELECTION | SHORT CIRCUIT TO GROUND | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 05 | 05 | SHIFTING ACTUATOR - (Y5) SOLENOID VALVE GEAR SELECTION | SHORT CIRCUIT TO GROUND | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 06 | 05 | SHIFTING ACTUATOR - (Y6) SOLENOID VALVE GEAR ENGAGEMENT | SHORT CIRCUIT TO GROUND | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 07 | 05 | SHIFTING ACTUATOR - (Y7) SOLENOID VALVE GEAR ENGAGEMENT | SHORT CIRCUIT TO GROUND | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 08 | 05 | SHIFTING ACTUATOR - (Y8) SOLENOID VALVE RANGE LOW | SHORT CIRCUIT TO GROUND | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 09 | 05 | SHIFTING ACTUATOR - (Y9) SOLENOID VALVE RANGE HIGH | SHORT CIRCUIT TO GROUND | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 0A | 05 | SHIFTING ACTUA-TOR - (Y10) MAIN VALVE | SHORT CIRCUIT TO GROUND | Impossible to change gear, not even in neutral.<br>The selected gear stays engaged.<br>The vehicle can only set off again in particular conditions (gear selected =< the 8th gear). | | Replacing the gearbox actuator (control unit) | | | | |
| 0B | 05 | DEVICE - WARNING LAMP/ BUZZER | SHORT CIRCUIT TO GROUND | Possible short circuit. | | Check wiring | 1- Measure type: Voltage (V)<br>Measure point 1: Connector for ECU power supply - vehicle side. Pin: 11<br>Measure point 2: Connector for ECU power supply - vehicle side. Pin: 16<br>2- Measure type: Voltage (V)<br>Measure point 1: Connector for ECU power supply - vehicle side. Pin: 11<br>Measure point 2: Connector for ECU power supply - vehicle side. Pin: 17 | 1- Connector Connected; Key +15 ON;<br>2- Connector Connected; Key +15 ON; | 1- Min. value: 22 V; Max. value: 28 V;<br>2- Min. value: 22 V; Max. value: 28 V; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 0D | 05 | DEVICE - REAR PTO - REAR ENGINE PTO EN-GAGED | SHORT CIRCUIT TO GROUND | PTO 1 not available. No additional system restrictions. | | Check wiring, control contactor, connections with the MUX system and gear lever | | | | |
| 0D | 05 | DEVICE - REAR PTO - REAR ENGINE PTO EN-GAGED | SHORT CIRCUIT TO GROUND | | | For STRALIS please check either for a possible short be-tween 9131 and 0131 cables or check for a possible wiring inver-sion on ST67 con-nector (PIN 4 of 0131 cable could be in-verted with PIN 2 of 9131 cable). | | | | |
| 0E | 05 | DEVICE - PTO 2 - LATERAL ENGINE PTO EN-GAGED | SHORT CIRCUIT TO GROUND | PTO2 not available. No additional system restrictions | | Check wiring, control contactor, connections with the MUX system and gear lever | | | | |
| 0E | 05 | DEVICE - PTO 2 - LATERAL ENGINE PTO EN-GAGED | SHORT CIRCUIT TO GROUND | | | For STRALIS please check either for a possible short be-tween 9131 and 0131 cables or check for a possible wiring inver-sion on ST67 con-nector (PIN 4 of 0131 cable could be in-verted with PIN 2 of 9131 cable). | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 05 | SHIFTING ACTUATOR - SOLENOID VALVE (Y1) | SHORT CIRCUIT TO GROUND | Vehicle moving:<br>The speed increases are managed as the changes.<br>The speed increases are not possible when the engine is at low speed.<br>The engagement time increases.<br>Vehicle stationary:<br>The engagement time is longer. | | Replacing the gearbox actuator (control unit) | | | | |
| 12 | 05 | CLUTCH ACTUATOR - (Y17) SOLENOID VALVE CLUTCH DISENGAGEMENT SLOW | SHORT CIRCUIT TO GROUND | Clutch control is implemented via the fast clutch uncoupling solenoid valve. It decreases comfort when manoeuvring. | | Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit) | Measure type: Resistance (Ohm)<br>Measure point 1: Connector for clutch actuator - gearbox side Pin: 9<br>Measure point 2: Connector for clutch actuator - gearbox side Pin: 16 | Connector Not connected;<br>Key +15 OFF; | Min. value: 14 Ohm; Max. value: 20 Ohm; | |
| 13 | 05 | CLUTCH ACTUATOR - (Y15) SOLENOID VALVE CLUTCH ENGAGEMENT SLOW | SHORT CIRCUIT TO GROUND | Clutch control is implemented via the fast clutch uncoupling solenoid valve. It decreases comfort when manoeuvring. | | Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit) | Measure type: Resistance (Ohm)<br>Measure point 1: Connector for clutch actuator - gearbox side Pin: 7<br>Measure point 2: Connector for clutch actuator - gearbox side Pin: 16 | Connector Not connected;<br>Key +15 OFF; | Min. value: 14 Ohm; Max. value: 20 Ohm; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 05 | CLUTCH ACTUATOR - (Y16) SOLENOID VALVE CLUTCH DISENGAGEMENT FAST | SHORT CIRCUIT TO GROUND | Clutch control is implemented via the fast clutch uncoupling solenoid valve. It decreases comfort when manoeuvring. | | Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit) | Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 12 Measure point 2: Connector for clutch actuator - gearbox side Pin: 17 | Connector Not connected; Key +15 OFF; | Min. value: 14 Ohm; Max. value: 20 Ohm; | |
| 15 | 05 | CLUTCH ACTUATOR - (Y14) SOLENOID VALVE CLUTCH ENGAGEMENT FAST | SHORT CIRCUIT TO GROUND | Clutch control is implemented via the fast clutch uncoupling solenoid valve. It decreases comfort when manoeuvring. | | Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit) | Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 8 Measure point 2: Connector for clutch actuator - gearbox side Pin: 17 | Connector Not connected; Key +15 OFF; | Min. value: 14 Ohm; Max. value: 20 Ohm; | |
| 16 | 05 | SUPPLY VOLTAGE - DEVICE | SHORT CIRCUIT TO GROUND | ECU output deactivated. No information from the gear lever, from the buzzer. Vehicle moving: Gearbox locked. Vehicle stationary: Gearbox automatically in neutral. System not available | | Control unit - gear lever wiring control | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 04 | CAN LINE - ENGINE - CONFIGURATION MESSAGE | TIMEOUT | The system adopts substitutive parameters.<br>Reduced functionality for the automatic mode and to calculate the starting gear, if there is a large difference between the parameters utilized and the actual values.<br><br>The quality of clutch uncoupling may decrease. | | Check vehicle CAN. | Measure type: Resistance (Ohm)<br>Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected;<br>Key +15 OFF; | Typical Value: 60 Ohm; | Reprogram the electronic control unit to rewrite the parameters. |
| 1A | 04 | CAN LINE - ENGINE - CONFIGURATION MESSAGE | TIMEOUT | | | Please make also a diagnosis check on EDC system. | | | | |
| 1B | 08 | CAN LINE - ENGINE - CONFIGURATION MESSAGE | WRONG SIGNAL | The system adopts substitutive parameters.<br>Reduced functionality for the automatic mode and to calculate the starting gear, if there is a large difference between the parameters utilized and the actual values.<br><br>The quality of clutch uncoupling may decrease. | | Check vehicle CAN. | Measure type: Resistance (Ohm)<br>Measure point 1: Connector (vehicle side) Pin: 8<br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected;<br>Key +15 OFF; | Typical Value: 60 Ohm; | Reprogram the electronic control unit to rewrite the parameters. |
| 1B | 08 | CAN LINE - ENGINE - CONFIGURATION MESSAGE | WRONG SIGNAL | | | Please make also a diagnosis check on EDC system. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1C | 08 | CAN LINE RE-TARDER - INTARDER - BRAKING TORQUE | WRONG SIGNAL | Impossible to calculate the gear resistance.<br>No automatic calculation of the starting gear.<br>The average starting gear is engaged at the stop.<br>No additional system restrictions. | | Check vehicle CAN. | Measure type: Resistance (Ohm)<br>Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected;<br>Key +15 OFF; | Typical Value: 60 Ohm; | Further CAN errors present (183, 184, etc.). |
| 1C | 08 | CAN LINE -RE-TARDER - INTARDER - BRAKING TORQUE | WRONG SIGNAL | Further Intarder errors (e.g. 27, 29). | | Check/Replace Intarder electronics. | | | | |
| 1D | 08 | CAN LINE -RE-TARDER - INTARDER - WATER TEMPERATURE INCREASE | WRONG SIGNAL | There are no requests to engage lower gears, from the retarder, to increase the engine speed to improve the cooling capacity. | | Check vehicle CAN. | Measure type: Resistance (Ohm)<br>Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected;<br>Key +15 OFF; | Typical Value: 60 Ohm; | Further CAN errors present (183, 184, etc.). |
| 1D | 08 | CAN LINE -RE-TARDER - INTARDER - WATER TEMPERATURE INCREASE | WRONG SIGNAL | Further Intarder errors (e.g. 27, 28). | | Check/Replace Intarder electronics. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1E | 08 | CAN LINE -RE-TARDER - INTARDER -CON-FIGUR-ATION MESSAGE | WRONG SIGNAL | Further Intarder errors (e.g. 27, 28). | | Check/Replace Intarder electronics. | | | | |
| 1E | 08 | CAN LINE -RE-TARDER - INTARDER -CON-FIGUR-ATION MESSAGE | WRONG SIGNAL | Impossible to calculate the gear resistance.<br>No automatic calculation of the starting gear.<br>The average starting gear is engaged at the stop.<br>No additional system restrictions. | | Check vehicle CAN. | Measure type: Resistance (Ohm)<br>Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected;<br>Key +15 OFF; | Typical Value: 60 Ohm; | Further CAN errors present (183, 184, etc.). |
| 1F | 08 | CAN LINE -RE-TARDER - ENGINE BRAKE - BRAKING TORQUE | WRONG SIGNAL | Further Intarder errors (e.g. 27, 28). | | Check/Replace Intarder electronics. | | | | |
| 1F | 08 | CAN LINE -RE-TARDER - ENGINE BRAKE - BRAKING TORQUE | WRONG SIGNAL | Impossible to calculate the gear resistance.<br>No automatic calculation of the starting gear.<br>The average starting gear is engaged at the stop.<br>No additional system restrictions. | | Check vehicle CAN. | Measure type: Resistance (Ohm)<br>Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected;<br>Key +15 OFF; | Typical Value: 60 Ohm; | Further CAN errors present (183, 184, etc.). |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 08 | CAN LINE -RE-TARDER - ENGINE BRAKE - CON-FIGUR-ATION MESSAGE | WRONG SIGNAL | Impossible to calcu-late the gear resis-tance.<br>No automatic cal-culation of the start-ing gear.<br>The average starting gear is engaged at the stop.<br>No additional system restrictions. | | Check vehicle CAN. | Measure type: Resistance (Ohm)<br>Measure point 1: Connector (ve-hicle side) Pin: 8<br><br>Measure point 2: Connector (ve-hicle side) Pin: 12 | Connector Connected;<br>Key +15 OFF; | Typical Value: 60 Ohm; | Further CAN errors present (183, 184, etc.). |
| 20 | 08 | CAN LINE -RE-TARDER - ENGINE BRAKE - CON-FIGUR-ATION MESSAGE | WRONG SIGNAL | Further Intarder er-rors (e.g. 27, 28). | | Check/Replace Intar-der electronics. | | | | |
| 21 | 04 | CAN LINE -RE-TARDER - ENGINE BRAKE - CON-FIGUR-ATION MESSAGE | TIMEOUT | Impossible to calcu-late the gear resis-tance.<br>No automatic cal-culation of the start-ing gear.<br>The average starting gear is engaged at the stop.<br>No additional system restrictions. | | Check vehicle CAN. | Measure type: Resistance (Ohm)<br>Measure point 1: Connector (ve-hicle side) Pin: 8<br><br>Measure point 2: Connector (ve-hicle side) Pin: 12 | Connector Connected;<br>Key +15 OFF; | Typical Value: 60 Ohm; | Further CAN errors present (26, 178, 183, 184, etc.). |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 21 | 04 | CAN LINE -RE-TARDER - ENGINE BRAKE - CON-FIGUR-ATION MESSAGE | TIMEOUT | Further Intarder er-rors (e.g. 27, 28). | | Check/Replace Intar-der electronics. | | | | |
| 21 | 04 | CAN LINE -RE-TARDER - ENGINE BRAKE - CON-FIGUR-ATION MESSAGE | TIMEOUT | | | Check fuse box fuses. | | | | |
| 22 | 0A | SHIFTING ACTUA-TOR - SO-LENOID VALVE (Y2) SPLITTER | INTER-RUPTION | Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 23 | 0A | SHIFTING ACTUA-TOR - SO-LENOID VALVE (Y3) SPLITTER | INTER-RUPTION | Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 24 | 0A | SHIFTING ACTUATOR - (Y4) SOLENOID VALVE GEAR SELECTION | INTERRUPTION | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 25 | 0A | SHIFTING ACTUATOR - (Y5) SOLENOID VALVE GEAR SELECTION | INTERRUPTION | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 26 | 0A | SHIFTING ACTUATOR - (Y6) SOLENOID VALVE GEAR ENGAGEMENT | INTERRUPTION | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 27 | 0A | SHIFTING ACTUATOR - (Y7) SOLENOID VALVE GEAR ENGAGEMENT | INTERRUPTION | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 0A | SHIFTING ACTUATOR - (Y8) SOLENOID VALVE RANGE LOW | INTERRUPTION | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 29 | 0A | SHIFTING ACTUATOR - (Y9) SOLENOID VALVE RANGE HIGH | INTERRUPTION | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 2A | 0A | SHIFTING ACTUATOR - (Y10) MAIN VALVE | INTERRUPTION | Impossible to change gear, not even in neutral.<br>The selected gear stays engaged.<br>The vehicle can only set off again in particular conditions (gear selected =< the 8$^{th}$ gear). | | Replacing the gearbox actuator (control unit) | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 2B | 0A | DEVICE - WARN-ING LAMP/ BUZZER | INTER-RUPTION | Possible wiring inter-ruption. | | Check wiring | 1- Measure type: Voltage (V) Measure point 1: Connector for ECU power supply - vehicle side. Pin: 11 Measure point 2: Connector for ECU power supply - vehicle side. Pin: 16 2- Measure type: Voltage (V) Measure point 1: Connector for ECU power supply - vehicle side. Pin: 11 Measure point 2: Connector for ECU power supply - vehicle side. Pin: 17 | 1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON; | 1- Min. value: 22 V; Max. value: 28 V; 2- Min. value: 22 V; Max. value: 28 V; | |
| 2D | 0A | DEVICE - REAR PTO - REAR ENGINE PTO EN-GAGED | INTER-RUPTION | | | For STRALIS please check either for a possible short between 9131 and 0131 cables or check for a possible wiring inversion on ST67 connector (PIN 4 of 0131 cable could be inverted with PIN 2 of 9131 cable). | | | | |
| 2D | 0A | DEVICE - REAR PTO - REAR ENGINE PTO EN-GAGED | INTER-RUPTION | PTO 1 not available. No additional system restrictions. | | Check wiring, control contactor, connections with the MUX system and gear lever | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 2E | 0A | DEVICE - PTO 2 - LATERAL ENGINE PTO ENGAGED | INTERRUPTION | PTO2 not available. No additional system restrictions | | Check wiring, control contactor, connections with the MUX system and gear lever | | | | |
| 2E | 0A | DEVICE - PTO 2 - LATERAL ENGINE PTO ENGAGED | INTERRUPTION | | | For STRALIS please check either for a possible short between 9131 and 0131 cables or check for a possible wiring inversion on ST67 connector (PIN 4 of 0131 cable could be inverted with PIN 2 of 9131 cable). | | | | |
| 31 | 0A | SHIFTING ACTUATOR - SOLENOID VALVE (Y1) | INTERRUPTION | Vehicle moving: The speed increases are managed as the changes. The speed increases are not possible when the engine is at low speed. The engagement time increases. Vehicle stationary: The engagement time is longer. | | Replacing the gearbox actuator (control unit) | | | | |
| 32 | 0A | CLUTCH ACTUATOR - (Y17) SOLENOID VALVE CLUTCH DISENGAGEMENT SLOW | INTERRUPTION | Comfort decreased when starting and manoeuvring; the clutch is controlled by the fast uncoupling valve. | | Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit) | Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 9 Measure point 2: Connector for clutch actuator - gearbox side Pin: 16 | Connector Not connected; Key +15 OFF; | Min. value: 14 Ohm; Max. value: 20 Ohm; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 33 | 0A | CLUTCH ACTUATOR - (Y15) SOLENOID VALVE CLUTCH ENGAGEMENT SLOW | INTERRUPTION | Comfort decreased when starting and manoeuvring; the clutch is controlled by the fast uncoupling valve. | | Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit) | Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 7 Measure point 2: Connector for clutch actuator - gearbox side Pin: 16 | Connector Not connected; Key +15 OFF; | Min. value: 14 Ohm; Max. value: 20 Ohm; | |
| 34 | 0A | CLUTCH ACTUATOR - (Y16) SOLENOID VALVE CLUTCH DISENGAGEMENT FAST | INTERRUPTION | Comfort decreased when starting and manoeuvring; the clutch is controlled by the fast uncoupling valve. | | Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit) | Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 12 Measure point 2: Connector for clutch actuator - gearbox side Pin: 17 | Connector Not connected; Key +15 OFF; | Min. value: 14 Ohm; Max. value: 20 Ohm; | |
| 35 | 0A | CLUTCH ACTUATOR - (Y14) SOLENOID VALVE CLUTCH ENGAGEMENT FAST | INTERRUPTION | Comfort decreased when starting and manoeuvring; the clutch is controlled by the fast uncoupling valve. | | Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit) | Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 8 Measure point 2: Connector for clutch actuator - gearbox side Pin: 17 | Connector Not connected; Key +15 OFF; | Min. value: 14 Ohm; Max. value: 20 Ohm; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 36 | 0A | SUPPLY VOLTAGE - DEVICE | INTER-RUPTION | ECU output deacti-vated.<br>No information from the gear lever, from the buzzer.<br>Vehicle moving: Gearbox locked. Ve-hicle stationary: Gear-box automatically in neutral.<br>System not available | | Control unit - gear lever wiring control | | | | |
| 3B | 06 | DEVICE - REAR PTO - SWITCH SIGNAL-LING PTO 1 EN-GAGE-MENT | SIGNAL NOT PLAUSIBLE | | | For STRALIS please check either for a possible short be-tween 9131 and 0131 cables or check for a possible wiring inver-sion on ST67 con-nector (PIN 4 of 0131 cable could be in-verted with PIN 2 of 9131 cable). | | | | |
| 3B | 08 | DEVICE - REAR PTO - SWITCH SIGNAL-LING PTO 1 EN-GAGE-MENT | SIGNAL NOT PLAUSIBLE | PTO1 not available.<br>No additional system restrictions | | Check wiring between the PTO1 check and control switches | | | | |
| 3C | 08 | DEVICE - PTO 2 - SWITCH SIGNAL-LING PTO 2 EN-GAGE-MENT | SIGNAL NOT PLAUSIBLE | PTO2 not available.<br>No additional system restrictions | | Check wiring between the PTO2 check and control switches | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 3C | 08 | DEVICE - PTO 2 - SWITCH SIGNAL-LING PTO 2 EN-GAGE-MENT | SIGNAL NOT PLAUSIBLE | | | For STRALIS please check either for a possible short be-tween 9131 and 0131 cables or check for a possible wiring inver-sion on ST67 con-nector (PIN 4 of 0131 cable could be in-verted with PIN 2 of 9131 cable). | | | | |
| 3D | 08 | DEVICE - REAR PTO - SWITCH SIGNAL-LING PTO 1 EN-GAGE-MENT | PERMA-NENT SIG-NAL | Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving. | | Check wiring between the PTO1 check and control switches | | | | |
| 3E | 08 | DEVICE - PTO 2 - SWITCH SIGNAL-LING PTO 2 EN-GAGE-MENT | PERMA-NENT SIG-NAL | Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving. | | Check wiring between the PTO2 check and control switches | | | | |
| 3F | 08 | DEVICE - REAR PTO - SWITCH SIGNAL-LING PTO 1 EN-GAGE-MENT | NO SIG-NAL | PTO1 not available. No additional system restrictions | | Check wiring between the PTO1 check and control switches | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 3F | 08 | DEVICE - REAR PTO - SWITCH SIGNAL-LING PTO 1 EN-GAGE-MENT | NO SIG-NAL | | | For STRALIS please check either for a poss-ible short between 9131 and 0131 cables or check for a possible wiring inversion on ST67 connector (PIN 4 of 0131 cable could be inverted with PIN 2 of 9131 cable). | | | | |
| 40 | 08 | DEVICE - PTO 2 - SWITCH SIGNAL-LING PTO 2 EN-GAGE-MENT | NO SIG-NAL | PTO2 not available. No additional system restrictions | | Check wiring between the PTO2 check and control switches | | | | |
| 40 | 08 | DEVICE - PTO 2 - SWITCH SIGNAL-LING PTO 2 EN-GAGE-MENT | NO SIG-NAL | | | For STRALIS please check either for a poss-ible short between 9131 and 0131 cables or check for a possible wiring inversion on ST67 connector (PIN 4 of 0131 cable could be inverted with PIN 2 of 9131 cable). | | | | |
| 42 | 06 | SHIFTING ACTUA-TOR - SO-LENOID VALVE (Y2) SPLITTER | SHORT CIRCUIT TO POSI-TIVE | Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 43 | 06 | SHIFTING ACTUATOR - SOLENOID VALVE (Y3) SPLITTER | SHORT CIRCUIT TO POSITIVE | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 44 | 06 | SHIFTING ACTUATOR - (Y4) SOLENOID VALVE GEAR SELECTION | SHORT CIRCUIT TO POSITIVE | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 45 | 06 | SHIFTING ACTUATOR - (Y5) SOLENOID VALVE GEAR SELECTION | SHORT CIRCUIT TO POSITIVE | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 46 | 06 | SHIFTING ACTUATOR - (Y6) SOLENOID VALVE GEAR ENGAGEMENT | SHORT CIRCUIT TO POSITIVE | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 47 | 06 | SHIFTING ACTUATOR - (Y7) SOLENOID VALVE GEAR ENGAGEMENT | SHORT CIRCUIT TO POSITIVE | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 48 | 06 | SHIFTING ACTUATOR - (Y8) SOLENOID VALVE RANGE LOW | SHORT CIRCUIT TO POSITIVE | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 49 | 06 | SHIFTING ACTUATOR - (Y9) SOLENOID VALVE RANGE HIGH | SHORT CIRCUIT TO POSITIVE | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Replacing the gearbox actuator (control unit) | | | | |
| 4A | 06 | SHIFTING ACTUATOR - (Y10) MAIN VALVE | SHORT CIRCUIT TO POSITIVE | Vehicle moving: Gearbox locked. Vehicle stationary: The reduced gears can be engaged. | | Replacing the gearbox actuator (control unit) | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 4B | 06 | DEVICE - WARN-ING LAMP/ BUZZER | SHORT CIRCUIT TO POSI-TIVE | Possible short circuit. | | Check wiring | 1- Measure type: Voltage (V) Measure point 1: Connector for ECU power supply - vehicle side. Pin: 11 Measure point 2: Connector for ECU power supply - vehicle side. Pin: 16 2- Measure type: Voltage (V) Measure point 1: Connector for ECU power supply - vehicle side. Pin: 11 Measure point 2: Connector for ECU power supply - vehicle side. Pin: 17 | 1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON; | 1- Min. value: 22 V; Max. value: 28 V; 2- Min. value: 22 V; Max. value: 28 V; | |
| 4D | 06 | DEVICE - REAR PTO - REAR ENGINE PTO EN-GAGED | SHORT CIRCUIT TO POSI-TIVE | PTO 1 not available. No additional system restrictions. | | Check wiring, control contactor, connections with the MUX system and gear lever | | | | |
| 4D | 06 | DEVICE - REAR PTO - REAR ENGINE PTO EN-GAGED | SHORT CIRCUIT TO POSI-TIVE | | | For STRALIS please check either for a poss-ible short between 9131 and 0131 cables or check for a possible wiring inversion on ST67 connector (PIN 4 of 0131 cable could be inverted with PIN 2 of 9131 cable). | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 4E | 06 | DEVICE - PTO 2 - LATERAL ENGINE PTO ENGAGED | SHORT CIRCUIT TO POSITIVE | PTO2 not available. No additional system restrictions | | Check wiring, control contactor, connections with the MUX system and gear lever | | | | |
| 4E | 06 | DEVICE - PTO 2 - LATERAL ENGINE PTO ENGAGED | SHORT CIRCUIT TO POSITIVE | | | For STRALIS please check either for a possible short between 9131 and 0131 cables or check for a possible wiring inversion on ST67 connector (PIN 4 of 0131 cable could be inverted with PIN 2 of 9131 cable). | | | | |
| 51 | 06 | SHIFTING ACTUATOR - SOLENOID VALVE (Y1) | SHORT CIRCUIT TO POSITIVE | Vehicle moving: Gearbox locked. Vehicle stationary: It is possible to engage the starting gear. The main valve is only activated in the coupling phase if the clutch is open. | | Replacing the gearbox actuator (control unit) | | | | |
| 52 | 06 | CLUTCH ACTUATOR - (Y17) SOLENOID VALVE CLUTCH DISENGAGEMENT SLOW | SHORT CIRCUIT TO POSITIVE | Generally, gearbox locked, system not available. Vehicle stationary: The coupling valve is de-energized; the gearbox is in neutral when the clutch opens. | | Replacing the gearbox actuator (control unit) | Measure type: Resistance (Ohm) Measure point 1: Connector for clutch actuator - gearbox side Pin: 9 Measure point 2: Connector for clutch actuator - gearbox side Pin: 16 | Connector Not connected; Key +15 OFF; | Min. value: 14 Ohm; Max. value: 20 Ohm; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 53 | 06 | CLUTCH ACTUATOR - (Y15) SOLENOID VALVE CLUTCH ENGAGEMENT SLOW | SHORT CIRCUIT TO POSITIVE | Generally, gearbox locked, system not available.<br>Vehicle stationary:<br>The coupling valve is de-energized; the gearbox is in neutral when the clutch opens. | | Replacing the gearbox actuator (control unit) | Measure type: Resistance (Ohm)<br>Measure point 1: Connector for clutch actuator - gearbox side Pin: 7<br>Measure point 2: Connector for clutch actuator - gearbox side Pin: 16 | Connector Not connected;<br>Key +15 OFF; | Min. value: 14 Ohm; Max. value: 20 Ohm; | |
| 54 | 06 | CLUTCH ACTUATOR - (Y16) SOLENOID VALVE CLUTCH DISENGAGEMENT FAST | SHORT CIRCUIT TO POSITIVE | Generally, gearbox locked, system not available.<br>Vehicle moving:<br>The clutch is kept in the position required by the uncoupling valve.<br>Vehicle stationary:<br>After a certain length of time the gearbox goes into neutral. | | Replacing the gearbox actuator (control unit) | Measure type: Resistance (Ohm)<br>Measure point 1: Connector for clutch actuator - gearbox side Pin: 12<br>Measure point 2: Connector for clutch actuator - gearbox side Pin: 17 | Connector Not connected;<br>Key +15 OFF; | Min. value: 14 Ohm; Max. value: 20 Ohm; | |
| 55 | 06 | CLUTCH ACTUATOR - (Y14) SOLENOID VALVE CLUTCH ENGAGEMENT FAST | SHORT CIRCUIT TO POSITIVE | Generally, gearbox locked, system not available.<br>Vehicle stationary:<br>The coupling valve is de-energized; the gearbox is in neutral when the clutch opens. | | Replacing the gearbox actuator (control unit) | Measure type: Resistance (Ohm)<br>Measure point 1: Connector for clutch actuator - gearbox side Pin: 8<br>Measure point 2: Connector for clutch actuator - gearbox side Pin: 17 | Connector Not connected;<br>Key +15 OFF; | Min. value: 14 Ohm; Max. value: 20 Ohm; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 56 | 06 | SUPPLY VOLTAGE - DEVICE | SHORT CIRCUIT TO POSI-TIVE | After switching over the key (Off-On) the fault is recognized during system set-up and the display does not go out.<br>Turning the key onto Off the display shows code EE.<br>No additional system restrictions. | | Control unit - gear lever wiring control | | | | |
| 5A | 09 | SHIFTING ACTUA-TOR - ELEC-TRONIC CON-TROL UNIT - IN-TENAL FAILURE | INTERNAL COM-MUNICA-TION ERROR | Vehicle moving: Gear-box locked, the clutch opens when the ve-hicle stops. Vehicle stationary: Gearbox automatically in neu-tral.<br>Gearbox locked; the system is not available. | | Replacing the gearbox actuator | | | | |
| 5B | 04 | CAN LINE - BRAKING SYSTEM - CON-TROL MESSAGE | TIMEOUT | Other CAN errors 180,181,182,183,184 and/or 177 present. | Short circuit to ground to pin 8 - CAN H poss-ible. | Check vehicle CAN. | Measure type: Resistance (Ohm)<br>Measure point 1: Connector (ve-hicle side) Pin: 8<br><br>Measure point 2: Connector (ve-hicle side) Pin: 12 | Connector Connected;<br>Key +15 OFF; | Typical Value: 60 Ohm; | |
| 5B | 04 | CAN LINE - BRAKING SYSTEM - CON-TROL MESSAGE | TIMEOUT | Impossible to calculate the gear resistance.<br>No automatic calcula-tion of the starting gear.<br>The average starting gear is engaged at the stop.<br>No additional system restrictions. | | Check fuse box fuses. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 5B | 04 | CAN LINE - BRAKING SYSTEM - CONTROL MESSAGE | TIMEOUT | | Message issued by ASR / ABS / EBS electronics. | Check ABS/ASR/EBS signal travel. | | | | The message contains the following signals: z_ABS: ABS operation. z_ASR_EDC: Signal ASR-EDC-Eingriffz_ASR_BR : Status ASR-Bremsbetriebz_EBS: Status EBS |
| 5C | 08 | CAN LINE - BRAKING SYSTEM - ABS ACTIVATED | WRONG SIGNAL | Impossible to calculate the gear resistance. No automatic calculation of the starting gear. The average starting gear is engaged at the stop. No additional system restrictions. | Error 91 present "EBC1 timeout" message issued by ABS / ASR / EBS electronics. | Check ABS / ASR / EBS signal travel. | | | | No z_ABS signal (signal contained in EBC1 message). |
| 5C | 08 | CAN LINE - BRAKING SYSTEM - ABS ACTIVATED | WRONG SIGNAL | | | Check CAN line. Check ECU correct programmino. | Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | |
| 5D | 08 | CAN LINE - BRAKING SYSTEM - ASR ACTIVATED (ENGINE) | WRONG SIGNAL | | | Check CAN line. Check ECU correct programmino. | Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 5D | 08 | CAN LINE - BRAKING SYSTEM - ASR ACTIVATED (ENGINE) | WRONG SIGNAL | Impossible to calculate the gear resistance.<br>No automatic calculation of the starting gear.<br>The average starting gear is engaged at the stop.<br>No additional system restrictions. | Error 91 present "EBC1 timeout" message issued by ABS / ASR / EBS electronics. | Check ABS/ASR/EBS signal travel. | | | | No z_ABS signal (signal contained in EBC1 message). |
| 5E | 08 | CAN LINE - BRAKING SYSTEM - ASR ACTIVATED (BRAKE) | WRONG SIGNAL | Impossible to calculate the gear resistance.<br>No automatic calculation of the starting gear.<br>The average starting gear is engaged at the stop.<br>No additional system restrictions. | Error 91 present "EBC1 timeout" message issued by ABS / ASR / EBS electronics. | Check ABS / ASR / EBS signal travel. | | | | No z_ABS signal (signal contained in EBC1 message). |
| 5E | 08 | CAN LINE - BRAKING SYSTEM - ASR ACTIVATED (BRAKE) | WRONG SIGNAL | | | Check CAN line.<br>Check ECU correct programmino. | Measure type: Resistance (Ohm)<br>Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected;<br>Key +15 OFF; | Typical Value: 60 Ohm; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 5F | 08 | CAN LINE - CRUISE CON-TROL / VEHICLE SPEED - CRUISE CON-TROL OFF | WRONG SIGNAL | No additional system restrictions. | | Check vehicle CAN. | Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | No z_cc_status signal (signal contained in CCVS mess-age). |
| 5F | 08 | CAN LINE - CRUISE CON-TROL / VEHICLE SPEED - CRUISE CON-TROL OFF | WRONG SIGNAL | Error 182 present "CCVS timeout" message issued by EDC. | | Check signal travel EDC. | | | | |
| 60 | 08 | CAN LINE - CRUISE CON-TROL / VEHICLE SPEED - PRO-GRAMME D SPEED | WRONG SIGNAL | No additional system restrictions. | | Check vehicle CAN. | Measure type: Resistance (Ohm) Measure point 1: Connector (ve-hicle side) Pin: 8<br><br>Measure point 2: Connector (ve-hicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | No z_cc_status signal (signal contained in CCVS mess-age). |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 60 | 08 | CAN LINE - CRUISE CON-TROL / VEHICLE SPEED - PRO-GRAMME D SPEED | WRONG SIGNAL | Error 182 present "CCVS timeout" message issued by EDC. | | Check signal travel EDC. | | | | |
| 61 | 08 | CAN LINE - ENGINE - NUMBER OF EN-GINE REVS. | WRONG SIGNAL | Vehicle moving: Clutch control is gov-erned by the time in-terval set by the con-trol unit. Reduction in driving comfort. The clutch opens under the threshold fixed by the system; the speed of the en-gine is not checked during gear increases. Vehicle stationary: Clutch control is gov-erned by the time in-terval set by the con-trol unit; reduction in manoeuvring com-fort. | | Check engine speed in error memory under environmental condi-tions. | | | | |
| 61 | 08 | CAN LINE - ENGINE - NUMBER OF EN-GINE REVS. | WRONG SIGNAL | | | Please make also a di-agnosis check on EDC system. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 62 | 08 | SHIFTING ACTUATOR - SENSORS - INPUT SHAFT SPEED | WRONG SIGNAL | Vehicle moving:<br>The time interval increases by which gear changes are governed.<br>When changing gear the clutch may be partly closed. If the gear is engaged, the input speed is replaced with the output speed.<br>Vehicle stationary:<br>The time interval increases by which gear changes are governed.<br>Reduction in driving and manoeuvring comfort. | | Check connector status and sensor efficiency.<br>Otherwise check:<br>- correct mounting of the sensor.<br>- correct mounting and play of phonic wheel. | | | | |
| 63 | 08 | SENSORS - TRANSMISSION OUTPUT SPEED | WRONG SIGNAL | The output speed is calculated via redundant signals, such as the tachograph signal, via the CAN line.<br>All the gears can be engaged manually.<br>Reduction in clutch performance due to the time needed to acquire the information from the CAN line. | | Check wiring and connections.<br>Replace sensor if required. | 1- Measure type: Voltage (V)<br>Measure point 1: Connector for clutch actuator - gearbox side Pin: 18<br>Measure point 2: Connector for clutch actuator - gearbox side Pin: 6<br>2- Measure type: Voltage (V)<br>Measure point 1: Connector for clutch actuator - gearbox side Pin: 11<br>Measure point 2: Connector for clutch actuator - gearbox side Pin: 6 | 1- Connector Connected; Key +15 ON;<br>2- Connector Connected; Key +15 ON; | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 64 | 08 | SIGNALS - SENSOR - TACHO-GRAPH SENSOR | WRONG SIGNAL | If the output speed signal 1 is available, there are no restrictions on the system. | | Check vehicle-end wiring.<br>Check and replace defective output sensor. | | | | Error 99,101 set; Output speed > 2500 rpm; Vehicle speed too high. |
| 64 | 08 | SIGNALS - SENSOR - TACHO-GRAPH SENSOR | WRONG SIGNAL | | | Verify the correct working of the tachograph. | | | | |
| 64 | 08 | SIGNALS - SENSOR - TACHO-GRAPH SENSOR | WRONG SIGNAL | | | Or alternatevely check that the stored value in the ECU for the axle ratio correct is (Diagnosis: Idendification Code Reading).<br>If the value is not correct, carry out again the programming (Programming: Configuration Change). | | | | |
| 65 | 08 | SIGNALS - SENSOR - TACHO-GRAPH+OUTPUT SHAFT SPEED SENSOR | BOTH SPEED SENSORS FAULTY | Vehicle moving:<br>The speed increases are managed as the changes.<br>The speed increases are not possible when the engine is at low speed.<br>The engagement time increases.<br>Vehicle stationary:<br>The engagement time is longer. | Wear of selector fork. | Check signal travel as with error 99 and 100.<br>Wear of selector fork.<br>Disassemble/replace transmission. | | | | Gear selected and displayed -> no power transmission. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 66 | 03 | SIGNALS - SENSOR - INPUT AND OUTPUT SPEED SENSOR | PLAUSIBILITY | Vehicle moving: The speed increases are managed as the changes. The speed increases are not possible when the engine is at low speed. The engagement time increases. Vehicle stationary: The engagement time is longer. | | Check if the position of the sensors is correct. Check the mechanical efficiency of the transmission. Check that the vehicle is not equipped with an electronic control unit programmed for the retarder, if the transmission does not require it. | | | | |
| 67 | 08 | CAN LINE - CRUISE CONTROL / VEHICLE SPEED - VEHICLE SPEED | WRONG SIGNAL | The system adopts substitutive parameters. Reduced functionality for the automatic mode and to calculate the starting gear, if there is a large difference between the parameters utilized and the actual values. The quality of clutch uncoupling may decrease. | Other CAN errors 26,180,181,182. | Check vehicle CAN. | Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8 Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | Reprogram the electronic control unit to rewrite the parameters. |
| 67 | 08 | CAN LINE - CRUISE CONTROL / VEHICLE SPEED - VEHICLE SPEED | WRONG SIGNAL | | | Please make also a diagnosis check on EDC system. | | | | |
| 67 | 08 | CAN LINE - CRUISE CONTROL / VEHICLE SPEED - VEHICLE SPEED | WRONG SIGNAL | Further errors saved in EDC. | EDC deactivation relay defective. | Replace deactivation relay. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 68 | 01 | SUPPLY VOLTAGE - ELEC-TRONIC CON-TROL UNIT | VOLTAGE TOO HIGH | Defective supply. | | Check for a fault in the 10A fuses (fuses holder no. 70602). | 1- Measure type: Voltage (V) Measure point 1: Connector for ECU power sup-ply - vehicle side. Pin: 4 Measure point 2: Con-nector for ECU power supply - vehicle side. Pin: 16 - 2- Measure type: Voltage (V) Measure point 1: Connector for ECU power sup-ply - vehicle side. Pin: 5 Measure point 2: Con-nector for ECU power supply - vehicle side. Pin: 16 - 3- Measure type: Voltage (V) Measure point 1: Connector for ECU power sup-ply - vehicle side. Pin: 4 Measure point 2: Con-nector for ECU power supply - vehicle side. Pin: 17 - 4- Measure type: Voltage (V) Measure point 1: Con-nector for ECU power supply - vehicle side. Pin: 5 Measure point 2: Con-nector for ECU power supply - vehicle side. Pin: 17 | 1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON; 3- Connector Connected; Key +15 ON; 4- Connector Connected; Key +15 ON; | 1- Min. value: 22 V; Max. value: 28 V; 2- Min. value: 22 V; Max. value: 28 V; 3- Min. value: 22 V; Max. value: 28 V; 4- Min. value: 22 V; Max. value: 28 V; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 69 | 02 | SUPPLY VOLTAGE - ELEC-TRONIC CON-TROL UNIT | VOLTAGE TOO LOW | Defective supply. | | Check for a fault in the 10A fuses (fuses holder no. 70602). | 1- Measure type: Voltage (V) Measure point 1: Connector for ECU power sup-ply - vehicle side. Pin: 4 Measure point 2: Con-nector for ECU power supply - vehicle side. Pin: 16 - 2- Measure type: Voltage (V) - Measure point 1: Con-nector for ECU power supply - vehicle side. Pin: 5 Measure point 2: Con-nector for ECU power supply - vehicle side. Pin: 16 - 3- Measure type: Voltage (V) Measure point 1: Con-nector for ECU power supply - vehicle side. Pin: 4 Measure point 2: Con-nector for ECU power supply - vehicle side. Pin: 17 - 4- Measure type: Voltage (V) Measure point 1: Connector for ECU power sup-ply - vehicle side. Pin: 5 - Measure point 2: Con-nector for ECU power supply - vehicle side. Pin: 17 | 1- Connector Connected; Key +15 ON; 2- Connector Connected; Key +15 ON; 3- Connector Connected; Key +15 ON; 4- Connector Connected; Key +15 ON; | 1- Min. value: 22 V; Max. value: 28 V; 2- Min. value: 22 V; Max. value: 28 V; 3- Min. value: 22 V; Max. value: 28 V; 4- Min. value: 22 V; Max. value: 28 V; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 6B | 02 | CLUTCH ACTUATOR - POSITION SENSOR | SUPPLY OUT OF RANGE | Vehicle moving:<br>The clutch is disengaged via time control.<br>Vehicle stationary:<br>Impossible to perform manoeuvres. If the vehicle has not started within a set time, neutral is engaged.<br>A fresh gear has to be selected with the gear lever to start the vehicle.<br>Comfort is diminished on starting. | | Check the sensor voltage supply. | Measure type: Voltage (V)<br>Measure point 1: Connector for clutch actuator - gearbox side Pin: 15<br>Measure point 2: Connector for clutch actuator - gearbox side Pin: 20 | Connector Connected;<br>Key +15 ON; | Min. value: 4.5 V; Max. value: 5.5 V; | |

Print 603.93.641

Base - November 2006

https://truckmanualshub.com/



| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 6C | | SIGNALS - GEAR SHIFT LEVER | WRONG SIGNAL | Control lever:<br>No shifting possible during travel.<br>At standstill the "last-starting gear" is selected in the manual mode (half-automatic mode), theautomatic starting gear in automatic mode.<br>If neutral is activated or existingat standstill, the starting gear is not engaged.<br>Neutral switch:<br>No shifting possible during travel.<br>At standstill a startinggear can be selected and the vehicle can be driven with a starting gearselected.<br>R gear selector signals:<br>If there is a fault (no signal) in one of the two.<br>Reverse gear switches at a standstill and if the tip-action speed rangeselector is pulled backwards (-/--), the low-ratio Reverse gear (RL) isengaged. | New shift lever: if there is any shifting request signal transmitted in the VCM_TC message. | Check wiring and connections between gear lever and Ecu: nominal value supply voltage gear selector 24 Volt.<br>Check CAN line between gear lever and Ecu: nominal value resistance CAN H - CAN L 60 Ohm. Replace CAN bus wiring and/or CAN modules.<br>Check and/or replace range selector. | 1- Measure type: Voltage (V)<br>Measure point 1: Connector (vehicle side) Pin: 11<br>Measure point 2: Connector (vehicle side) Pin: 16<br>2- Measure type: Resistance (Ohm)<br>Measure point 1: Connector (vehicle side) Pin: 3<br><br>Measure point 2: Connector (vehicle side) Pin: 6<br>3- Measure type: Resistance (Ohm)<br>Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | 1- Connector Connected;<br>Key +15 OFF;<br>2- Connector Connected;<br>Key +15 OFF;<br>3- Connector Connected;<br>Key +15 OFF; | 1- Max. value: 19,5 V;<br>2- Typical Value: 60 Ohm;<br>3- Typical Value: 60 Ohm; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 6C | 00 | SIGNALS - GEAR SHIFT LEVER | WRONG SIGNAL | The gearbox may have lower performance or be locked. It depends on the conditions generating it. | | Select PARAMETER READ environment. Move the shift lever and verify the value changes. Check cabling, if failure persists, the lever is worn. | | | | |
| 6E | 04 | CAN LINE - COMMUNICATION LINES - GEAR SHIFT LEVER | COMMUNICATION ERROR | After switching over the key (Off-On) the fault is recognized during system set-up and the display shows the error code; the system is not available. Vehicle moving: gearbox locked, the system automatically engages the last gear used to start the vehicle. If the gearbox has the reverse gear engaged t/m is automatically put into neutral. No information on the gear lever is available. The display shows alternately the error code and the information on the gear. | | Check vehicle CAN. | 1- Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 3<br><br>Measure point 2: Connector (vehicle side) Pin: 6<br>2- Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | 1- Connector Connected; Key +15 OFF;<br>2- Connector Connected; Key +15 OFF; | 1- Typical Value: 60 Ohm;<br>2- Typical Value: 60 Ohm; | |



Print 603.93.641

Base - November 2006

https://truckmanualshub.com/



| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 6E | 04 | CAN LINE - COMMUNICATION LINES - GEAR SHIFT LEVER | COMMUNICATION ERROR | | | Check wiring and connections between gear lever and Ecu. | Measure type: Voltage (V)<br>Measure point 1: Connector (vehicle side) Pin: 11<br>Measure point 2: Gear lever connector Pin: 15 | Connector Connected;<br>Key +15 ON; | Max. value: 24 V; | Replace CAN gear selector switch.<br>Conduct a test drive with function check.<br>Check transmission for leaks. |
| 71 | 04 | CAN LINE -RETARDER - INTARDER -CONFIGURATION MESSAGE | TIMEOUT | Impossible to calculate the gear resistance.<br>No automatic calculation of the starting gear.<br>The average starting gear is engaged at the stop.<br>No additional system restrictions. | | Check vehicle CAN. | Measure type: Resistance (Ohm)<br>Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected;<br>Key +15 OFF; | Typical Value: 60 Ohm; | |
| 71 | 04 | CAN LINE -RETARDER - INTARDER -CONFIGURATION MESSAGE | TIMEOUT | | | Check/Replace Intarder electronics. | | | | |
| 72 | 00 | CLUTCH ACTUATOR - CLUTCH | ENGAGEMENT NOT REQUESTED, ENGAGED GEAR AND STATIONARY VEHICLE | Standstill: shift to neutral, after neutral system available. | | Check the mechanical operation of the clutch unit and the pneumatic circuit. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 75 | 00 | CLUTCH ACTUATOR - CLUTCH | SELF-ADJUSTMENT ERROR | System not available. | | Check the mechanical system of the clutch engage/disengage unit. | | | | |
| 76 | 00 | CLUTCH ACTUATOR - CLUTCH | DOES NOT DISENGAGE | Vehicle moving: Try engaging the gear. If the gear is engaged, the clutch stays engaged. The gearbox stays locked. Vehicle stationary: If the clutch fails to disengage, the engine remains locked. The system selects neutral automatically. | | Check the mechanical operation of the clutch unit and the pneumatic circuit. | | | | |
| 77 | 00 | CLUTCH ACTUATOR - CLUTCH | DOES NOT ENGAGE | Vehicle moving: If the gearbox has a gear engaged, the clutch tries to close with the highest speed. Gearbox locked. Vehicle stationary: Automatic engagement of neutral after time lag governed by the system. System not available. | | Check the mechanical operation of the clutch unit and the pneumatic circuit. | | | | |



Print 603936411

Base - November 2006

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 78 | 00 | CLUTCH ACTUATOR - (Y17) SOLENOID VALVE CLUTCH DISENGAGEMENT SLOW | MECHANICAL FAILURE | Reduction in clutch performance. The function performed by a damaged valve is performed by another valve following this scheme:mechanical fault of the Y17 valve >> function performed by valve Y16 mechanical fault of the Y16 valve >> function performed by valve Y17 mechanical fault of the Y15 valve >> function performed by valve Y14 mechanical fault of the Y14 valve >> function performed by valve Y15 | | Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit) | | | | |
| 79 | 00 | CLUTCH ACTUATOR - (Y16) SOLENOID VALVE CLUTCH DISENGAGEMENT FAST | MECHANICAL FAILURE | Reduction in clutch performance. The function performed by a damaged valve is performed by another valve following this scheme:mechanical fault of the Y17 valve >> function performed by valve Y16 mechanical fault of the Y16 valve >> function performed by valve Y17 mechanical fault of the Y15 valve >> function performed by valve Y14 mechanical fault of the Y14 valve >> function performed by valve Y15 | | Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit) | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 7A | 00 | CLUTCH ACTUATOR - (Y15) SOLENOID VALVE CLUTCH ENGAGEMENT SLOW | MECHANICAL FAILURE | Reduction in clutch performance. The function performed by a damaged valve is performed by another valve following this scheme:mechanical fault of the Y17 valve >> function performed by valve Y16 mechanical fault of the Y16 valve >> function performed by valve Y17 mechanical fault of the Y15 valve >> function performed by valve Y14 mechanical fault of the Y14 valve >> function performed by valve Y15 | | Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit) | | | | |
| 7B | 00 | CLUTCH ACTUATOR - (Y14) SOLENOID VALVE CLUTCH ENGAGEMENT FAST | MECHANICAL FAILURE | Reduction in clutch performance. The function performed by a damaged valve is performed by another valve following this scheme:mechanical fault of the Y17 valve >> function performed by valve Y16 mechanical fault of the Y16 valve >> function performed by valve Y17 mechanical fault of the Y15 valve >> function performed by valve Y14 mechanical fault of the Y14 valve >> function performed by valve Y15 | | Check the clutch actuator and the integrity of the connections with the gear actuator (electronic control unit) | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 7C | 00 | CLUTCH ACTUATOR - POSITION SENSOR | SIGNAL OUT OF RANGE | Vehicle moving: The clutch is engaged - disengaged via time lag signal. Vehicle stationary: Manoeuvring impossible. If the vehicle fails to start within a certain length of time set by the control unit, the gearbox automatically goes into neutral; starting is again possible after engaging the gear with the gear lever. Reduction in clutch performance. | | Check the sensor voltage supply. | Measure type: Voltage (V) Measure point 1: Connector for clutch actuator - gearbox side Pin: 10 Measure point 2: Connector for clutch actuator - gearbox side Pin: 20 | Connector Connected; Key +15 ON; | Min. value: 0.5 V; Max. value: 4.5 V; | |
| 7D | 00 | SHIFTING ACTUATOR - PRESSURE REDUCTION VALVE | PRESSURE TOO HIGH AT ALTITUDE | No system restriction. | | Check system supply air pressure 7 bars. | | | | |
| 7E | 03 | SHIFTING ACTUATOR - SENSORS - PRESSURE SENSOR | SIGNAL OUT OF RANGE | No system restriction if there is enough air in the system. The Cluster fails to display the AL code if the air system does not have the right pressure. The clutch is controlled with a time interval; the control times may turn out longer. | | Gear actuator replacement (control unit) | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 7F | 03 | SHIFTING ACTUATOR - SENSORS - ECU TEMPERATURE | SIGNAL OUT OF RANGE | No system restriction. | | Replacing the gearbox actuator (control unit) | | | | |
| 80 | 00 | SENSORS - OIL TEMPERATURE SIGNAL | SIGNAL OUT OF RANGE | No system restriction; the system takes the control unit temperature signal as reference. | | Reprogram and in case replace the gearbox actuator (control unit). | | | | |
| 81 | 06 | SHIFTING ACTUATOR - SENSORS - GEAR ENGAGED | SHORT CIRCUIT TO POSITIVE | Vehicle moving: When the trouble occurs while changing gear, the coupling signal is substituted by the time check signal.<br><br>The gearbox is then locked; it is possible to engage neutral.<br>Vehicle stationary: it is possible to select the starting gear.<br>The main valve and the gear coupling valve remain active until the clutch, on closing, exceeds the reference threshold or the start conditions occur. | | Verify that sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm)<br>Measure point 1: Sensor connector Pin: 1<br>Measure point 2: Sensor connector Pin: 2 | Connector Not connected;<br>Key +15 OFF; | Typical Value: 69 Ohm; | |



Print 603.93641

Base - November 2006

https://truckmanualshub.com/



| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 81 | 06 | SHIFTING ACTUATOR - SENSORS - GEAR ENGAGED | SHORT CIRCUIT TO POSITIVE | | | Check VDB CAN-line integrity. | | | | |
| 82 | 05 | SHIFTING ACTUATOR - SENSORS - GEAR ENGAGED | SHORT CIRCUIT TO GROUND | Vehicle moving: When the trouble occurs while changing gear, the coupling signal is substituted by the time check signal.<br><br>The gearbox is then locked; it is possible to engage neutral.<br>Vehicle stationary: it is possible to select the starting gear.<br>The main valve and the gear coupling valve remain active until the clutch, on closing, exceeds the reference threshold or the start conditions occur. | | Verify that sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm)<br>Measure point 1: Sensor connector Pin: 1<br>Measure point 2: Sensor connector Pin: 2 | Connector Not connected;<br>Key +15 OFF; | Typical Value: 69 Ohm; | |
| 82 | 05 | SHIFTING ACTUATOR - SENSORS - GEAR ENGAGED | SHORT CIRCUIT TO GROUND | | | Check VDB CAN-line integrity. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 83 | 0A | SHIFTING ACTUATOR - SENSORS - GEAR ENGAGED | INTERRUPTION | Vehicle moving: When the trouble occurs while changing gear, the coupling signal is substituted by the time check signal.<br><br>The gearbox is then locked; it is possible to engage neutral.<br>Vehicle stationary: it is possible to select the starting gear.<br>The main valve and the gear coupling valve remain active until the clutch, on closing, exceeds the reference threshold or the start conditions occur. | | Verify that sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm)<br>Measure point 1: Sensor connector Pin: 1<br>Measure point 2: Sensor connector Pin: 2 | Connector Not connected;<br>Key +15 OFF; | Typical Value: 69 Ohm; | |
| 83 | 0A | SHIFTING ACTUATOR - SENSORS - GEAR ENGAGED | INTERRUPTION | | | Check VDB CAN-line integrity. | | | | |
| 84 | 00 | SHIFTING ACTUATOR - SENSORS - GEAR ENGAGED | SELF-ADJUSTMENT ERROR | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Verify that sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm)<br>Measure point 1: Sensor connector Pin: 1<br>Measure point 2: Sensor connector Pin: 2 | Connector Not connected;<br>Key +15 OFF; | Typical Value: 69 Ohm; | |

Print 603.93641 Base - November 2006

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 85 | 06 | SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR | SHORT CIRCUIT TO POSITIVE | Vehicle moving: Only some gears can be selected. Vehicle stationary: All the gears can be selected; the reverse gears cannot be selected. | | Verify that sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2 | Connector Not connected; Key +15 OFF; | Typical Value: 69 Ohm; | |
| 85 | 06 | SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR | SHORT CIRCUIT TO POSITIVE | | | Check VDB CAN-line integrity. | | | | |
| 85 | 06 | SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR | SHORT CIRCUIT TO POSITIVE | | | Replace ECU. If replacing the ECU corrects the problem, reinstall the original ECU to confirm that the problem is in the ECU. | | | | |
| 86 | 05 | SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR | SHORT CIRCUIT TO GROUND | | | Check VDB CAN-line integrity. | | | | |
| 86 | 05 | SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR | SHORT CIRCUIT TO GROUND | | | Replace ECU. If replacing the ECU corrects the problem, reinstall the original ECU to confirm that the problem is in the ECU. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 86 | 05 | SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR | SHORT CIRCUIT TO GROUND | Vehicle moving: Only some gears can be selected. Vehicle stationary: All the gears can be selected; the reverse gears cannot be selected. | | Verify that sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2 | Connector Not connected; Key +15 OFF; | Typical Value: 69 Ohm; | |
| 87 | 0A | SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR | INTERRUPTION | Vehicle moving: Only some gears can be selected. Vehicle stationary: All the gears can be selected; the reverse gears cannot be selected. | | Verify that sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2 | Connector Not connected; Key +15 OFF; | Typical Value: 69 Ohm; | |
| 87 | 0A | SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR | INTERRUPTION | | | Check VDB CAN-line integrity. | | | | |
| 87 | 0A | SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR | INTERRUPTION | | | Replace ECU. If replacing the ECU corrects the problem, reinstall the original ECU to confirm that the problem is in the ECU. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 88 | 00 | SHIFTING ACTUATOR - SENSORS - GEAR SELECTOR | SELF-ADJUSTMENT ERROR | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Verify that sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm)<br>Measure point 1: Sensor connector Pin: 1<br>Measure point 2: Sensor connector Pin: 2 | Connector Not connected;<br>Key +15 OFF; | Typical Value: 69 Ohm; | |
| 89 | 06 | SHIFTING ACTUATOR - SENSORS - RANGE UNIT | SHORT CIRCUIT TO POSITIVE | Vehicle moving: Locking engaged gear range assembly.<br>Only the gears of the current gear assembly can be changed by time control.<br>Vehicle stationary:<br>All the starting gears can be selected; the low range gear assembly can be selected by the time control.<br>The main valve and the range valve remain active until the clutch coupling exceeds a pre-arranged threshold or the running condition is detected. | | Verify that sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm)<br>Measure point 1: Sensor connector Pin: 1<br>Measure point 2: Sensor connector Pin: 2 | Connector Not connected;<br>Key +15 OFF; | Typical Value: 69 Ohm; | |
| 89 | 06 | SHIFTING ACTUATOR - SENSORS - RANGE UNIT | SHORT CIRCUIT TO POSITIVE | | | Check VDB CAN-line integrity. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 8A | 05 | SHIFTING ACTUATOR - SENSORS - RANGE UNIT | SHORT CIRCUIT TO GROUND | Vehicle moving: Locking engaged gear range assembly.<br>Only the gears of the current gear assembly can be changed by time control.<br>Vehicle stationary:<br>All the starting gears can be selected; the low range gear assembly can be selected by the time control.<br>The main valve and the range valve remain active until the clutch coupling exceeds a pre-arranged threshold or the running condition is detected. | | Verify that sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm)<br>Measure point 1: Sensor connector Pin: 1<br>Measure point 2: Sensor connector Pin: 2 | Connector Not connected;<br>Key +15 OFF; | Typical Value: 69 Ohm; | |
| 8A | 05 | SHIFTING ACTUATOR - SENSORS - RANGE UNIT | SHORT CIRCUIT TO GROUND | | | Check VDB CAN-line integrity. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 8B | 0A | SHIFTING ACTUATOR - SENSORS - RANGE UNIT | INTERRUPTION | Vehicle moving: Locking engaged gear range assembly. Only the gears of the current gear assembly can be changed by time control. Vehicle stationary: All the starting gears can be selected; the low range gear assembly can be selected by the time control. The main valve and the range valve remain active until the clutch coupling exceeds a pre-arranged threshold or the running condition is detected. | | Verify that sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2 | Connector Not connected; Key +15 OFF; | Typical Value: 69 Ohm; | |
| 8B | 0A | SHIFTING ACTUATOR - SENSORS - RANGE UNIT | INTERRUPTION | | | Check VDB CAN-line integrity. | | | | |
| 8C | 00 | SHIFTING ACTUATOR - SENSORS - RANGE UNIT | SELF-ADJUSTMENT ERROR | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Verify that sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2 | Connector Not connected; Key +15 OFF; | Typical Value: 69 Ohm; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 8D | 06 | SHIFTING ACTUATOR - SENSORS - SPLITTER UNIT | SHORT CIRCUIT TO POSITIVE | Splitter assembly locked. Driving is possible only with the last gear assembly selected by the splitter. If the required gear cannot be engaged, the highest available gear is engaged. If the trouble occurs a gear change the splitter control is made by the time control. | | Verify that sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2 | Connector Not connected; Key +15 OFF; | Typical Value: 69 Ohm; | |
| 8E | 05 | SHIFTING ACTUATOR - SENSORS - SPLITTER UNIT | SHORT CIRCUIT TO GROUND | Splitter assembly locked. Driving is possible only with the last gear assembly selected by the splitter. If the required gear cannot be engaged, the highest available gear is engaged. If the trouble occurs a gear change the splitter control is made by the time control. | | Verify that sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2 | Connector Not connected; Key +15 OFF; | Typical Value: 69 Ohm; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 8F | 0A | SHIFTING ACTUATOR - SENSORS - SPLITTER UNIT | INTERRUPTION | Splitter assembly locked.<br>Driving is possible only with the last gear assembly selected by the splitter.<br>If the required gear cannot be engaged, the highest available gear is engaged.<br>If the trouble occurs a gear change the splitter control is made by the time control. | | Verify that sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm)<br>Measure point 1: Sensor connector Pin: 1<br>Measure point 2: Sensor connector Pin: 2 | Connector Not connected;<br>Key +15 OFF; | Typical Value: 69 Ohm; | |
| 90 | 00 | SHIFTING ACTUATOR - SENSORS - SPLITTER UNIT | SELF-ADJUSTMENT ERROR | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Verify that sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm)<br>Measure point 1: Sensor connector Pin: 1<br>Measure point 2: Sensor connector Pin: 2 | Connector Not connected;<br>Key +15 OFF; | Typical Value: 69 Ohm; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 91 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT | DOES NOT DISENGAGE | Vehicle moving:<br>When selecting the change from the lower gear assembly to the higher one, the highest gear of the lower gear assembly is selected.<br>When selecting the change from the higher gear assembly to the lower one, the lowest gear of the higher gear assembly is selected.<br>Vehicle stationary:<br>If it is not possible to select the lower gear assembly, the lowest gear of the higher gear assembly is used for picking up.<br>It is not possible to engage the reverse gear of the higher gear assembly. | | First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves | | | | |
| 91 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT | DOES NOT DISENGAGE | | | Try to engage gears with the vehicle at rest and check if the failure is still present. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 91 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT | DOES NOT DISENGAGE | | | Check the mechanical system of the range unit. | | | | |
| 92 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT | SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION | If the selected gear assembly cannot be engaged, the relevant actuator tries to repeat engagement for three times. When the attempts fail, the system can have the following reactions:<br>1) When the selection from the lower to the higher gear assembly fails, the highest gear of the lower assembly is engaged.<br>2) When the selection from the higher to the lower gear assembly fails, the lowest gear of the higher gear assembly is engaged.<br>Vehicle stationary: if the lower gear assembly cannot be selected, the lowest gear of the higher gear assembly is selected for picking up. | | First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 92 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT | SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION | | | Try to engage gears with the vehicle at rest and check if the failure is still present. | | | | |
| 92 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT | SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION | | | Check the mechanical system of the range unit. | | | | |
| 93 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT | DOES NOT ENGAGE | If the selected gear assembly cannot be engaged, the relevant actuator tries to repeat engagement for three times.<br>If it is not possible to engage the fresh gear assembly the system tries to go back to the previous one; if this attempt fails after a certain length of time the system goes into neutral. | | First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves | | | | |
| 93 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT | | DOES NOT ENGAGE | | Try to engage gears with the vehicle at rest and check if the failure is still present. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 93 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT | DOES NOT ENGAGE | | | Check the mechanical system of the range unit. | | | | |
| 94 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT | DOES NOT DISENGAGE | Vehicle moving: The highest-lowest gear that can be selected is the highest-lowest one available on the gear assembly selected previously with the splitter. Vehicle stationary: The highest-lowest gear that can be selected corresponds to the highest-lowest pick-up gear on the gear assembly previously engaged by the splitter. | | First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves | | | | |
| 94 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT | DOES NOT DISENGAGE | | | Verify that B7 sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2 | Connector Not connected; Key +15 OFF; | Typical Value: 69 Ohm; | |
| 94 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT | DOES NOT DISENGAGE | | | Try to engage gears with the vehicle at rest and check if the failure is still present. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 94 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT | DOES NOT DISENGAGE | | | Check the mechanical system of the splitter unit (eventually replace the gears/splitter shaft). | | | | |
| 95 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT | SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION | Vehicle moving: The highest-lowest gear that can be selected is the highest-lowest one available on the gear assembly selected previously with the splitter. Vehicle stationary: The highest-lowest gear that can be selected corresponds to the highest-lowest pick-up gear on the gear assembly previously engaged by the splitter. | | First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves | | | | |
| 95 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT | SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION | | | Verify that B7 sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2 | Connector Not connected; Key +15 OFF; | Typical Value: 69 Ohm; | |
| 95 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT | SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION | | | Try to engage gears with the vehicle at rest and check if the failure is still present. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 95 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT | SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION | | | Check the mechanical system of the splitter unit (eventually replace the gears/splitter shaft). | | | | |
| 96 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT | DOES NOT ENGAGE | System not available. | | First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves | | | | |
| 96 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT | DOES NOT ENGAGE | | | Verify that B7 sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2 | Connector Not connected; Key +15 OFF; | Typical Value: 69 Ohm; | |
| 96 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT | DOES NOT ENGAGE | | | Try to engage gears with the vehicle at rest and check if the failure is still present. | | | | |
| 96 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT | DOES NOT ENGAGE | | | Check the mechanical system of the splitter unit. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 97 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR | DOES NOT DISENGAGE | | | Check the mechanical system of the gear engagement unit. | | | | |
| 97 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR | DOES NOT DISENGAGE | Vehicle moving: T/m engages on the previous gear. If the previous gear cannot be engaged due to the vehicle's speed, the system selects the gear that can be selected as close as possible to the previous gear. When the attempt is not successful the T/m is in neutral. Vehicle stationary: If the previous gear cannot be engaged the T/m goes into neutral. | | First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves | | | | |
| 97 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR | DOES NOT DISENGAGE | | | Try to engage gears with the vehicle at rest and check if the failure is still present. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 98 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR | SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION | Vehicle moving: T/m engages on the previous gear. If the previous gear cannot be engaged due to the vehicle's speed, the system selects the gear that can be selected as close as possible to the previous gear. When the attempt is not successful the T/m is in neutral. Vehicle stationary: If the previous gear cannot be engaged the T/m goes into neutral. | | First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves | | | | |
| 98 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR | SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION | | | Try to engage gears with the vehicle at rest and check if the failure is still present. | | | | |
| 98 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR | SPLITTER LEAVES THE INITIAL POSITION BUT DOES NOT REACH THE FINAL POSITION | | | Check the mechanical system of the gear engagement unit. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 99 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR | DOES NOT ENGAGE | Vehicle moving: T/m engages on neutral. It is necessary to start engaging another gear with the gear lever; if the system is not able to engage the gear it shuts down and is no longer available. | | First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves | | | | |
| 99 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR | DOES NOT ENGAGE | | | Try to engage gears with the vehicle at rest and check if the failure is still present. | | | | |
| 99 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR SELECTOR | DOES NOT ENGAGE | | | Check the mechanical system of the gear engagement unit. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 9A | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED | DOES NOT DISENGAGE | Vehicle moving: The clutch is engaged in the previous gear. The next attempt at engaging will have to start with the selector switch. Vehicle stationary: gear change permitted only after the neutral signal has been received. Starting and driving can be attempted with the gear engaged, if the gear is equal to or lower than the lowest gear of the selected range. | | First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves | | | | |
| 9A | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED | DOES NOT DISENGAGE | | | Try to engage gears with the vehicle at rest and check if the failure is still present. | | | | |
| 9A | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED | DOES NOT DISENGAGE | | | Check the mechanical system of the gear engagement unit. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 9B | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED | DOES NOT ENGAGE | Vehicle moving: T/m stays on neutral. Another gear selection can be set with the selector lever; if the system comes out of the neutral position, but the gear is not engaged within a certain time, the system goes back into neutral. Vehicle stationary: T/m stays on neutral. When a gear is engaged the clutch is engaged. If the clutch travel is too long, T/m goes back into the neutral position. Another gear selection can be set with the selector lever. | | First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves | | | | |
| 9B | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED | DOES NOT ENGAGE | | | Try to engage gears with the vehicle at rest and check if the failure is still present. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 9B | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED | DOES NOT ENGAGE | | | Check the mechanical system of the gear engagement unit. | | | | |
| 9C | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED | WRONG GEAR SHIFTING | The gearbox automatically goes into neutral and the clutch stays open. Another gear selection can be set with the selector lever. | | First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves | | | | |
| 9C | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED | WRONG GEAR SHIFTING | | | Try to engage gears with the vehicle at rest and check if the failure is still present. | | | | |
| 9C | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED | WRONG GEAR SHIFTING | | | Check the mechanical system of the gear engagement unit. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 9E | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED | DISENGAGEMENT NOT REQUESTED | | | Try to engage gears with the vehicle at rest and check if the failure is still present. | | | | |
| 9E | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED | DISENGAGEMENT NOT REQUESTED | | | Check the mechanical system of the gear engagement unit. | | | | |
| 9E | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED | DISENGAGEMENT NOT REQUESTED | The main valve will be automatically operated together with the gear valves to couple in the final position.<br>If the gear has uncoupled completely, a suitable gear will be automatically engaged according to the speed conditions. | | First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves | | | | |
| 9E | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - GEAR ENGAGED | DISENGAGEMENT NOT REQUESTED | | | Verify that B4 sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm)<br>Measure point 1: Sensor connector Pin: 1<br>Measure point 2: Sensor connector Pin: 2 | Connector Not connected;<br>Key +15 OFF; | Typical Value: 69 Ohm; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 9F | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT | DISENGAGEMENT NOT REQUESTED | The main valve will be automatically operated together with the gear valves to couple in the final position. If the gear has uncoupled completely, a suitable gear will be automatically engaged according to the speed conditions. | | First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves | | | | |
| 9F | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT | DISENGAGEMENT NOT REQUESTED | | | Verify that B4 sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2 | Connector Not connected; Key +15 OFF; | Typical Value: 69 Ohm; | |
| 9F | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT | DISENGAGEMENT NOT REQUESTED | | | Try to engage gears with the vehicle at rest and check if the failure is still present. | | | | |
| 9F | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - RANGE UNIT | DISENGAGEMENT NOT REQUESTED | | | Check the mechanical system of the gear engagement unit. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| A0 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT | DISENGAGEMENT NOT REQUESTED | | | Verify that B7 sensor resistance should be between 60 and 90 Ohms. | Measure type: Resistance (Ohm) Measure point 1: Sensor connector Pin: 1 Measure point 2: Sensor connector Pin: 2 | Connector Not connected; Key +15 OFF; | Typical Value: 69 Ohm; | |
| A0 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT | DISENGAGEMENT NOT REQUESTED | | | Try to engage gears with the vehicle at rest and check if the failure is still present. | | | | |
| A0 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT | DISENGAGEMENT NOT REQUESTED | The main valve will be automatically operated together with the gear valves to couple in the final position. If the gear has uncoupled completely, a suitable gear will be automatically engaged according to the speed conditions. | | First of all remove possible failures due to interruptions or short-circuit on sensors and solenoid valves | | | | |
| A0 | 00 | SHIFTING ACTUATOR - CONTROL CYLINDERS - SPLITTER UNIT | DISENGAGEMENT NOT REQUESTED | | | Check the mechanical system of the range splitter (in case replace the sleeves and the gears shaft). | | | | |



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Base - November 2006

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| A3 | 00 | CAN LINE - ENGINE - TORQUE REQUEST | NO AVAIL-ABLE SYMPTOM | Speed cannot be in-creased (during downshifts). | Transmission end possibilities. | Check/assemble the gear shift rail with det-ent for gate. | | | | Gear change shaft:<br>- Old: 1327 306 005<br>- New: 1327 306 008<br>Introduction ex trans-mission number into production:<br>12 AS 2301 No. 141912 AS 2301 IT No. 203583 |
| A3 | 00 | CAN LINE - ENGINE - TORQUE REQUEST | NO AVAIL-ABLE SYMPTOM | Vehicle moving:<br>Gear change not syn-chronized.<br>Vehicle stationary:<br>Starting permitted.<br>Decrease in function-ality and clutch com-fort. | | Check the following function vehicle com-ponents:<br>- Injection pump<br>- Diesel filter- Fuel conduct and circuit Wiring (signal travel)<br>- Mechanics engine brake flaps | | | | |
| A4 | 08 | CAN LINE - ENGINE - RE-QUESTED ENGINE TORQUE | WRONG SIGNAL | Further errors saved in EDC. | | Please make also a di-agnosis check on EDC system. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| A5 | 08 | CAN LINE - ENGINE - ACCELER-ATOR PEDAL POSITION | WRONG SIGNAL | Further errors saved in EDC. | | Please make also a di-agnosis check on EDC system. | | | | |
| A5 | 08 | CAN LINE - ENGINE - ACCELER-ATOR PEDAL POSITION | WRONG SIGNAL | Vehicle moving:<br>No calculation of ve-hicle weight and gear resistance possible.<br>Impossible to calcu-late starting gear.<br>Throttle pedal posi-tion will be replaced by request for in-formation from the driver.<br>The coupling quality could be reduced.<br>Vehicle stationary:<br>Starting is possible.<br>On reaching the stop, the average starting gear will be engaged.<br>The manoeuvring and starting quality could be reduced. | | Check accelerator/ac-celerator wiring.Re-place/repair acceler-ator/periphery. | | | | |
| A6 | 00 | CAN LINE - ENGINE - IDLE SWITCH / ACCELER-ATOR PEDAL | PLAUSIBIL-ITY | Vehicle moving:<br>Gear changing poss-ible<br>Vehicle stationary:<br>Impossible to start the vehicle.<br>System not available. | | Check accelerator/ac-celerator wiring/idling switch.<br>Replace/repair/teach-in accelerator/periphery. | | | | Error is set with idling signal 1 and accelerator pedal posi-tion > 20%. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| A6 | 00 | CAN LINE - ENGINE - IDLE SWITCH / ACCELER-ATOR PEDAL | PLAUSIBIL-ITY | Further errors saved in EDC. | | Please make also a di-agnosis check on EDC system. | | | | |
| A7 | 08 | CAN LINE - ENGINE - ENGINE TORQUE | WRONG SIGNAL | System not available. | | Check vehicle CAN. | Measure type: Resistance (Ohm)<br>Measure point 1: Connector (ve-hicle side) Pin: 8<br><br>Measure point 2: Connector (ve-hicle side) Pin: 12 | Connector Connected;<br>Key +15 OFF; | Typical Value: 60 Ohm; | |
| A7 | 08 | CAN LINE - ENGINE - ENGINE TORQUE | WRONG SIGNAL | | | Intermittent or incor-rect signal. | Please make also a diagnosis check on EDC system. | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| A8 | 08 | CAN LINE - ENGINE - LOW IDLE SWITCH | WRONG SIGNAL | Vehicle moving: No system restriction present while driving. Vehicle stationary: After RESETTING the display shows codes AP or FP until the throttle pedal is pressed and the idling signal is off. If the idling signal fails to arrive within a certain length of time, the display will show the error with code AC or will no longer show code FP. Starting is possible if the control unit detects a throttle potentiometer value > the threshold and the engine idling speed + a predefined threshold. | | Check accelerator / accelerator wiring / idling switch. Replace / repair / teach-in accelerator / periphery. | | | | Error is set with idling signal 0 and accelerator pedal position > 0%. |
| A9 | 00 | SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - ECU RELAY CUT-OFF | DOES NOT SWITCH OFF | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | The relay is located within the E.C.U. Before replacing the E.C.U., check that the voltage supplied is correct. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| AA | 00 | SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - ECU RELAY CUT-OFF | DOES NOT SWITCH ON | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | The relay is located within the E.C.U. Before replacing the E.C.U., check that the voltage supplied is correct. | | | | |
| AB | 08 | CAN LINE - ENGINE - ENGINE TORQUE | WRONG SIGNAL | Vehicle moving: No calculation of vehicle weight and gear resistance possible. Impossible to calculate starting gear. The information on the torque percentage is obtained from the driver's controls (throttle pedal). Vehicle stationary: Starting possible. When the vehicle stops the system selects the average starting gear. Attention to possible overloads on the clutch. | EDC deactivation relay defective. | Replace deactivation relay. | | | | No error saved in EDC. |
| AB | 08 | CAN LINE - ENGINE - ENGINE TORQUE | WRONG SIGNAL | | | Intermittent or incorrect signal. | Please make also a diagnosis check on EDC system. | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| AE | 08 | CAN LINE - ENGINE - KICK-DOWN SWITCH | WRONG SIGNAL | The kickdown function is not available. No additional functional restrictions. | | Check the following components:<br>- EDC-Accelerator pedal (teach-in)<br>- Wiring (signal travel)<br>- Kickdown switch | | | | Error on the signal from the throttle pedal |
| AF | 04 | SUPPLY VOLTAGE - ELECTRONIC CONTROL UNIT | SIGNAL KEY (+15) NOT PRESENT | Defective supply (+ 15). | | Check for a fault in the 10A fuses (fuses holder no. 70602). | 1- Measure type: Voltage (V) Measure point 1: Connector for ECU power supply - vehicle side. Pin: 1 Measure point 2: Connector for ECU power supply - vehicle side. Pin: 16<br>2- Measure type: Voltage (V) Measure point 1: Connector for ECU power supply - vehicle side. Pin: 1 Measure point 2: Connector for ECU power supply - vehicle side. Pin: 17 | 1- Connector Connected; Key +15 ON;<br>2- Connector Connected; Key +15 ON; | 1- Min. value: 22 V; Max. value: 28 V;<br>2- Min. value: 22 V; Max. value: 28 V; | |
| B0 | 00 | SIGNALS - GEAR SHIFT LEVER | SHIFT LEVER POSITION NOT DEFINED | The gearbox may have lower performance or be locked. It depends on the conditions generating it. | | Select PARAMETER READ environment. Move the shift lever and verify the value changes. Check cabling, if failure persists, the lever is worn. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| B1 | 04 | CAN LINE -COM-MUNICA-TION LINES - VEHICLE | COM-MUNICA-TION ERROR | Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving. | | Verify CAN line (for a possible disconnection of ST11 connector). | Measure type: Resistance (Ohm) Measure point 1: Connector (ve-hicle side) Pin: 8<br><br>Measure point 2: Connector (ve-hicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | |
| B1 | 04 | CAN LINE -COM-MUNICA-TION LINES - VEHICLE | COM-MUNICA-TION ERROR | | | Check wiring | | | | |
| B2 | 04 | CAN LINE -COM-MUNICA-TION LINES - VEHICLE | COM-MUNICA-TION ERROR (WARN-ING) | Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving. | | Verify CAN line (for a possible disconnection of ST11 connector). | Measure type: Resistance (Ohm) Measure point 1: Connector (ve-hicle side) Pin: 8<br><br>Measure point 2: Connector (ve-hicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | |
| B2 | 04 | CAN LINE -COM-MUNICA-TION LINES - VEHICLE | COM-MUNICA-TION ERROR (WARN-ING) | | | Check wiring | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| B3 | 00 | CAN LINE -COM-MUNICA-TION LINES - VEHICLE | QUEUE OVERRUN | Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving. | | Verify CAN line (for a possible disconnection of ST11 connector). | Measure type: Resistance (Ohm) Measure point 1: Connector (ve-hicle side) Pin: 8<br><br>Measure point 2: Connector (ve-hicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | |
| B3 | 00 | CAN LINE -COM-MUNICA-TION LINES - VEHICLE | QUEUE OVERRUN | | | Check wiring | | | | |
| B4 | 04 | CAN LINE - ENGINE - CONTROL MESSAGE | TIMEOUT | Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving. | | Check vehicle CAN. | Measure type: Resistance (Ohm) Measure point 1: Connector (ve-hicle side) Pin: 8<br><br>Measure point 2: Connector (ve-hicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | |
| B4 | 04 | CAN LINE - ENGINE - CONTROL MESSAGE | TIMEOUT | In the EEC1 message timeout at the fol-lowing signals:<br>- theoretical injection volume EDC<br>- current injected vol-ume EDC<br>- output speed of en-gine | | Please make also a di-agnosis check on EDC system. | | | | |



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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| B4 | 04 | CAN LINE - ENGINE - CONTROL MESSAGE | TIMEOUT | | | Check fuse box fuses. | | | | |
| B5 | 04 | CAN LINE - ENGINE - CON-TROL MESSAGE | TIMEOUT | Vehicle moving: gear-box locked, the clutch opens auto-matically when the vehicle stops. Vehicle stationary: gearbox automatically in neu-tral, impossible to continue driving. | | Check vehicle CAN. | Measure type: Resistance (Ohm) Measure point 1: Connector (ve-hicle side) Pin: 8<br><br>Measure point 2: Connector (ve-hicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| B6 | 04 | CAN LINE - CRUISE CONTROL / VEHICLE SPEED - CONTROL MESSAGE | TIMEOUT | No vehicle speed based on wheels (redundant 2 output speed information, if output speed is not detected on 2nd output speed sensor of CAN tachograph).<br>No service brake signal.<br>When running by inertia, the service brake signal is considered active.<br>No Cruise Control active information.<br>No calculation of vehicle weight and gear resistance possible.<br>Impossible to calculate starting gear.<br>The ensuing variable single fault message is deleted.<br>The clutch always disengages at the associated brake pedal engine speed (higher engine revs). | | Check vehicle CAN. | Measure type: Resistance (Ohm)<br>Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected;<br>Key +15 OFF; | Typical Value: 60 Ohm; | The following signals are in CCVS:-Veh. speed v_fzg (km/h)-Brake switch z_fbr (1 active/0 not active)-Cruise control target speed v_cc_set (km/h)-Cruise control status v cc status |
| B6 | 04 | CAN LINE - CRUISE CONTROL / VEHICLE SPEED - CONTROL MESSAGE | TIMEOUT | | | Please make also a diagnosis check on EDC system. | | | | |



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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| B6 | 04 | CAN LINE - CRUISE CON-TROL / VEHICLE SPEED - CONTROL MESSAGE | TIMEOUT | | | Check fuse box fuses. | | | | |
| B7 | 04 | CAN LINE - RE-TARDER - ENGINE BRAKE - CONTROL MESSAGE | TIMEOUT | No calculation of vehicle weight and gear resistance possible. Impossible to calculate starting gear. No information on exhaust brake torque. If the exhaust brake is activated, the coupling quality can turn out poor at the start of coupling.<br>The exhaust brake is considered as not activated.<br>No additional functional restrictions. | | Check vehicle CAN. | Measure type: Resistance (Ohm)<br>Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected;<br>Key +15 OFF; | Typical Value: 60 Ohm; | ERC1_ER contains the current engine brake torque. |
| B7 | 04 | CAN LINE - RE-TARDER - ENGINE BRAKE - CONTROL MESSAGE | TIMEOUT | | | Please make also a diagnosis check on Intarder. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| B7 | 04 | CAN LINE - RE-TARDER - ENGINE BRAKE - CONTROL MESSAGE | TIMEOUT | | | Check fuse box fuses. | | | | |
| B8 | 04 | CAN LINE - RE-TARDER - INTARDER - CON-TROL MESSAGE | TIMEOUT | No calculation of ve-hicle weight and gear resistance possible. Impossible to calcu-late the starting gear. The average starting gear will be engaged. No additional func-tional restrictions | | Check vehicle CAN. | Measure type: Resistance (Ohm) Measure point 1: Connector (ve-hicle side) Pin: 8<br><br>Measure point 2: Connector (ve-hicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | Message ERC1_DR contains: -Secondary retarder brake torque -Request, in-crease in en-gine speed |
| B8 | 04 | CAN LINE - RE-TARDER - INTARDER - CON-TROL MESSAGE | TIMEOUT | | | Please make also a di-agnosis check on Intar-der. | | | | |
| B8 | 04 | CAN LINE - RE-TARDER - INTARDER - CON-TROL MESSAGE | TIMEOUT | | | Check fuse box fuses. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| BC | 00 | SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - INTENAL FAILURE | INCORRET WORKING | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Delete the fault memory: if the error remains, call the Help Desk and follow their instructions to reprogram or replace the control unit if necessary. | | | | |
| BD | 00 | SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - INTENAL FAILURE | INCORRET WORKING | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Delete the fault memory: if the error remains, call the Help Desk and follow their instructions to reprogram or replace the control unit if necessary. | | | | |
| BE | 00 | SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - INTENAL FAILURE | PROGRAMMING DATA NOT VALID | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Reprogram the electronic control unit to rewrite the parameters. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| BF | 00 | SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - INTENAL FAILURE | PROGRAMMING DATA NOT VALID | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Reprogram the electronic control unit to rewrite the parameters. | | | | |
| C0 | 00 | SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - INTENAL FAILURE | EEPROM ACCESS FAILURE | No calculation of vehicle weight and gear resistance possible. Impossible to calculate the starting gear. The average starting gear will be engaged. No additional functional restrictions | | Erase the failure memory and retry.If the problem persists, contact the Help Desk and follow the instructions for the possible replacement of the gearcase. | | | | |
| C1 | 01 | SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - ECU TEMPERATURE | TOO HIGH | Vehicle moving: Gear changing blocked. The clutch opens when the vehicle stops and neutral is engaged. Impossible to keep on driving. The display alternately shows the too high temperature and the information on the gear. System not available. | | Verify fluid level. | | | | ECU temperature on electronics circuit board greater than 125 °C and oiltemperature greater than 130 °C. |



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Base - November 2006

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| C2 | 08 | CAN LINE - BRAKING SYSTEM - FRONT WHEELS SPEED | NO SIGNAL | The automatic shift unit is deactivated. No further system restrictions. | | Check / Replace speed sensor. | | | | Error entered in other electronic units as well (EDC, ABS, etc.) |
| C2 | 08 | CAN LINE - BRAKING SYSTEM - FRONT WHEELS SPEED | NO SIGNAL | Error stored only in transmission electronic unit. | | Last time of error storage on the reading out environmental conditions. Cancel Faults Memory | | | | |
| C2 | 08 | CAN LINE - BRAKING SYSTEM - FRONT WHEELS SPEED | NO SIGNAL | Error still active. | Vehicle speed sensor disconnected or failed. | Check / Replace wiring speed sensor. Check signal travel. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| C2 | 08 | CAN LINE - BRAKING SYSTEM - FRONT WHEELS SPEED | NO SIGNAL | | Signal out of tolerance. | Gear actuator replacement (control unit) | | | | Alternative solution: disassemble transmission actuator and replace transmission actuator lower section. |
| C5 | 08 | CAN LINE - BRAKING SYSTEM - AVERAGE FRONT WHEEL SPEED | WRONG SIGNAL | No calculation of vehicle weight and gear resistance possible. Impossible to calculate the starting gear. The average starting gear will be engaged. No additional functional restrictions | | Check fuse box fuses. | | | | Signal is contained in CAN message "SWI". |
| C5 | 08 | CAN LINE - BRAKING SYSTEM - AVERAGE FRONT WHEEL SPEED | WRONG SIGNAL | | Message is generated in the ABS electronics. | Check ABS. | | | | |
| C5 | 08 | CAN LINE - BRAKING SYSTEM - AVERAGE FRONT WHEEL SPEED | WRONG SIGNAL | The automatic shift unit is deactivated. No further system restrictions. | Check / Replace speed sensor. | | | | | Error entered in other electronic units as well (EDC, ABS, etc.) |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| C5 | 08 | CAN LINE - BRAKING SYSTEM - AVERAGE FRONT WHEEL SPEED | WRONG SIGNAL | Error stored only in transmission electronic unit. | | Last time of error storage on the reading out environmental conditions.<br>Cancel Faults Memory | | | | |
| C5 | 08 | CAN LINE - BRAKING SYSTEM - AVERAGE FRONT WHEEL SPEED | WRONG SIGNAL | Error still active. | Vehicle speed sensor disconnected or failed. | Check/Replace wiring speed sensor.<br>Check signal travel. | | | | |
| C5 | 08 | CAN LINE - BRAKING SYSTEM - AVERAGE FRONT WHEEL SPEED | WRONG SIGNAL | Signal out of tolerance. | Gear actuator replacement (control unit) | Alternative solution: disassemble transmission actuator and replace transmission actuator lower section. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| C7 | 04 | CAN LINE - BRAKING SYSTEM - SPEED WHEELS MESSAGE | TIMEOUT | No calculation of vehicle weight and gear resistance possible. Impossible to calculate the starting gear. The average starting gear will be engaged. No additional functional restrictions | | Check fuse box fuses. | Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | |
| C7 | 04 | CAN LINE - BRAKING SYSTEM - SPEED WHEELS MESSAGE | TIMEOUT | | Message issued by ASR / ABS / EBS electronics. | Check ABS / ASR / EBS signal travel. | | | | |
| C7 | 04 | CAN LINE - BRAKING SYSTEM - SPEED WHEELS MESSAGE | TIMEOUT | Other errors 91,100,177 present. | Short circuit to ground to pin 8 - CAN H possible. | Check vehicle CAN. | Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | |
| E2 | 04 | CAN LINE - MUX | TIMEOUT | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Check the CAN line and the working of the other ECU's connected. | Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | After replacing any ECU's connected to CAN line, carry out the Cancel Faults Memory. |



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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| E3 | 00 | SHIFTING ACTUATOR - ELECTRONIC CONTROL UNIT - INTENAL FAILURE | APPLICATION ERROR FOR CAN COMMUNICATION | Vehicle moving: gearbox locked, the clutch opens automatically when the vehicle stops. Vehicle stationary: gearbox automatically in neutral, impossible to continue driving. | | Check the CAN line and the working of the other ECU's connected. | Measure type: Resistance (Ohm)<br>Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected;<br>Key +15 OFF; | Typical Value: 60 Ohm; | After replacing any ECU's connected to CAN line, carry out the Cancel Faults Memory. |
| E7 | 00 | CAN LINE - COMMUNICATION LINES - VCM | EEC3 TIMEOUT ERROR | In initialization phase: default config. (current lever/no addit. Manoeuvring mode/ normal mode).<br>After initialization phase: no functional limitation. | The message VCM_TC is not received for approx. 150 ms or is ignored because it is not valid always for the same time. | Verify presence and recognition VCM ECU.Verify CAN line. | Measure type: Resistance (Ohm)<br>Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected;<br>Key +15 OFF; | Typical Value: 60 Ohm; | The error passes intermittent in phase of initialization when it receives the corrected message, but only the shift lever configuration is updated.<br>After the initialization after a reset of the system. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| F1 | 08 | CAN LINE - COMMUNICATION LINES - GEAR SHIFT LEVER | VCM_TC CAN MESSAGE MISSING | In initialization phase: default config. (current lever/no addit. Manoeuvring mode/ normal mode). After initialization phase: no functional limitation. | The message VCM_TC is not received for approx. 150 ms or is ignored because it is not valid always for the same time. | Verify presence and recognition VCM ECU. Verify CAN line. | Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | The error passes intermittent in phase of initialization when it receives the corrected message, but only the shift lever configuration is updated. After the initialization after a reset of the system. |
| F6 | 00 | CAN LINE - COMMUNICATION LINES - VCM | PTI (Power takeoff Information) MESSAGE TIMEOUT ERROR | In initialization phase: default config. (current lever/no addit. Manoeuvring mode/ normal mode). After initialization phase: no functional limitation. | The message VCM_TC is not received for approx. 150 ms or is ignored because it is not valid always for the same time. | Verify presence and recognition VCM ECU. Verify CAN line. | Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | The error passes intermittent in phase of initialization when it receives the corrected message, but only the shift lever configuration is updated. After the initialization after a reset of the system. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| F7 | 00 | CAN LINE - COM-MUNICA-TION LINES - VCM | PTI (Power takeoff In-formation) MESSAGE SIGNAL FAILURE | | | For STRALIS please check either for a possible short be-tween 9131 and 0131 cables or check for a possible wiring inver-sion on ST67 con-nector (PIN 4 of 0131 cable could be in-verted with PIN 2 of 9131 cable). | | | | |
| F7 | 00 | CAN LINE - COM-MUNICA-TION LINES - VCM | PTI (Power takeoff In-formation) MESSAGE SIGNAL FAILURE | | | Check vehicle CAN. | Measure type: Resistance (Ohm) Measure point 1: Connector (ve-hicle side) Pin: 8<br><br>Measure point 2: Connector (ve-hicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| FD | 04 | CAN LINE - COMMUNICATION LINES - VEHICLE | EM_CMD CAN MESSAGE TIMEOUT | No system restriction. | The message EM_CMD CAN is not received for approx. 150 ms or is ignored because it is not valid always for the same time. | Verify presence and recognition EM (Expansion Module) ECU. Verify CAN line. | Measure type: Resistance (Ohm) Measure point 1: Connector (vehicle side) Pin: 8<br><br>Measure point 2: Connector (vehicle side) Pin: 12 | Connector Connected; Key +15 OFF; | Typical Value: 60 Ohm; | |

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SECTION 5

# Power take off


| | Page |
|---|---|
| DESCRIPTION | 3 |
| MAIN DATA | 4 |
| TIGHTENING TORQUE | 5 |
| TOOLS | 6 |
| EXPERIMENTAL TOOLS | 8 |
| - Operation (power take off disengaged) | 11 |
| - Operation (power take off engaged) | 12 |
| REMOVING - REFITTING TOTAL POWER TAKE-OFF ASSEMBLY | 13 |
| - Removal | 13 |
| - Refitting | 14 |
| OVERHAULING | 15 |
| - Disassembling the main box | 15 |
| - Disassembling the drive assembly | 15 |
| - Disassembling bearing for shaft with gear wheel | 15 |
| - Disassembling the oil pump | 16 |
| - Assembling the oil pump | 17 |
| - Cleaning and checking parts | 17 |
| - Assembling the bearing for shaft with gear wheel | 18 |
| - Fitting drive assembly | 18 |
| - Adjusting drive output shaft tapered bearings | 20 |
| - Assembling the main housing | 21 |
| - Adjusting ball bearing | 21 |

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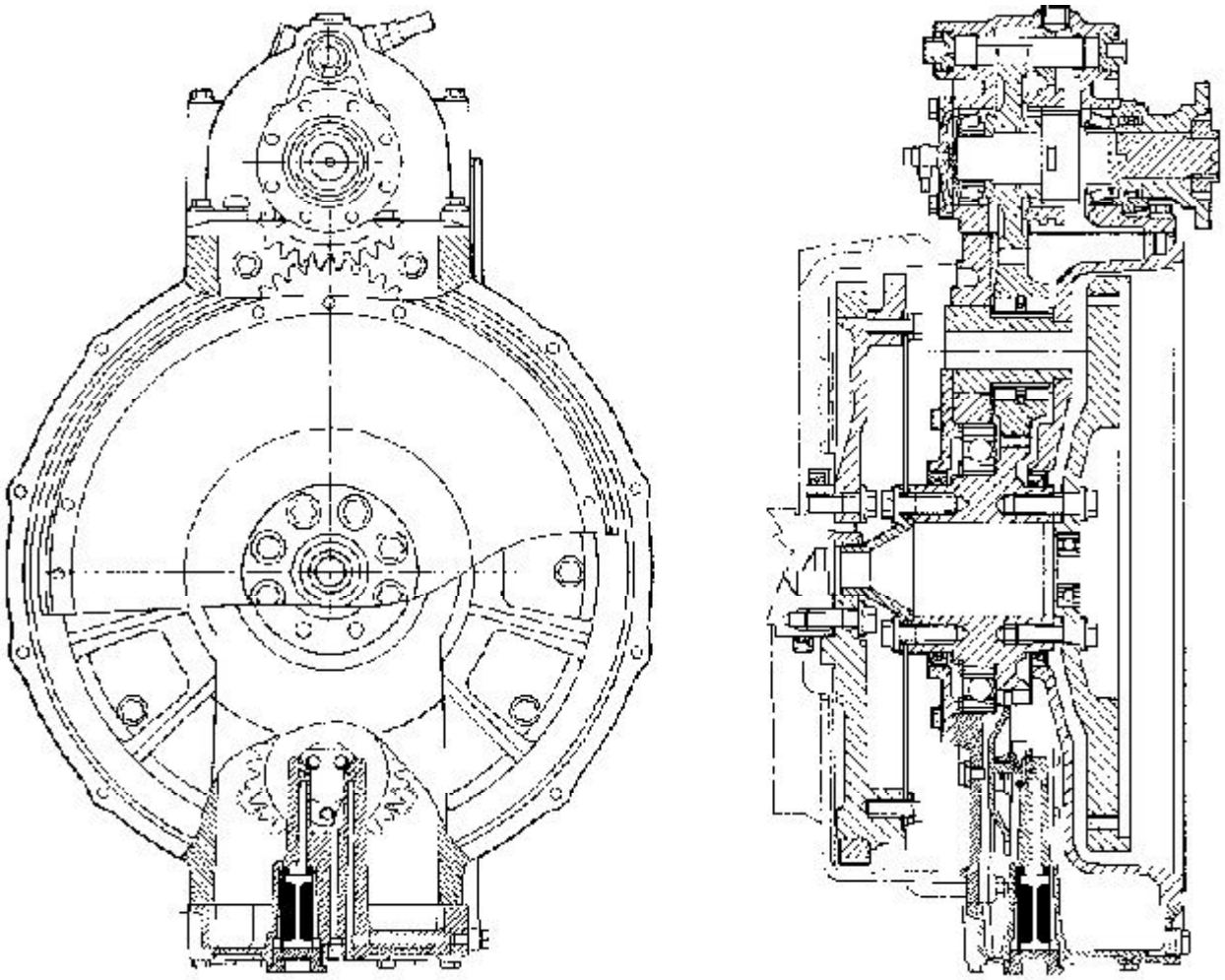
Aquila Trucks Centres

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## DESCRIPTION

The total power takeoff is mounted between the engine flywheel and the clutch unit. The power takeoff is equipped with a non-synchronized pneumatic-mechanic connection to transfer the drive shaft motion to the pick up flange. The lubrication is carried out by an oil pump.

Figure 1

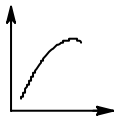
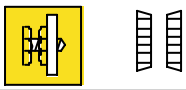
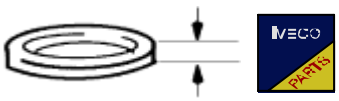
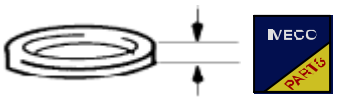
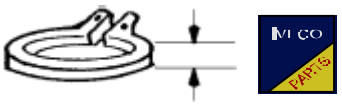


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CROSS SECTION

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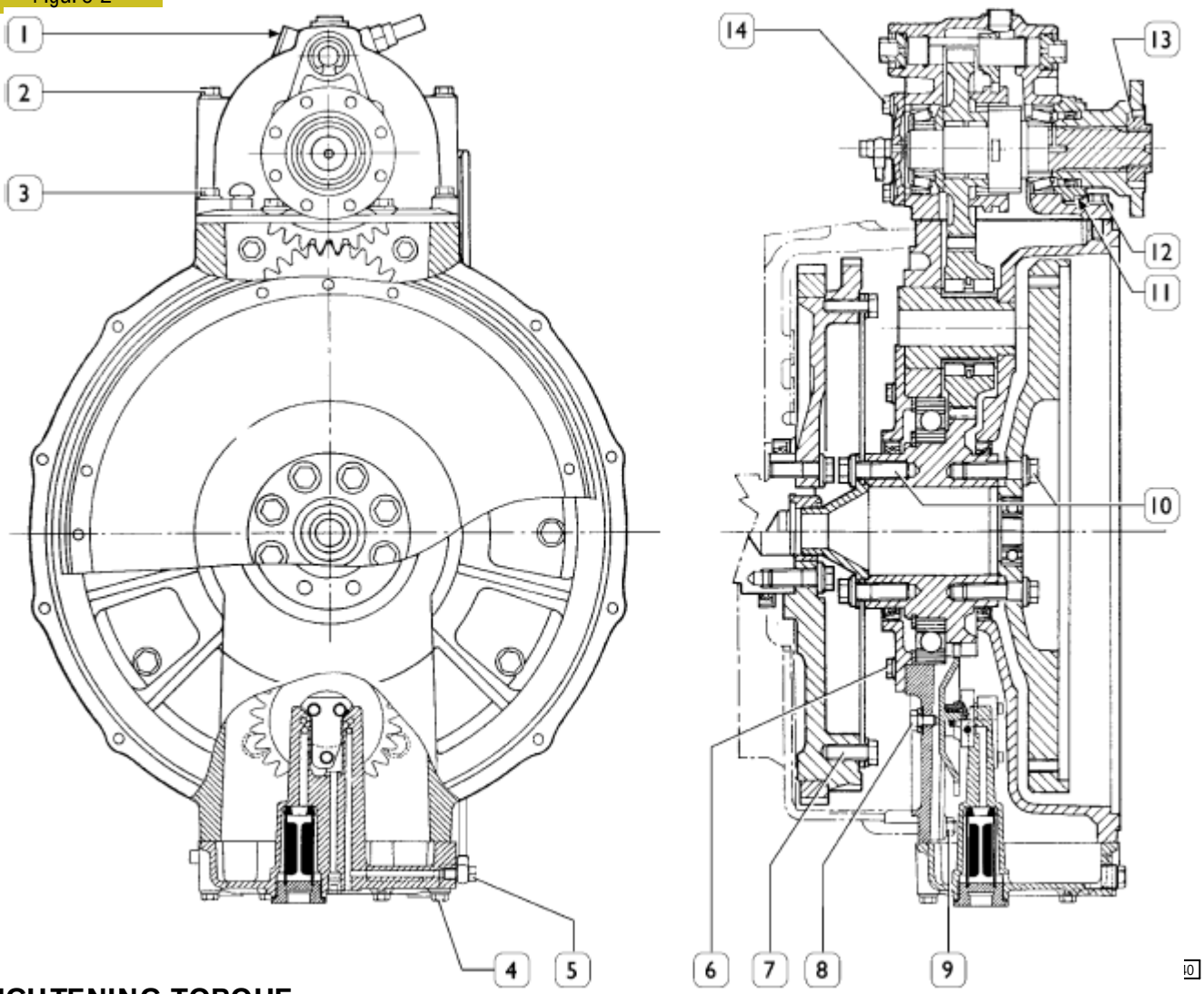
## MAIN DATA

| | | |
|---|---|---|
|  | Ratio revolutions - rpm | 1 : 1.29 |
|  | Torque | 900 Nm |
|  | Direction of rotation | Same as engine |
| Type of engagement/release control | | Pneumatic ** |
|  | Type of lubricant<br>Quantity | TUTELA ZC 90 - SAE 80 W/90<br>2.5 l |
| Foreseen duration of the nominal torque (hours)* | | 500 |
| Type of motion output (vehicle travelling direction) | | Rear with flange |
| Gearbox connection | | SAE 1 |
| Weight (without flywheels) (kg) | | 70 |
| Weight (with clutch flywheel) (kg) | | 102.6 |
|  | Bearings for output shaft | 2 tapered roller bearings |
|  | Bearing settings | Using setting rings |
|  | Distances setting rings | 5.5 - 5.6 - 5.7 - 5.8 - 5.9<br>6 - 6.1 - 6.2 mm |
|  | Bearing for control shaft | 1 ball bearing |
|  | Bearing settings | Using setting rings |
|  | Thickness setting rings | 3.95 - 4 - 4.05 - 4.10 - 4.15 - 4.20<br>4.25 - 4.30 mm |
|  | Thickness safety split ring | 3.60 - 3.65 - 3.70 - 3.80<br>3.85 - 3.90 mm |

* At a speed of 2450 rpm. Indicative value for the operation without bumps and vibrations
** Pressure value 10 bar always supplied

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Figure 2



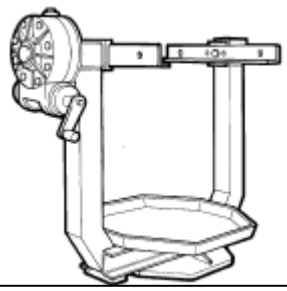
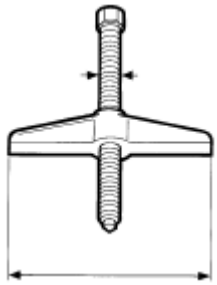
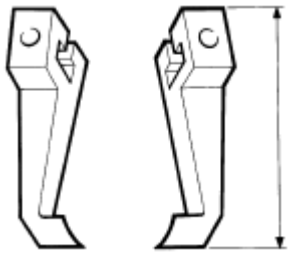
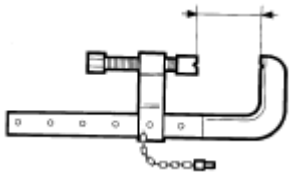
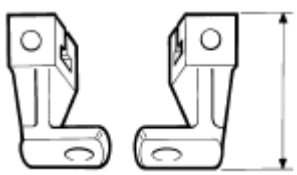

## TIGHTENING TORQUE

| DESCRIPTION | | TORQUE Nm | TORQUE kgm |
|---|---|---|---|
| 1 | Plug | 27.5 | 2.75 |
| **2** | Screw M10x140 | 43 | 4.3 |
| **3** | Screw | 43 | 4.3 |
| **4** | Screw M8x60 | 18 | 1.8 |
| **5** | Joint | 5.5 | 0.55 |
| **6** | Screw for cover | 22 | 2.2 |
| **7** | Screw | 82 | 8.2 |
| **8** | Screw M10x1.5 | 10 | 1 |
| **9** | Nut with flange for stud bolt | 29 | 2.9 |
| **10** | * Screws must be tightened in two stages: 1st stage pre-torque<br>2nd stage to angle | 95<br>60° | 9,5<br>60° |
| **11** | Screw M8x30 | 18 | 1.8 |
| **12** | Screw M10x30 | 43 | 4.3 |
| **13** | Nut M33x1.5 | 465 | 46.5 |
| **14** | Screw M8x30 | 18 | 1,8 |

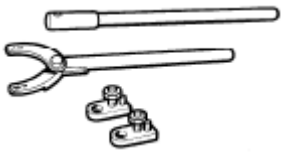
NOTE: Apply LOCTITE 242 on the plugs and joints in contact with the lubricant

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## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99305121** |  | Hot air apparatus |
| **99322205** |  | Revolving stand for overhauling units |
| **99341003** |  | Double-acting bridge |
| **99341009** |  | Pair of brackets |
| **99341015** |  | Clamp |
| **99341016** |  | Pair of brackets with hole |

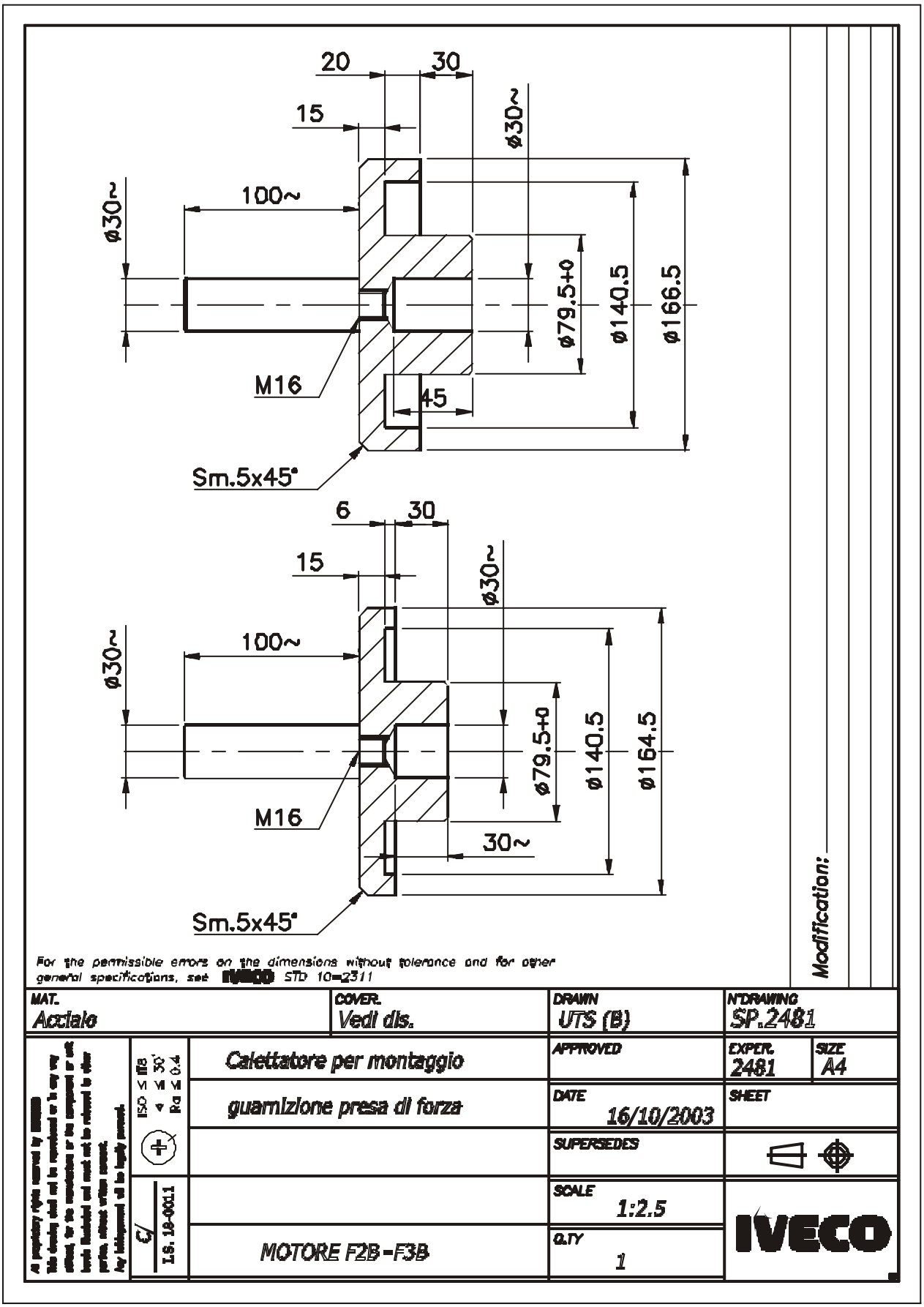
Aquila Trucks Centres

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99345049** |  | Counter block for pullers |
| **99360503** |  | Rings for lifting cylinder units |
| **99363241** |  | Plates (2) to measure gearbox main or transmission shaft bearing preload |
| **99370317** |  | Counter lever with extension to fasten flanges |
| **99395216** |  | Pair of meters for tightening to angle with 1/2" and 3/4" square coupling |

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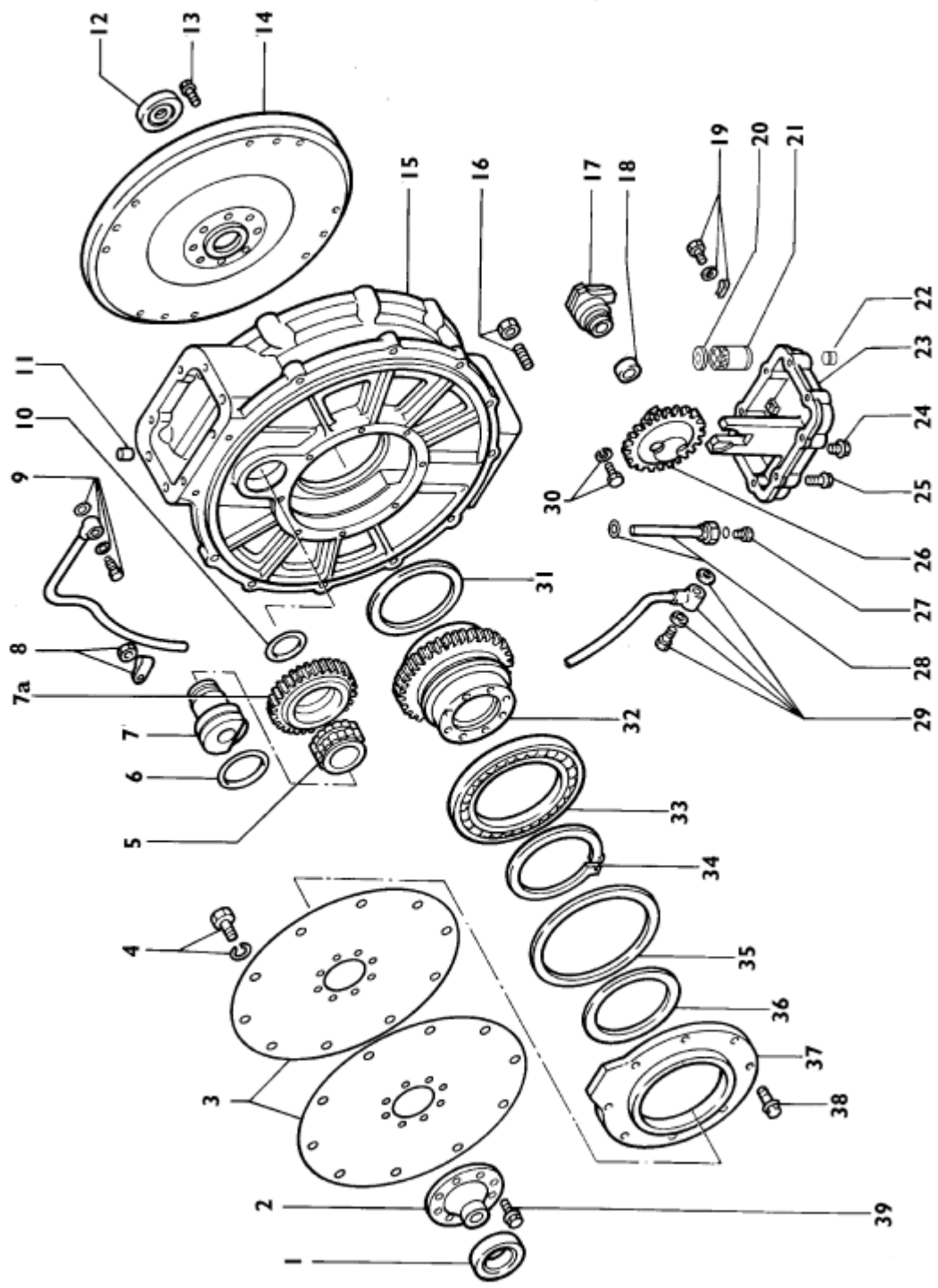
## EXPERIMENTAL TOOLS

This chapter illustrates the mechanical working drawing of the experimental tools (S.P.) used to overhaul the overall power takeoff described in this section, which can be manufactured by the repair shops themselves.



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Figure 3

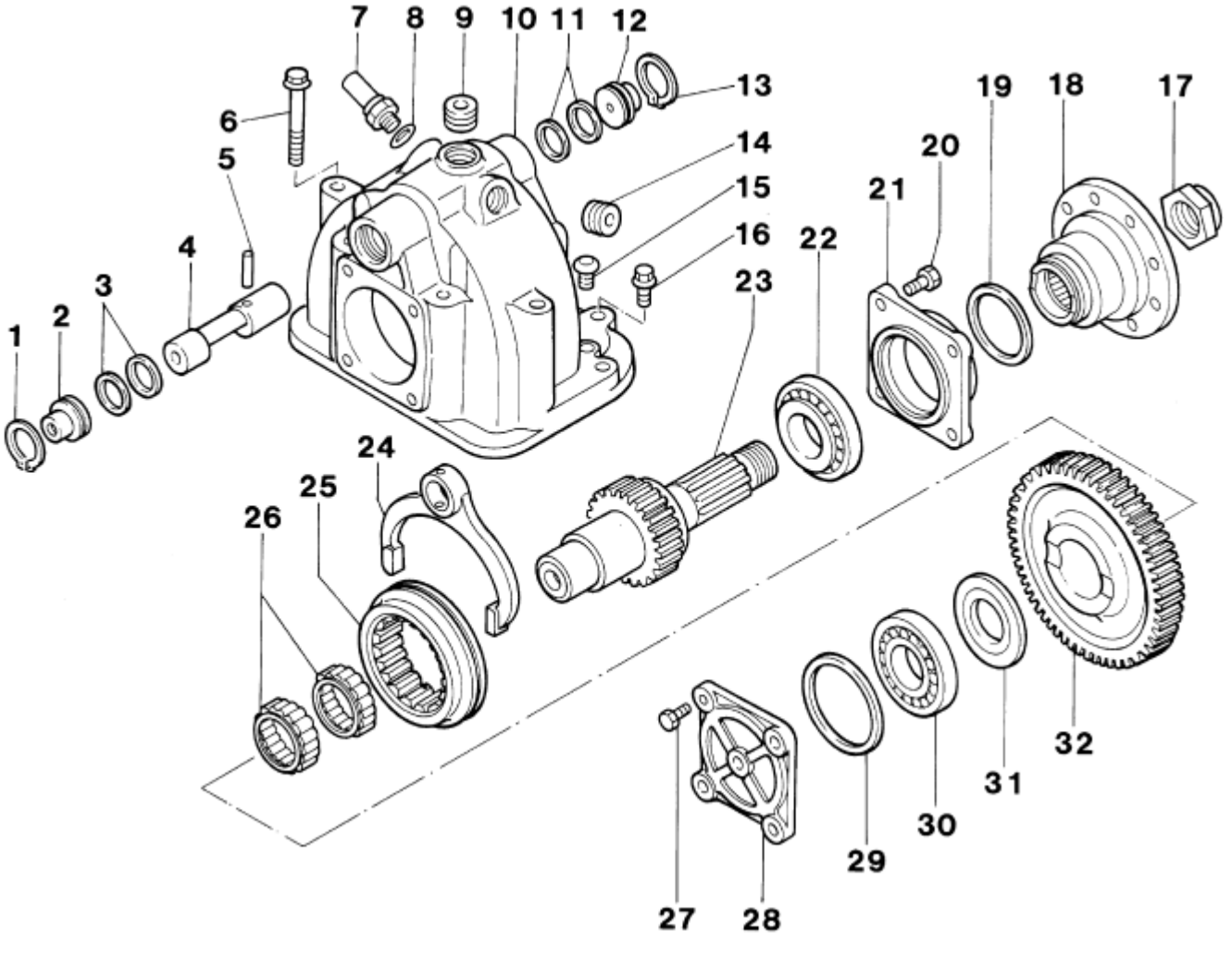



COMPONENT PARTS OF THE POWER TAKE-OFF (DEMONSTRATION)

1. Bushing - 2 Flange - 3 Laminar coupling - 4. Screw and washer - 5. Roller bearing - 6. Seal - 7. Shaft for middle gear - 7a Middle gear - 8. Bracket with nut - 9. Fitting with washers - 10. Seal - 11. Locating peg - 12 Bearing - 13 Screw - 14. Flywheel - 15. Box - 16. Stud bolt with nut - 17. Oil pump - 18. Bearing - 19. Screw washer and bracket - 20. Seal - 21. Oil filter - 22 Plug - 23. Cover - 24. Plug - 25. Screw - 26. Gear - 27. Screw with washer - 28. Pipe with washer - 29. Pipe with fitting and washers - 30. Screw - 31. Seal - 32. Pinion shaft 33. Ball bearing - 34. Split ring - 35. Adjustment ring - 36. Seal - 37. Cover - 38. Screw - 39. Screw

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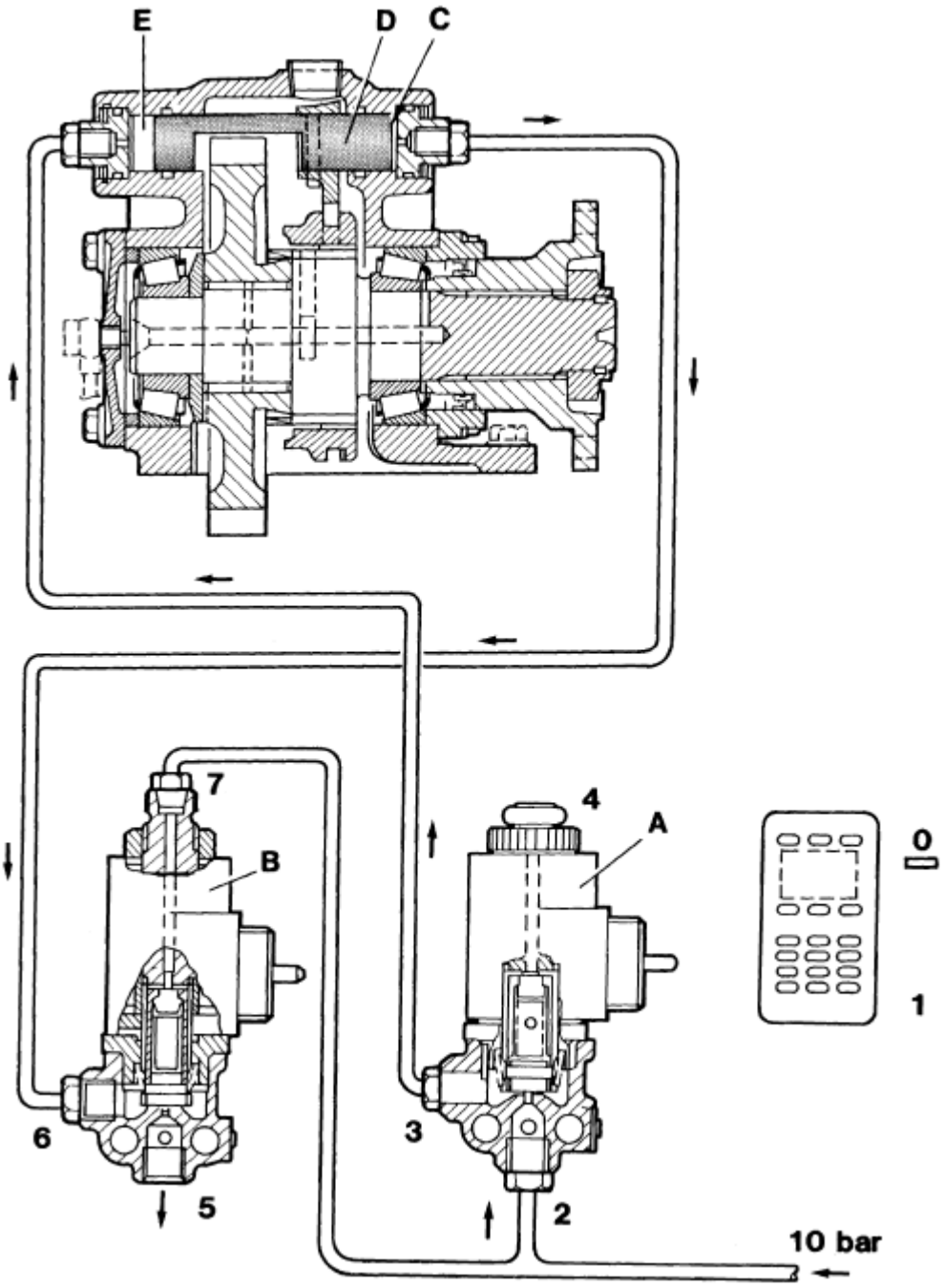
Figure 4




EXPLODED VIEW OUTPUT UNIT COMPONENTS
1. Safety split ring - 2. Joint - 3. Choke ring - 4. Fork shaft - 5. Pin - 6. Screws - 7. Transmitter - 8. Washer - 9. Plug - 10. Housing - 11. Choke rings - 12. Joint - 13. Safety split ring - 14. Plug - 15. Vent - 16. Screws - 17. Nut - 18. Flange - 19. Seal - 20. Screws - 21. Cover - 22. Conical bearings - 23. Grooved transmission shaft - 24. Selector fork - 25. Sliding joint - 26. Roller bearings - 27. Screws - 28. Cover - 29. Setting ring - 30. Conical bearing - 31. Shoulder ring - 32. Gear wheel

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Figure 5



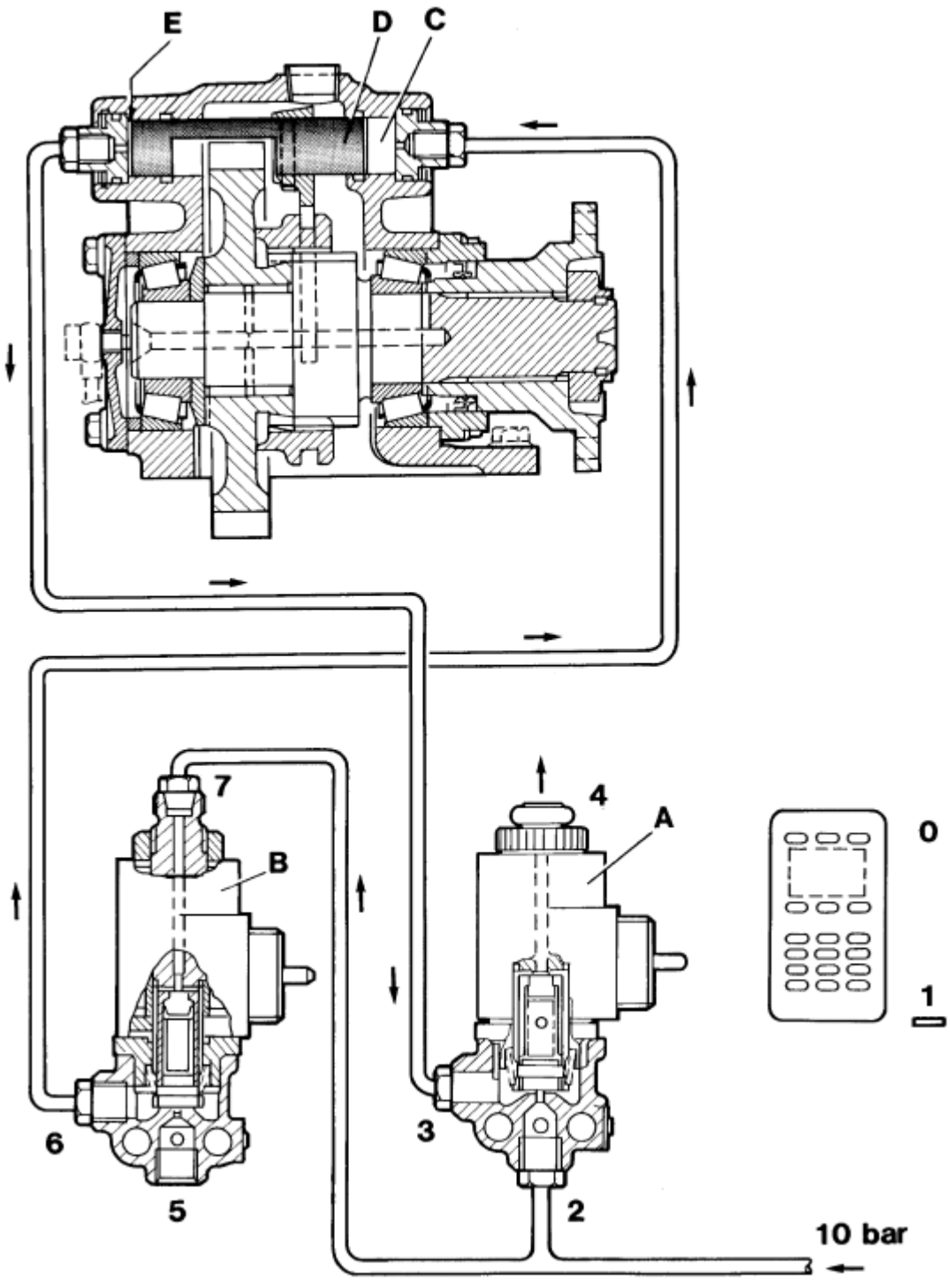

## Operation (power take off disengaged)

A = Electro-pneumatic valve N.A. (usually open) with switch disengaged
B = Electro-pneumatic valve N.C. (usually closed) with switch disengaged

With the switch in position 0 (disengaged) the electromagnets of the valves A - B are disconnected and therefore the circuit of the valve A remains open and that of valve B remains closed.
The air taken in enters valve A by link (2), leaves by link (3) and passes through the pipes to chamber E, moving the control rod with fork D in power take off position disengaged.
At the same time the air in chamber C passes through the piping to the link (6) and passes into the air by link (5).

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Figure 6




## Operation (power take off engaged)

A = Electro-pneumatic valve N.A. (usually closed) with switch disengaged
B = Electro-pneumatic valve N.C. (usually open) with switch disengaged

With the switch in position 1 (engaged) the electromagnets of the valves A - B are excited and therefore the circuit of the valve A open and open that of valve B.
The air taken in through link (7)enters valve B leaves by link (6) and passes through the pipes to chamber C, moving the control rod with fork D in power take off position engaged.
At the same time the air in chamber E passes through the piping to the link (3) into valve A and passes into the air by link (4).

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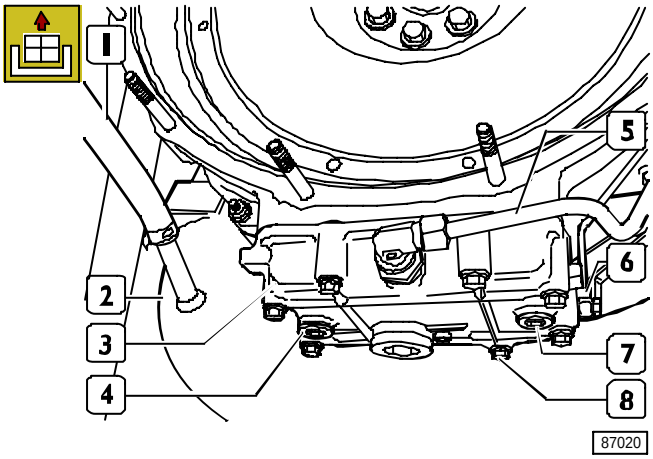
# 534501 REMOVING - REFITTING TOTAL POWER TAKE-OFF ASSEMBLY

## Removal

This operation comprises:

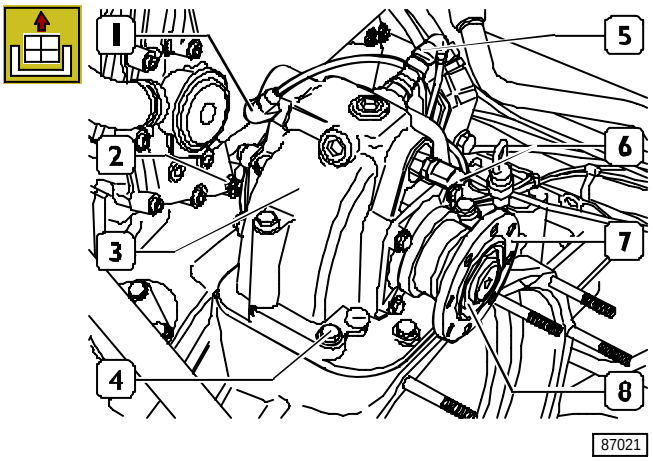
- Removing - refitting propeller shafts (see relevant section 505620).
- Removing - refitting gearbox (see relevant section 530210).
- Removing - refitting clutch (see relevant section 505210).

Figure 7




Remove the plugs (4 and 7) and drain the oil in a suitable container.
From the lower cover (3) disconnect the oil pipes (5 and 6).
Remove the screws (8) and the lower cover (3)
If fitted, slacken the clamp and disconnect the oil vapour pipes (1) from the exhaust pipe (2).
Remove the chassis exhaust pipe fasteners (2).

Figure 8



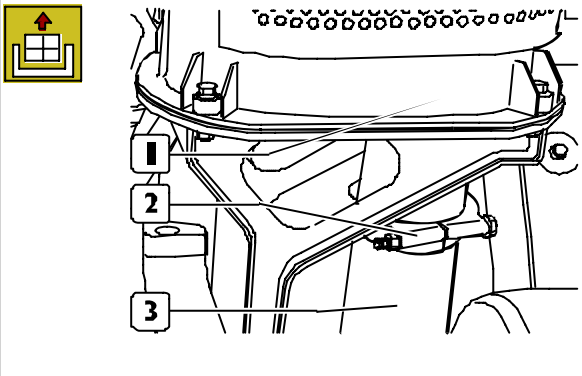

Remove the bolts and disconnect the flange drive shaft (7).
From the power take off assembly (3):

- Disconnect the electrical connection (5);
- disconnect the air pipes (1 and 6);
- remove the pipe union (2) and the oil pipe.

**NOTE** If the power take off assembly is to be overhauled (3). Slacken the nut (8) fastening the drive output flange (7).

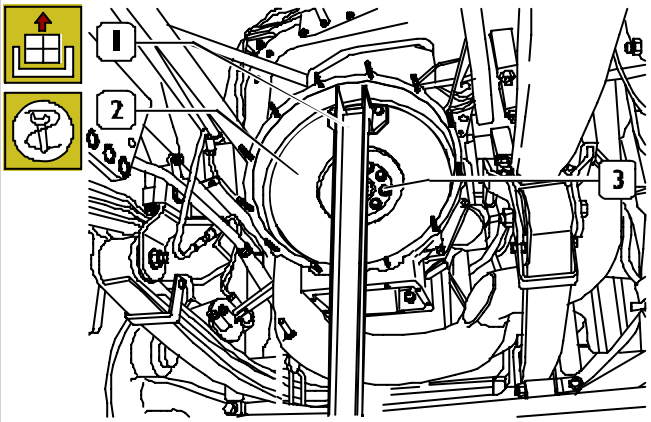
Remove the screws (4) and the power take off assembly (3).

Figure 9



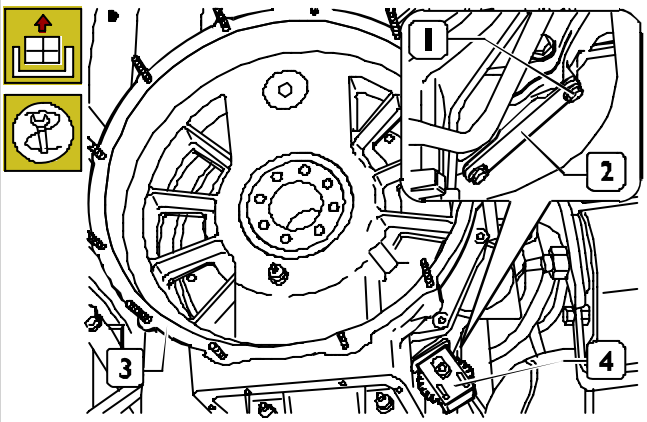

Slacken the clamp (2) fastening the exhaust pipe (3) to the muffler (1).

Figure 10




Place bracket 99360551 (1) on the hydraulic lift and fit the bracket on the clutch coupling flywheel (2).
Remove the screws (3) and disconnect the flywheel (2) from the power take off shaft.

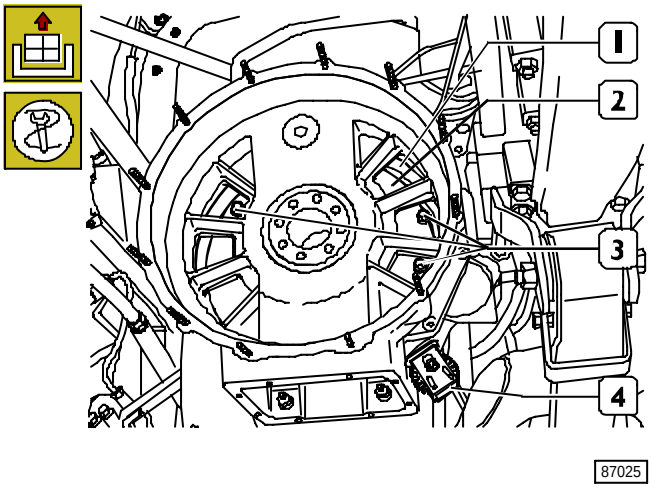
Figure 11




Remove the screws (1) and the inspection cover (2) from the gear case (3).
Apply the flywheel rotation tool 99360321 (4) on the gear case (3). For engines F3B, this tool shall be completed with spacer 99360325.

Aquila Trucks Centres

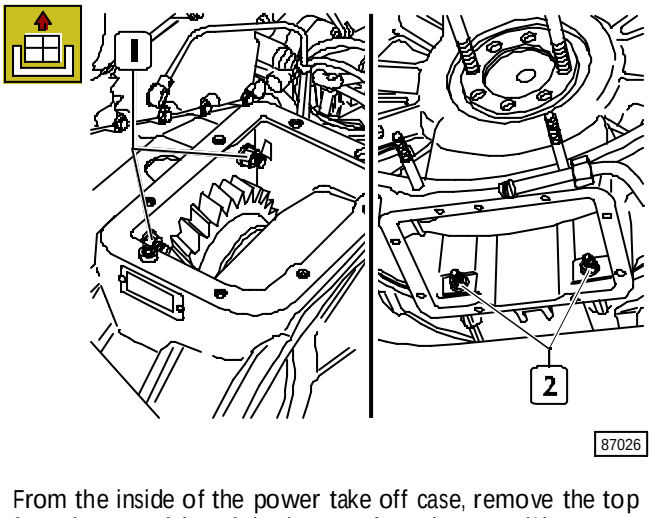
Figure 12




Remove the screws (2) fastening the joint (3) to the engine flywheel (1).

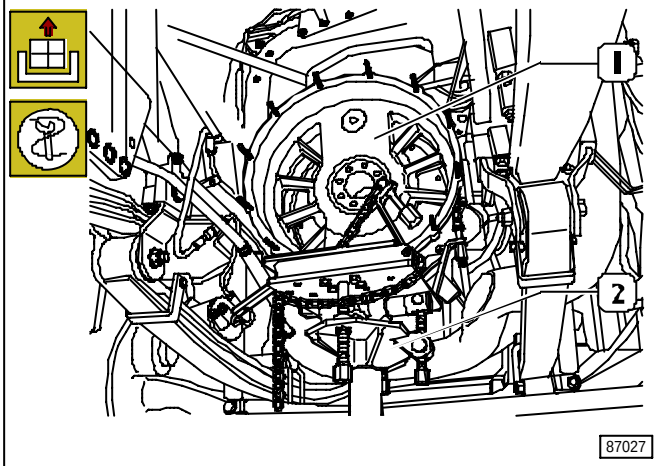
**NOTE** To gain access of the remaining screws (2) which are not visible, turn the engine flywheel with tool 99360321 (4).

Figure 13




From the inside of the power take off case, remove the top fastening nuts (1) and the bottom fastening nuts (2).

Figure 14




Place a hydraulic lift fitted with support 99370629 (2) under the power take off case (1) and sling it with the appropriate chain (1).
Remove the nuts and the power take off case from the engine.

## Refitting

To refit the power take off assembly, reverse the removal procedure and observe the following precautions:

- lubricate the connecting shaft tang with MOLYCOTE HSC grease;
- apply LOCTITE 510 on the power take off assembly surface and the bottom cover;
- apply LOCTITE 242E oil on the screw or the contact plug threading;
- tighten the screws/nuts to the prescribed torque;

**NOTE** For angle tightening of the clutch coupling flywheel fastening screws use tool 99395216.

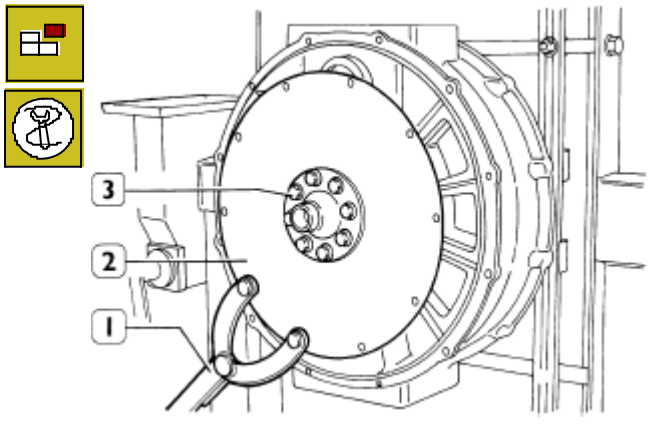
- the drive output flange fastening nut shall be tightened (if it was not carried out during overhaul) to torque 465 Nm (46,5 kgm) after fitting the power take off assembly ;
- fill the assembly with the lubrication oil of the recommended type and in the prescribed quantity.

Aquila Trucks Centres

## OVERHAULING

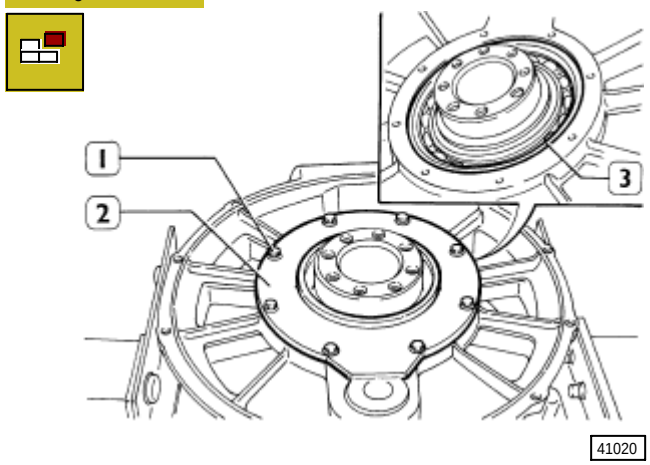
### Disassembling the main box

Figure 15



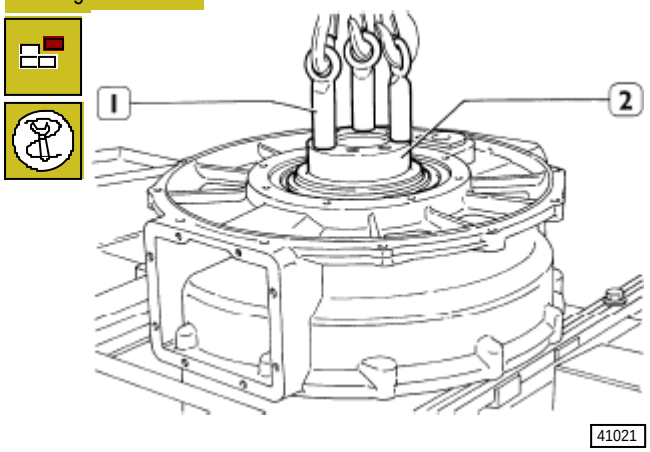

Position the whole assembly on the rotary stand 99322205. Lock the rotation of the laminar coupling (2) with the reaction lever 99370317 (1) and using a suitable wrench unscrew the retaining screws (3). Remove the laminar coupling and the flange.

Figure 16




Unscrew the screws (1), take off the cover (2) together with the seal and recover the adjustment ring (3).

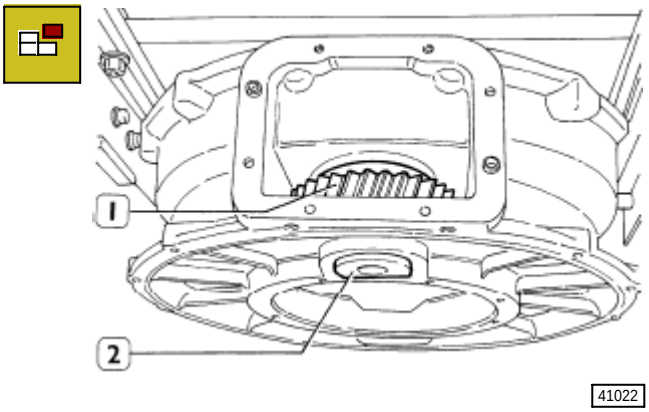
Figure 17




Using the eyebolt 993605003 (1) and lift, remove the shaft with the gear wheel (2).

### 534510 Disassembling the drive assembly

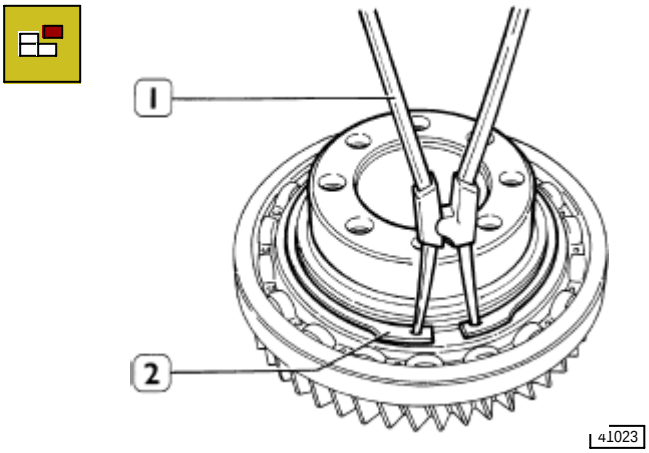
Figure 18




Using an appropriate drift, drive out the shaft (2) and extract the middle gear (1). Take the seal out of the box.

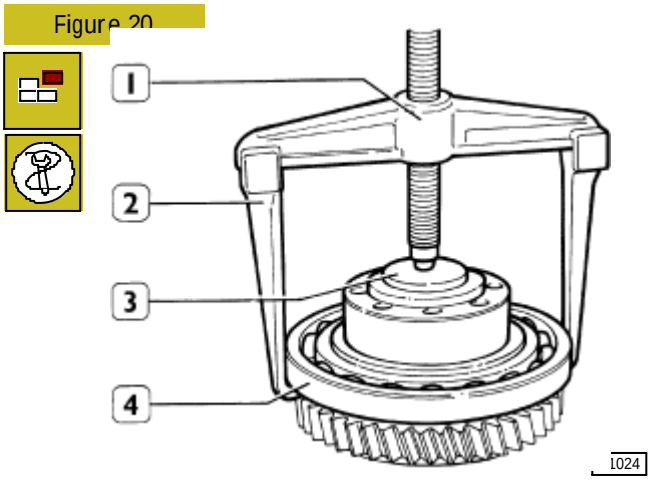
### Disassembling bearing for shaft with gear wheel

Figure 19




Using suitable pliers (1), remove the seeger ring (2).

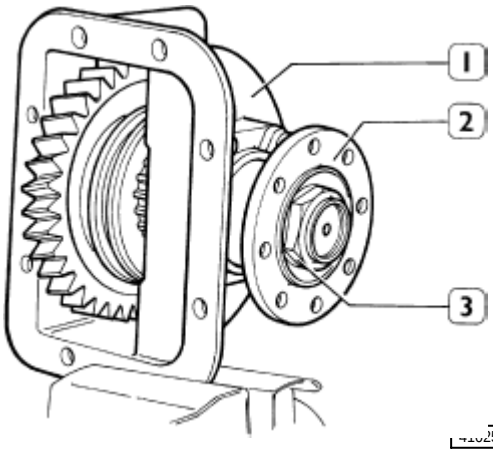
Figure 20




Extract the ball bearing (4) with the extractor 99341003 (1), grips 99341009 (2) and reaction block 99345049 (3).

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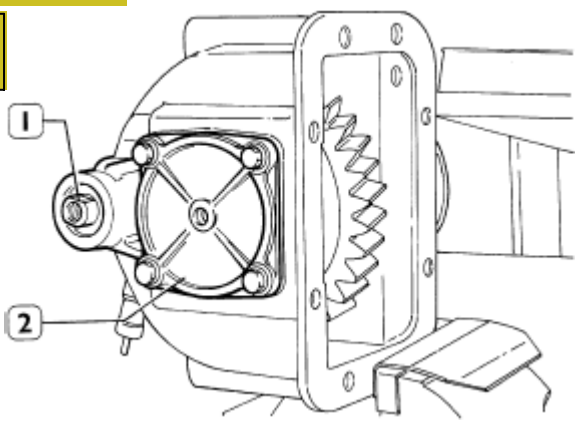
Figure 21




41025

Put the assembly in a vice, unscrew the nut (3), extract the flange (2), unscrew the screws and remove the cover (1).

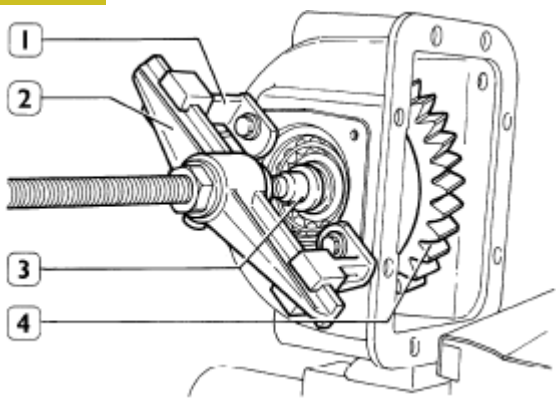
Figure 22




41026

Unscrew the screws and take off the cover (2); recover the adjustment ring.
Take off the split ring and extract the fitting (1); unscrew the electric transmitter.

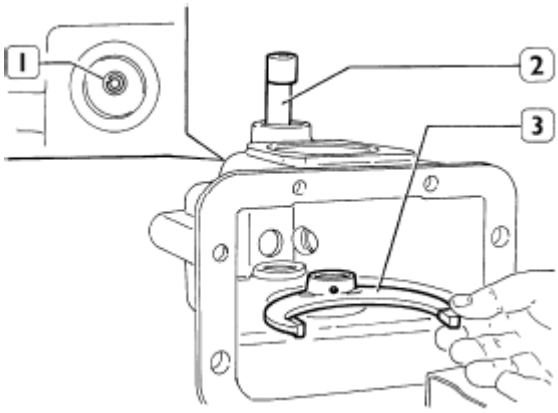
Figure 23




41027

Apply the extractor 99341002 (2) with the grips 99341016 (1) and extract the toothed output shaft (3).
Take out the gear (4).

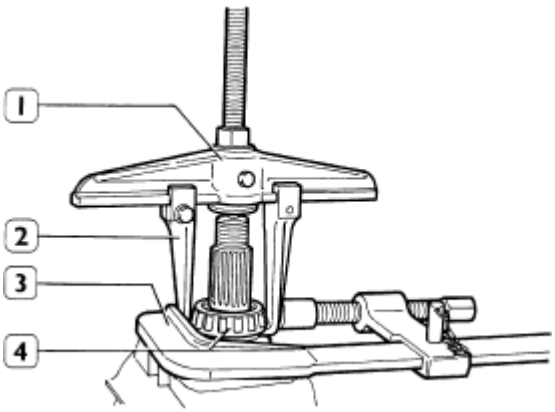
Figure 24




41028

Drive out the spring pin (1), take out the shaft (2) and the drive fork (3).

Figure 25

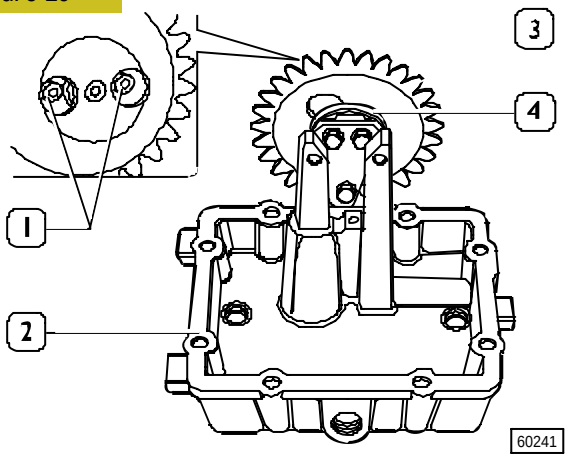



41029

Put the toothed output shaft in a vice. Using the extractor 993441002 (1), grips 99341009 (2) and clamp 99341015 (3), extract the tapered roller bearing (4).

## 534532 Disassembling the oil pump

Figure 26



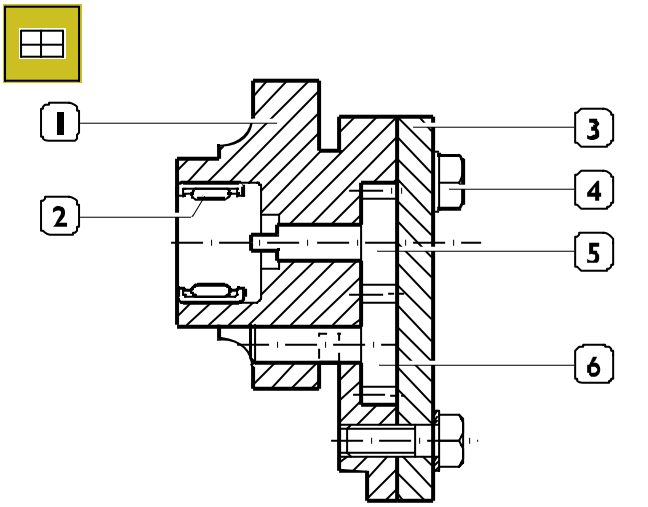

60241

Extract the shaft together with the gear (3) from the oil pump (4). Unscrew the screws (1) securing the oil pump (4) and detach it from the cover (2).

Aquila Trucks Centres

## Assembling the oil pump

Figure 27




71567

Take out the fixing screws (4) and remove the cover (3) from the pump casing (1).
Extract the gear shafts (5 and 6) from the pump casing (1).
Using a suitable extractor, remove the roller bearing (2) from the pump casing (1).

### Cleaning and checking parts

After completing removal, immerse all the parts except for the bearings in a wash tank containing a solution of water and soda heated to a temperature of 80 to 85°C until the lubricant residues have dissolved.

Using a wire brush and scraper, get rid of any deposits on the parts, remains of gaskets and traces of Loctite and sealant from the mating surfaces, taking care not to damage them.

Wash again and dry the parts with compressed air.

Using a benchtop electric cleaning machine with wire brushes, remove any remains of Loctite and sealant from the threads of the screws.

To clean the bearings thoroughly, you need to put them in a bath of kerosene and, with the aid of a brush, eliminate all traces of lubricant.

Dry them with compressed air, bearing in mind that the jet of air must not cause the bearings to turn.

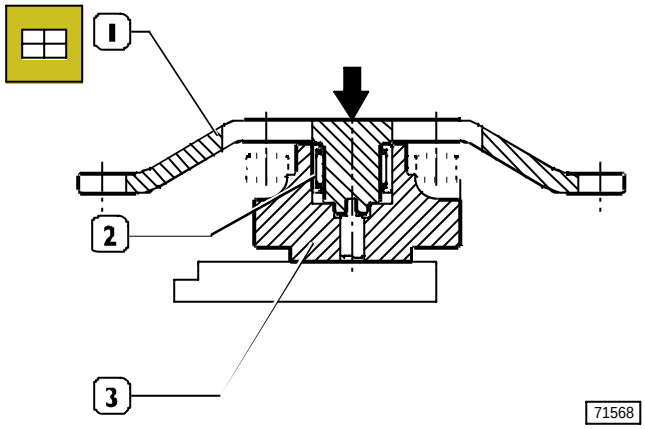
Then lubricate the bearings with oil of the same type used for the gears.

Keeping the bearings pressed down by hand while turning them slightly in both directions you should feel no roughness nor hear any noise as they move.

Carefully check that the rollers and cages, as well as the external and internal rolling races, are not worn.

Check all the parts to decide whether to reuse them or replace them.

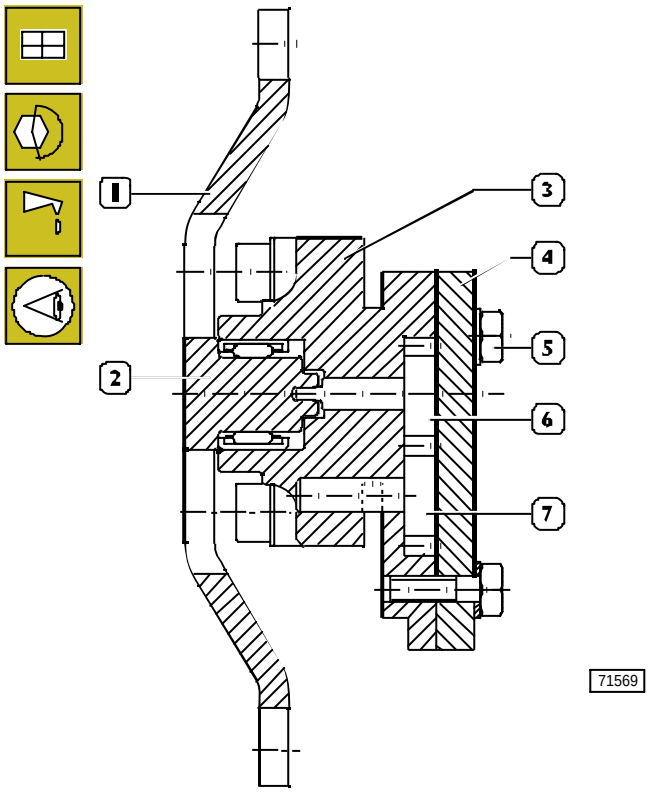
Figure 28




71568

Key the roller bearing (2) onto the driven gear shaft (1).
Apply a press on the gear (1) so as to fit the roller bearing (2) in the pump casing (3).

Figure 29




71569

Mount the gear (6) in the pump casing so that the end of the shaft goes into the corresponding compartment of the shaft (2) of the driven gear (1) and the gear (7).

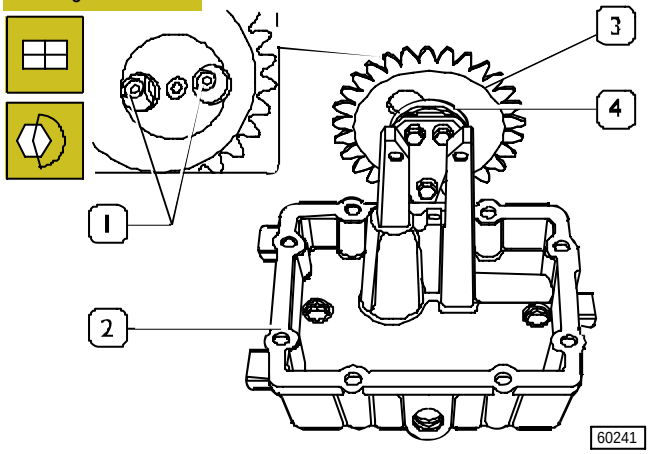
**NOTE** The gears need to be lubricated beforehand.

Put the cover (4) on the pump casing (3). Screw down the fixing screws (5) and tighten them to the required torque.

**NOTE** When handling the oil pump, take care the shaft (2) of the driven gear does not come out of the gear shaft (6).

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Figure 30



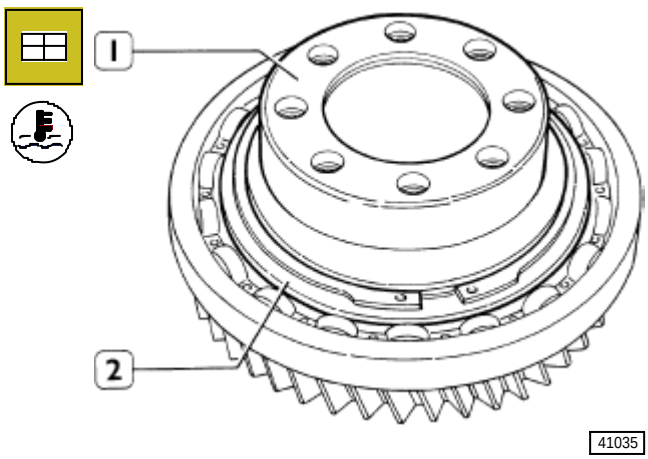

60241

Put the oil pump (4) on the bottom cover (2) and secure it there with the screws (1), tightening them to the required torque.

**NOTE** When handling bottom cover (2), take care the shaft of the driven gear (3) does not come out of the oil pump gear shaft.

## Assembling the bearing for shaft wth gear wheel

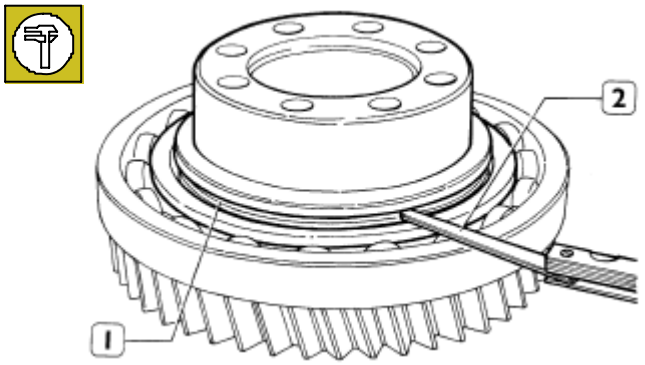
Figure 31




41035

Heat the internal ring of the bearing (2) to approx. 80ºC and key it on the shaft (1).
Leave it to cool to pass on to the next step.

Figure 32

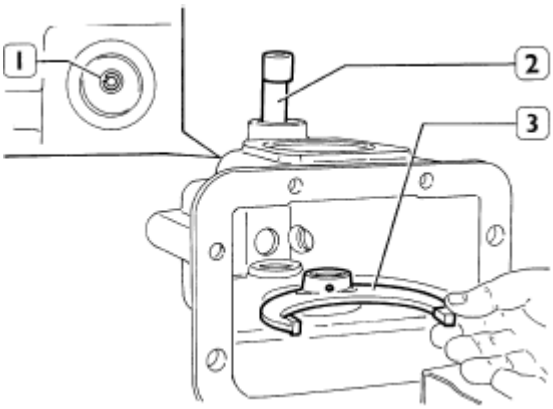



41036

Using a feeler gauge (2), measure the gap (1) between the bearing and the seat of the seeger ring. Then select the seeger ring that gives the less clearance possible.

## Fitting drive assembly

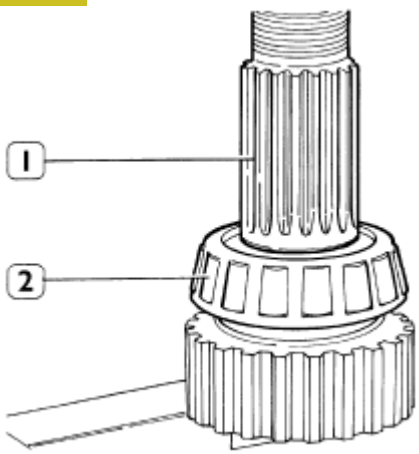
Figure 33




41028

Put the box in a vice.
Fit on the fork (3), key on the shaft (2) and drive on the spring pin (1).

Figure 34

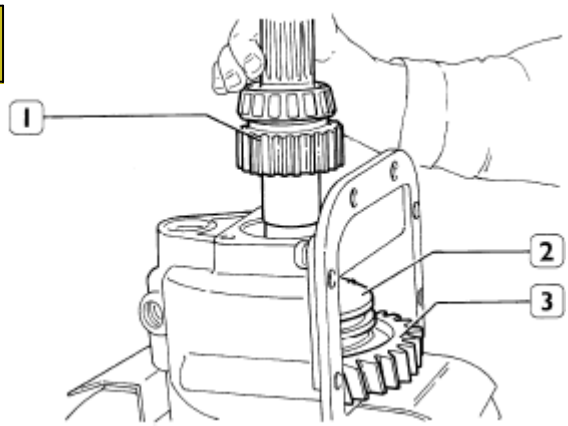



41037

Heat the internal ring of the bearing (2) to approx. 80ºC and key it on the toothed shaft (1).

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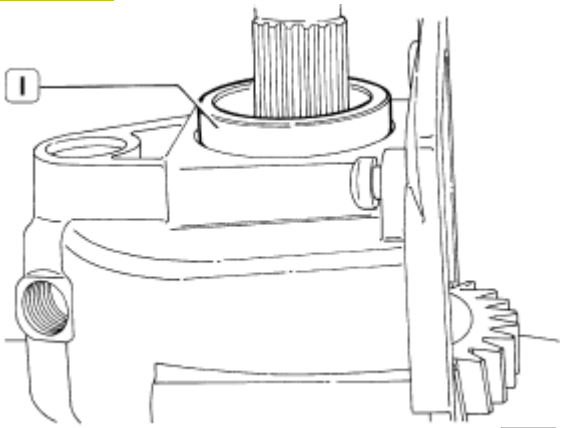
Figure 35




41038

Put the gear (3) together with the sliding sleeve (2) in the box; insert the toothed shaft (1).

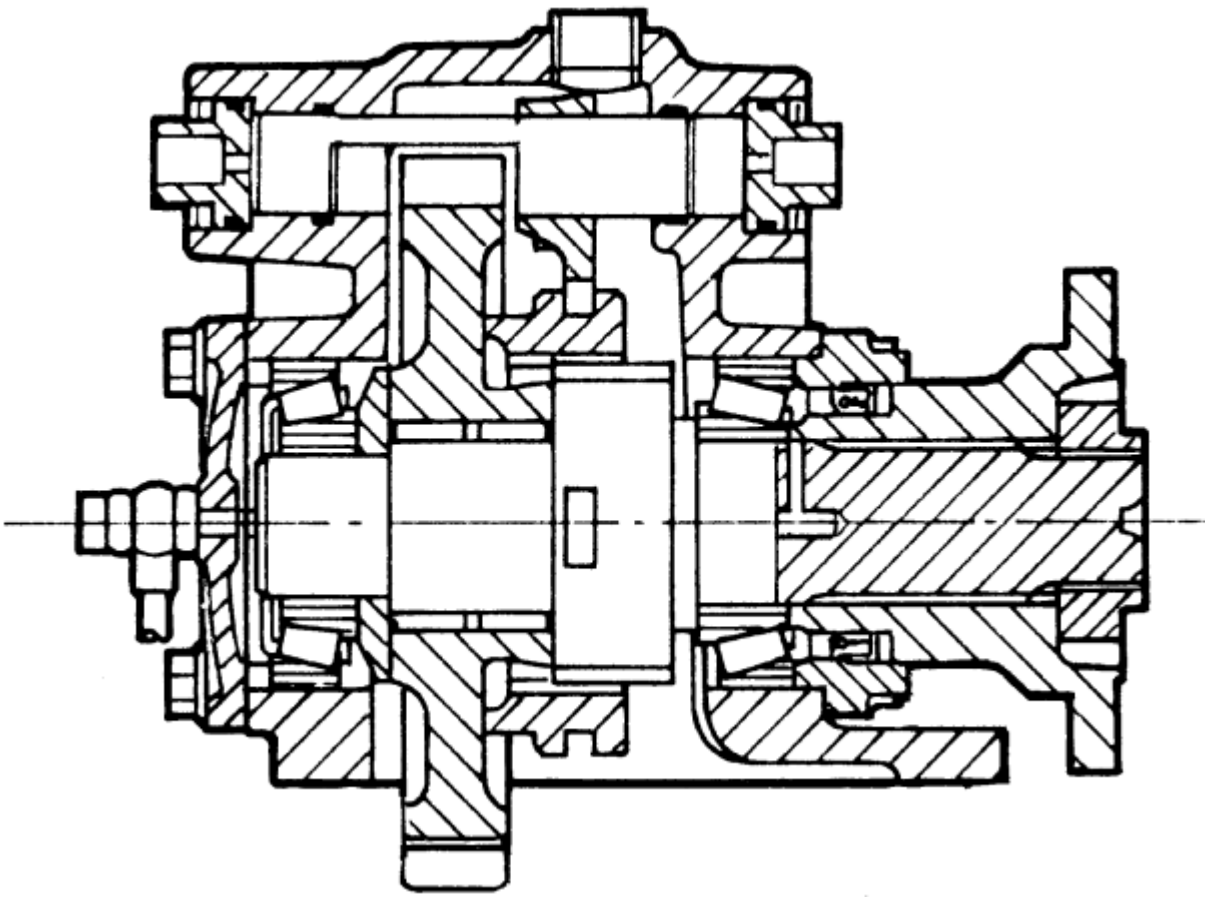
Figure 36




41040

Fit on the external ring (1) for the bearing.

Figure 37



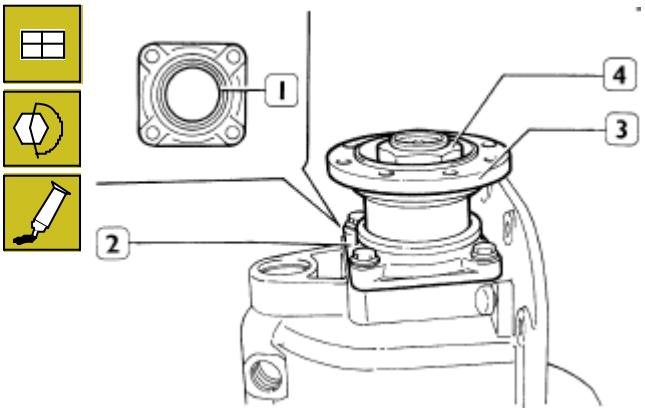
41039

SECTION OF DRIVE ASSEMBLY

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## Adjusting drive output shaft tapered bearings

Figure 38

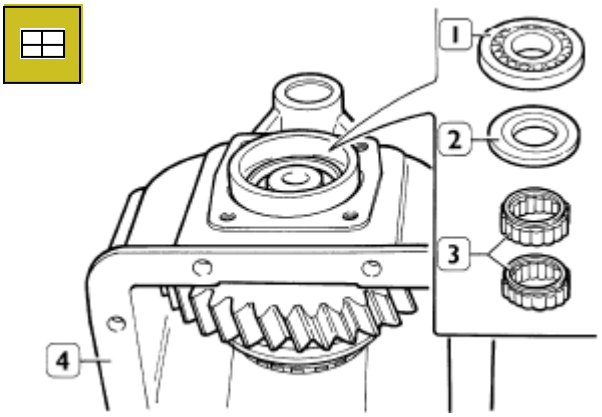



41041

Using an appropriate drift, fit the seal (1) in the cover (2). Apply LOCTITE 410 on the supporting surface. Mount the cover (2) and tighten the screws to a torque of 18 Nm. Fit on the flange (3) and screw down the nut (4) by hand.

**NOTE** Tightening the nut (4) to a torque of 380 Nm (38 kgm) has to be done on the vehicle, after fitting the drive assembly on the main box.

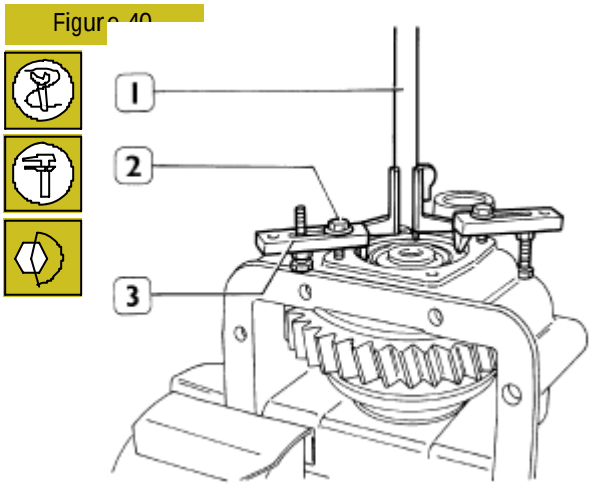
Figure 39




41042

Take the box (4) out of the vice and turn it over. Fit the roller bearings (3), thrust washer (2) and tapered roller bearing (1) on the shaft.

Figure 40

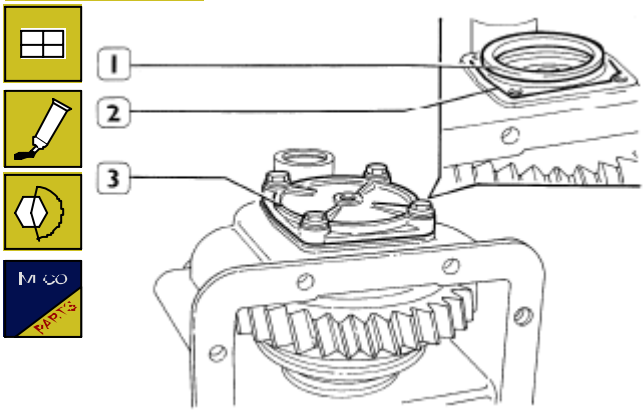



41043

Fit the plates 99363241 (3) on the outer ring of the bearing. Tighten the screws (2) to a torque of 18 Nm (1.8 kgm), corresponding to an axial load of approx. 250 kg, and turn the output shaft.
Using a feeler gauge (1), measure the distance between the supporting surface and the outer ring of the bearing.
The measurement will correspond to the thickness of the adjustment ring.

**NOTE** The thickness of the adjustment ring will have to be selected by rounding off.
For example, measurement 6 to 6.04 mm, select ring of thickness 6 mm.
measurement 6.05 to 6.09, select ring of thickness 6.1 mm.

Figure 41



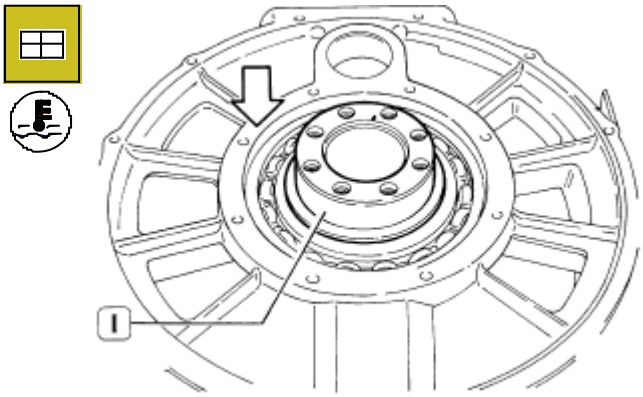

41044

Mount the adjustment ring (1). Apply LOCTITE 510 sealant on the supporting surface (2). Mount the cover (3) and lock the screws to a torque of 18 Nm (1.8 kgm).
Replace the seals on the fittings (2-12, Figure 4) then mount them and position the split rings (1-13, Figure 4). Screw on the transmitter (7, Figure 4).

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## Assembling the main housing

Figure 42

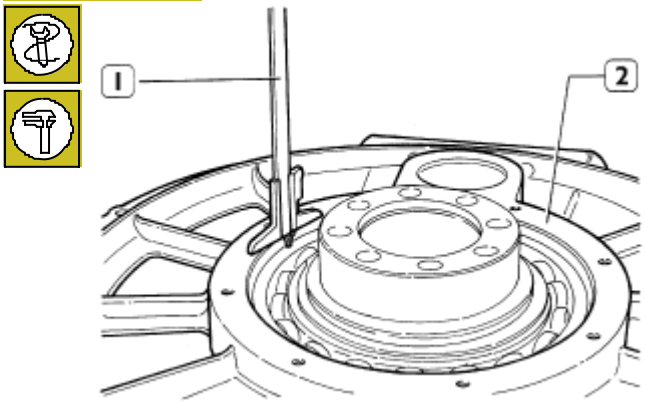



41045

Slightly heat the seat (⇓) for the ball bearing on the box and mount the shaft (1) with the gear wheel together with the bearing.

## Adjusting ball bearing

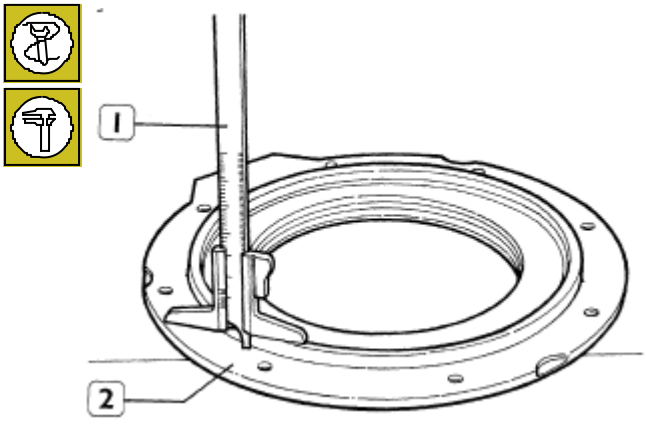
Figure 43




41046

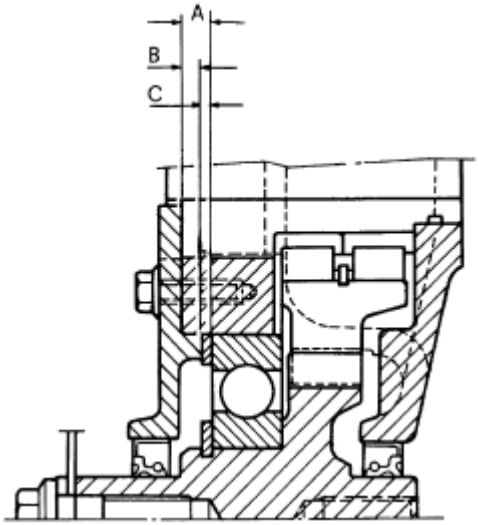
Measure the distance (A, Figure 45) on the main box (2) with a feeler gauge (1).

Figure 44




Measure the distance (B, Figure 45) on the cover (2) for the bearing with a feeler gauge (1).

Figure 45



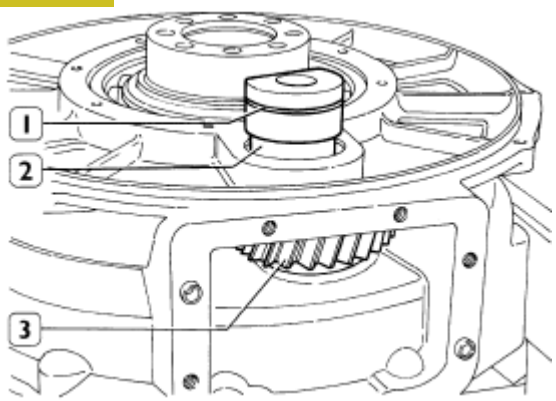

41048

PARTIAL SECTION OF BEARING AND SHAFT WITH GEAR WHEEL

The value "C" of the adjustment ring is given by the following formula: A - B = C

**NOTE** If the value of "C" is the same as the nominal thickness of the adjustment ring (see table on page 4), fit the relevant ring.
Whereas, if "C" is different, fit the adjustment ring for the smaller value.
For example, "C" = 4.14 to 4.11 mm, fit the ring of 4.1 mm.

Figure 46

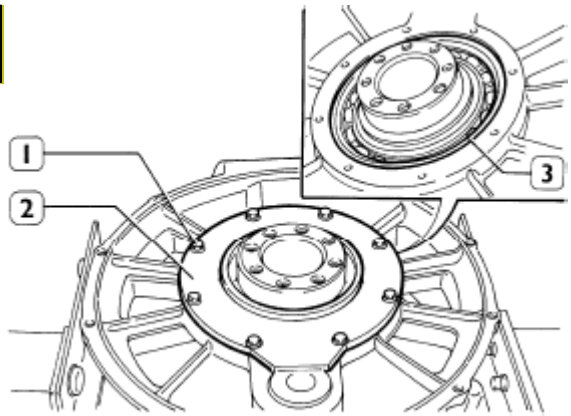



41049

Fit the middle gear (3) in the box, drive in (2) after replacing the seals (1).

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Figure 47

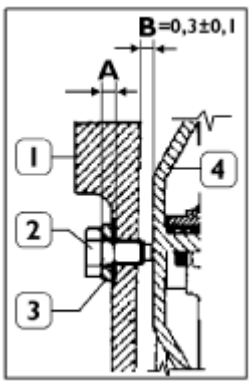



41020

Fit the setting ring (3), apply LOCTITE 510 sealant to the contact surface; fit the cover (2) complete with choke ring and tighten the screws (1) to torque 22 Nm (2.2 kg).

**NOTE** To fit the seal ring into cover (2) and on the opposite side of the box, use tool SP 2481 illustrated on page 8.

Figure 48




If the shoulder screw (2) of the oil pump gear (4) has been removed from the case (1), measure the adjusting washer thickness (3) as follows.

Temporarily fit the bottom cover with the oil pump.
Screw down the screw (2) without the washer (3) in contact with the driven gear (4).
Using a feeler gauge, measure the distance between the underside of the head of the screw (2) and the box (1), distance A.

Take out the screw (2), apply LOCTITE 242E on its thread and screw it back on, placing a washer in between with a thickness of:

$$S = A + B$$

where A is the distance measured

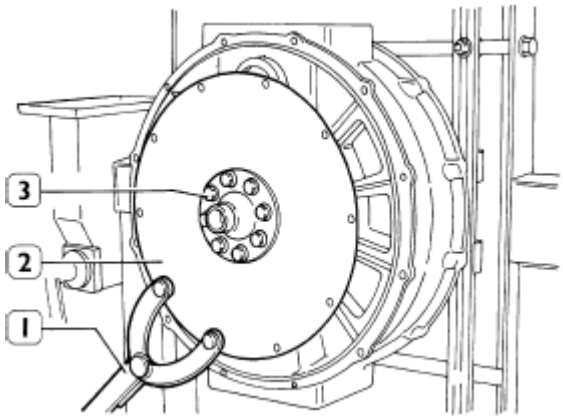
$$B = 0.3 \pm 0.1$$

corresponding to the distance between the end of the screw (2) and the driven gear (4).
Tighten the screw (2) to the required torque.

**NOTE** Screw (2) has a left-hand thread.

Remove again the bottom cover with the oil pump.

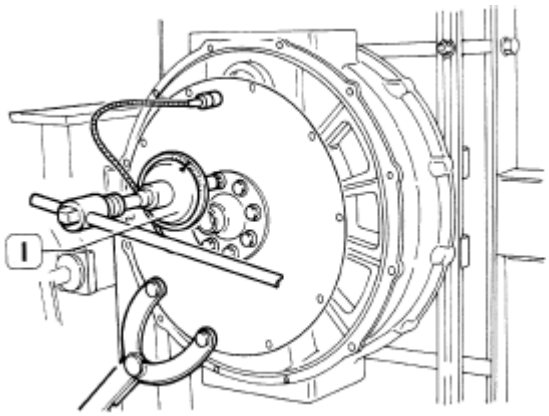
Figure 49




41019

Fit the joint (2) with the flange and clamp it with the reaction lever 99370317 (1); fasten the screws (3) to torque 95 Nm (9.5 Kgm) 1st step.

Figure 50




41050

Fit tool 99395216 (1) to a box spanner and tighten the screws by a further 60°, 2nd stage.

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SECTION 6

# 5054 Transfer box TC 1800-TC 2200


| | Page |
|---|---|
| DESCRIPTION OF TRANSFER BOX ASSEMBLY TC 1800 - TC 2200 | 3 |
| MAIN DATA | 3 |
| VERSION WITH P.T.O. (OPT. 391-392) | 5 |
| P.T.O. SPECIFICATIONS | 5 |
| USING THE TRANSFER BOX | 6 |
| - On-road driving (normal ratio) | 6 |
| - Diagram of drive transmission with normal ratio | 7 |
| - Off-road driving (reduced ratio) | 8 |
| - Center differential locking | 9 |
| - Version with P.T.O. | 10 |
| TORQUE TRANSFER | 13 |
| - Transfer ratio calculation | 13 |
| - Control locking divider and differential gears | 14 |
| TIGHTENING TORQUES | 16 |
| TOOLS | 20 |
| LUBRICATION | 24 |
| TRANSFER BOX REMOVING AND REFITTING | 25 |
| - Removal | 25 |
| - Refitting | 25 |
| DISASSEMBLING THE TRANSFER BOX | 25 |
| CLEANING AND CHECKING PARTS | 29 |
| REPLACING OUTPUT SHAFT COVER SEALS | 29 |

https://truckmanualshub.com/
Aquila Trucks Centres

Page


REPLACING INPUT SHAFT COVER SEAL ..... 29

INPUT SHAFT ..... 30

- Removal ..... 30

- Fitting ..... 30

EPICYCLIC TORQUE TRANSFER UNIT ..... 31

- Removal ..... 31

- Fitting ..... 32

COUNTERSHAFT ..... 32

- Removal ..... 32

- Fitting ..... 32

ASSEMBLING THE TRANSFER BOX ..... 33

ADJUSTING THE BEARING PRE-LOAD ..... 36

- Input shaft ..... 36

- Countershaft ..... 36

- Output shaft ..... 37

COMPLETING ASSEMBLY ..... 38

- Adjusting push-rod switch signalling interaxle locking and P.T.O. engagement (if applicable) ..... 39

- Adjusting pulse transmitter ..... 39

- Replenishing oil ..... 39

Aquila Trucks Centres

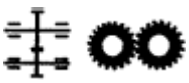
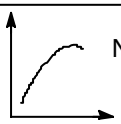
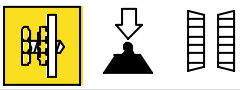
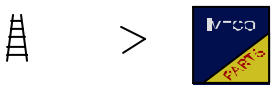
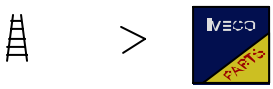
## DESCRIPTION OF TRANSFER BOX ASSEMBLY TC 1800 - TC 2200

The transfer box is located between the gearbox and the middle axle.
It is composed of a set of constant mesh helical spur gears.
These gears are mounted on three shafts: input shaft, countershaft and secondary output shaft.
The sliding toothed sleeve for coupling normal gears (on road) and reduced gears (off road) is mounted on the input shaft.

The interaxle differential gear that provides independent speed transmission between the front and rear axles is mounted on the output shaft.
In addition, there is the differential locking device.
The transfer box is made in two versions:

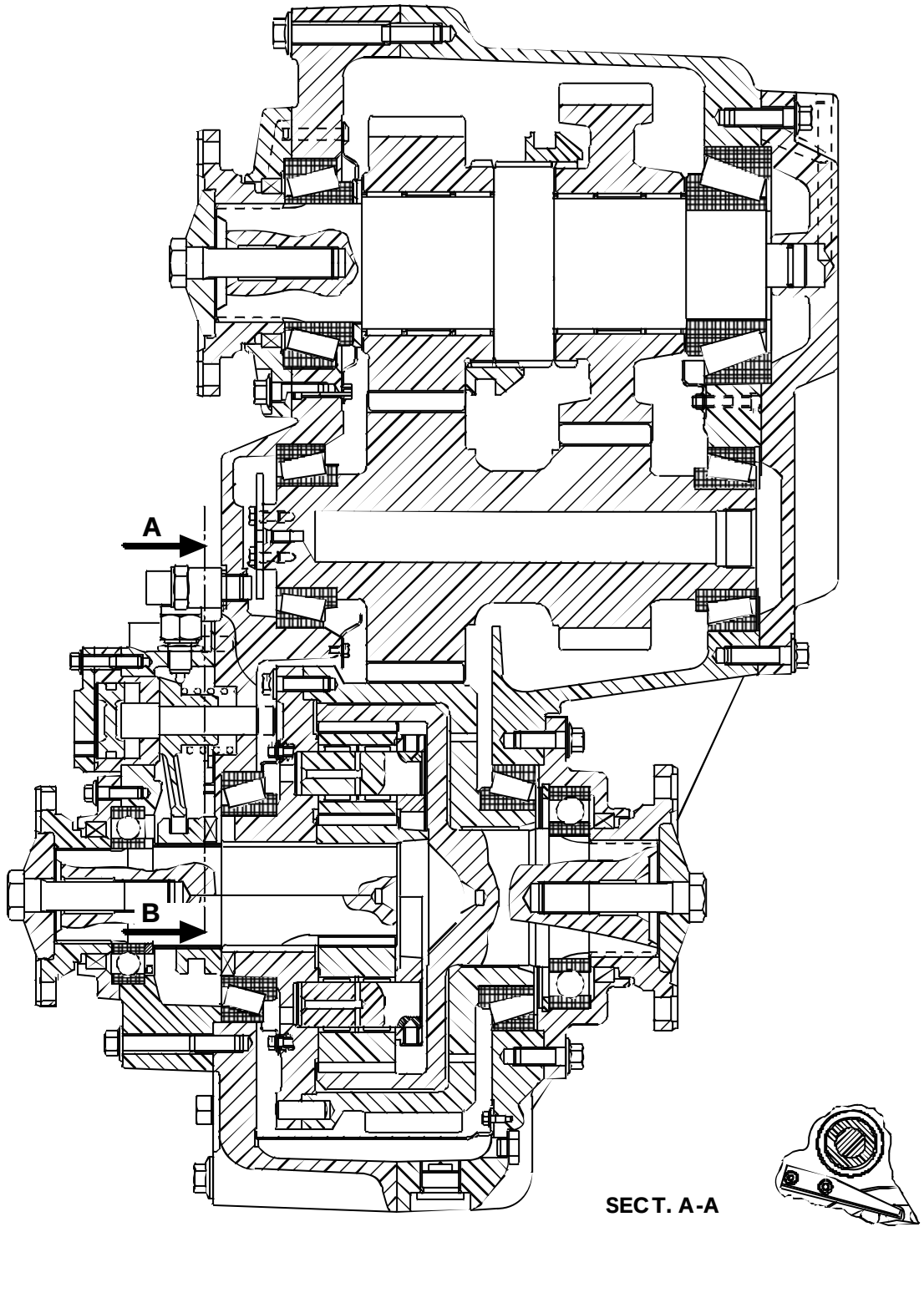
- For vehicles with two axles (4x4) and four axles (8x8) with a division of 1:2:2.
- For vehicles with three axles (6x6) with a division of 1:4:0.

## MAIN DATA

| | | TC 1800 | TC 2200 |
|---|---|---|---|
|  | Gears | Constant mesh helical spur gears | |
|  | Transmission ratios:<br>normal (on road)<br>reduced (off road) | <br>1 : 1<br>1 : 1.6 | |
|   | Maximum input torque Nm | 18,000 | 22,000 |
|  | 4x4 vehicles<br>Torque reduction<br>6x6 vehicles | 1 : 2.2<br><br>1 : 4 | |
|  | Bearing pre-load for:<br>input shaft<br>countershaft<br>output shaft | <br>0.05 ÷ 0.10 mm | |
|  | Bearing pre-load adjustment | with adjustment rings | |
|  | Adjustment ring thickness<br>input shaft mm<br>countershaft .mm<br>output shaft mm | <br>1-1.1-1.2-1.3-1.4-1.5-1.6-1.7-1.8-1.9<br>1-1.6-1.7-1.8-1.9-2.0-2.1-2.2-2.3-2.4-2.5<br>1-1.1-1.2-1.3-1.4-1.5-1.6-1.7-1.8-1.9-2 | |
|  | Thickness of adjustment rings for pulse transmitter mm | 1 - 1.5 | |
|  | Type of oil<br>- for arctic climate only<br>Quantity litres | **TUTELA ZC 90**<br>**TUTELA GI/A**<br>6.5 | |
|  | Weight of reduction gear - divider kg | 265 | - |

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Figure 1

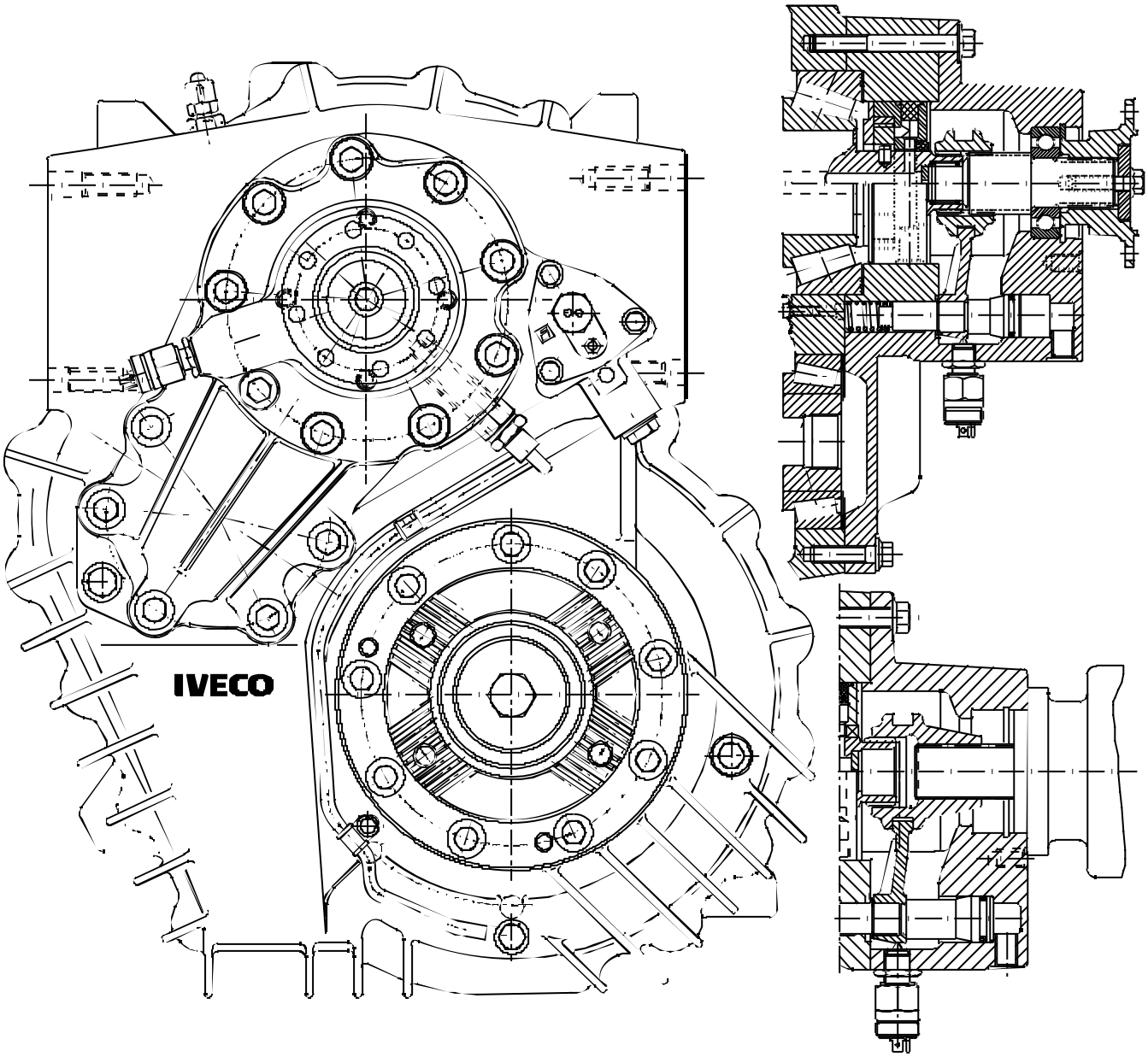



LONGITUDINAL SECTION OF TRANSFER BOX

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## VERSION WITH P.T.O. (OPT. 391-392)

Figure 2



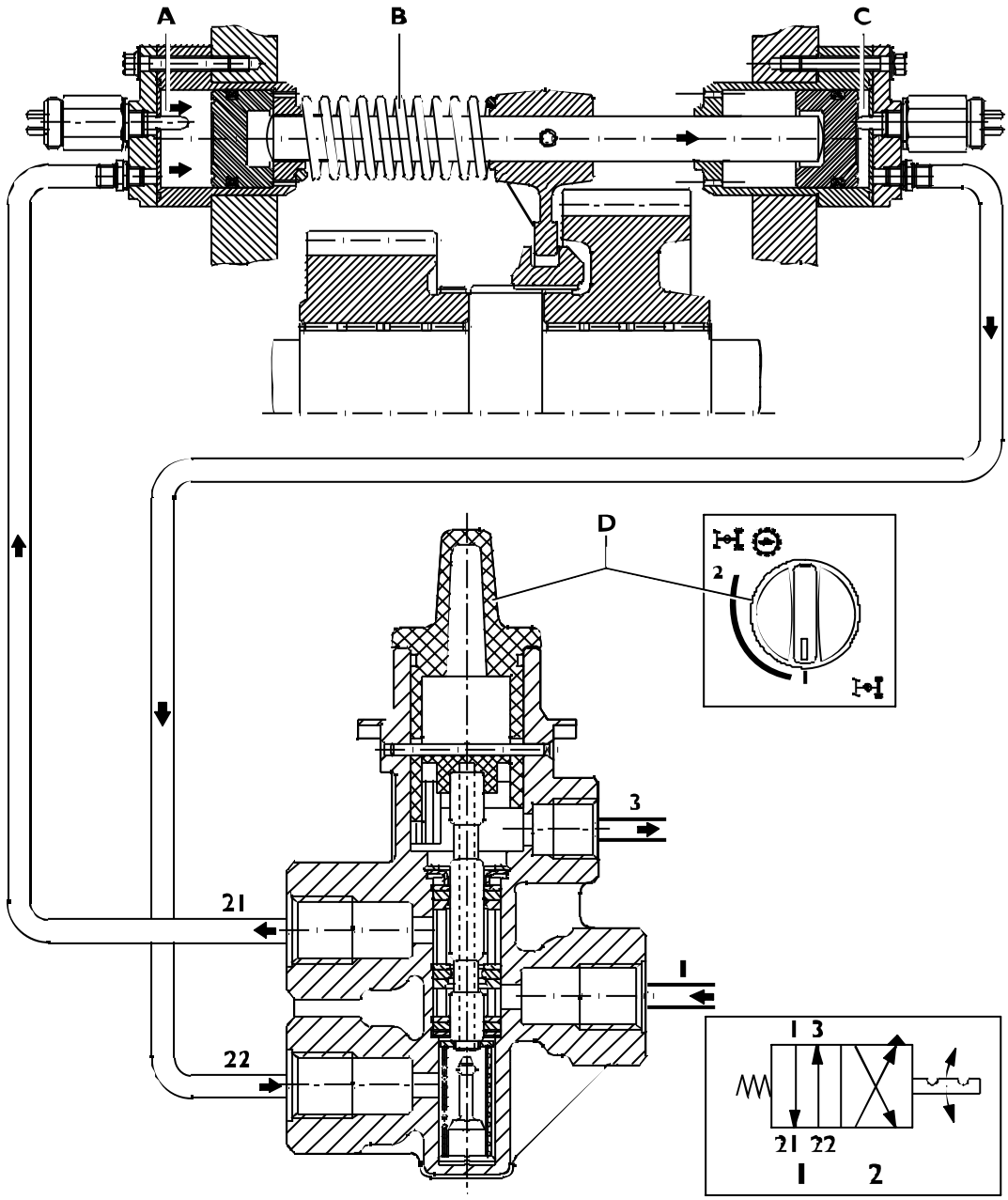

## P.T.O. SPECIFICATIONS

| | | |
|---|---|---|
| Max. torque available | 1,180 Nm | |
| Ratio | 1 : 1 | |
| Direction of rotation | same as engine | |
| P.T.O. coupling control | Pneumatic | |
| Connection version | Flange | Pump |

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## USING THE TRANSFER BOX
## On-road driving (normal ratio)

Figure 3




With the control knob D on I, the incoming air at the fitting I passes through the distributor and comes out of the fitting 21 and, going to supply the chamber A, causes the piston to move to its limit stop.

Control knob positions:

- position 1 = on-road driving.
- position 2 = off-road driving.

User instructions:

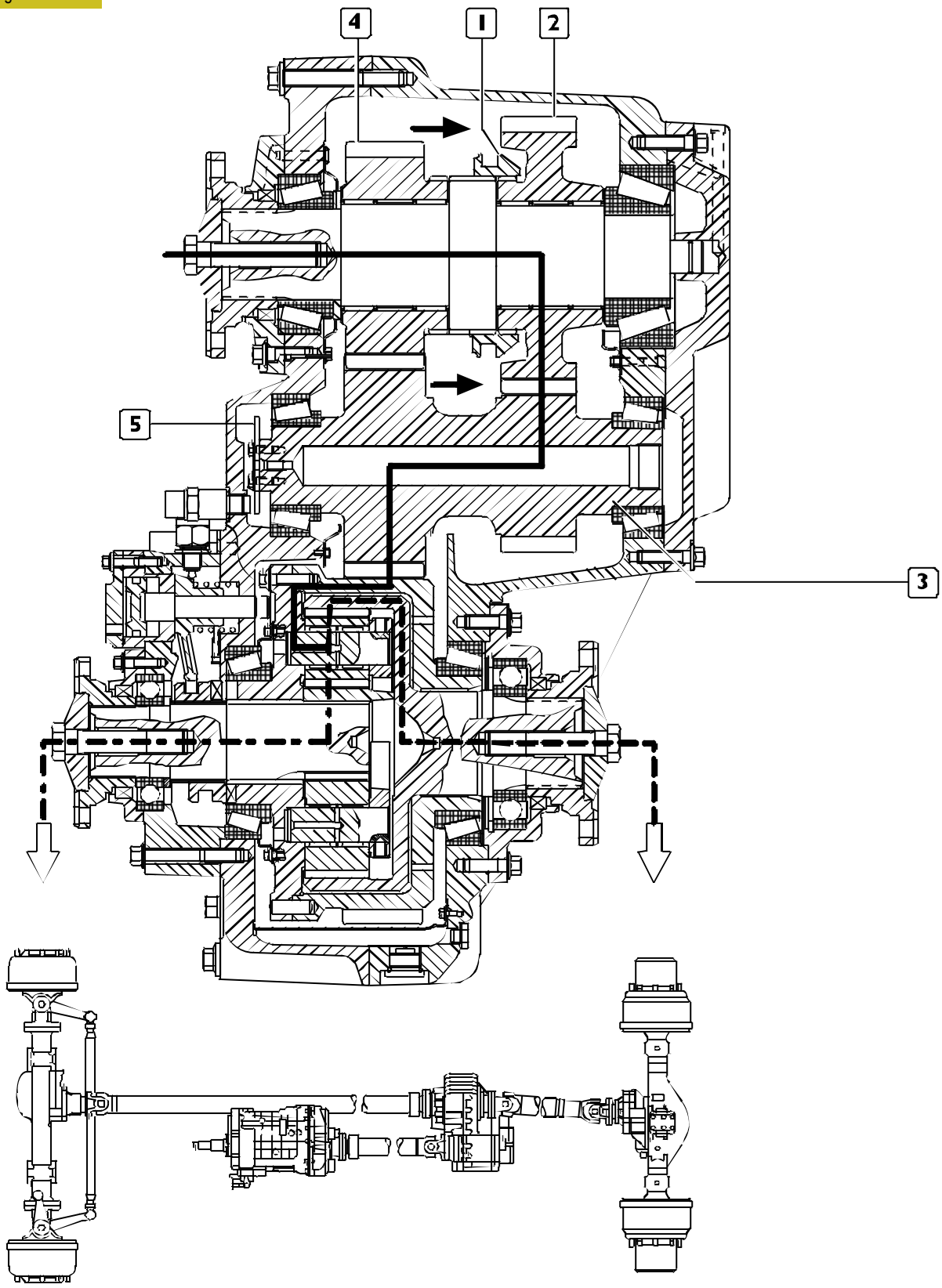
- release the throttle.
- turn the knob onto 1;
- never press the clutch pedal while operating the reduction gear control.

The spring B keeps the fork and the sleeve in the on-road ratio position.
The air in the chamber C gets discharged into the atmosphere through the fitting 3.

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## Diagram of drive transmission with normal ratio

Figure 4



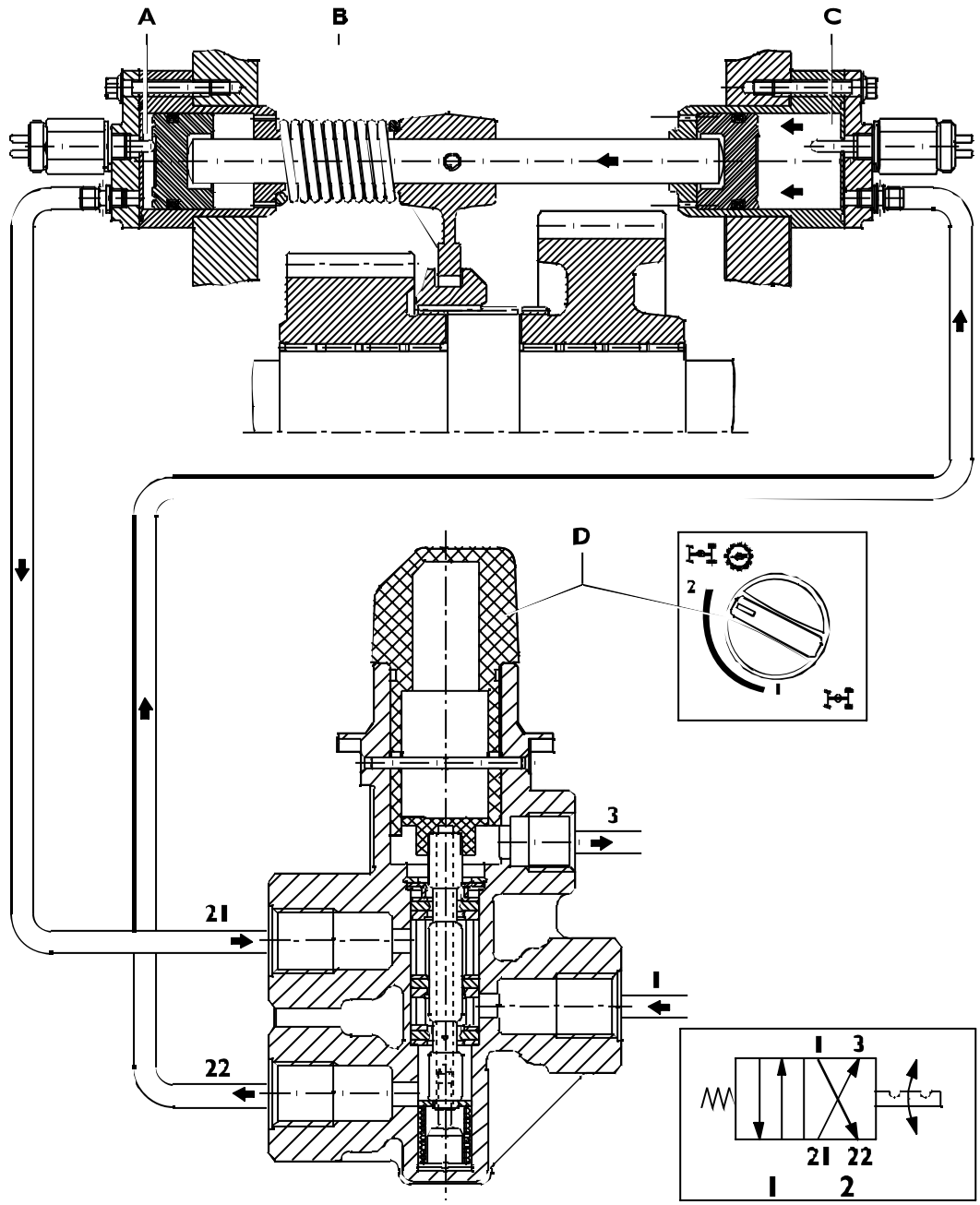

With the control knob on 1, the sleeve (1) moves in the direction of the arrows, making the gear (2) integral with the input shaft and thereby creating a 1:1 ratio with the divider unit.

The drive transmission passes through the countershaft (3), where the phonic wheel (5) is secured for reading the speed.

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## Off-road driving (reduced ratio)

Figure 5




With the control knob D on 2, the incoming air at the fitting I passes through the distributor and comes out of the fitting 22 and, going to supply the chamber C, causes the piston to move to its limit stop.

User instructions:

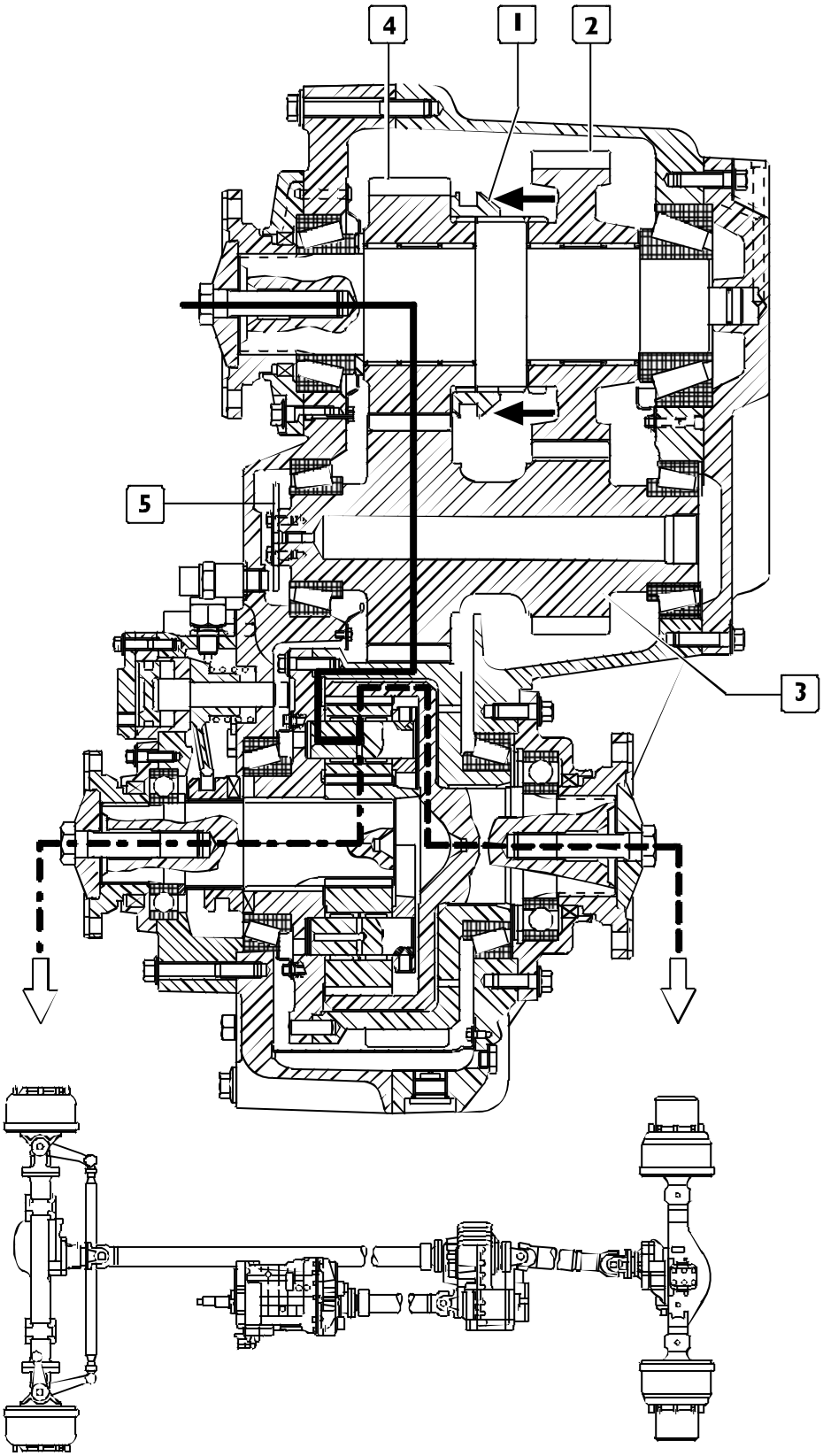
- Release the throttle.
- Turn the knob onto 1.
- Briefly press the throttle pedal.

The fork and the sleeve will move towards the off-road ratio. The movement of the piston will close the contact of the switch that will switch on the reduced speed indicator light on the dashboard.
The air in the chamber A gets discharged into the atmosphere through the fitting 3.

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## Diagram of drive transmission with reduced ratio

Figure 6




With the control knob on 2, the sleeve (1) moves in the direction of the arrows, making the gear (4) integral with the input shaft and thereby creating a 1:1.6 ratio with the divider unit.

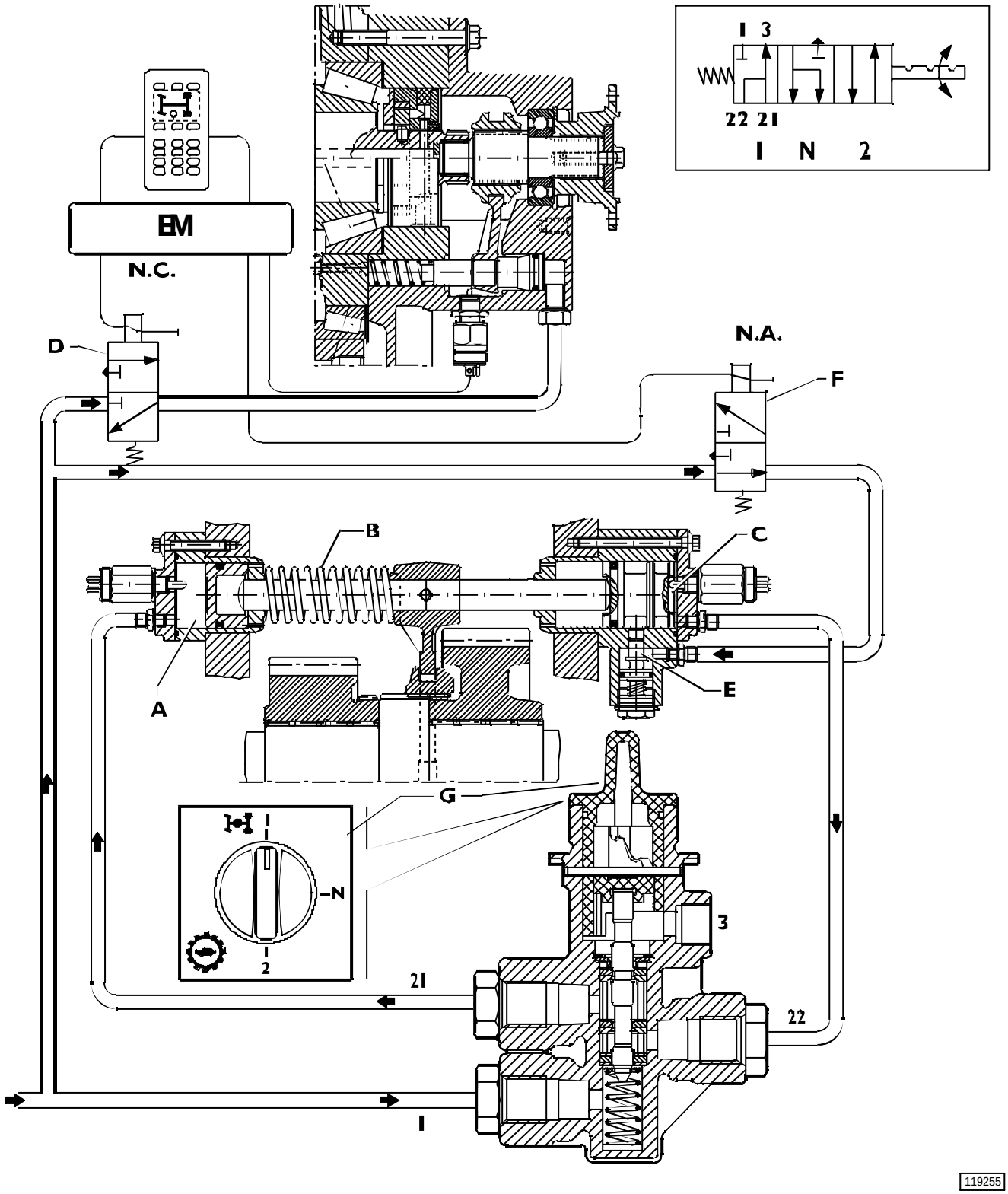
The drive transmission passes through the countershaft (3), where the phonic wheel (5) is secured for reading the speed.

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**Version with P.T.O.**

Control on on-road driving position

Figure 7



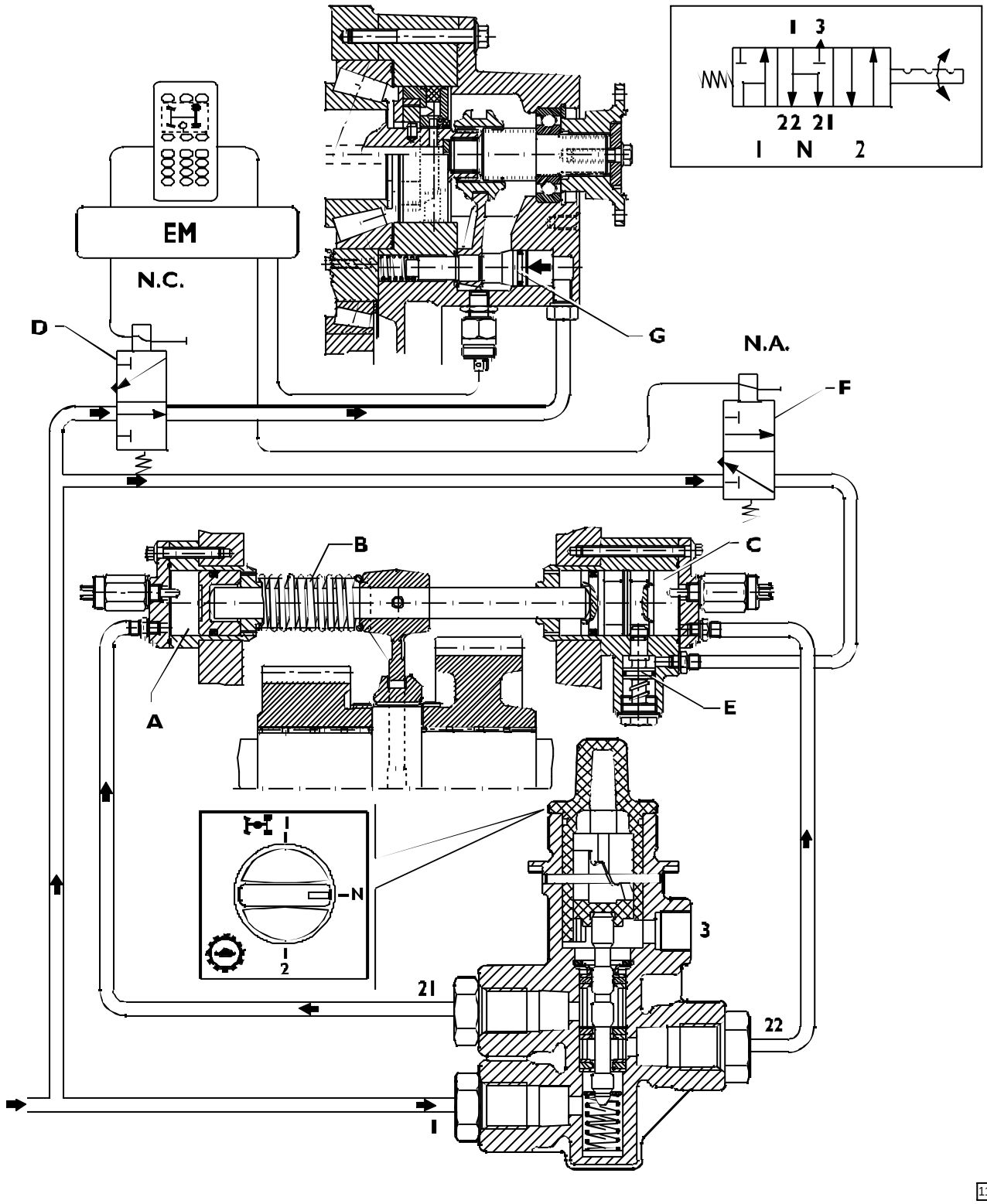

With the control knob on 1, the incoming air at the fitting 1 of the distributor will not supply the outlets 21 and 22.
The spring B keeps the fork and the sleeve in the on-road ratio position.

The chambers A and C of the cylinder are in communication with the atmosphere through the bleed of the distributor.
The push rod E, on receiving the air from the normally open solenoid valve F, will be turned off, thereby permitting the piston of the chamber C to be able to move.

Aquila Trucks Centres

Control on neutral position

Figure 8




With the knob on position N, the incoming air at the fitting 1 passes through the distributor and comes out of the fittings 21 and 22, thereby supplying both the chamber A and the chamber C, causing the fork and the sleeve to move into the neutral position.

Power take-off coupling

Turning on the electric power take-off control switch energizes the solenoid valves D and F simultaneously.

The normally closed solenoid valve D, on energizing, opens and supplies the power take-off coupling cylinder G.

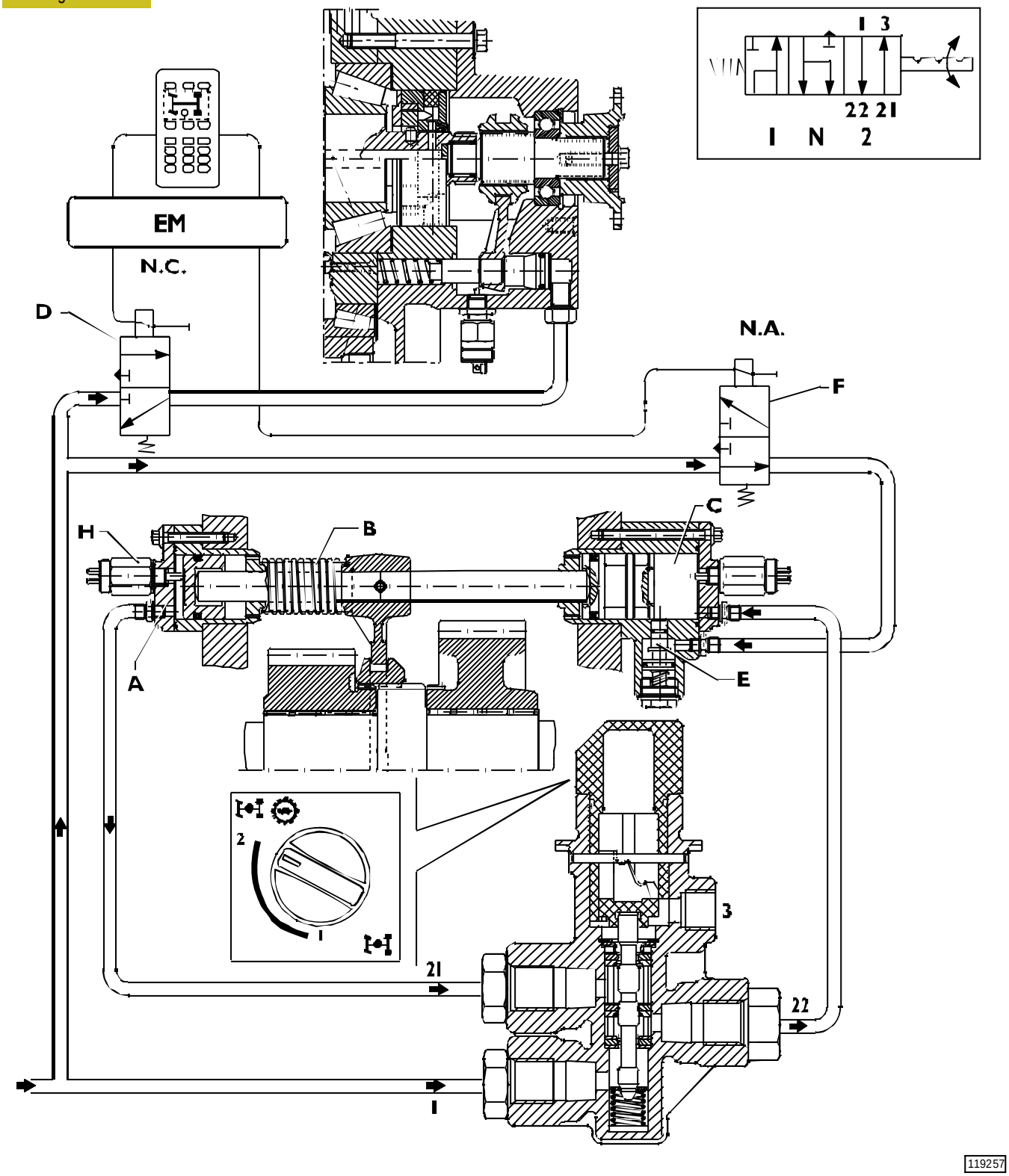
The normally open solenoid valve V, on energizing, closes and prevents the air from keeping the safety push rod E turned off.

This last condition is necessary to lock the piston and the fork in the neutral position.

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Control on off-road driving position

Figure 9




With the control knob on 2, the incoming air at the fitting 1 passes through the distributor and comes out of the fitting 22 supplying the chamber C and causing the piston to move to its limit stop.
The fork and the sleeve will move towards the off-road ratio gear.

The movement of the piston will close the contact of the switch H that will switch on the reduced speed indicator light on the dashboard and the air in the chamber A gets discharged into the atmosphere through the bleed 3 of the distributor.
The push rod E, on receiving the air from the normally open solenoid valve F will be turned off, thereby permitting the piston of the chamber C to be able to move.

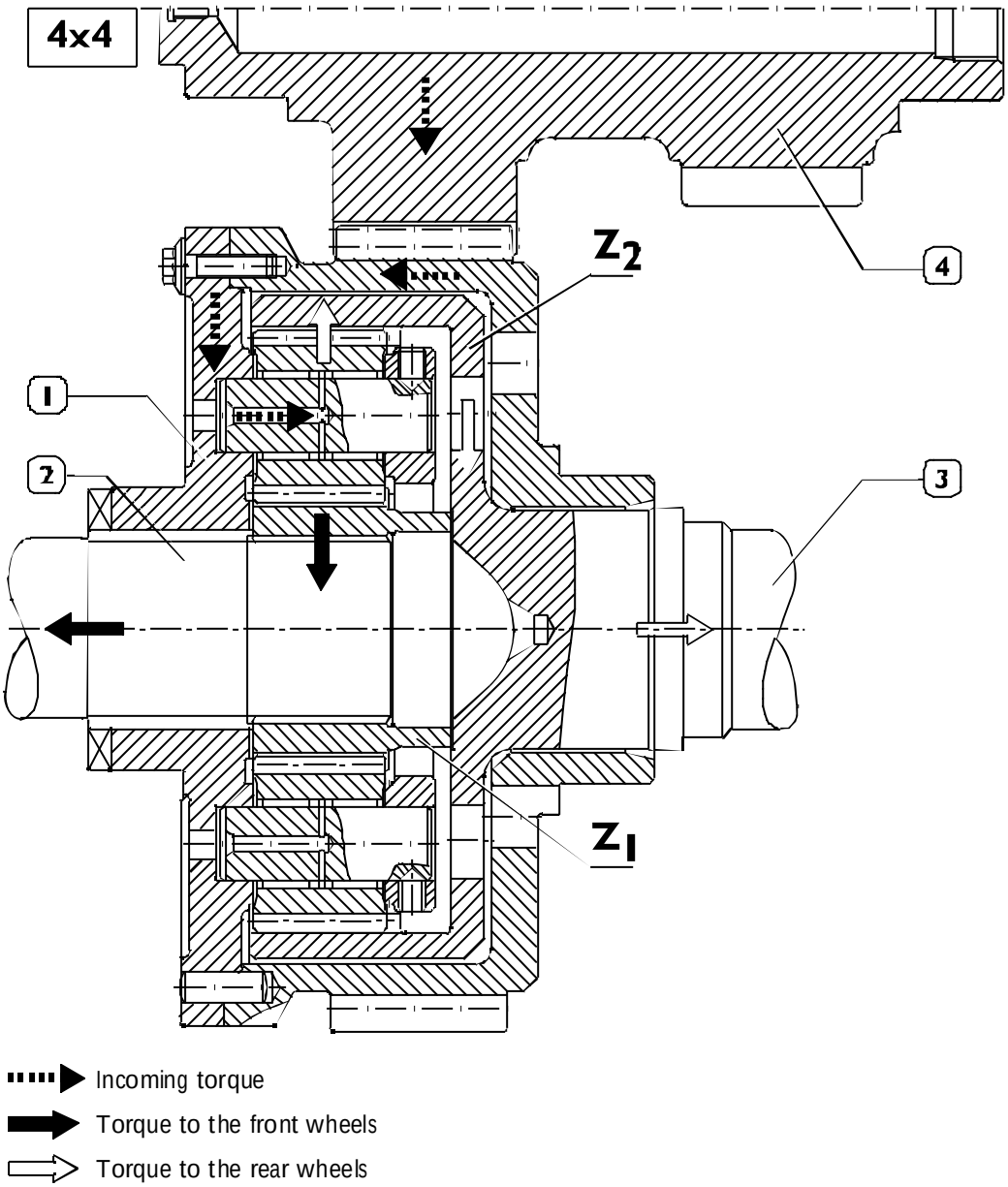
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## TORQUE TRANSFER

The drive transmitted by the input shaft through the countershaft (4) will turn the planet gear train (1), which via the ring gear $Z_2$ and the planet wheel $Z_1$ will transmit the drive to the rear (3) and front (2) output shafts.

### Transfer ratio calculation

Figure 10




4x4 - 8x8 vehicles

$$\text{Front axle } T_1 = \frac{Z_1}{Z_1 + Z_2} = \frac{33}{33 + 72} = 0,31$$

$$\text{Rear axle } T_2 = \frac{Z_2}{Z_1 + Z_2} = \frac{72}{33 + 72} = 0,68$$

$$\text{Total transfer} = \frac{T_2}{T_1} = \frac{0,68}{0,31} = 2,2$$

6x6 vehicles

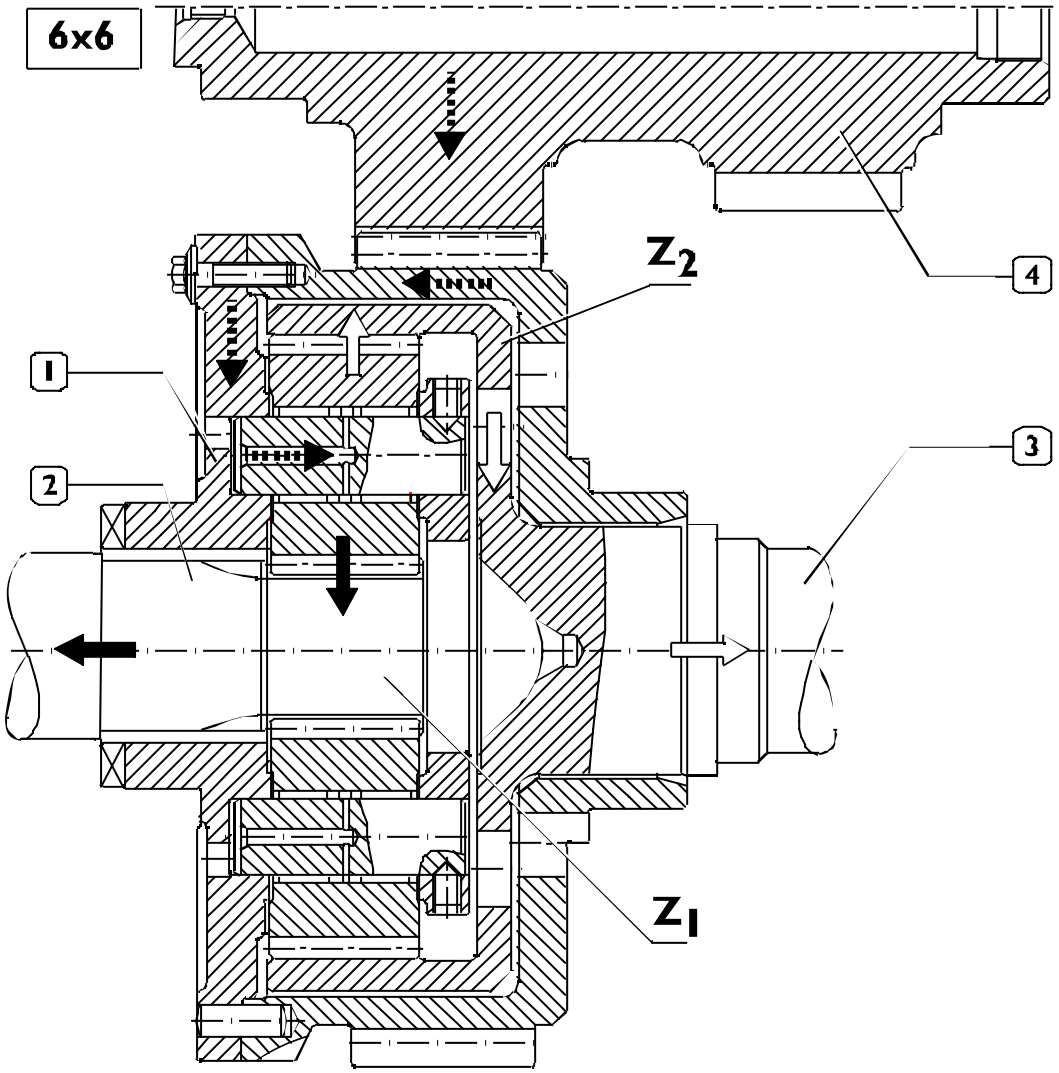
$$\text{Front axle } T_1 = \frac{Z_1}{Z_1 + Z_2} = \frac{18}{18 + 72} = 0.2$$

$$\text{Rear axle } T_2 = \frac{Z_2}{Z_1 + Z_2} = \frac{72}{18 + 72} = 0.8$$

$$\text{Total transfer} = \frac{T_2}{T_1} = \frac{0.8}{0.2} = 4.0$$

Aquila Trucks Centres

Figure 11




## Center differential locking

Vehicles 4x4 - 6x4 - 6x6 - 8x4 - 8x8

Locking must only be used to drive over muddy and slippery ground.

Correct operation requires carrying out the following steps:

- Pass on to the locking position with the vehicle stationary or at low speed.
- Proceed with caution.

When the bad road conditions have been passed, proceed as follows:

- Pass on to the unlocking position keeping the vehicle's speed.
- Temporarily lift the throttle.
- Go back to the safety speed

If locking is not immediately turned off, you need to change the direction of travel in order to get rid of any tension.

- On muddy and slippery ground, never turn the wheels in no-load conditions when differential locking is engaged as this would cause damage (just a few seconds would be enough).
- Never engage differential locking while one wheel is turning in no-load conditions; this would severely damage the gears.

Aquila Trucks Centres

Figure 12

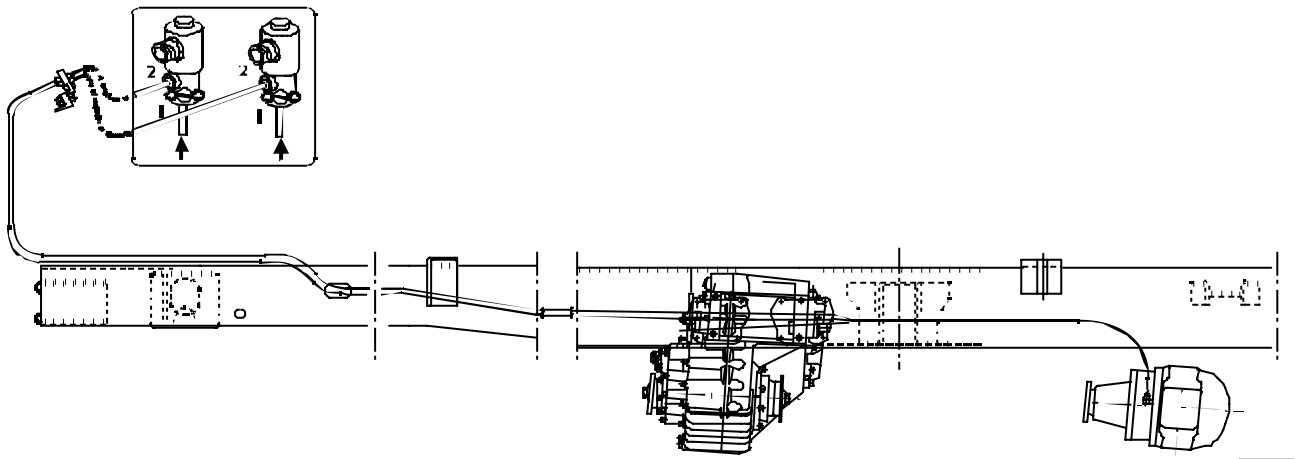
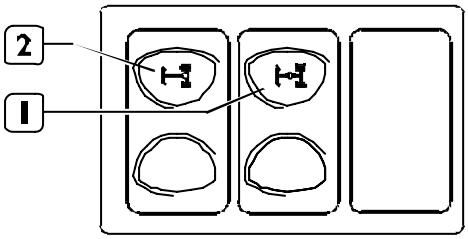



DIAGRAM OF 4x4 VEHICLE DIFFERENTIAL LOCKING CONTROL

Figure 13




1 = Longitudinal differential lock relay
2 = Transverse differential lock relay

When locking is turned on, the associated indicator lights on the dashboard come on.

Figure 14

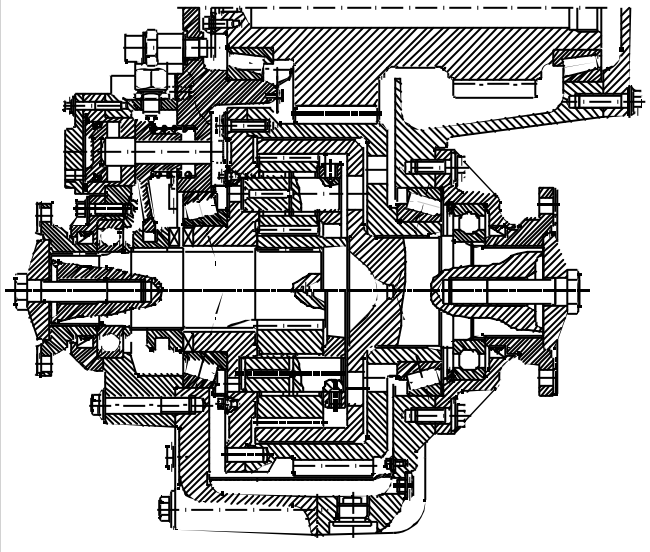



Figure 15

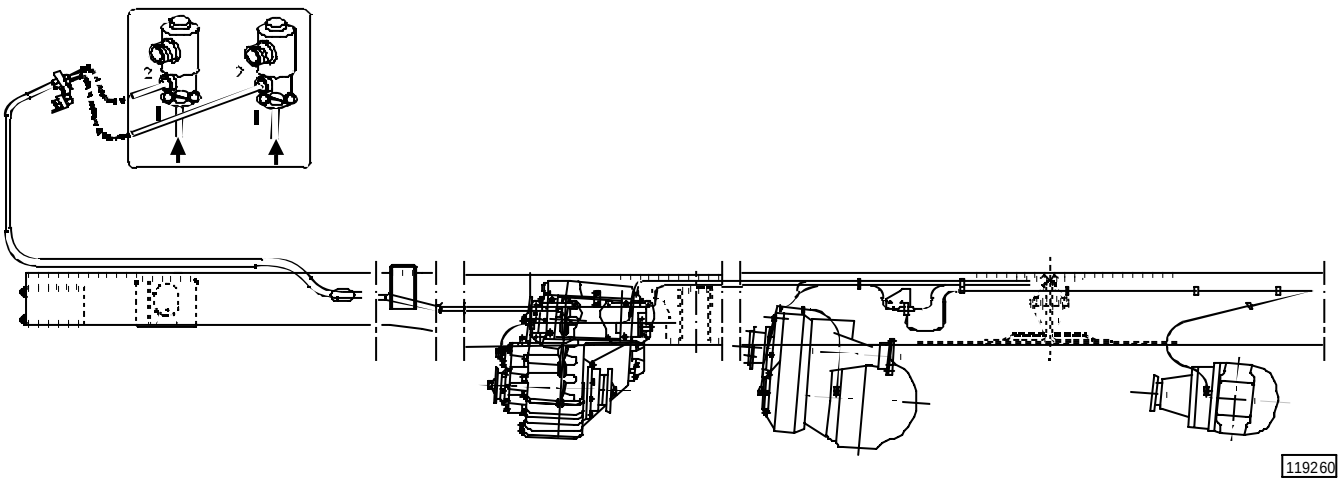
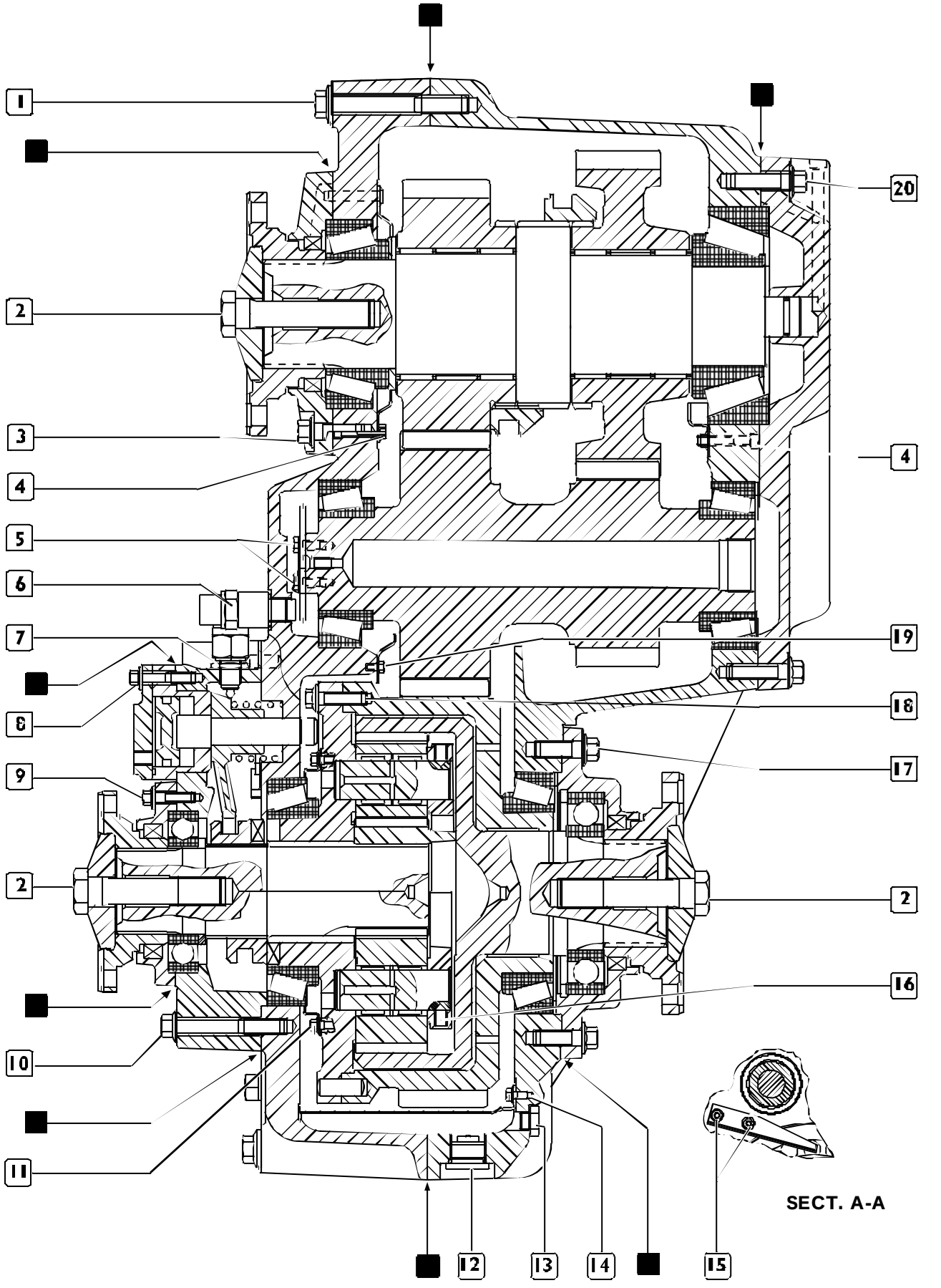



DIAGRAM OF 6x6 VEHICLE DIFFERENTIAL LOCKING CONTROL

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Aquila Trucks Centres

## TIGHTENING TORQUES

Figure 16



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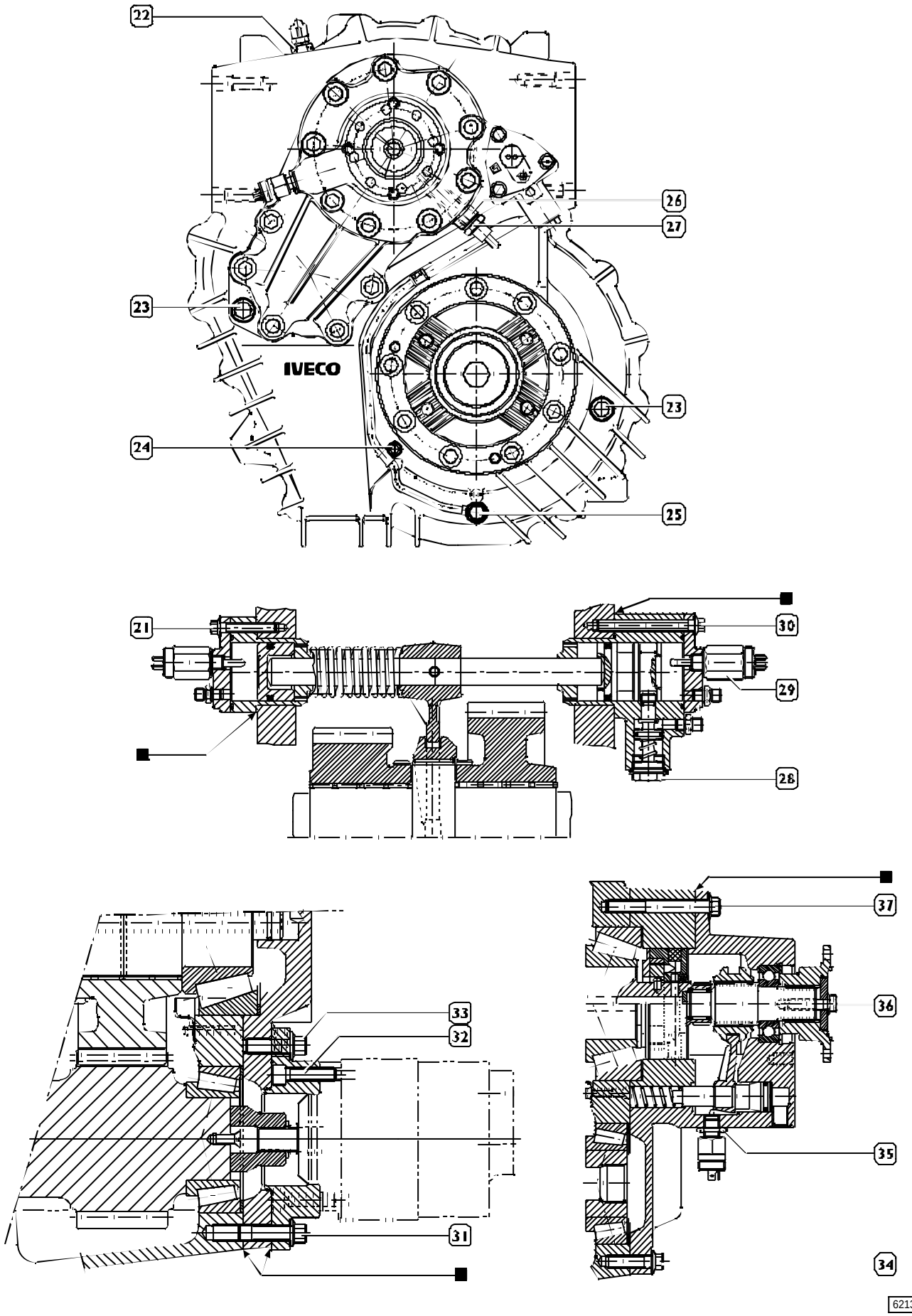
| | DESCRIPTION | TORQUE | |
|---|---|---|---|
| | | Nm | kgm |
| 1 | Screw M 14 (TC 1800) | 92 ± 9 | 9.4 ± 0.9 |
| 1 | Screw M 14 (TC 2200 | 120 ± 12 | 12.2 ± 1.2 |
| 2 | Pin M 22 x 1.5 | 500 ± 50 | 50.9 ± 5.1 |
| 3 | Screw M 12 (TC 1800) | 58 ± 6 | 5.9 ± 0.6 |
| 3 | Screw M 12 (TC 2200) | 78 ± 8 | 7.9 ± 0.8 |
| 4 | Screw M 6 | 9.5 ± 0.5 | 1 ± 0.05 |
| 5 | Screw M 6 | 9.5 ± 0.5 | 1 ± 0.05 |
| 6 | Pulse transmitter M 18 x 1.5 | 45 ± 5 | 4.6 ± 0.5 |
| 7 | Push-rod switch nut M 18 x 1.5 | 45 ± 5 | 4.6 ± 0.5 |
| 8 | Screw M 8 (TC 1800) | 19 ± 2 | 1.9 ± 0.2 |
| 8 | Screw M 8 (TC 2200) | 22.5 ± 2.5 | 2.3 ± 0.25 |
| 9 | Screw M 10 | 45 ± 5 | 4.6 ± 0.5 |
| 10 | Screw M 12 (TC 1800) | 58 ± 6 | 5.9 ± 0.6 |
| 10 | Screw M 12 (TC 2200) | 78 ± 8 | 7.9 ± 0.8 |
| 11 | Screw M 6* | 7 ± 1 | 0.7 ± 0.1 |
| 12 | Screw plug M 27 x 2 (TC 1800) | 100 ± 10 | 9.8 ± 1 |
| 12 | Screw plug M 27 x 2 (TC 2200) | 55 ± 5 | 5.6 ± 0.5 |
| 13 | Screw plug M 14 x 1.5 (TC 1800) | 60 ± 6 | 6.1 ± 0.6 |
| 13 | Screw plug M 14 x 1.5 (TC 2200) | 78 ± 8 | 7.9 ± 0.8 |
| 14 | Screw M 5 | 4.5 ± 0.5 | 0.46 ± 0.05 |
| 15 | Screw M 5* (TC 1800) | 4.5 ± 0.5 | 0.46 ± 0.05 |
| 15 | Screw M 5* (TC 2200) | 5 ± 0.5 | 0.5 ± 0.05 |
| 16 | Grub screw M 10* | 33 ± 3 | 3.4 ± 0.3 |
| 17 | Screw M 12 (TC 1800) | 58 ± 6 | 5.9 ± 0.6 |
| 17 | Screw M 12 (TC 2200) | 78 ± 8 | 7.9 ± 0.8 |
| 18 | Screw M 10 | 65 | 6.6 |
| 19 | Screw M 5 | 5 ± 0.5 | 0.5 ± 0.05 |
| 20 | Screw M 12 (TC 1800) | 58 ± 6 | 5.9 ± 0.6 |
| 20 | Screw M 12 (TC 2200) | 78 ± 8 | 7.9 ± 0.8 |

* Apply LOCTITE AVX.

J Apply LOCTITE 510

Aquila Trucks Centres

Figure 17



Aquila Trucks Centres

| | DESCRIPTION | TORQUE | |
|---|---|---|---|
| | | Nm | kgm |
| 21 | Screw M 8 (TC 1800) | 19 ± 2 | 1,9 ± 0.2 |
| 21 | Screw 8 (TC 2200) | 22.5 ± 2.5 | 2.3 ± 0.25 |
| 22 | Oil vapour vent | 100 ± 10 | 10.2 ± 1.02 |
| 23 | Screw plug M 22 (TC 1800) | 70 ± 7 | 7.1 ± 0.7 |
| 23 | Screw plug M 22 x 1.5 (TC 2200) | 110 ± 10 | 11.2 ± 1.02 |
| 24 | Screw M 6 | 7 ± 1 | 0.7 ± 0.1 |
| 25 | Threaded filling-pipe M 14 | 45 ± 5 | 4.6 ± 0.5 |
| 26 | Terminal filling-pipe 1/4" | 45 ± 5 | 4.6 ± 0.5 |
| 27 | Terminal filling-pipe M 22 x 1.5 (TC 1800) | 70 ± 7 | 7.1 ± 0.7 |
| 27 | Terminal filling-pipe M 22 x 1.5 (TC 2200) | 78 ± 8 | 7.9 ± 0.8 |
| 28 | Plug M 28 x 1.5 | 110 ± 10 | 11.2 ± 1.02 |
| 29 | Push rod switch M 14 x 1.5 | 45 ± 5 | 4.6 ± 0.5 |
| 30 | Screw M 8 (TC 1800) | 19 ± 2 | 1.9 ± 0.2 |
| 30 | Screw M 8 (TC 2200) | 22.5 ± 2.5 | 2.3 ± 0.25 |
| 31 | Special screw M 12 x 80 | 78 ± 8 | 7.9 ± 0.8 |
| 32 | Screw M 10 (TC 1800)* | 49 ± 3 | 5 ± 0.3 |
| 32 | Screw M 10 (TC 2200)* | 47 ± 3 | 4.8 ± 0.3 |
| 33 | Screw M 12 | 78 ± 8 | 7.9 ± 0.8 |
| 34 | Screw M 12 (TC 1800) | 58 ± 6 | 5.9 ± 0.6 |
| 34 | Screw M 12 (TC 2200) | 78 ± 8 | 7.9 ± 0.8 |
| 35 | Push-rod switch nut M 18 x 1.5 (TC 1800) | 45 ± 5 | 4.6 ± 0.5 |
| 35 | Push-rod switch nut M 18 x 1.5 (TC 2200) | 50 ± 5 | 5.1 ± 0.5 |
| 36 | Screw M 10 (TC 1800) | 45 ± 5 | 4.6 ± 0.5 |
| 36 | Screw M 10 (TC 2200) | 50 ± 5 | 5.1 ± 0.5 |
| 37 | Screw M 12 (TC 1800) | 58 ± 6 | 5.9 ± 0.6 |
| 37 | Screw M 12 (TC 2200) | 78 ± 8 | 7.9 ± 0.8 |

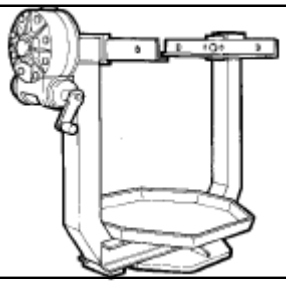
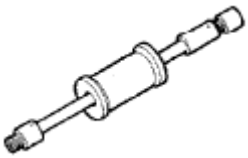
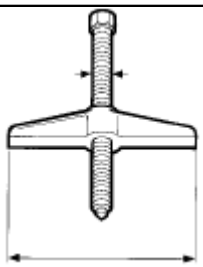
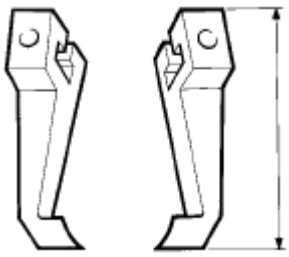
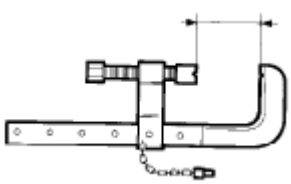
* Apply LOCTITE 242

J Apply LOCTITE 510

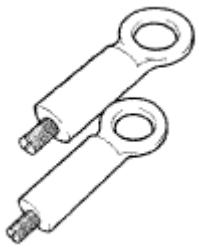
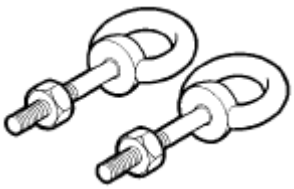
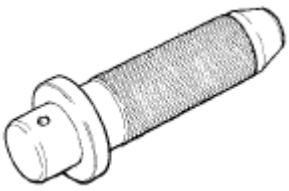
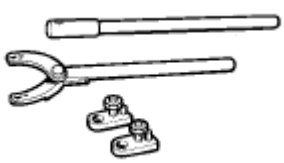
Aquila Trucks Centres

## TOOLS

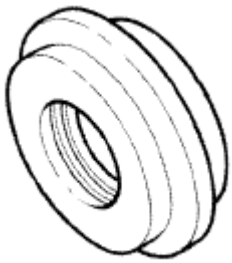
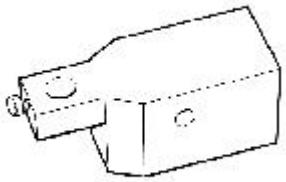
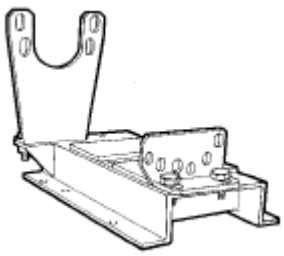
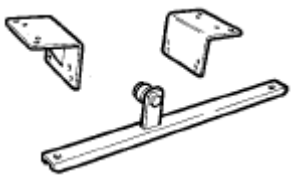
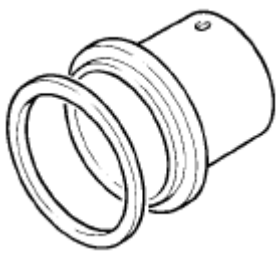
**NOTE** When removing and refitting parts, keep strictly to using the specific tools

| TOOL No. | | DESCRIPTION |
|---|---|---|
| **99305121** |  | Hot-air device. |
| **99322205** |  | Rotary stand to overhaul assemblies (capacity 1000 daN, torque 120 daN). |
| **99340205** |  | Puller with slide-hammer |
| **99341003** |  | Single-acting bridge. |
| **99341009** |  | Pair of brackets. |
| **99341015** |  | Clamp. |

## Aquila Trucks Centres

| TOOL No. | | DESCRIPTION |
|---|---|---|
| **99342143** |  | Pin to extract epicyclic assembly planet pins (use with 99340205). |
| **99345049** |  | Extractor reaction block. |
| **99360502** |  | Pair of rings to remove and refit the transfer half box. |
| **99366067** |  | M8 eyebolts to remove and refit countershaft. |
| **99370006** |  | Kit for valve seat regrinding. |
| **99370317** |  | Reaction lever with extension to retain flanges. |

## Aquila Trucks Centres

| TOOL No. | | DESCRIPTION |
|---|---|---|
| **99370362** |  | Keying device to fit gasket on front drive output shaft cover (use with 99370006). |
| **99370415** |  | Comparator holder base for adjusting secondary shaft bearings (use with 99395604) |
| **99370565** |  | Eyebolts to remove and refit epicyclic assembly. |
| **99370631** |  | Mount to remove and refit transfer box. |
| **99371051** |  | Bracket to support reduction transfer box while overhauling (use with 99322205). |
| **99374253** |  | Keying device to fit gasket on covers of drive input shaft and rear drive output shaft. |

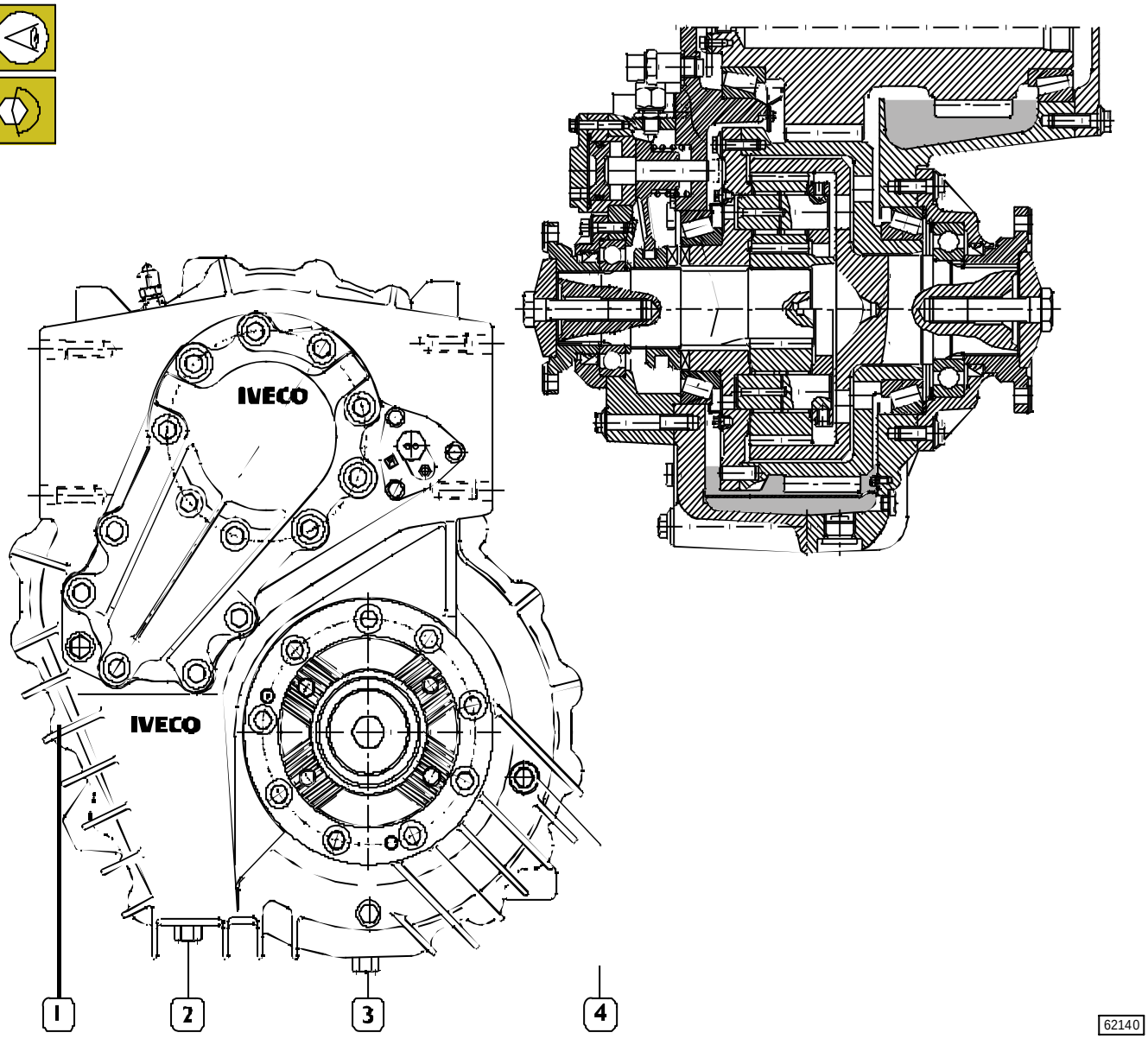
Aquila Trucks Centres

| TOOL No. | | DESCRIPTION |
|---|---|---|
| **99395604** |  | Dial gauge (0-10 mm) |

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## LUBRICATION

Figure 18




Procedure to check the oil level and refuelling

Make sure the vehicle is on level ground.

- Remove the plug (4). A small quantity of oil may spill out.
- Make sure that the oil reaches the plug hole (4). Top up through the plug hole (1) after removing the plug.
- Close both plugs, tightening them to the required torque.

Changing oil

The oil should be changed periodically at the following intervals:

- With road use, every 150,000 km
- With heavy-duty use, every 1,500 hours

Type of oil: Tutela ZC 90 (SAE 80 W 90)
Tutela GI/A for arctic climate

Quantity: 6.5 litres

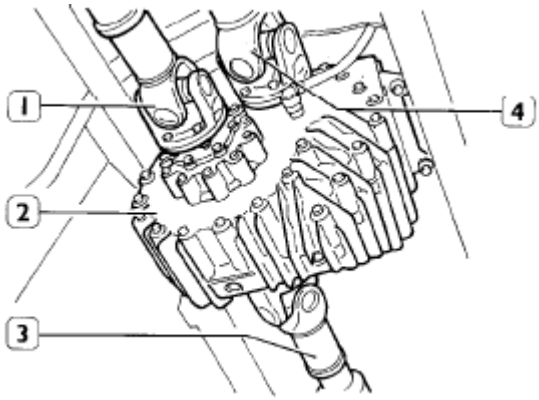
Remove the plugs (2 and 3) to drain the oil.

Aquila Trucks Centres

## 505401 TRANSFER BOX REMOVING AND REFITTING

### Removal

Figure 19




39869

To remove the reduction gear - divider (2), proceed as follows:

- Disconnect the batteries.
- Disconnect the electrical and air connections.
- Unscrew the nuts for the propeller shaft flange retaining screws (1 - 3 - 4) and disconnect them.
- Put the bracket 99370631 on the hydraulic lift and secure it to the reduction gear - divider.
- Unscrew the nuts for the screws fixing the reduction gear - divider to the chassis frame.
- Lower the lift and take out the reduction gear - divider.

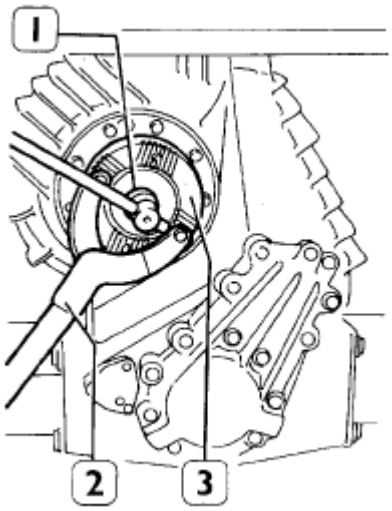
### Refitting

The operations to perform to refit this assembly are not particularly difficult. Therefore, it is sufficient to repeat the steps described for removal in reverse order.

## 505401 DISASSEMBLING THE TRANSFER BOX

Put the reduction gear - divider on the rotary stand 99322205 with the brackets 99371051. Set it upright, unscrew the plugs and drain off the oil.

Figure 20

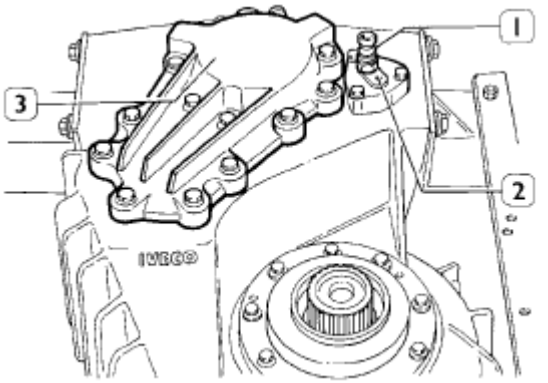



62141

Lock the rotation of the flange (3) with the reaction lever 99370317 (2). Unscrew the retaining screw with an appropriate socket wrench (1) and take off the flange.

Version without P.T.O.

Figure 21




62142

Turn the assembly 90° with its back facing upwards.

Unscrew the push-rod switch (1) for engaging normal speeds (if applicable).

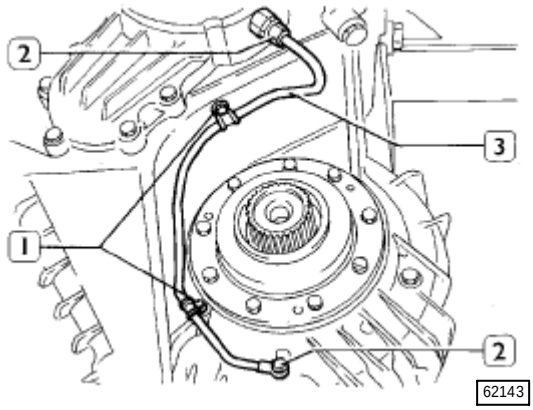
Unscrew the 3 screws and take off the cover (2) with the piston. Unscrew the 14 screws and take off the cover (3).

Take off the adjustment rings for the pre-load of the countershaft and drive input shaft bearings.

Aquila Trucks Centres

Version with P.T.O.

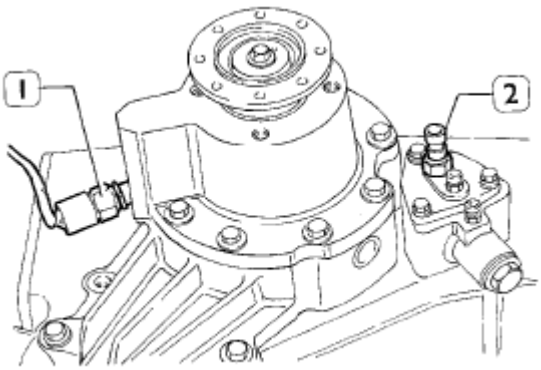
Figure 22




62143

Unscrew the two screws (1) fixing the clamps. Unscrew the two fittings (2) and remove the oil pipe (3).

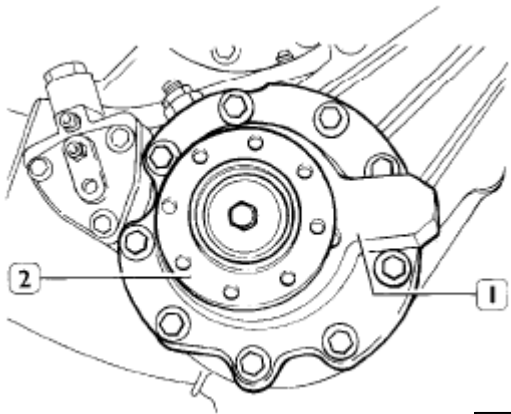
Figure 23




62144

Unscrew the push-rod switch (1) for engaging the P.T.O. and the push-rod switch (2) for engaging normal speeds.

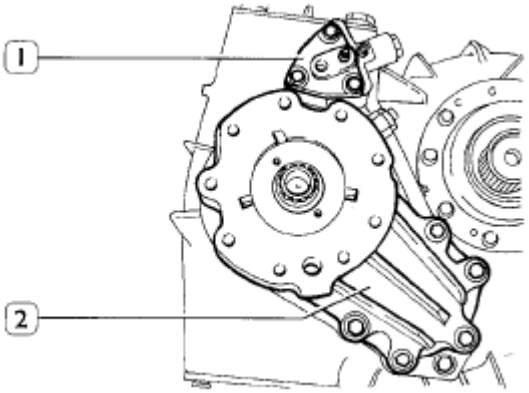
Figure 24




62145

Unscrew the 9 screws and take off the power take-off (1) together with the flange (2) and drive fork.

Figure 25

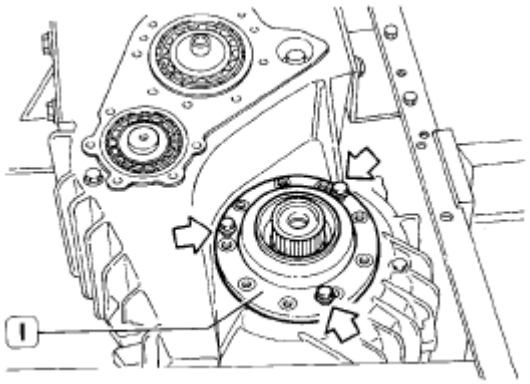



62146

Unscrew the 3 screws and take off the cover (1) with the piston. Unscrew the remaining 5 screws and take off the cover (2). Take off the adjustment rings for the pre-load of the countershaft and drive input shaft bearings.

Both versions

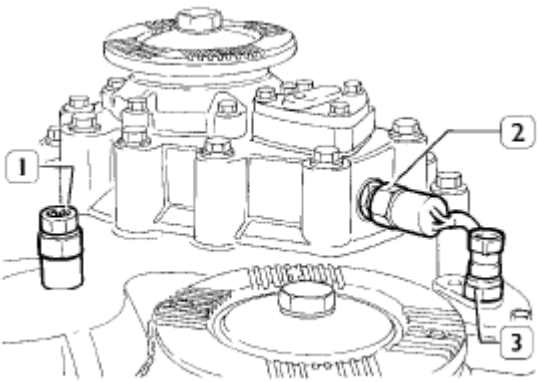
Figure 26




39875

Unscrew the 9 screws, then using the 3 reaction screws screwed into the holes shown by the arrows, take off the cover (1) and take out the adjustment rings for the pre-load of the output shaft bearings.

Figure 27



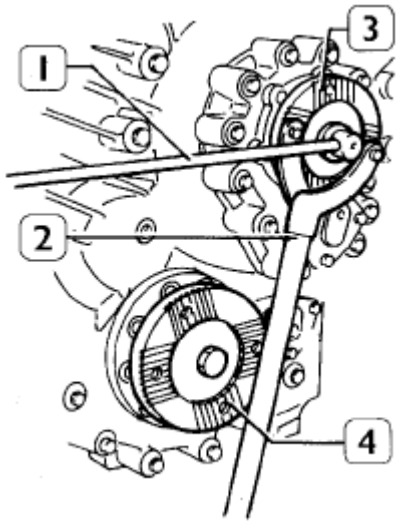

62147

Turn the assembly 180°.

Unscrew the vehicle speed pulse transmitter (1), divider locking indicator push-rod switch (2) and the push-rod switch (3) for enging reduced speeds (if applicable).

Aquila Trucks Centres

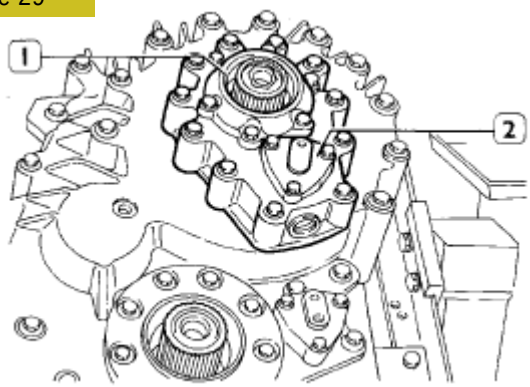
Figure 28




62148

Lock rotation of the flange (3) with the reaction lever 99370317 (2). Unscrew the retaining screw with an appropriate socket wrench (1) and take out the flange; repeat this step to take out the flange (4).

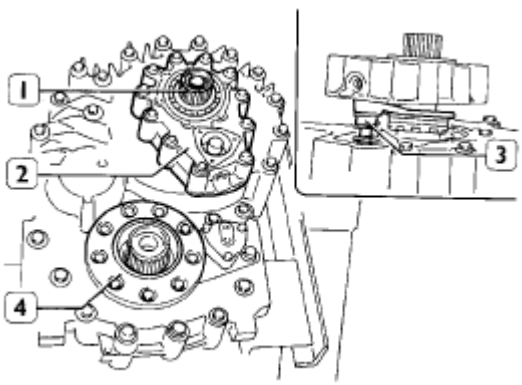
Figure 29




62149

Unscrew the 6 screws and take off the cover (1) with the seal. Unscrew the 3 screws and take off the cover (2) with the piston for locking the divider.

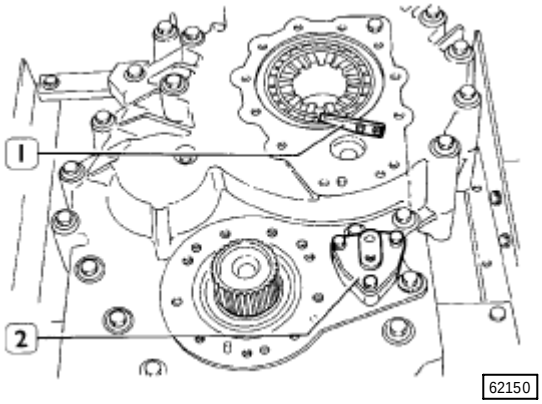
Figure 30




39872

Unscrew the 11 screws and take off the cover (2) together with the shaft (1) and the fork (3) for divider locking. Unscrew the 9 screws and take off the cover (4) together with the seal.

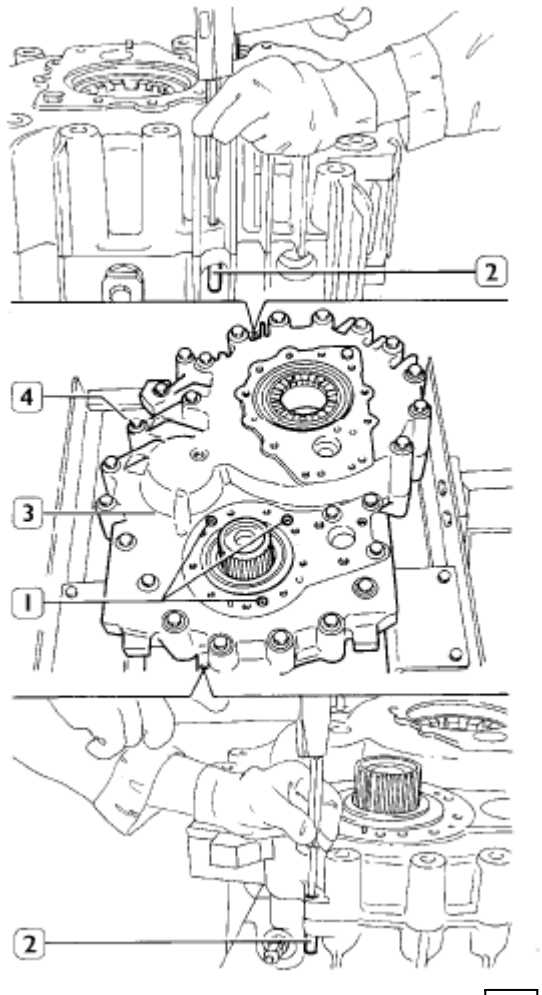
Figure 31




62150

Unscrew the 3 screws, take off the cover (2) with the driving piston and take out the internal spring. Using an Allen wrench, unscrew the screws and take off the safety plate (1).

Figure 32

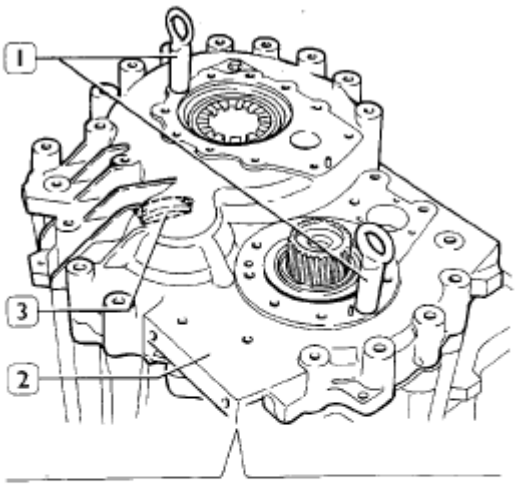


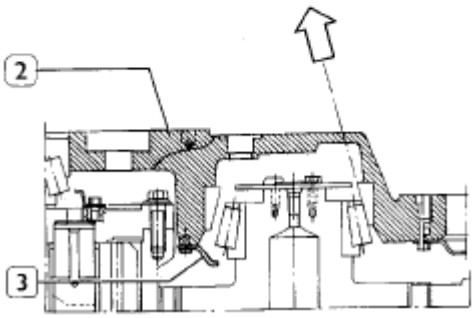

62151

Unscrew the 3 Allen screws (1) fixing the internal plate.
Unscrew the screws (4) fixing the half box.
Using an appropriate punch, take out the 2 pins (2) centring the half box (3).

Aquila Trucks Centres

Figure 33



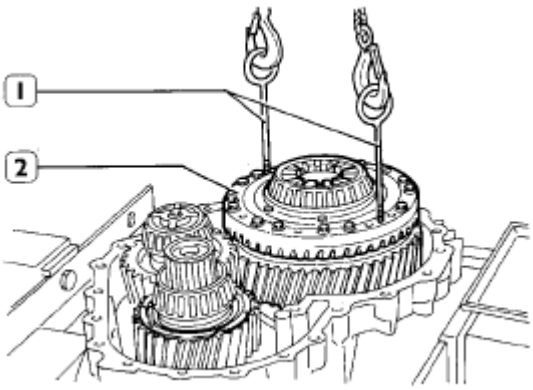




62152

Position the two rings 99360502 (1) as shown in the figure to balance the half box (2).

Using hooks and a rope, lift the half box, moving it in the direction of the arrow to free the plate (3) from under the bearing of the middle shaft.

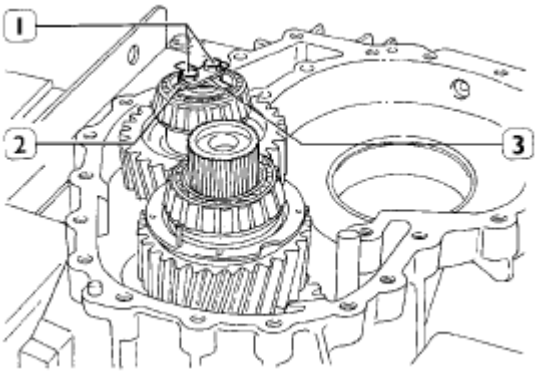
Figure 34




62153

Using eyebolts 99370565 (1), ropes and the lift, extract the epicyclic divider (2) from the box.

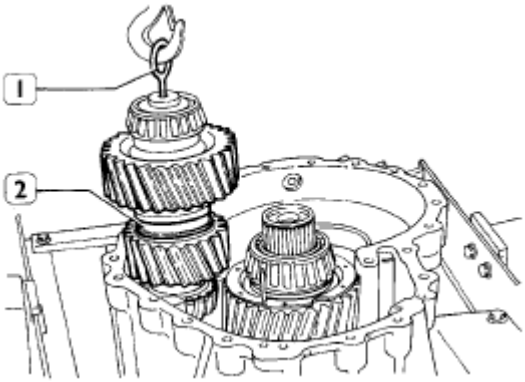
Figure 35




62154

Straighten the safety plate (3). Unscrew the screws (1) then remove the phonic wheel (2).

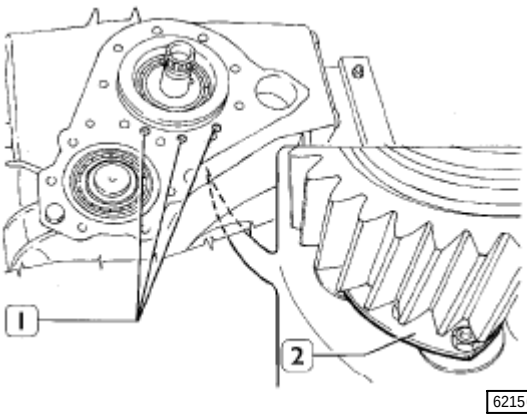
Figure 36




62155

Using the eyebolt 99366067 (1), a rope and the lift, extract the countershaft (2) from the box.

Figure 37



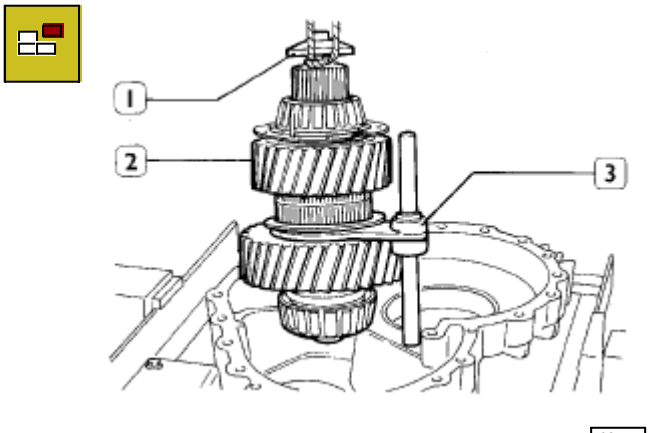

62156

Unscrew the 3 screws (1) on the opposite side of the box and extract the plate (2) that prevents you from taking out the input shaft.

**NOTE** To do this, operate from the bottom without making the assembly turn since when the plate gets detached the input shaft would fall.

Aquila Trucks Centres

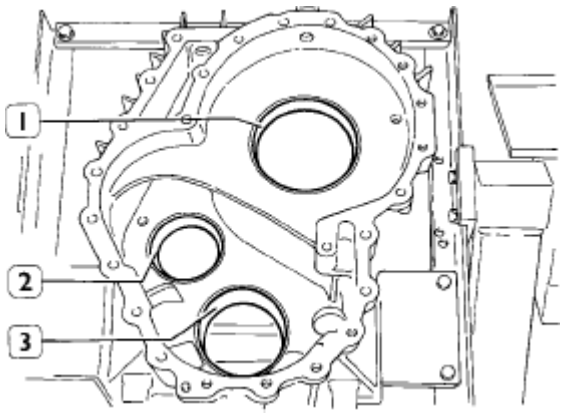
Figure 38




62157

Screw the screw and washer (1) onto the input shaft (2). Using a rope and the lift, extract the input shaft (2) together with the drive fork (3) from the box.

Figure 39




39881

Using an appropriate drift, extract the outer rings (1 - 2 - 3) of the bearings from the box.

## CLEANING AND CHECKING PARTS

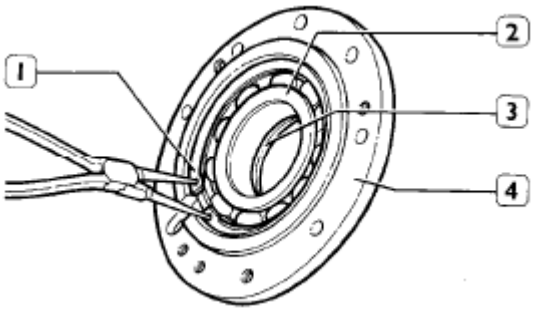
After removing the reduction gear - divider, remove the shafts and the epicyclic divider assembly and thoroughly clean all the parts.

Check that the parts show no sign of too much wear, seizure or cracking.

Always replace the seals with each removal.

## REPLACING OUTPUT SHAFT COVER SEALS

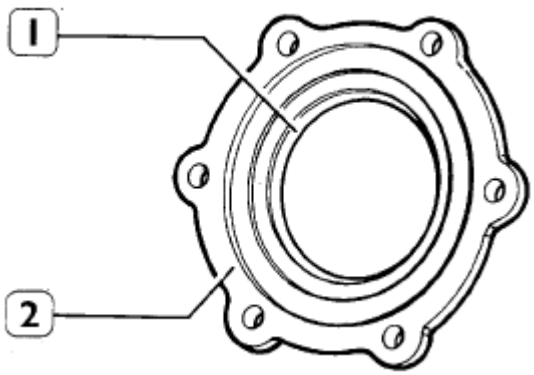
Figure 40




39892

To replace the seal (3) of the cover (4) of the rear output shaft, you need to take off the seeger ring (1) and extract the bearing (2). The seal is fitted on with the keying device 99374253.

Figure 41

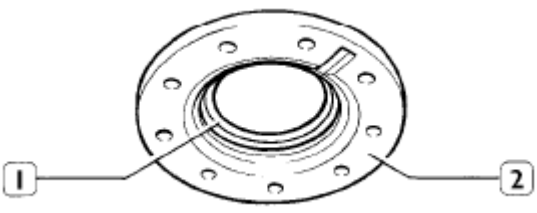



39893

The seal (1) for the cover (2) of the front output shaft is fitted using the keying device 99370362 and the grip 99370006.

## REPLACING INPUT SHAFT COVER SEAL

Figure 42




62158

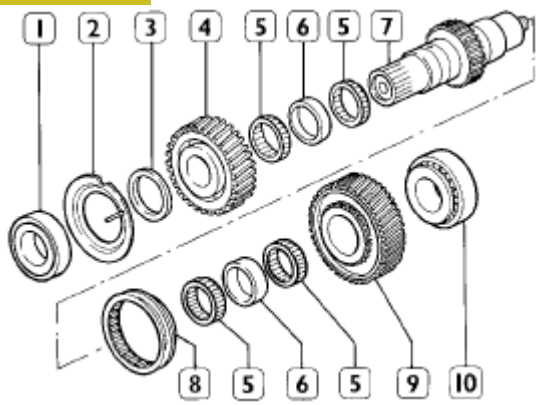
The seal (1) for the cover (2) of the input shaft is fitted using the keying device 99374253.

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## INPUT SHAFT

### Removal

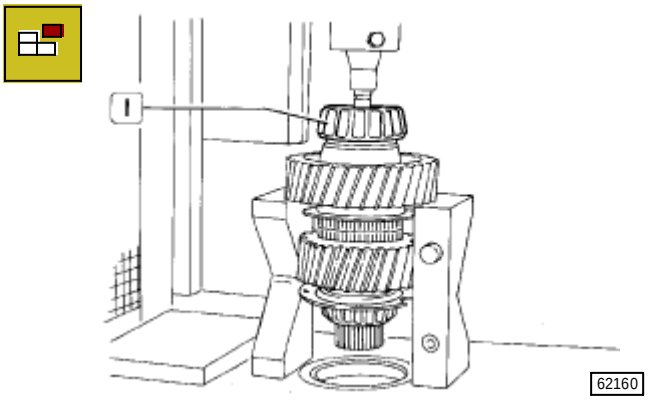
Figure 43




COMPONENT PARTS OF THE INPUT SHAFT
1. Bearing - 2. Plate - 3. Spacer ring - 4. Gear - 5. Roller bearings - 6. Spacer ring - 7. Shaft - 8. Sliding sleeve - 9. Gear - 10. Bearing.

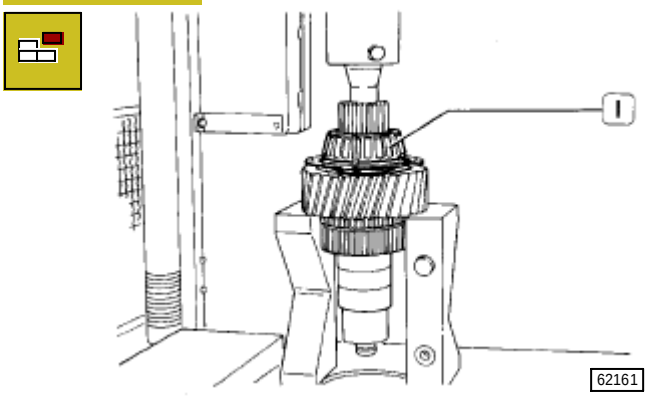
**NOTE** The bearings (1, Figure 44 and Figure 45) are removed using a hydraulic press.

Figure 44




After taking out the bearing (1), manually extract the gear (9, Figure 43), roller bearings (5, Figure 43), spacer ring (6, Figure 43) and sliding sleeve (8, Figure 43).

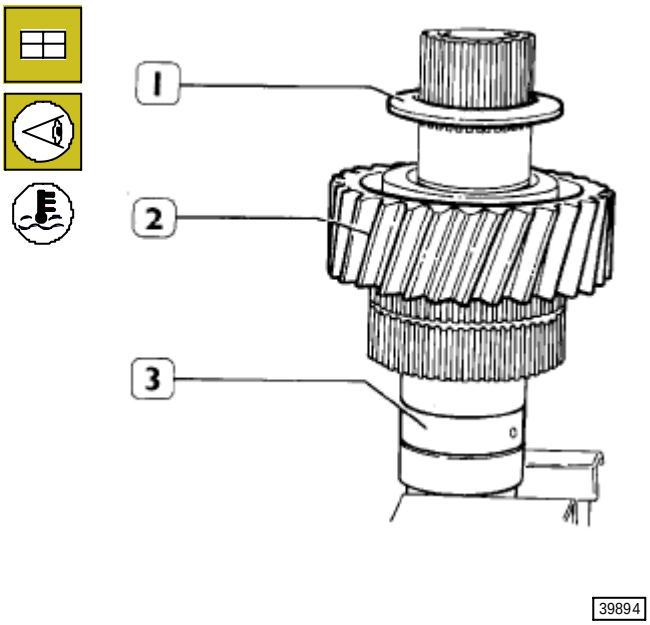
Figure 45




Take out the bearing (1), too, and extract the plate (2, Figure 82), spacer ring (3, Figure 43), gear (4, Figure 43), roller bearings (5, Figure 43) and spacer ring (6, Figure 43).

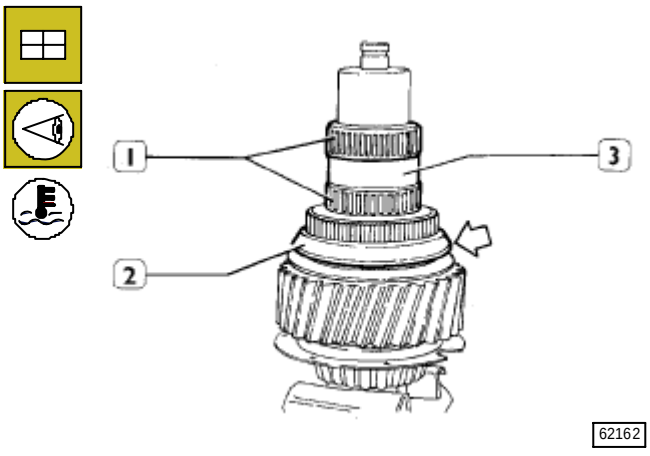
### Fitting

Figure 46




Tighten the shaft (3) in a vice with the grooved part facing upwards.
Mount the roller bearings (5, Figure 43) with the spacer (6, Figure 43), key on the gear (2, Figure 46) with the coupling toothing facing downwards. Mount the spacer ring (1) and the plate (2, Figure 43).
Heat the internal ring of the roller bearing (1, Figure 43) to 80 - 90ºC and mount it on the shaft.

Figure 47



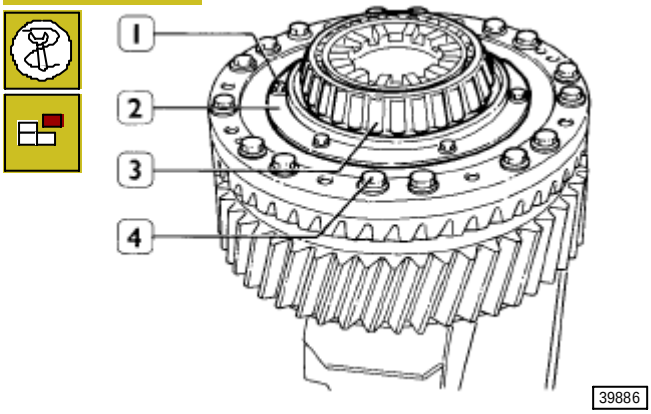

Turn over the shaft and grip it in a vice.
Mount the sliding sleeve (2) with the flaring (arrow) facing upwards. Mount the roller bearings (1) and the spacer (3).
Mount the gear (9, Figure 43) with the coupling toothing facing the sliding sleeve.
Heat the internal ring of the bearing (10, Figure 43) to 80 - 90 ºC and mount it on the shaft.

Aquila Trucks Centres

## EPICYCLIC TORQUE TRANSFER UNIT

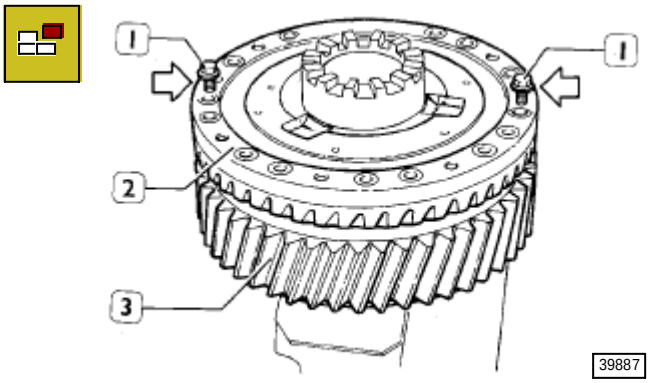
### Removal

Figure 48



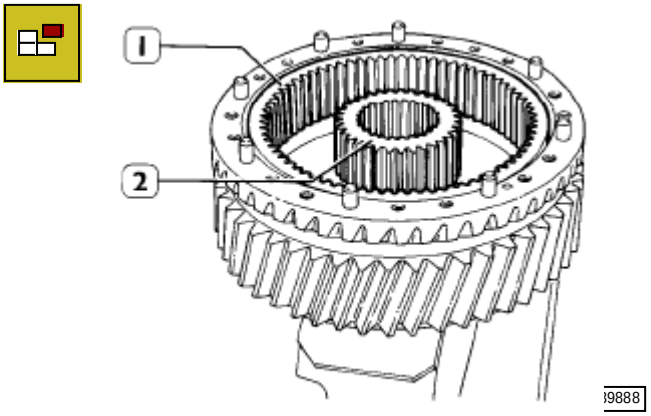

Unscrew the screws (1) and remove the oil seal (2). Using the bridge 99341003, brackets 99341009 and clamp 99341015 and the reaction block 99345049, take out the bearing (3), then unscrew the screws (4).

Figure 49




Using 2 screws (1) screwed into the holes shown by the arrows, extract the planet wheel holder (2) from the ring gear (3).

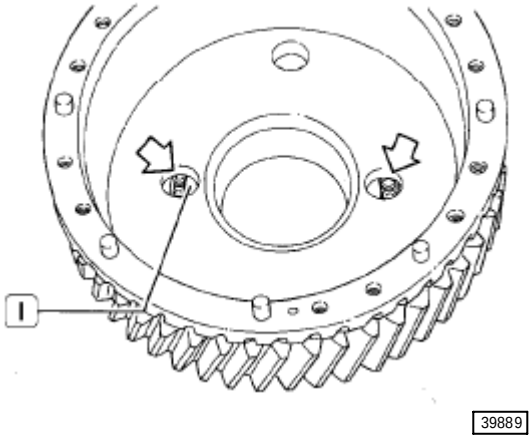
Figure 50




Remove the sun wheel (2) and take out the rear drive output shaft (1).

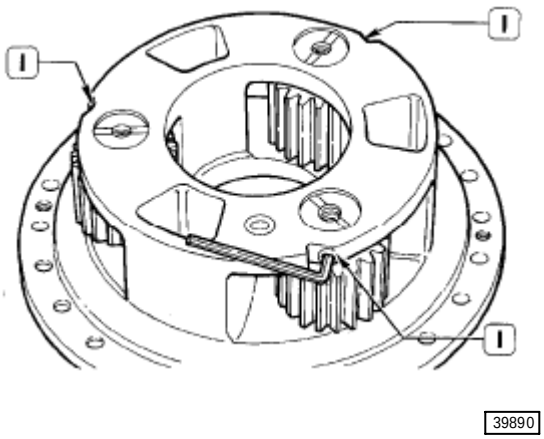
**NOTE** On versions with a division ratio of 1:4, used on 6x6 models, there is no sun wheel as the toothing is on the front drive output shaft.

Figure 51



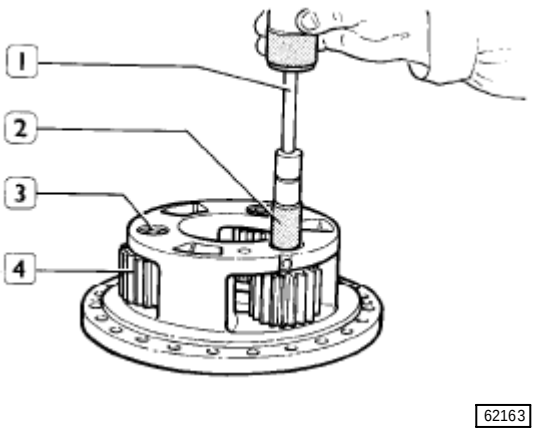

Using an appropriate drift through the holes (arrows), take the bearing (1) out.

Figure 52




Using an Allen wrench, unscrew the 3 grub screws (1).

Figure 53

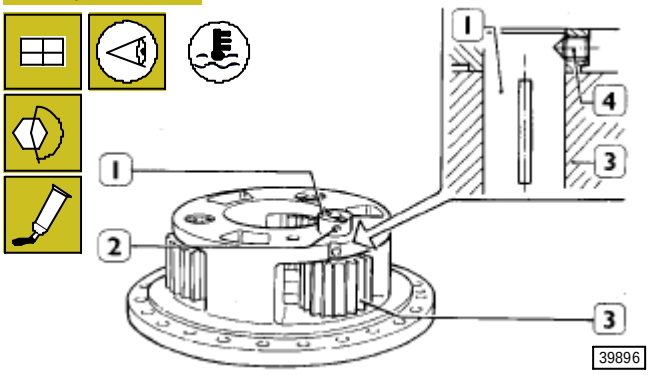



Using a puller with slide-hammer 99340205 (1) together with pin 99342143 (2), take out the shafts (3) for the gears (4).

Aquila Trucks Centres

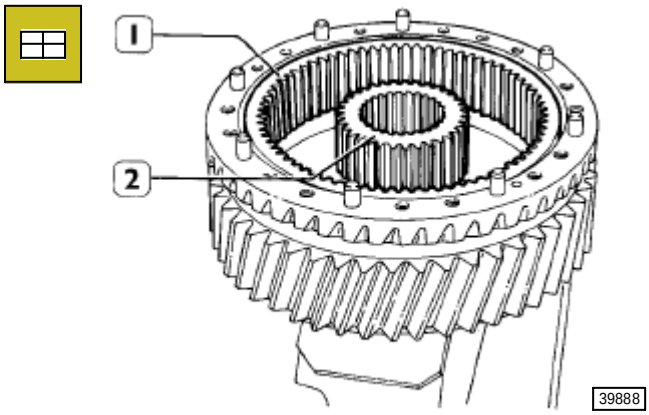
## Fitting

Figure 54



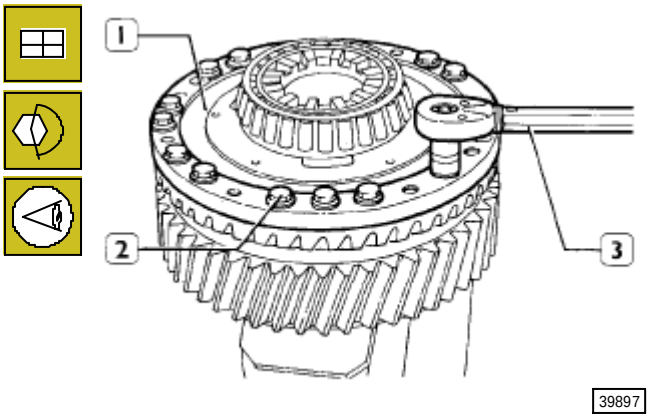

On the planet wheel holder, mount the gears (3), key on the pin (1) so that the recess (2) coincides with the hole for the grub screw (4). Apply LOCTITE AVX on the grub screw (4) and lock it to the required torque. Repeat these steps for the other pins. Turn the planet wheel holder over and, after heating it to 80 - 90°C, key on the internal ring of the bearing.

Figure 55



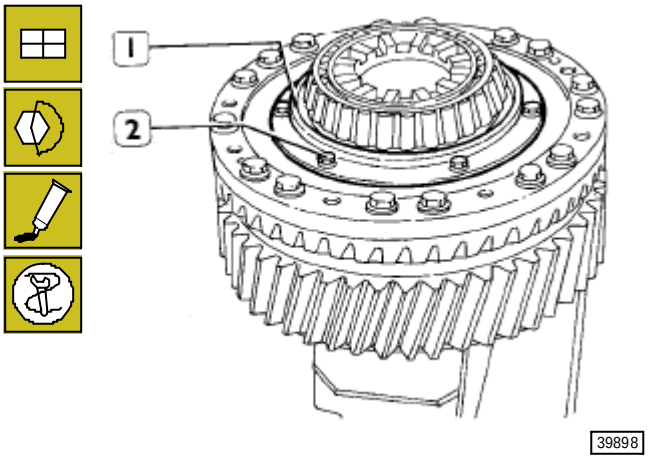

Mount the rear drive output shaft (1) and the sun wheel (2) (if applicable) on the ring gear and put the assembly in a vice.

Figure 56




Mount the planet wheel holder assembly (1), making the centring pins coincide. Screw down the screws (2) and lock them with a torque wrench (3) to the required torque.

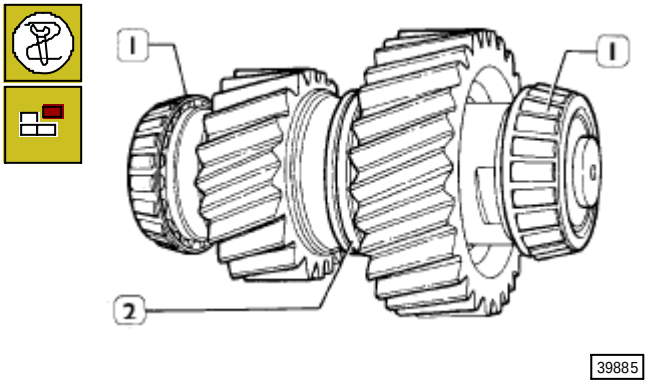
Figure 57




Fit on the oil seal (1). Apply LOCTITE AVX on the screws (2) and screw them down to the required torque.
Turn over the assembly and key on the bearing after heating the middle ring to 80 - 90°C.

## COUNTERSHAFT
## Removal

Figure 58




Removing the bearings (1) of the countershaft (2) presents no difficulty as it is a destructive operation.

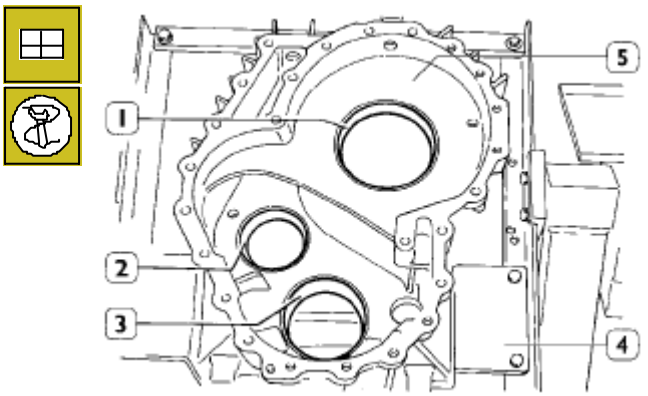
## Fitting

Fit the new bearings (1) on the countershaft after heating the internal rings to 80 - 90°C.

Aquila Trucks Centres

## ASSEMBLING THE TRANSFER BOX

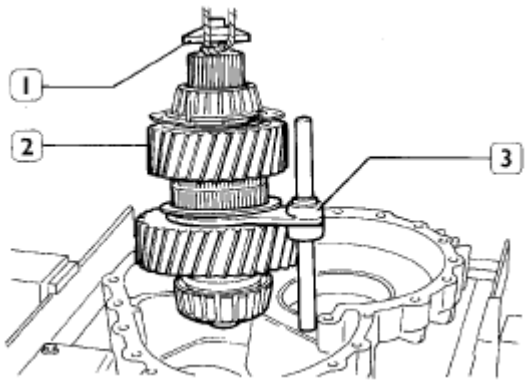
Figure 59




62366

Put the box (5) on the stand 99322205 with the brackets 99371051 (4). Using an appropriate drift, key on the outer rings (1 – 2 – 3) of the bearings.

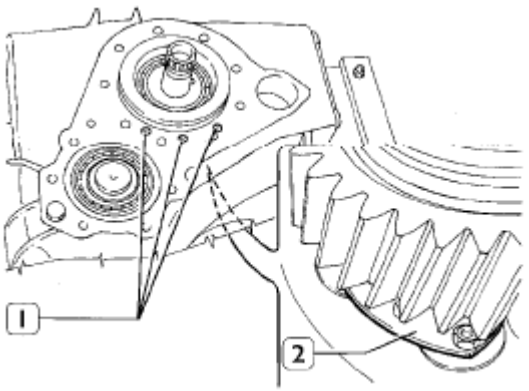
Figure 60




62157

Screw the screw and washer (1) onto the input shaft. Using a rope and the lift, mount the shaft (2) together with the drive fork (3) in the box.

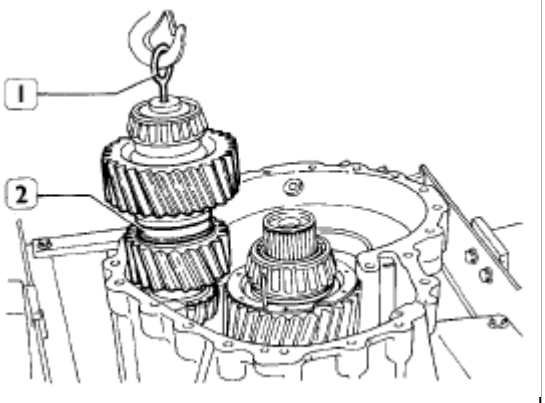
Figure 61




62156

Insert the plate (2) and lockit by screwing down the 3 screws (1) on the opposite side of the box to the required torque, working from the bottom without making the assembly turn.

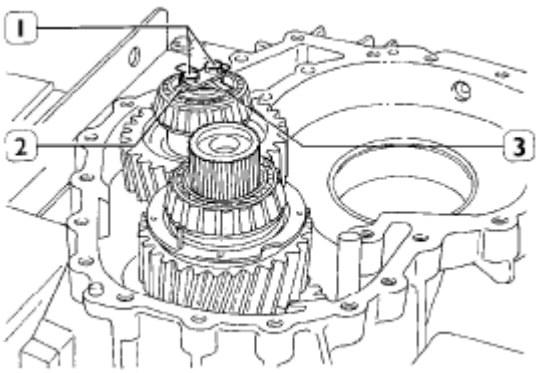
Figure 62




62155

Using the eyebolt 99366067 (1), mount the countershaft (2).

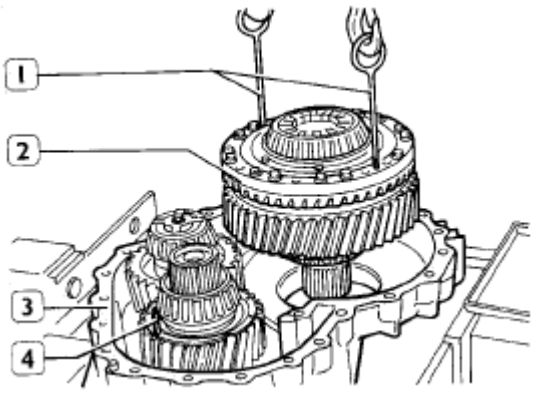
Figure 63




62154

Mount the phonic wheel (1) and the safety plate (3). Screw down the screws (2) to the required torque and bend back the safety plate.

Figure 64

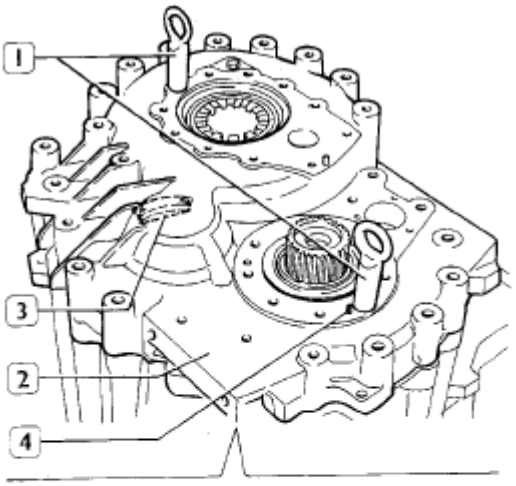


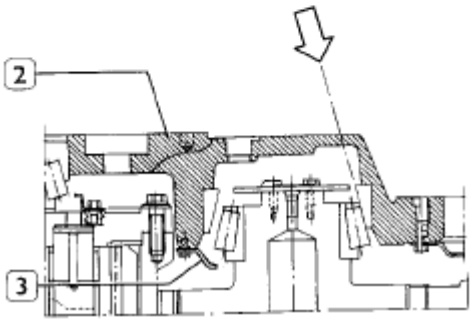

62164

Using the eyebolts 99370565 (1), mount the epicyclic divider (2) in the box. Put LOCTITE 410 sealant on the supporting surface (3). Position the pin (4) of the plate in correspondence with the respective hole on the box.

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Figure 65

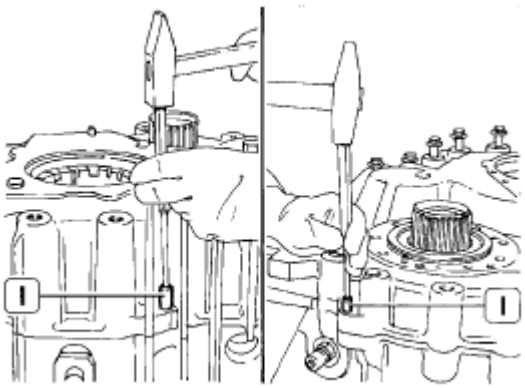



62165

Using the rings 99360502 (1), hooks and a rope, insert the half box (2), following the direction of the arrow to insert the pin (4) of the plate and the plate (3) under the bearing of the middle shaft.

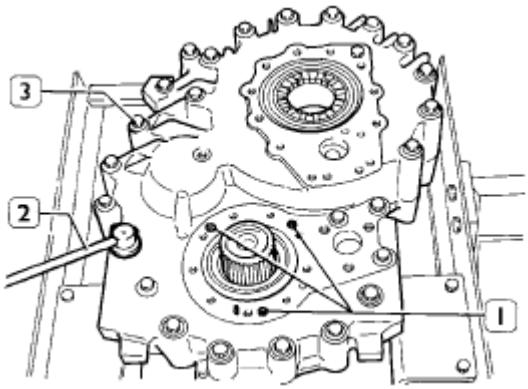
Figure 66




62166

Using an appropriate punch, insert the two centring pins (1).

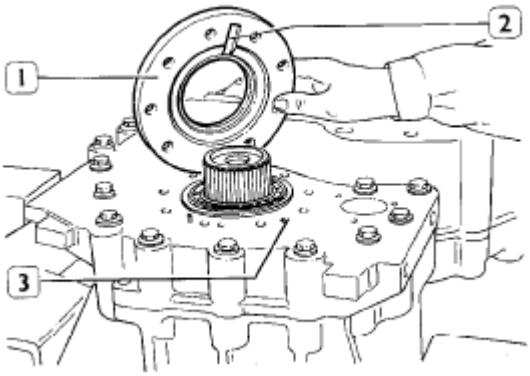
Figure 67




62167

Screw down the 3 socket-head screws (1) fixing the internal plate.
Using a torque wrench (2), tighten the screws (3) fixing the half box to the required torque.

Figure 68



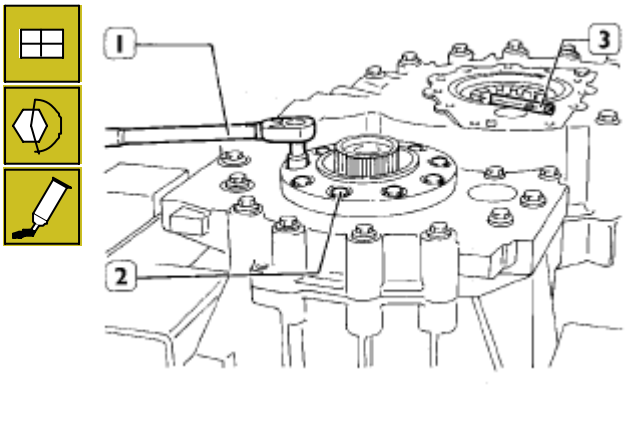

62168

Put on LOCTITE 510 sealant.
Position the cover (1) together with the seal.

**NOTE** The oil passage (2) has to be positioned in correspondence with the respective hole (3).

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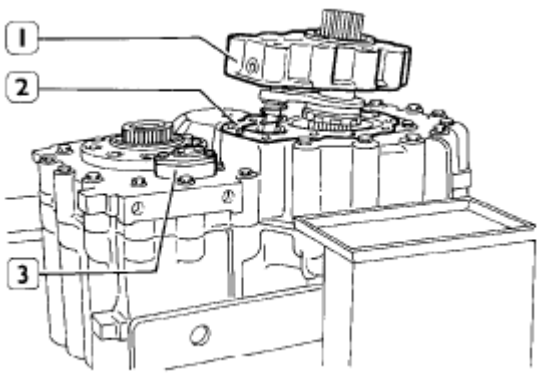
Figure 69




39903

Lock the screws (2) of the cover to the required torque using a torque wrench (1). Position the safety plate (3). Put LOCTITE AVX on the screws and lock them to the required torque.

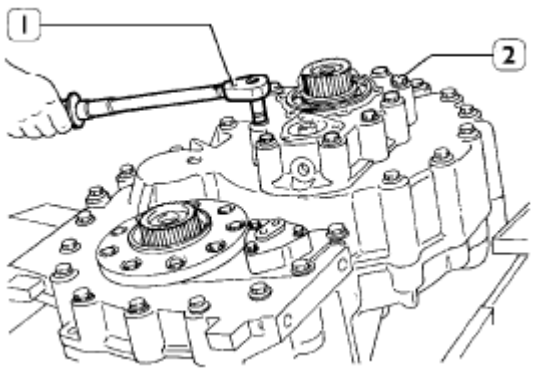
Figure 70




39904

Mount on the cover (3) together with the driving piston and internal spring. Spread the seat (2) with LOCTITE 510, then fit on the cover (1) together with the divider coupling drive fork and shaft.

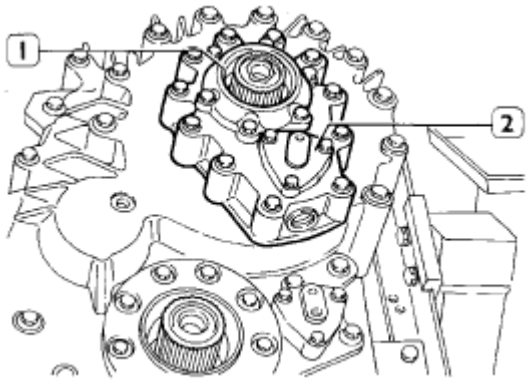
Figure 71




39905

Tighten the screws (2) with a torque wrench (1) to the required torque.

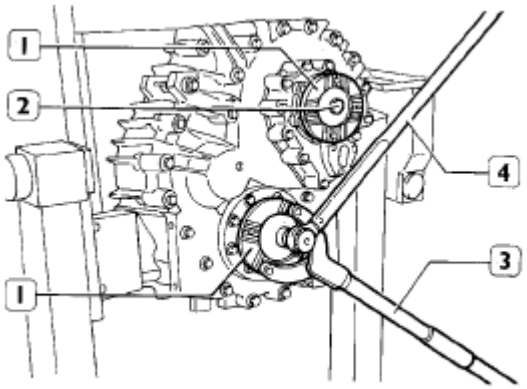
Figure 72




62149

Mount the cover (2) together with the driving piston. Spread on LOCTITE 510, fit on the cover (1) and tighten the screws to the required torque.

Figure 73




39906

Key on the two flanges (1), put on the washers and, with the reaction lever 99370317 (3) and torque wrench (4), tighten the screws (2) to the required torque.

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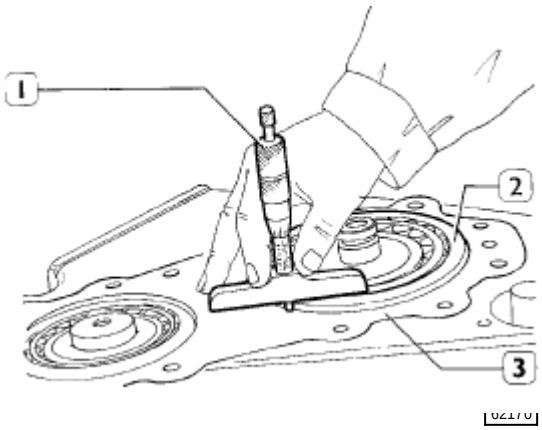
## ADJUSTING THE BEARING PRE-LOAD

The pre-load of the input shaft, countershaft and output shaft is adjusted as follows:

### Input shaft

- Make sure the external race of the bearing driven into the housing on the front side has reached its stop.
- Bed down the shaft into its seat by applying an axial load of 50 kg on the external ring of the rear bearing while turning the shaft at the same time.

Figure 74



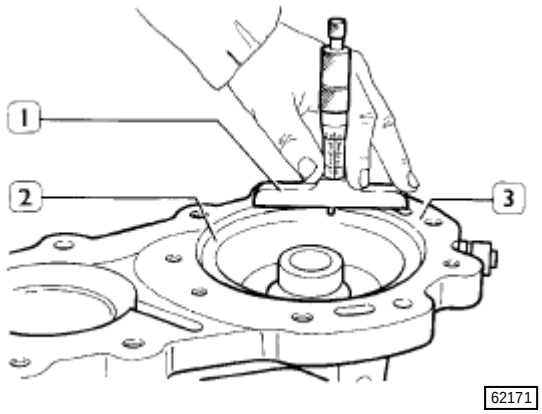

- Using a depth micrometer (1), measure the protrusion of the external race (2) of the bearing with respect to the face of the box (3) at two opposite points at least, while maintaining the axial load.

The distance A measured has to be between:

TC 1800 6.3 ÷ 7.5 mm;

TC 2200 10.5 ÷ 11.5 mm.

Figure 75




- Using a depth micrometer (1), measure the depth of the seat (2) of the rear cover with respect to the face.

The distance B measured has to be between:

TC 1800 8.5 ÷ 8.6 mm;

TC 2200 12.5 ÷ 12.6 mm.

The difference between the two measurements made gives the thickness $S_e$ of the adjustment rings; add the required pre-load to this value.

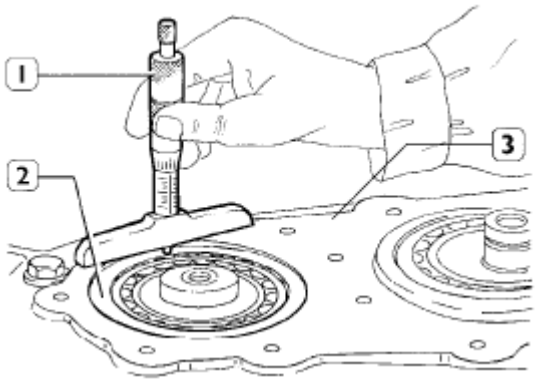
$$S_e = (A - B) + 0.05 \text{ mm}$$

The thicknesses always have to be selected by rounding up to get a total pre-load of from 0.05 to 0.10 mm.

### Countershaft

- Make sure the external race of the bearing driven into the housing on the front side has reached its stop.
- Bed down the shaft into its seat by applying an axial load of 50 kg on the external ring of the rear bearing while turning the shaft at the same time.

Figure 76




- Using a depth micrometer (1), measure the protrusion of the external race (2) of the bearing with respect to the face of the box (3) at two opposite points at least, while maintaining the axial load.

The distance C measured has to be between:

2.5 and 3.4 mm

To this measurement, add the required pre-load to get the thickness $S_r$:

$$S_r = C + 0.05 \text{ mm}$$

The thicknesses always have to be selected by rounding up to get a total pre-load of from 0.05 to 0.10 mm.

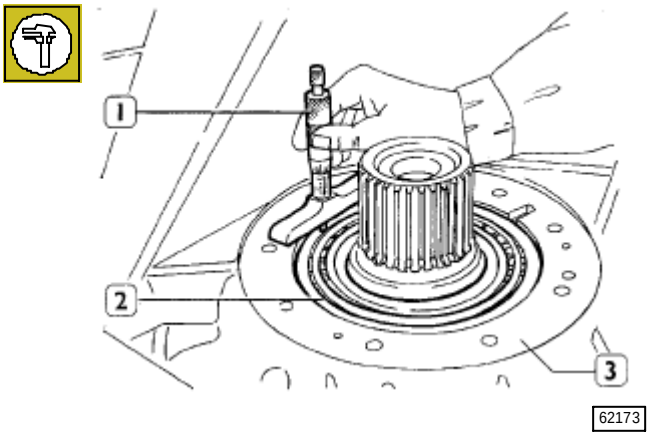
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## Output shaft

- Make sure the external race of the bearing driven into the housing on the front side has reached its stop.
- Bed down the shaft into its seat by applying an axial load of 50 kg on the external ring of the rear bearing while turning the shaft at the same time.

TC 1800

Figure 77

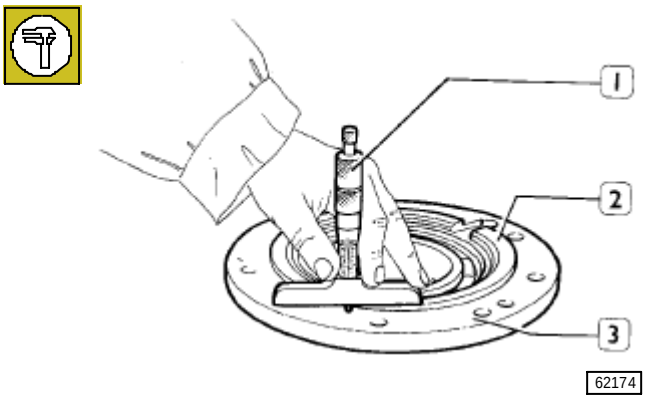



- Using a depth micrometer (1), measure the protrusion of the external race (2) of the bearing with respect to the face of the box (3) at two opposite points at least, while maintaining the axial load.

The distance D measured has to be between:

5.0 and 6.8 mm

Figure 78




- Using a depth micrometer (1), measure the protrusion of the seat (2) of the rear cover with respect to the face (3).

The distance E measured has to be between:

3.9 and 4.0 mm

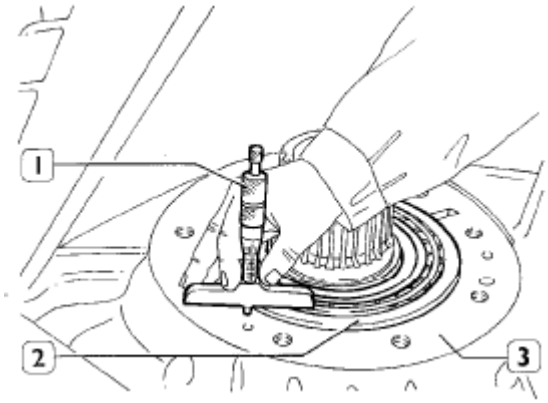
The difference between the two measurements made gives the thickness $S_u$ of the adjustment rings; add the required pre-load to this value.

$$S_u = (D - E) + 0.05 \text{ mm}$$

The thicknesses always have to be selected by rounding up to get a total pre-load of from 0.05 to 0.10 mm.

TC 2200

Figure 79

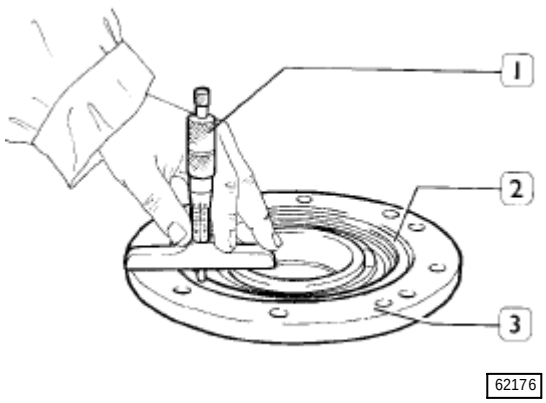



- Using a depth micrometer (1), measure the protrusion of the external race (2) of the bearing with respect to the face of the box (3) at two opposite points at least, while maintaining the axial load.

The distance D measured has to be between:

5.2 and 7.0 mm

Figure 80




- Using a depth micrometer (1), measure the depth of the seat (2) of the rear cover with respect to the face (3).

The distance E measured has to be between:

8.0 and 8.1 mm

The difference between the two measurements made gives the thickness $S_u$ of the adjustment rings; add the required pre-load to this value.

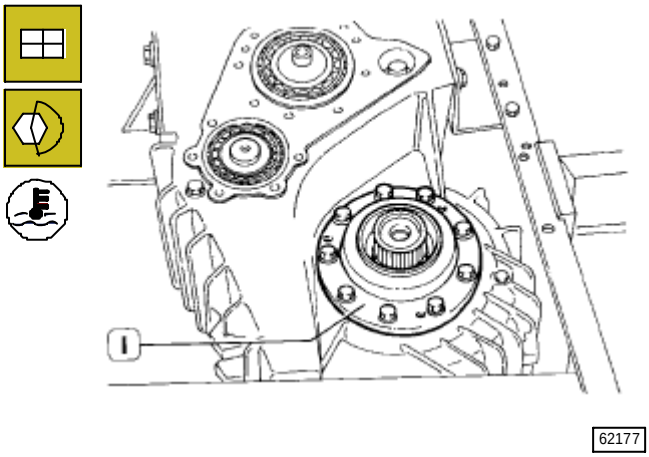
$$S_u = (E - D) + 0.05 \text{ mm}$$

The thicknesses always have to be selected by rounding up to get a total pre-load of from 0.05 to 0.10 mm.

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## COMPLETING ASSEMBLY

Figure 81

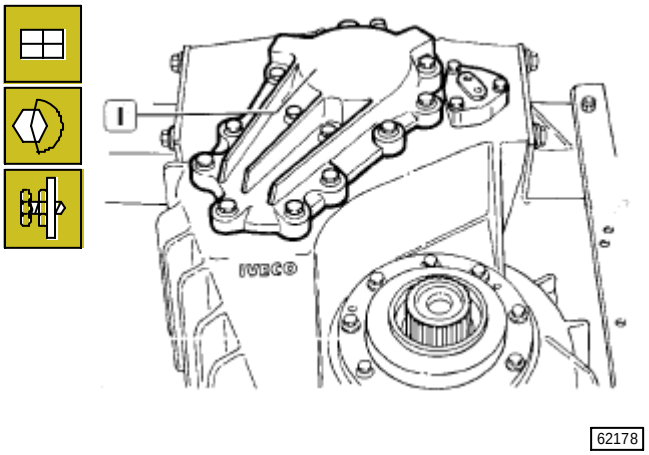



62177

Put on the adjustment rings of the thickness calculated beforehand. Then key on the cover together with the bearing, after heating to 80 - 90°C, and tighten the screws to the required torque.

Version without P.T.O.

Figure 82



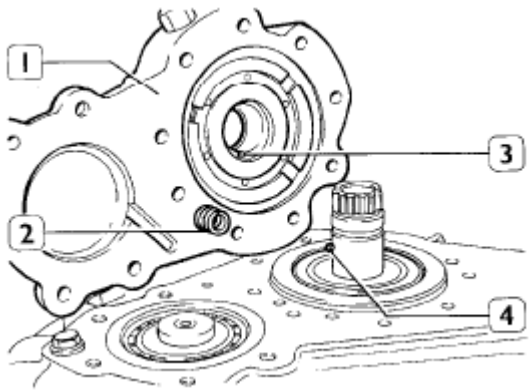

62178

Put on the adjustment rings of the thickness calculated beforehand. Then fit on the cover (1) and tighten the screws to the required torque.

Mount the push-rod switches to engage normal and reduced speeds and divider locking and the vehicle speed pulse transmitter and set them as described on the following page.

Version with P.T.O.

Figure 83

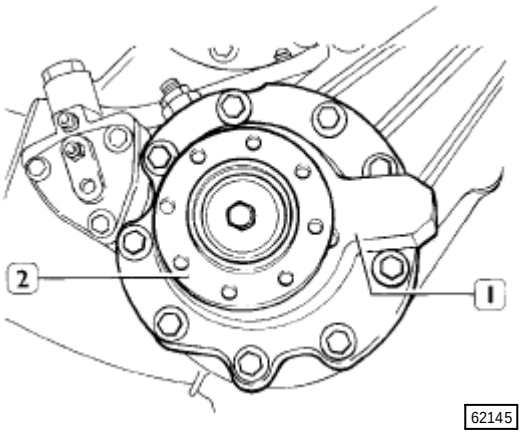



62179

Put on the adjustment rings of the thickness calculated beforehand. Then fit on the cover (1) together with the spring (2).

**NOTE** Fit on the cover paying attention to the alignment of the slot (3) with the grub screw (4) on the shaft.

Figure 84




62145

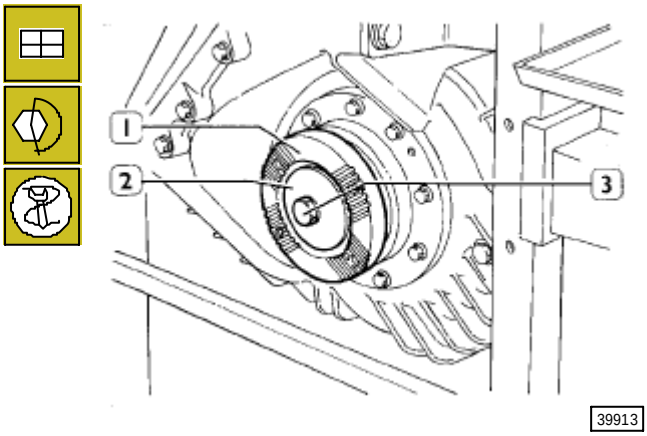
Mount the power take-off (1) together with the flange (2) and drive fork. Then tighten the fixing screws to the required torque.

Mount the push-rod switches to engage normal and reduced speeds (if applicable), divider locking and to engage the P.T.O. and the vehicle speed pulse transmitter and set them as described on the following page.

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Both versions

Figure 85



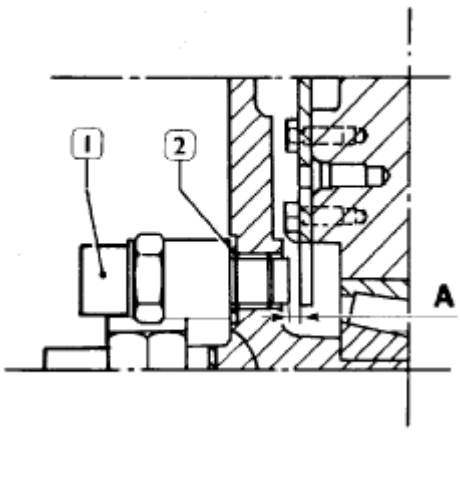

Key on the flange (1) and put on the washer (2). Using the reaction lever 99370317 and a torque wrench, tighten the screw (3) to a torque of 500 ± 50 Nm.

## Adjusting push-rod switch signalling interaxle locking and P.T.O. engagement (if applicable)

Screw down the switch to close the electric contacts, unscrew it by one turn, then lock the lock nut to the required torque.

## Adjusting pulse transmitter

Figure 86




Select the adjustment ring (2) so as to obtain the distance A of 2 - 2.8 mm when fitting the pulse transmitter (1).

## Replenishing oil

Screw down the oil drain plugs.

Add the appropriate type of oil to the assembly (see table on page 3) by following the procedure described on page 24.

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SECTION 7

# 5056 Propeller shafts

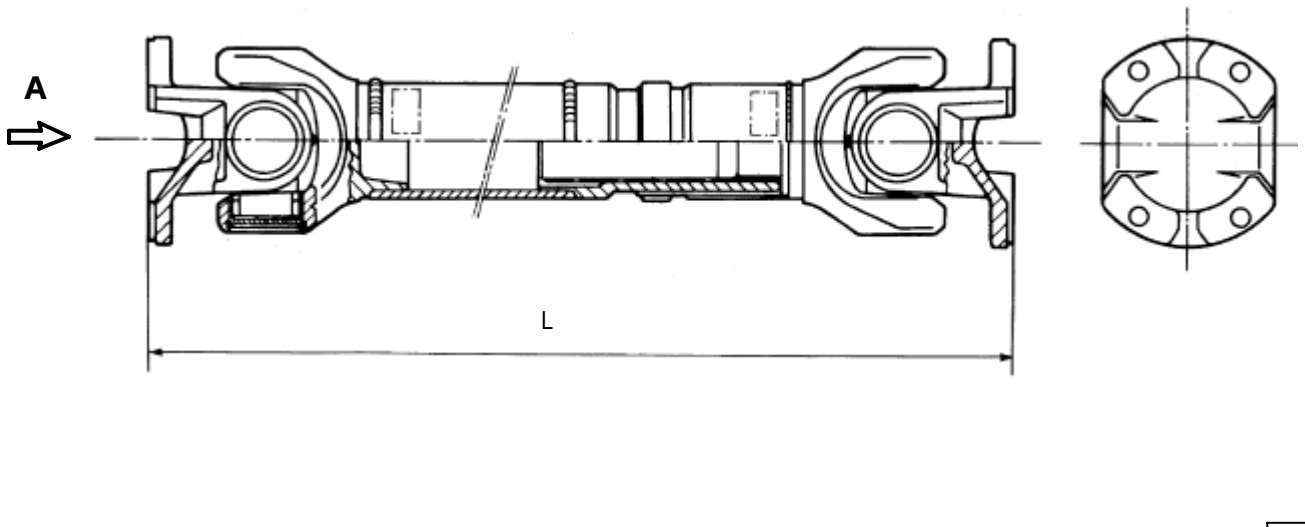

| | Page |
|---|---|
| MAIN DATA | 3 |
| - Vehicles 4x2 | 5 |
| - Vehicles 6x4 | 6 |
| - Vehicles 8x4x4 | 8 |
| - Vehicles 4x4 | 9 |
| - Vehicles 6x6 | 10 |
| - Vehicles 8x8x4 | 10 |
| TROUBLESHOOTING | 11 |
| - Main operating faults | 11 |
| TIGHTENING TORQUES | 12 |
| TOOLS | 12 |
| PROPELLER SHAFT REMOVAL AND REFITTING | 13 |
| - Removal | 13 |
| - Refitting | 13 |
| REPAIRS | 13 |
| - Disassembling the universal joint | 13 |
| - Assembling the universal joint | 13 |
| CHECKING PROPELLER SHAFTS ON VEHICLES | 14 |

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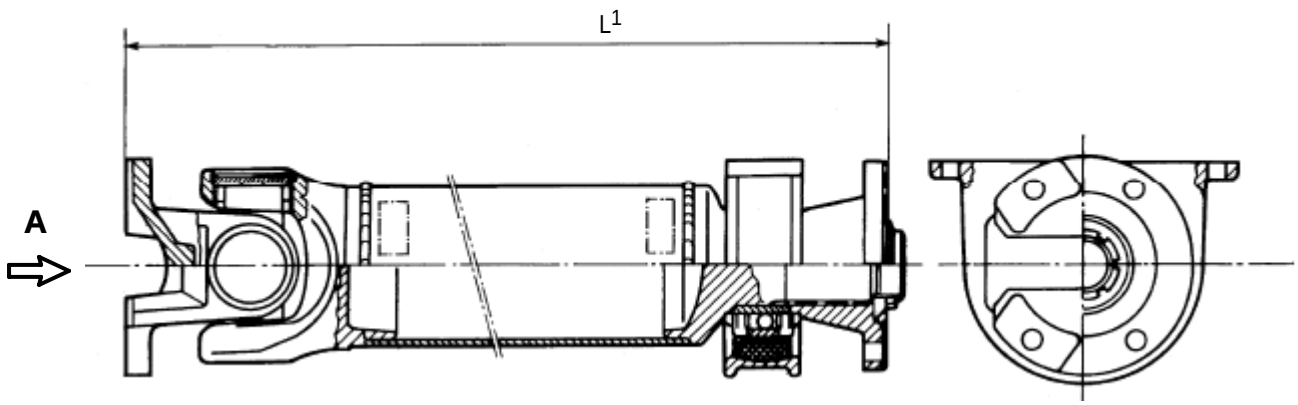
## MAIN DATA

Figure 1




SLIDING PROPELLER SHAFT

Figure 2




PROPELLER SHAFT FOR CONNECTION WITH SPRING BEARING

Universal joint working angle: 25°

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## MAIN DATA

| Description | mm |
|---|---|
| Assembly (radial) clearance of joint in seats on fork | 0.03 |
| Maximum eccentricity of propeller shaft | |
| - measured in the middle | 0.4 |
| - measured at the end | 0.25 |
| - measured on the shank | 0.15 |

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**Vehicles 4x2**

| Wheelbase | | 3500 | 3800 | | 4200 | | 4500 | | 4800 | | 5100 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Model | Gearbox type | L mm min. max. | L1 mm | L mm min. max. | L1 mm | L mm min. max. | L1 mm | L mm min. max. | L1 mm | L mm min. max. | L1 mm | L mm min. max. |
| 190T 31/33 | ZF 9 S 1310 T.O. | - | 935 | 1225 ÷ 1335 | 1205 | 1350 ÷ 1460 | 1655 | 1175 ÷ 1285 | 1655 | 1175 ÷ 1285 | 1880 | 1575 ÷ 1685 |
| 190T 31/33 | ZF 9 S 1310 T.O. + Multipower | - | - | 1975 ÷ 2085 | 1025 | 1350 ÷ 1460 | 1475 | 1175 ÷ 1285 | 1700 | 1250 ÷ 1360 | 1700 | 1575 ÷ 1685 |
| 190T 33/36 | ZF 16 S 1620 T.D. | - | - | 2050 ÷ 2160 | 1150 | 1325 ÷ 1435 | 1595 | 1150 ÷ 1260 | 1820 | 1220 ÷ 1330 | 1820 | 1550 ÷ 1660 |
| 190T 33/36 | ZF 16 S 1620 T.D. + Multipower | - | - | 1850 ÷ 1960 | - | 2300 ÷ 2410 | 1420 | 1150 ÷ 1260 | 1645 | 1220 ÷ 1330 | 1645 | 1550 ÷ 1660 |
| 190T 41/45/50 | ZF 16 S 2220 T.O.<br>ZF 16 S 2520 T.O. | - | - | 1875 ÷ 1985 | - | 2275 ÷ 2385 | 1420 | 1150 ÷ 1260 | - | - | 1645 | 1550 ÷ 1660 |
| 190T 41/45/50 | ZF 16 S 2220/2520 T.O. + Multipower | - | - | 1700 ÷ 1810 | - | 2100 ÷ 2210 | 1240 | 1150 ÷ 1260 | - | - | 1465 | 1550 ÷ 1660 |
| 190T 41/45/50 | ZF 12 AS 2330 T.O. | - | - | 1975 ÷ 2085 | - | 2400 ÷ 2510 | - | 2670 ÷ 2780 | - | - | - | 3290 ÷ 3400 |
| 190T 41/45/50 | ZF 12 AS 2330 T.O. + Multipower | - | - | 1800 ÷ 1910 | - | 2200 ÷ 2310 | - | 2490 ÷ 2600 | - | - | - | 3110 ÷ 3220 |
| 400T 33/36 | ZF 16 S 1620 T.D. | 1750 ÷ 1860 | - | 2050 ÷ 2160 | - | - | - | - | | - | - | - |
| 400T 33/36 | ZF 16 S 1620 T.D. + Multipower | 1550 ÷ 1660 | - | 1850 ÷ 1960 | - | - | - | - | - | - | - | - |
| 400T 41/45/50 | ZF 16 S 2220 T.O.<br>ZF 16 S 2520 T.O. | 1550 ÷ 1660 | - | 1875 ÷ 1985 | - | - | - | - | - | - | - | - |
| 400T 41/45/50 | ZF 16 S 2220/2520 T.O. + Multipower | 1375 ÷ 1485 | - | 1700 ÷ 1810 | - | - | - | - | - | - | - | - |
| 400T 41/45/50 | ZF 12 AS 2330 T.O. | 1675 ÷ 1785 | - | 1975 ÷ 2085 | - | - | - | - | - | - | - | - |
| 400T 41/45/50 | ZF 12 AS 2330 T.O. + Multipower | 1475 ÷ 1585 | - | 1800 ÷ 1910 | - | - | - | - | - | - | - | - |

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**Vehicles 6x4**

| Wheelbase | | 3200 | | 3500 | | 3820 | | 4200 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Between gearbox and intermediate axle | Between axles | Between gearbox and intermediate axle | Between axles | Between gearbox and intermediate axle | Between axles | Between gearbox and intermediate axle | | Between axles |
| Model | Gearbox type | L mm min. max. | L mm min. max. | L mm min. max. | L mm min. max. | L mm min. max. | L mm min. max. | L1 | L mm min. max. | L mm min. max. |
| J 260T 31/33/B | ZF 9 S 1310 T.O. | 1450 ÷ 1560 | 830 ÷ 940 | 1775 ÷ 1885 | 830 ÷ 940 | 2025 ÷ 2135 | 830 ÷ 940 | - | - | 830 ÷ 940 |
| J 260T 31/33/B | ZF 9 S 1310 T.O. + Multipower | 1275 ÷ 1385 | 830 ÷ 940 | 1575 ÷ 1685 | 830 ÷ 940 | 1850 ÷ 1960 | 830 ÷ 940 | - | - | 830 ÷ 940 |
| J 260T 31/33 | ZF 9 S 1310 T.O. | - | - | - | - | - | - | 960 | 1475 ÷ 1585 | 830 ÷ 940 |
| J 260T 31/33 | ZF 9 S 1310 T.O. + Multipower | - | - | - | - | - | - | 780 | 1475 ÷ 1585 | 830 ÷ 940 |
| Y 260T 31/33/B | ZF 9 S 1310 T.O. | 1375 ÷ 1485 | 670 ÷ 830 | 1700 ÷ 1810 | 670 ÷ 830 | 1950 ÷ 2060 | 670 ÷ 830 | - | 2350 ÷ 2460 | 830 ÷ 940 |
| Y 260T 31/33/B | ZF 9 S 1310 T.O. + Multipower | 1200 ÷ 1310 | 670 ÷ 830 | 1525 ÷ 1635 | 670 ÷ 830 | 1775 ÷ 1885 | 670 ÷ 830 | - | 2150 ÷ 2260 | 830 ÷ 940 |
| Y 260T 31/33 | ZF 9 S 1310 T.O. | - | - | - | - | - | - | 960 | 1400 ÷ 1510 | 670 ÷ 830 |
| Y 260T 31/33 | ZF 9 S 1310 T.O. + Multipower | - | - | - | - | - | - | 780 | 1400 ÷ 1510 | 670 ÷ 830 |
| J 260T 33/36 | ZF 12 AS 1420 T.D<br>ZF 12 AS 1930 T.D. | 1375 ÷ 1485 | 830 ÷ 940 | 1675 ÷ 1785 | 830 ÷ 940 | 1950 ÷ 2060 | 830 ÷ 940 | - | 2350 ÷ 2460 | 830 ÷ 940 |
| J 260T 33/36 | ZF 12 AS 1420 T.D.<br>ZF 12 AS 1930 T.D. } +Multipower | 1200 ÷ 1310 | 830 ÷ 940 | 1525 ÷ 1635 | 830 ÷ 940 | 1775 ÷ 1885 | 830 ÷ 940 | - | 2200 ÷ 2310 | 830 ÷ 940 |
| J 260T 33/36 | ZF 16 S 1620 T.D. | 1350 ÷ 1460 | 830 ÷ 940 | 1675 ÷ 1785 | 830 ÷ 940 | 1950 ÷ 2060 | 830 ÷ 940 | - | 2350 ÷ 2460 | 830 ÷ 940 |
| J 260T 33/36 | ZF 16 S 1620 T.D. + Multipower | 1175 ÷ 1285 | 830 ÷ 940 | 1475 ÷ 1585 | 830 ÷ 940 | 1750 ÷ 1860 | 830 ÷ 940 | - | 2150 ÷ 2260 | 830 ÷ 940 |
| Y 260T 33/36/B | ZF 16 S 1620 T.D. | 1275 ÷ 1385 | 670 ÷ 830 | 1600 ÷ 1710 | 670 ÷ 830 | 1875 ÷ 1985 | 670 ÷ 830 | - | - | - |
| Y 260T 33/36/B | ZF 16 S 1620 T.D. + Multipower | 1100 ÷ 1210 | 670 ÷ 830 | 1400 ÷ 1510 | 670 ÷ 830 | 1700 ÷ 1810 | 670 ÷ 830 | - | - | - |
| Y 260T 33/36 | ZF 16 S 1620 T.D. | - | - | - | - | - | - | - | 2275 ÷ 2385 | 670 ÷ 830 |
| Y 260T 33/36 | ZF 16 S 1620 T.D. + Multipower | - | - | - | - | - | - | - | 2100 ÷ 2210 | 670 ÷ 830 |
| 260/380T 41/45/50T | ZF 16 S 2220/2520 T.O.<br>+Multipower | 950 ÷ 1060 | 775 ÷ 955 | 1275 ÷ 1385 | 775 ÷ 955 | 1525 ÷ 1635 | 775 ÷ 955 | - | 1950 ÷ 2060 | 775 ÷ 955 |
| 260/380T 41/45/50 | ZF 16 S 2220/2520 T.O. | 1125 ÷ 1235 | 775 ÷ 955 | 1450 ÷ 1560 | 775 ÷ 955 | 1700 ÷ 1810 | 775 ÷ 955 | - | 2100 ÷ 2210 | 775 ÷ 955 |
| 260/380T 41/45/50/P | ZF 12 AS 2330 T.O. | 1225 ÷ 1335 | 775 ÷ 955 | 1550 ÷ 1660 | 775 ÷ 955 | 1800 ÷ 1910 | 775 ÷ 955 | - | 2225 ÷ 2335 | 775 ÷ 955 |
| 260/380T 41/45/50/P | ZF 12 AS 2330 T.O.+Multipower | 1050 ÷ 1160 | 775 ÷ 955 | 1375 ÷ 1485 | 775 ÷ 955 | 1625 ÷ 1735 | 775 ÷ 955 | - | 2050 ÷ 2160 | 775 ÷ 955 |
| f 380T 36 | ZF 16 S 1620 T.D. | 1300 ÷ 1410 | 775 ÷ 955 | 1625 ÷ 1735 | 775 ÷ 955 | 1900 ÷ 2010 | 775 ÷ 955 | - | 2300 ÷ 2410 | 775 ÷ 955 |
| f 380T 36 | ZF 16 S 1620 T.D.+Multipower | 1125 ÷ 1235 | 775 ÷ 955 | 1425 ÷ 1535 | 775 ÷ 955 | 1700 ÷ 1810 | 775 ÷ 955 | - | 2100 ÷ 2210 | 775 ÷ 955 |
| f 380T 36 | ZF 12 AS 1930 T.D. | 1325 ÷ 1435 | 775 ÷ 955 | 1650 ÷ 1760 | 775 ÷ 955 | 1900 ÷ 2010 | 775 ÷ 955 | - | 2300 ÷ 2410 | 775 ÷ 955 |
| f 380T 36 | ZF 12 AS 1930 T.D.+Multipower | 1125 ÷ 1235 | 775 ÷ 955 | 1475 ÷ 1585 | 775 ÷ 955 | 1725 ÷ 1835 | 775 ÷ 955 | - | 2150 ÷ 2260 | 775 ÷ 955 |
| J 440T 33/36T | ZF 16 S 1620 T.D. | 1350 ÷ 1460 | 830 ÷ 940 | 1675 ÷ 1785 | 830 ÷ 940 | - | - | - | - | - |
| J 440T 33/36T | ZF 16 S 1620 T.D.+Multipower | 1175 ÷ 1285 | 830 ÷ 940 | 1475 ÷ 1585 | 830 ÷ 940 | - | - | - | - | - |
| J 440T 33/36T | ZF 12 AS 1420 T.D.<br>ZF 12 AS 1930 T.D. | 1375 ÷ 1485 | 830 ÷ 940 | 1675 ÷ 1785 | 830 ÷ 940 | - | - | - | - | - |
| J 440T 33/36T | ZF 12 AS 1420 T.D.<br>ZF 12 AS 1930 T.D. } +Multipower | 1200 ÷ 1310 | 830 ÷ 940 | 1525 ÷ 1635 | 830 ÷ 940 | - | - | - | - | - |
| 260T 33/36 | ZF 12 AS 1420 T.D.<br>ZF 12 AS 1930 T.D. | - | - | - | - | 1900 ÷ 2010 | 670 ÷ 830 | - | 2300 ÷ 2410 | 670 ÷ 830 |
| 260T 33/36 | ZF 12 AS 1420 T.D.<br>ZF 12 AS 1930 T.D. } +Multipower | - | - | - | - | 1700 ÷ 1810 | 670 ÷ 830 | - | 2100 ÷ 2210 | 670 ÷ 830 |
| 440/720T 41/45/50T | ZF 16 S 2220/2520 T.O.<br>+Multipower | 950 ÷ 1060 | 775 ÷ 955 | - | - | - | - | - | - | - |
| 440/720T 41/45/50T | ZF 16 S 2220/2520 T.O. | 1125 ÷ 1235 | 775 ÷ 955 | - | - | - | - | - | - | - |
| 440/720T 41/45/50/P | ZF 12 AS 2330 T.O. | 1225 ÷ 1335 | 775 ÷ 955 | - | - | - | - | - | - | - |
| 440/720T 41/45/50/P | ZF 12 AS 2330 T.O.+Multipower | 1050 ÷ 1160 | 775 ÷ 955 | - | - | - | - | - | - | - |

J rear axle 452146
Y rear axle MT23 - 155
f rear axle 453291

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Aquila Trucks Centres

**Vehicles 6x4 (it follows)**

| Wheelbase | | 4500 | | | 4800 | | | 5100 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Between gearbox and intermediate axle | | Between axles | Between axles | | Between axles | Between axles | | Between axles |
| Model | Gearbox type | L1 mm | L mm min. max. | L mm min. max. | L1 mm | L mm min. max. | L mm min. max. | L1 mm | L mm min. max. | L mm min. max. |
| J 260T 31/33 | ZF 9 S 1310 T.O. | 1230 | 1475 ÷ 1585 | 830 ÷ 940 | 1685 | 1350 ÷ 1460 | 830 ÷ 940 | 1685 | 1650 ÷ 1760 | 830 ÷ 940 |
| J 260T 31/33 | ZF 9 S 1310 T.O. + Multipower | 1050 | 1475 ÷ 1585 | 830 ÷ 940 | 1505 | 1350 ÷ 1460 | 830 ÷ 940 | 1505 | 1650 ÷ 1760 | 830 ÷ 940 |
| J 260T 33/36 | ZF 12 AS 1420 T.D.<br>ZF 12 AS 1930 T.D. | 1165 | 1475 ÷ 1585 | 830 ÷ 940 | 1615 | 1350 ÷ 1460 | 830 ÷ 940 | 1615 | 1650 ÷ 1760 | 830 ÷ 940 |
| J 260T 33/36 | ZF 12 AS 1420 T.D.<br>ZF 12 AS 1930 T.D. } +Multipower | 985 | 1475 ÷ 1585 | 830 ÷ 940 | 1435 | 1350 ÷ 1460 | 830 ÷ 940 | 1435 | 1650 ÷ 1760 | 830 ÷ 940 |
| J 260T 33/36 | ZF 16 S 1620 T.D. | 1150 | 1475 ÷ 1585 | 830 ÷ 940 | 1595 | 1350 ÷ 1460 | 830 ÷ 940 | 1595 | 1650 ÷ 1760 | 830 ÷ 940 |
| J 260T 33/36 | ZF 16 S 1620 T.D. + Multipower | 970 | 1475 ÷ 1585 | 830 ÷ 940 | 1420 | 1350 ÷ 1460 | 830 ÷ 940 | 1420 | 1650 ÷ 1760 | 830 ÷ 940 |
| Y 260T 33/36 | ZF 16 S 1620 T.D. | - | - | - | 1595 | 1275 ÷ 1385 | 670 ÷ 830 | - | - | - |
| Y 260T 33/36 | ZF 16 S 1620 T.D. + Multipower | - | - | - | 1420 | 1275 ÷ 1385 | 670 ÷ 830 | - | - | - |
| 260T/380T41/45/50 | ZF 16 S 2220/2520 T.O. | 970 | 1425 ÷ 1535 | 775 ÷ 955 | 1420 | 1300 ÷ 1410 | 775 ÷ 955 | 1420 | 1600 ÷ 1710 | 775 ÷ 955 |
| 260T/380T41/45/50 | ZF 16 S 2220/2520 T.O. +Multipower | - | 2200 ÷ 2310 | 775 ÷ 955 | 1240 | 1300 ÷ 1410 | 775 ÷ 955 | 1240 | 1600 ÷ 1710 | 775 ÷ 955 |
| f 380T 36 | ZF 16 S 1620 T.D. | 1150 | 1425 ÷ 1535 | 775 ÷ 955 | - | - | - | - | - | - |
| f 380T 36 | ZF 16 S 1620 T.D. + Multipower | 970 | 1425 ÷ 1535 | 775 ÷ 955 | - | - | - | - | - | - |
| Y 260T 31/33 | ZF 9 S 1310 T.O. | - | - | - | 1685 | 1275 ÷ 1385 | 670 ÷ 830 | - | - | - |
| Y 260T 31/33 | ZF 9 S 1310 T.O. + Multipower | - | - | - | 1505 | 1275 ÷ 1385 | 670 ÷ 830 | - | - | - |
| 260/380T 41/45/50/P | ZF 12 AS 2330 T.O. | 1075 | 1425 ÷ 1535 | 775 ÷ 955 | 1525 | 1300 ÷ 1410 | 775 ÷ 955 | 1525 | 1600 ÷ 1710 | 775 ÷ 955 |
| 260/380T 41/45/50/P | ZF 12 AS 2330 T.O. + Multipower | - | 2300 ÷ 2410 | 775 ÷ 955 | 1345 | 1300 ÷ 1410 | 775 ÷ 955 | 1345 | 1600 ÷ 1710 | 775 ÷ 955 |
| 260T 33/36 | ZF 12 AS 1420 T.D.<br>ZF 12 AS 1930 T.D. | - | - | - | 1615 | 1275 ÷ 1385 | 670 ÷ 830 | - | - | - |
| 260T 33/36 | ZF 12 AS 1420 T.D.<br>ZF 12 AS 1930 T.D. } +Multipower | - | - | - | 1435 | 1275 ÷ 1385 | 670 ÷ 830 | - | - | - |

J rear axle 452146

Y rear axle MT23 - 155

f rear axle 453291

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Aquila Trucks Centres

**Vehicles 8x4x4**

| Wheelbase | | 4250 | | 4750 | | | 5020 | | | 5820 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Between gearbox and intermediate axle | Between axles | Between gearbox and intermediate axle | | Between axles | Between gearbox and intermediate axle | | Between axles | Between gearbox and intermediate axle | | Between axles |
| Model | Gearbox type | L mm min. max. | L mm min. max. | L1 mm | L mm min. max. | L mm min. max. | L1 mm | L mm min. max. | L mm min. max. | L1 mm | L mm min. max. | L mm min max |
| 340T 36 | ZF 16 S 1620 T.D. | 2400 ÷ 2510 | 830 ÷ 940 | 1510 | 1400 ÷ 1510 | 830 ÷ 940 | 1510 | 1650 ÷ 1760 | 830 ÷ 940 | 1820 | 2150 ÷ 2260 | 830 ÷ 940 |
| 340T 36 | ZF 16 S 1620 T.D. +Multipower | 2200 ÷ 2310 | 830 ÷ 940 | 1330 | 1400 ÷ 1510 | 830 ÷ 940 | 1330 | 1650 ÷ 1760 | 830 ÷ 940 | 1645 | 2150 ÷ 2260 | 830 ÷ 940 |
| 340T 36 | ZF 12 AS 1930 T.D. | 2400 ÷ 2510 | 830 ÷ 940 | 1525 | 1400 ÷ 1510 | 830 ÷ 940 | 1525 | 1650 ÷ 1760 | 830 ÷ 940 | 1840 | 2150 ÷ 2260 | 830 ÷ 940 |
| 340T 36 | ZF 12 AS 1930 T.D. +Multipower | 2225 ÷ 2335 | 830 ÷ 940 | 1345 | 1400 ÷ 1510 | 830 ÷ 940 | 1345 | 1650 ÷ 1760 | 830 ÷ 940 | 1660 | 2150 ÷ 2260 | 830 ÷ 940 |
| 340T 36 B/P-/P | ZF 16 S 1620 T.D. | 2300 ÷ 2410 | 650 ÷ 790 | 1510 | 1325 ÷ 1435 | 650 ÷ 790 | 1510 | 1600 ÷ 1710 | 650 ÷ 790 | 1820 | 2100 ÷ 2210 | 650 ÷ 790 |
| 340T 36 B/P-/P | ZF 16 S 1620 T.D. +Multipower | 2150 ÷ 2260 | 650 ÷ 790 | 1330 | 1325 ÷ 1435 | 650 ÷ 790 | 1330 | 1600 ÷ 1710 | 650 ÷ 790 | 1645 | 2100 ÷ 2210 | 650 ÷ 790 |
| 340T 36/P | ZF 12 AS 1930 T.D. | - | - | - | - | - | 1525 | 1575 ÷ 1685 | 670 ÷ 830 | 1840 | 2075 ÷ 2185 | 670 ÷ 830 |
| 340T 36/P | ZF 12 AS 1930 T.D. +Multipower | - | - | - | - | - | 1345 | 1575 ÷ 1685 | 670 ÷ 830 | 1660 | 2075 ÷ 2185 | 670 ÷ 830 |
| 410T 36 | ZF 16 S 1620 T.D. | 2350 ÷ 2460 | 775 ÷ 955 | 1505 | 1325 ÷ 1435 | 775 ÷ 955 | 1505 | 1600 ÷ 1710 | 775 ÷ 955 | 1820 | 2100 ÷ 2210 | 775 ÷ 955 |
| 410T 36 | ZF 16 S 1620 T.D. +Multipower | 2150 ÷ 2260 | 775 ÷ 955 | 1330 | 1325 ÷ 1435 | 775 ÷ 955 | 1330 | 1600 ÷ 1710 | 775 ÷ 955 | 1645 | 2100 ÷ 2210 | 775 ÷ 955 |
| 410T 36 | ZF 12 AS 1930 T.D. | 2350 ÷ 2460 | 775 ÷ 955 | 1525 | 1325 ÷ 1435 | 775 ÷ 955 | 1525 | 1600 ÷ 1710 | 775 ÷ 955 | 1840 | 2100 ÷ 2210 | 775 ÷ 955 |
| 410T 36 | ZF 12 AS 1930 T.D. +Multipower | 2175 ÷ 2285 | 775 ÷ 955 | 1345 | 1325 ÷ 1435 | 775 ÷ 955 | 1345 | 1600 ÷ 1710 | 775 ÷ 955 | 1660 | 2100 ÷ 2210 | 775 ÷ 955 |
| 340T 41/45/P | ZF 16 S 2220 T.O. | - | - | - | - | - | 1330 | 1575 ÷ 1685 | 670 ÷ 830 | 1645 | 2075 ÷ 2185 | 670 ÷ 830 |
| 340T 41/45/P | ZF 16 S 2220 T.O. +Multipower | - | - | - | - | - | 1150 | 1575 ÷ 1685 | 670 ÷ 830 | 1465 | 2075 ÷ 2185 | 670 ÷ 830 |
| 340T 41/45/P | ZF 12 AS 2330 T.O. | - | - | - | - | - | 1435 | 1575 ÷ 1685 | 670 ÷ 830 | 1750 | 2075 ÷ 2185 | 670 ÷ 830 |
| 340T 41/45/P | ZF 12 AS 2330 T.O.+Multipower | - | - | - | - | - | - | - | - | 1570 | 2075 ÷ 2185 | 670 ÷ 830 |
| 340T 41/45/B 410T 41/45/50/B | ZF 16 S 2220/2520 T.O. | 2150 ÷ 2260 | 775 ÷ 955 | 1330 | 1325 ÷ 1435 | 775 ÷ 955 | 1330 | 1600 ÷ 1710 | 775 ÷ 955 | 1645 | 2100 ÷ 2210 | 775 ÷ 955 |
| 340T 41/45 B 410T 41/45/50/B | ZF 16 S 2220/2520 T.O. +Multipower | 2000 ÷ 2110 | 775 ÷ 955 | 1150 | 1325 ÷ 1435 | 775 ÷ 955 | 1150 | 1600 ÷ 1710 | 775 ÷ 955 | 1465 | 2100 ÷ 2210 | 775 ÷ 955 |
| 340T 41/45/B/P | ZF 12 AS 2330 T.O. | 2250 ÷ 2360 | 775 ÷ 955 | 1435 | 1325 ÷ 1435 | 775 ÷ 955 | 1435 | 1600 ÷ 1710 | 775 ÷ 955 | 1750 | 2100 ÷ 2210 | 775 ÷ 955 |
| 410T 41/45/50/B | ZF 12 AS 2330 T.O. | 2250 ÷ 2360 | 775 ÷ 955 | 1435 | 1325 ÷ 1435 | 775 ÷ 955 | 1435 | 1600 ÷ 1710 | 775 ÷ 955 | 1750 | 2100 ÷ 2210 | 775 ÷ 955 |
| 340T 41/45/B/P 410T 41/45/50/B | ZF 12 AS 2330 T.O.+Multipower | 2075 ÷ 2185 | 775 ÷ 955 | 1255 | 1325 ÷ 1435 | 775 ÷ 955 | 1255 | 1600 ÷ 1710 | 775 ÷ 955 | 1570 | 2100 ÷ 2210 | 775 ÷ 955 |

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Aquila Trucks Centres

**Vehicles 4x4**

| Wheelbase | | 3800 | | | 4200 | | | 4500 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Between gearbox and transfer box | Between transfer box and rear axle | Between transfer box and front axle | Between gearbox and transfer box | Between transfer box and rear axle | Between transfer box and front axle | Between gearbox and transfer box | Between transfer box and rear axle | Between transfer box and front axle |
| Model | Gearbox type | L mm min. max. | L mm min. max. | L mm min. max. | L mm min. max. | L mm min. max. | L mm min. max. | L mm min. max. | L mm min. max. | L mm min. max. |
| 190T 31/33 W | ZF 9 S 1310 T.O. | 925 ÷ 1035 | 875 ÷ 985 | 1800 ÷ 1910 | 925 ÷ 1035 | 1250 ÷ 1360 | 1800 ÷ 1910 | 925 ÷ 1035 | 1525 ÷ 1635 | 1800 ÷ 1910 |
| 190T 31/33 W | ZF 9 S 1310 T.O. + Multipower | 700 ÷ 810 | 875 ÷ 985 | 1800 ÷ 1910 | 700 ÷ 810 | 1250 ÷ 1360 | 1800 ÷ 1910 | 700 ÷ 810 | 1525 ÷ 1635 | 1800 ÷ 1910 |
| 190T 33/36 W | ZF 12 AS 1420 T.D./12 AS 1930 T.D. | 825 ÷ 935 | 875 ÷ 985 | 1800 ÷ 1910 | 825 ÷ 935 | 1250 ÷ 1360 | 1800 ÷ 1910 | 825 ÷ 935 | 1525 ÷ 1635 | 1800 ÷ 1910 |
| 190T 33/36 W | ZF 12 AS 1420 T.D./12 AS 1930 T.D. +Multipower | 650 ÷ 760 | 875 ÷ 985 | 1800 ÷ 1910 | 650 ÷ 760 | 1250 ÷ 1360 | 1800 ÷ 1910 | 650 ÷ 760 | 1525 ÷ 1635 | 1800 ÷ 1910 |
| 190T 33/36 W | ZF 16 S 1620 T.D. | 825 ÷ 935 | 875 ÷ 985 | 1800 ÷ 1910 | 825 ÷ 935 | 1250 ÷ 1360 | 1800 ÷ 1910 | 825 ÷ 935 | 1525 ÷ 1635 | 1800 ÷ 1910 |
| 190T 33/36 W | ZF 16 S 1620 T.D. + Multipower | 650 ÷ 760 | 875 ÷ 985 | 1800 ÷ 1910 | 650 ÷ 760 | 1250 ÷ 1360 | 1800 ÷ 1910 | 650 ÷ 760 | 1525 ÷ 1635 | 1800 ÷ 1910 |
| 190T 41/45 W | ZF 16 S 2220 T.O. + Multipower | 497 ÷ 587 | 850 ÷ 960 | 1800 ÷ 1910 | 497 ÷ 587 | 1250 ÷ 1360 | 1800 ÷ 1910 | 497 ÷ 587 | 1525 ÷ 1635 | 1800 ÷ 1910 |
| 190T 41/45 W | ZF 12 AS 2330 T.O. | 750 ÷ 860 | 850 ÷ 960 | 1800 ÷ 1910 | 750 ÷ 860 | 1250 ÷ 1360 | 1800 ÷ 1910 | 750 ÷ 860 | 1525 ÷ 1635 | 1800 ÷ 1910 |
| 190T 41/45 W | ZF 12 AS 2330 T.O. + Multipower | 571 ÷ 681 | 850 ÷ 960 | 1800 ÷ 1910 | 571 ÷ 681 | 1250 ÷ 1360 | 1800 ÷ 1910 | 571 ÷ 681 | 1525 ÷ 1635 | 1800 ÷ 1910 |
| 190T 41/45 W | ZF 16 S 2220 T.O. | 650 ÷ 760 | 850 ÷ 960 | 1800 ÷ 1910 | 650 ÷ 760 | 1250 ÷ 1360 | 1800 ÷ 1910 | 650 ÷ 760 | 1525 ÷ 1635 | 1800 ÷ 1910 |
| 400T 41/45 WT | ZF 12 AS 2330 T.O. | 750 ÷ 860 | 850 ÷ 960 | 1800 ÷ 1910 | - | - | - | - | - | - |
| 400T 41/45 WT | ZF 12 AS 2330 T.O. + Multipower | 571 ÷ 681 | 850 ÷ 960 | 1800 ÷ 1910 | - | - | - | - | - | - |
| 400T 41/45 WT | ZF 16 S 2220 T.O. + Multipower | 497 ÷ 587 | 850 ÷ 960 | 1800 ÷ 1910 | - | - | - | - | - | - |
| 400T 41/45 WT | ZF 16 S 2220 T.O. | 650 ÷ 760 | 850 ÷ 960 | 1800 ÷ 1910 | - | - | - | - | - | - |

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Aquila Trucks Centres

**Vehicles 6x6**

| Wheelbase | | 3500 | | | | 3820 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Between gearbox and transfer box | Between transfer box and intermediate axle | Between axles | Between transfer box and front axle | Between gearbox and transfer box | Between transfer box and intermediate axle | Between axles | Between transfer box and front axle |
| Model | Gearbox type | L mm min. max. | L mm min. max. | L mm min. max. | L mm min. max. | L mm min. max. | L mm min. max. | L mm min. max. | L mm min. max. |
| 260/380T 36 W | ZF 16 S 1620 T.D. | 571 ÷ 681 | 700 ÷ 810 | 775 ÷ 955 | 1525 ÷ 1635 | 825 ÷ 935 | 700 ÷ 810 | 775 ÷ 955 | 1800 ÷ 1910 |
| 260/380T 36 W | ZF 16 S 1620 T.D. + Multipower | 410 ÷ 440 | 700 ÷ 810 | 775 ÷ 955 | 1525 ÷ 1635 | 650 ÷ 760 | 700 ÷ 810 | 775 ÷ 955 | 1800 ÷ 1910 |
| 260/380T 36 W | ZF 12 AS 1930 T.D. | 571 ÷ 681 | 700 ÷ 810 | 775 ÷ 955 | 1525 ÷ 1635 | 825 ÷ 935 | 700 ÷ 810 | 775 ÷ 955 | 1800 ÷ 1910 |
| 260/380T 36 W | ZF 12 AS 1930 T.D. + Multipower | 420 ÷ 460 | 700 ÷ 810 | 775 ÷ 955 | 1525 ÷ 1635 | 650 ÷ 760 | 700 ÷ 810 | 775 ÷ 955 | 1800 ÷ 1910 |
| 260T 41/45 W | ZF 16 S 2220 T.O. | 390 ÷ 440 | 700 ÷ 810 | 775 ÷ 955 | 1525 ÷ 1635 | 650 ÷ 760 | 700 ÷ 810 | 775 ÷ 955 | 1800 ÷ 1910 |
| 260T 41/45 W | ZF 16 S 2220 T.O. + Multipower | - | - | - | - | 500 ÷ 550 | 700 ÷ 810 | 775 ÷ 955 | 1800 ÷ 1910 |
| 260T 41/45 W | ZF 12 AS 2330 T.O. | 500 ÷ 550 | 700 ÷ 810 | 775 ÷ 955 | 1525 ÷ 1635 | 750 ÷ 860 | 700 ÷ 810 | 775 ÷ 955 | 1800 ÷ 1910 |
| 260T 41/45 W | ZF 12 AS 2330 T.O. + Multipower | - | - | - | - | 570 ÷ 660 | 700 ÷ 810 | 775 ÷ 955 | 1800 ÷ 1910 |
| 380T 41/45 W | ZF 16 S 2220 T.O. | 390 ÷ 440 | 700 ÷ 833 | 775 ÷ 955 | 1525 ÷ 1635 | 650 ÷ 750 | 700 ÷ 833 | 775 ÷ 955 | 1800 ÷ 1910 |
| 380T 41/45 W | ZF 16 S2220 T.O. + Multipower | - | - | - | - | 500 ÷ 550 | 700 ÷ 833 | 775 ÷ 955 | 1800 ÷ 1910 |
| 380T 41/45 W | ZF 12 AS 2330 T.O. | 500 ÷ 550 | 700 ÷ 810 | 775 ÷ 955 | 1525 ÷ 1635 | 750 ÷ 860 | 700 ÷ 810 | 775 ÷ 955 | 1800 ÷ 1910 |
| 380T 41/45 W | ZF 12 AS 2330 T.O. + Multipower | - | - | - | - | 554 ÷ 644 | 700 ÷ 810 | 775 ÷ 955 | 1800 ÷ 1910 |
| 720T 41/45 WT | ZF 16 S 2220 T.O. | 390 ÷ 440 | 700 ÷ 833 | 775 ÷ 955 | 1525 ÷ 1635 | - | - | - | - |
| 720T 41/45 WT | ZF 12 AS 2330 T.O. | 500 ÷ 550 | 700 ÷ 810 | 775 ÷ 955 | 1525 ÷ 1635 | - | - | - | - |

**Vehicles 8x8x4**

| Wheelbase | | 4750 | | | | |
|---|---|---|---|---|---|---|
| | | Between gearbox and transfer box | Between transfer box and intermediate axle | Between rear axles | Between front axles | Between transfer box and front axle |
| Model | Gearbox | L mm min. max. | L mm min. max. | L mm min. max. | L mm min. max. | L mm min. max. |
| 410T 45 W | ZF 16 S 2220 T.O. | 1700 ÷ 1810 | 590 ÷ 700 | 775 ÷ 955 | 830 ÷ 940 | 1320 ÷ 1500 |
| 410T 45 W | ZF 16 S 2220 T.O. + Multipower | 1500 ÷ 1610 | 590 ÷ 700 | 775 ÷ 955 | 830 ÷ 940 | 1320 ÷ 1500 |
| 410T 45 W | ZF 12 AS 2330 T.O. | 1800 ÷ 1910 | 590 ÷ 700 | 775 ÷ 955 | 830 ÷ 940 | 1320 ÷ 1500 |
| 410T 45 W | ZF 12 AS 2330 T.O. + Multipower | 1575 ÷ 1685 | 590 ÷ 700 | 775 ÷ 955 | 830 ÷ 940 | 1320 ÷ 1500 |

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## TROUBLESHOOTING

### Main operating faults

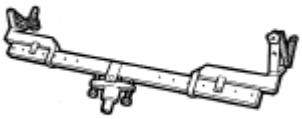
| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Transmission noise and vibration | Deformed shaft. | Replace the shaft. |
| | Shaft not balanced. | Check the balance and determine the points where you need to weld on the balancing plates. |
| | Too much clearance between grooved profiles. | Replace the shaft. |
| | Loose screws and nuts fixing the shaft to the sleeves on the gearbox or on the rear axle. | After making a thorough check, fully tighten the loose screws and nuts; replace any damaged parts. |
| | Universal joints of the propeller shaft seized or too worn. | Overhaul or replace the universal joints. |
| | Insufficient lubrication of the various parts. | Lubricate via the grease nipples. |
| | Loose screws fixing the flexible mounting. | Tighten the screws to the required torque. |
| | Silentblock of the central mounting deteriorated. | Replace the mounting. |
| | Bearing of the central flexible mounting deteriorated or with too much play. | Replace the mounting |
| | Loose screws or ring nuts fixing the flange on the shank of the propeller shaft. | Tighten the screws or ring nuts to the required torque. |

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## TIGHTENING TORQUES

| DESCRIPTION | TORQUE | |
|---|---|---|
| | Nm | kgm |
| Ring nut for fixing flange on connecting shaft: | | |
| M 40x1.5 | 350 + 50 | 35 + 5 |
| M 55x1.5 | 380 + 70 | 38 + 7 |
| Screw fixing flange on connecting shaft: M 20 x 160 | 450 ± 34 | 45 ± 3.4 |
| Nut for screw fixing propeller shaft flanges | 133.5 ± 13.5 | 13.3 ± 1.3 |
| Nut for M12 screw fixing bracket for flexible mounting to chassis frame | 92 ± 9 | 9.2 ± 1 |
| Nut for M14 fixing flexible mounting to chassis frame | 146.5 ± 14.5 | 14.6 ± 1.4 |

## TOOLS

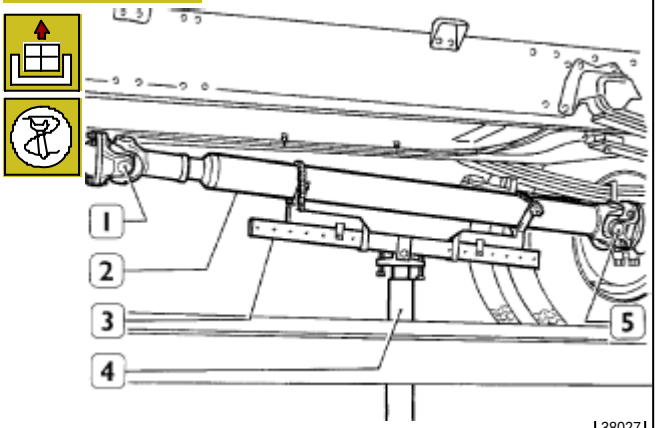
| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99370618** |  | Mount to remove-refit propeller shaft |

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## 505620 PROPELLER SHAFT REMOVAL AND REFITTING

### Removal

Figure 3

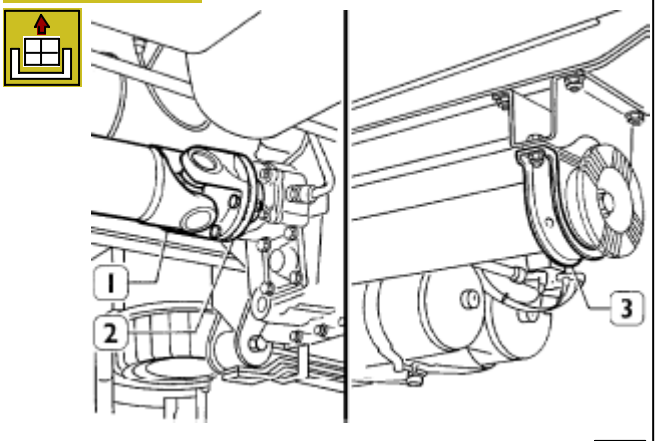



38027

Place a hydraulic jack (4) equipped with the mount 99370618 (3) under the rear propeller shaft (2).
Disconnect the propeller shaft (2) from the rear axle and from the flexible mounting by unscrewing the screws and nuts fixing the flanges (1 and 5).
Lower the hydraulic jack completely to detach the propeller shaft.

Removal and refitting are described for a vehicle with a propeller shaft in two sections.

Figure 4




38028

Repeat these steps for the front propeller shaft (1), disconnecting it from the flange (2) of the gearbox and removing the flexible mounting (3) as well.

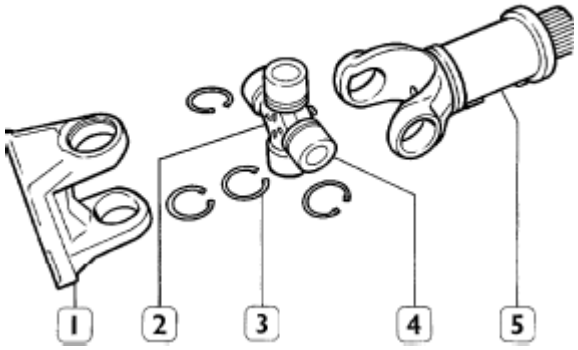
### Refitting

For refitting, carry out the steps described for removal in reverse order, observing the following:
- The self-locking nuts always have to be replaced and tightened to the required torque.

## 505620 REPAIRS

### Disassembling the universal joint

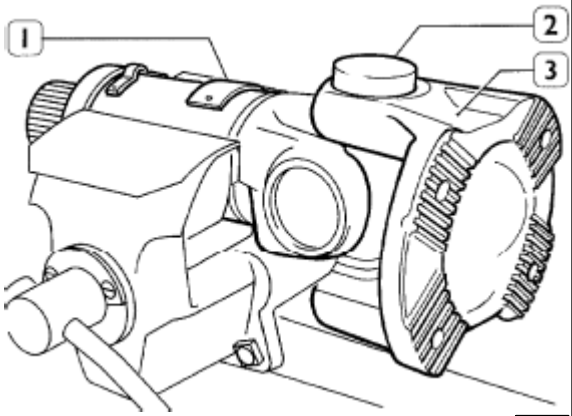
Fi




38029

COMPONENT PARTS OF THE UNIVERSAL JOINT
1. Fork - 2. Joint - 3. Split rings - 4. Bearings - 5. Sliding sleeve.

Figure 6




38030

Put the universal joint assembly (1) in a vice.
Using suitable pliers, take off the split rings (3, Fig. 3).
Strike a mallet on the fork (3, Fig. 4) till the bearing (2) partly comes out of its seat, that is until the joint interferes with the fork.
Turn the part over and repeat the above operations.
Take one of the two bearings (2) out by hand.
Take out the fork (3) and, with the aid of a punch, extract the other bearing.
With the same procedure, extract the bearings from the other fork and free the joint.
To remove the opposite joint, repeat the above steps.

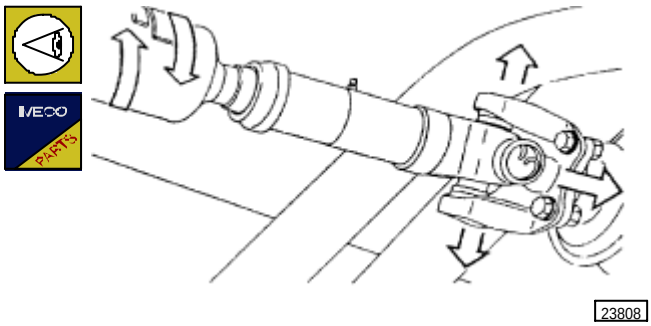
### Assembling the universal joint

Insert the joint into the fork and into the forked sleeve.
Mount the bearings together with the rollers, and therefore the split rings, on the pins of the joint.

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## CHECKING PROPELLER SHAFTS ON VEHICLES

Figure 7




The drive shafts are supplied ready for assembly.
They are statically and dynamically balanced.
The plates welded to the propeller shafts are for balancing.
If there are no plates, it is necessary to balance the shaft again.
Working on the propeller shaft and at the same time, in the opposite direction, on the sliding sleeve (arrows), check there is not too much clearance between the splines.
Working on the forks of the sleeves (arrows), check that the joints are not worn; if they are, replace them as described above.

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SECTION 8

# Axles


| | | Page |
|---|---|---|
| AXLES | | 3÷12 |
| FRONT AXLES | 5985/2D | 13÷54 |
| INTERMEDIATE AXLES | 452191/2D<br>453291/2D | 55÷100 |
| INTERMEDIATE AXLES | 452146/2D | 101÷132 |
| REAR AXLES | 451391/2D<br>452191/2D<br>453291/2D | 133÷168 |
| REAR AXLES | 452146/2D | 169÷190 |
| AXLES IN TANDEM MERITOR MT 23-155/2D: | | |
| - INTERMEDIATE AXLE MD 11-155/2D | | 193÷234 |
| - REAR AXLE MR 11-155/2D | | 235÷264 |

Aquila Trucks Centres

Aquila Trucks Centres

# Axles


| | Page |
|---|---|
| TROUBLESHOOTING | 5 |
| - Main operating faults | 5 |
| REMOVING - RE-FITTING IN PLACE THE FRONT DRIVE AXLE (4x4 - 6x6 Vehicles) | 6 |
| - Removal | 6 |
| - Refitting | 6 |
| REMOVING REAR AXLES (4x2 - 4x4 Vehicles) | 8 |
| REMOVING THE REAR AXLE (6x4 - 6x6 - 8x4x4 Vehicles) | 10 |
| REMOVING THE INTERMEDIATE AXLE (6x4 - 6x6 - 8x4x4 Vehicles) | 11 |
| - Instructions to adjust and check the functioning of the transmitter that controls the engagement of differential and reduction gear unit locking | 12 |
| REFITTING IN PLACE THE AXLE (Vehicles : all versions) | 12 |

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## TROUBLESHOOTING

### Main operating faults

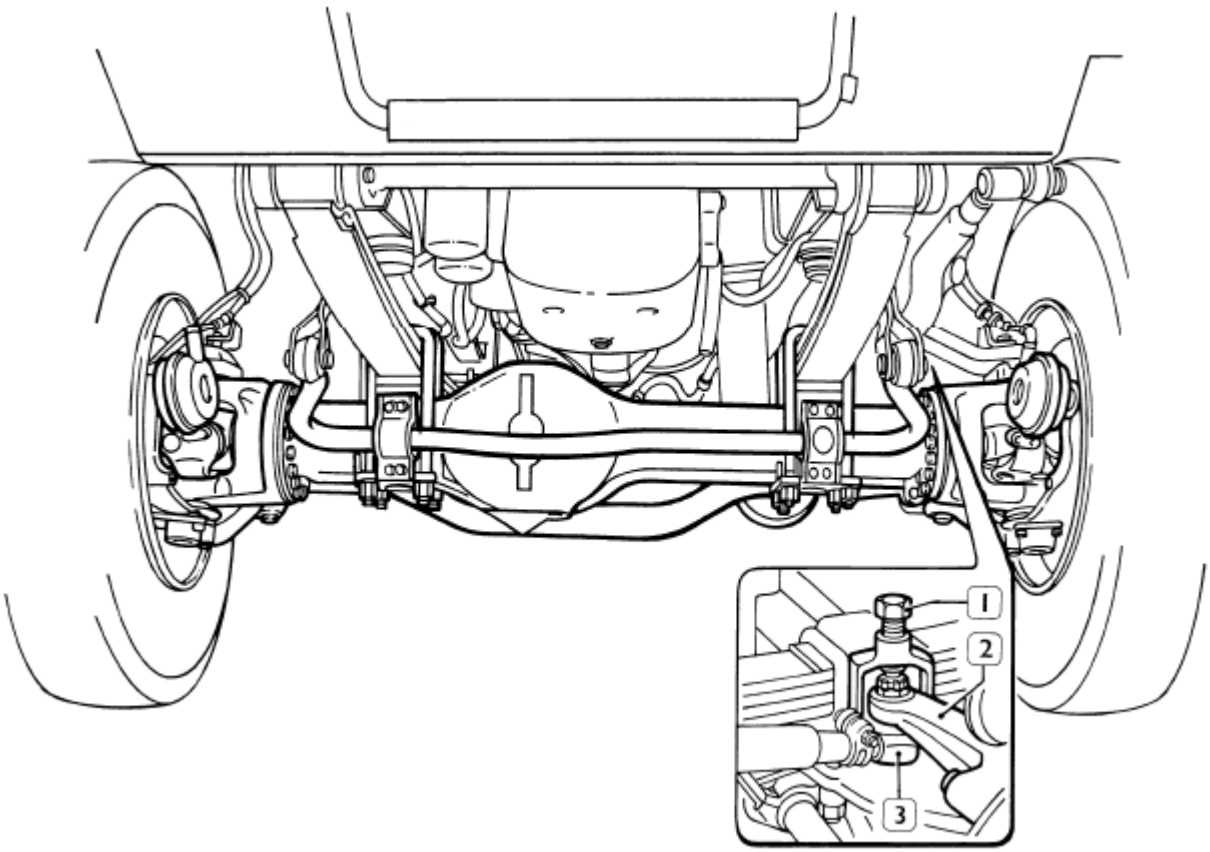
| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Wheel hubs noisy | Insufficient lubrication. | Check there are no leaks from gaskets or the axle casing and top up oil to correct level. |
| | Wheel hub bearings inefficient. | Remove the hub and replace inefficient parts. |
| | Bad adjustment of wheel hub bearings. | Adjust bearings. |
| | Half-shaft splines to fit planetary gears of epicyclic gears are worn. | Overhaul and replace worn or damaged parts. |
| Noise | Lubricating oil level low. | Check there are no leaks from gaskets or axle casing and top up to correct level. |
| | Half shaft splines to fit the differential crown wheels damaged. | Overhaul the axle and replace worn or damaged parts. |
| | Bad adjustment of hub bearings. | Adjust the bearings backlash. |
| | Bad adjustment or wear on differential gears or bearings. | Locate the trouble and overhaul the unit. |
| Noise at release | Improper fitting backlash between pinion and ring bevel gear. | Remove the gear housing inspection cover and adjust backlash between pinion and ring bevel gear. |
| Noise during acceleration | Insufficient lubrication. | Check that there are no leaks from the gaskets or the casing and top up to the correct level. |
| | Gear housing bearings badly set or deteriorated. | Overhaul the unit. |
| | Bad tooth contact between pinion and ring bevel gear. | Adjust the contact. |
| Cornering noise | Improper backlash between planetary gears and crown wheels. | Overhaul or replace the unit. |

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## 522810 REMOVING - RE-FITTING IN PLACE THE FRONT DRIVE AXLE (4x4 - 6x6 Vehicles)

### Removal

Figure 1



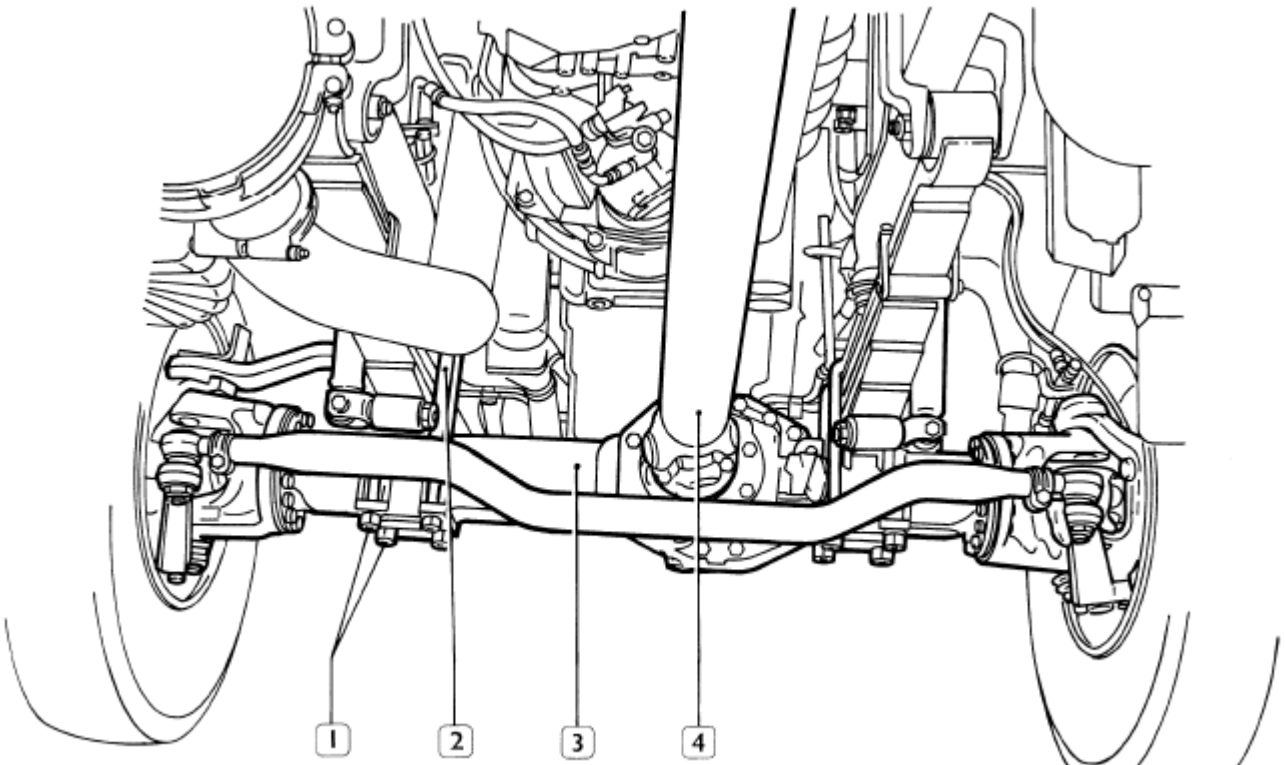

Place the vehicle on flat ground and lock the rear wheels.
Loosen the front wheel fastening nuts.
Using a hydraulic jack, lift the front of the vehicle and rest it on two supporting stands.
Remove the wheel nuts then remove the wheels using hydraulic truck 99321024.

Using puller 99347068 (1) remove tie-rod kingpin (3) from the arm (2).
Disconnect:

- air delivery hoses from the diaphragm brake cylinders;
- ABS transmitters electric cable;
- for vehicles that are provided with it, the electric cable for brake lining wear indicator.

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Figure 2




40561

Place a hydraulic jack with stand 99370617 under the front drive axle (3).
Unscrew the nuts and disconnect the propeller shaft (4).
Unscrew nuts (1) and remove the clips (2) fastening the leaf springs to the axle.
Lower the hydraulic jack and withdraw the axle (3)

## Refitting

To re-fit in place, follow the removal instructions in reverse.

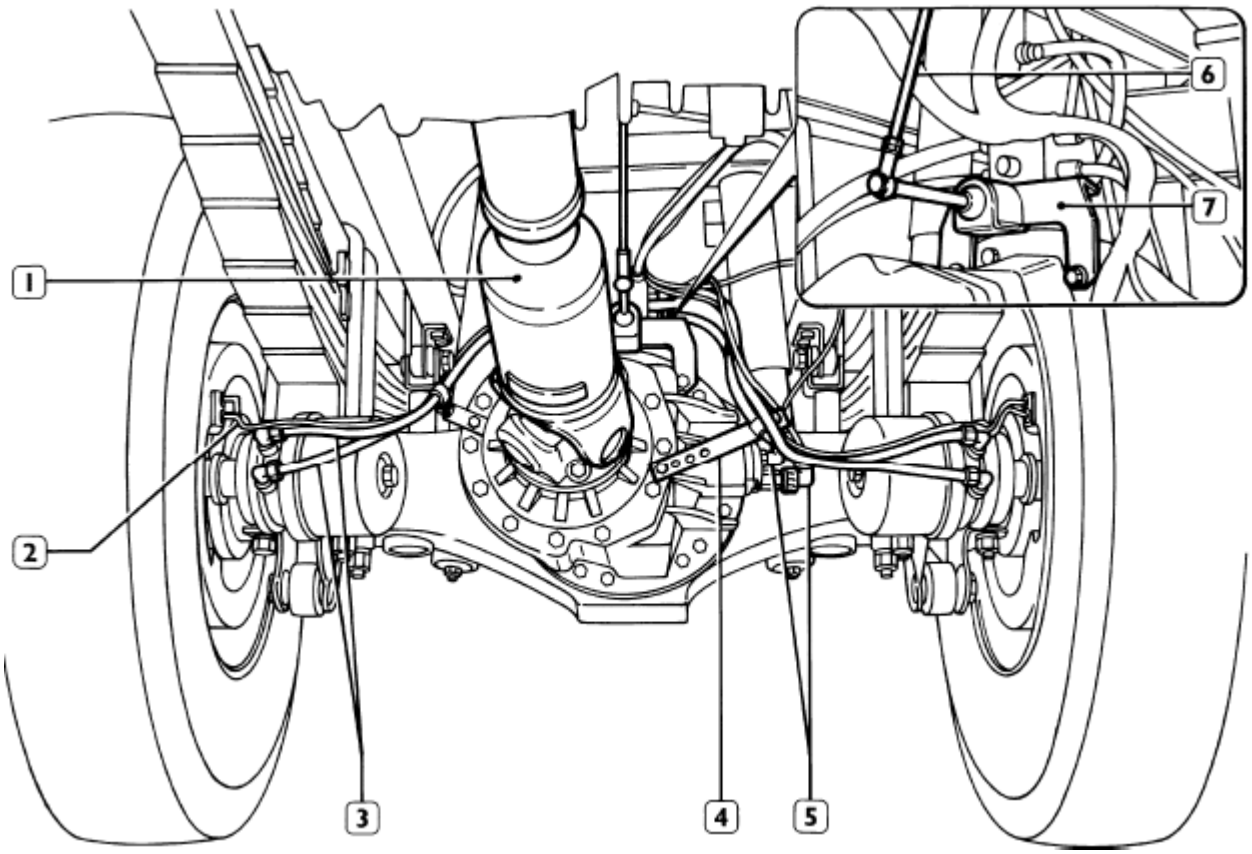
Nuts and bolts must be tightened to the prescribed torques.

Check and adjust the front wheels geometry.

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## 525010 REMOVING REAR AXLES (4x2 - 4x4 Vehicles)

Figure 3

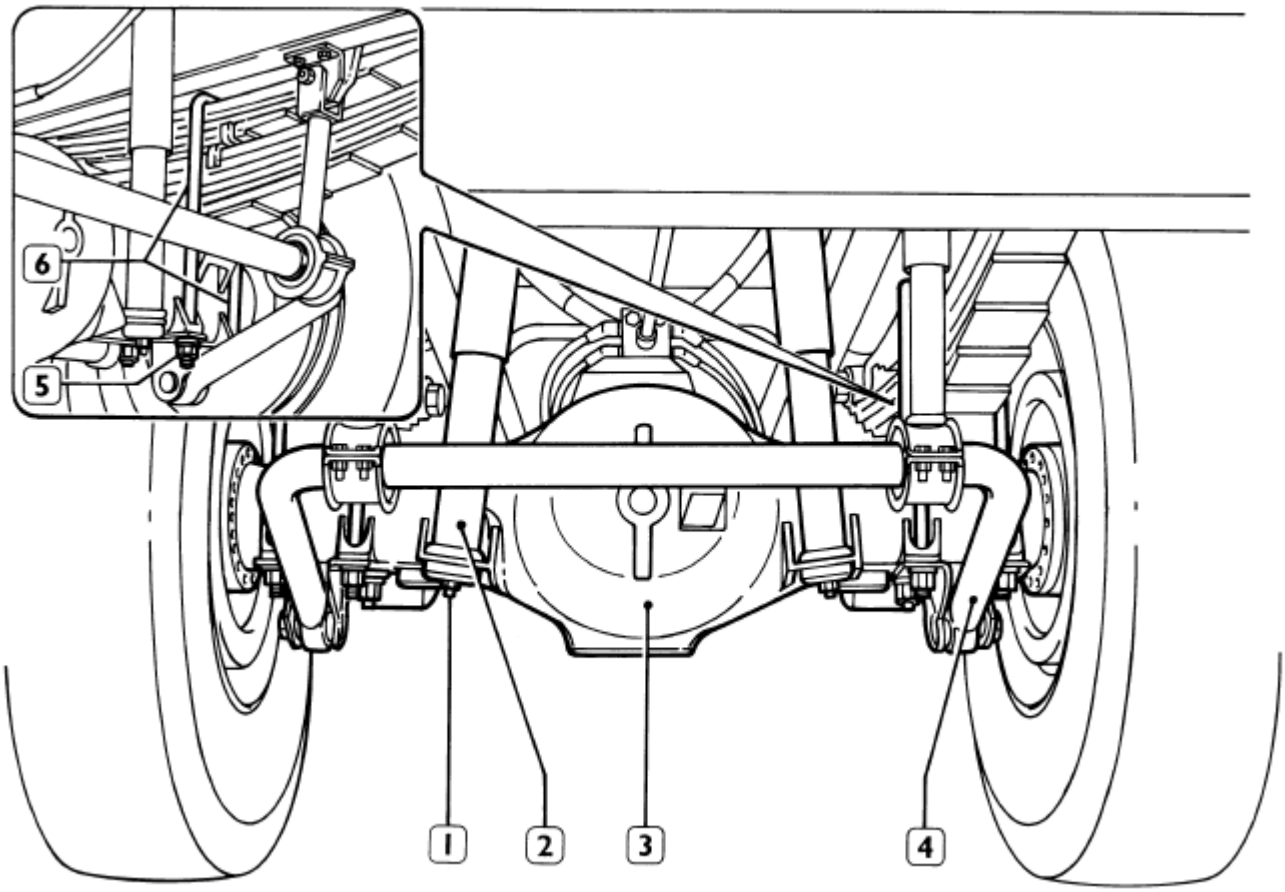



Place the vehicle on flat ground and lock the front wheels.
Remove the nut guards and loosen the nuts.
Lift the rear of the vehicle and rest it on two supporting stands.
Set the hydraulic truck 99321024 under the wheels, remove the wheel nuts then remove the wheels.
Remove the propeller shaft (1) and braking control tie-rod (6) from the rear axle.

Disconnect the air hoses and electric cable (5) from the differential locking device. Disconnect brake cylinder air delivery hoses (3).
Remove the bracket (7) securing hoses, cables and couplings to the axle casing.
Disconnect the brake lining wear indicator cables (2) and ABS transmitter electric cable.
Remove the hose clamp bracket (4).
Place a hydraulic jack fitted with support 99370617 under the axle.

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Figure 4



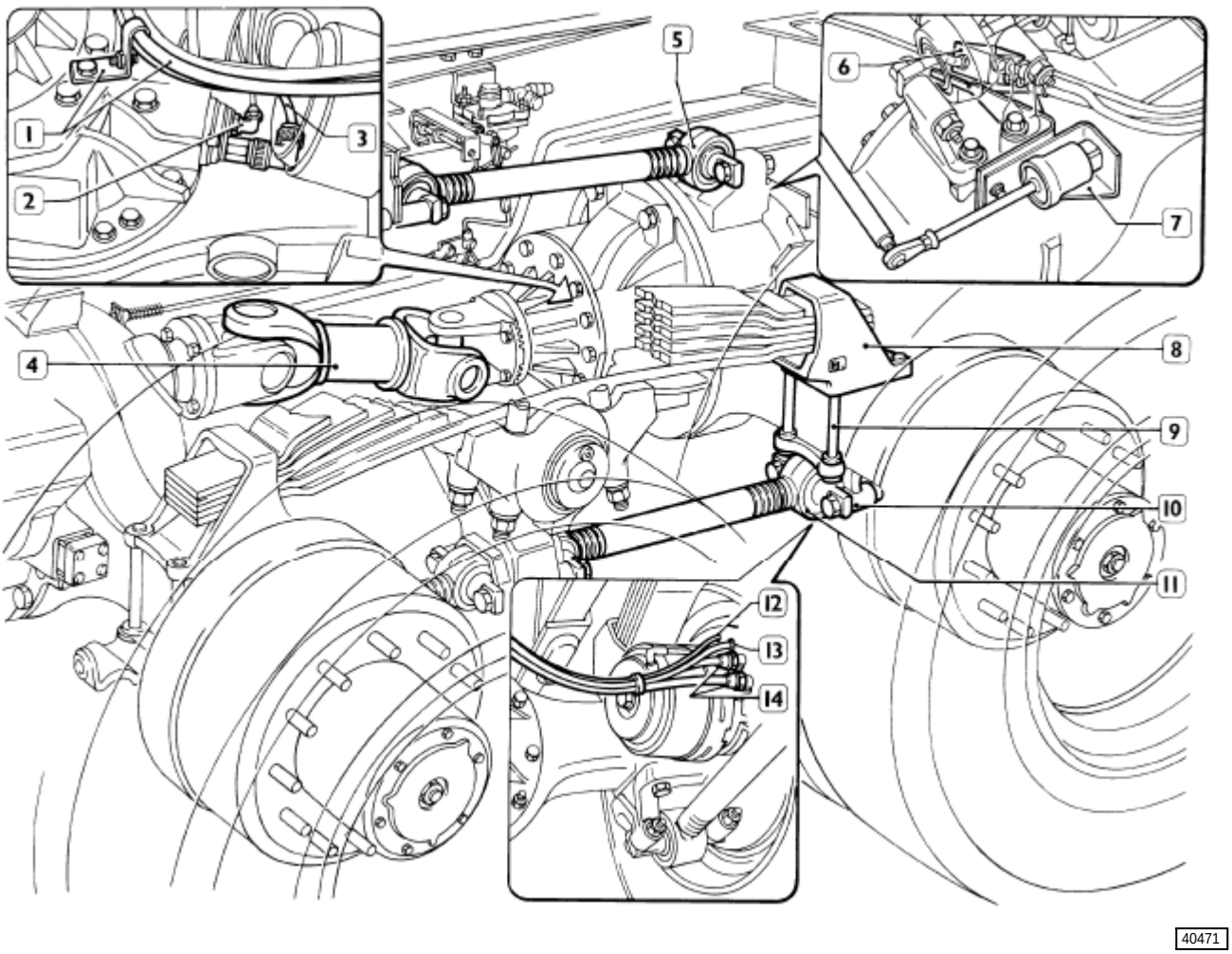

40470

Unscrew the nuts (1) and remove the shock absorbers (2) from the lower supports.
Unscrew the securing screws (5) and withdraw the brackets (6) that connect the leaf spring to the axle.
Rotate the torsion bar (4) and anchor it to the chassis.
Lower the hydraulic jack and remove the rear axle (3)

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## REMOVING THE REAR AXLE (6x4 - 6x6 - 8x4x4 Vehicles)

Figure 5



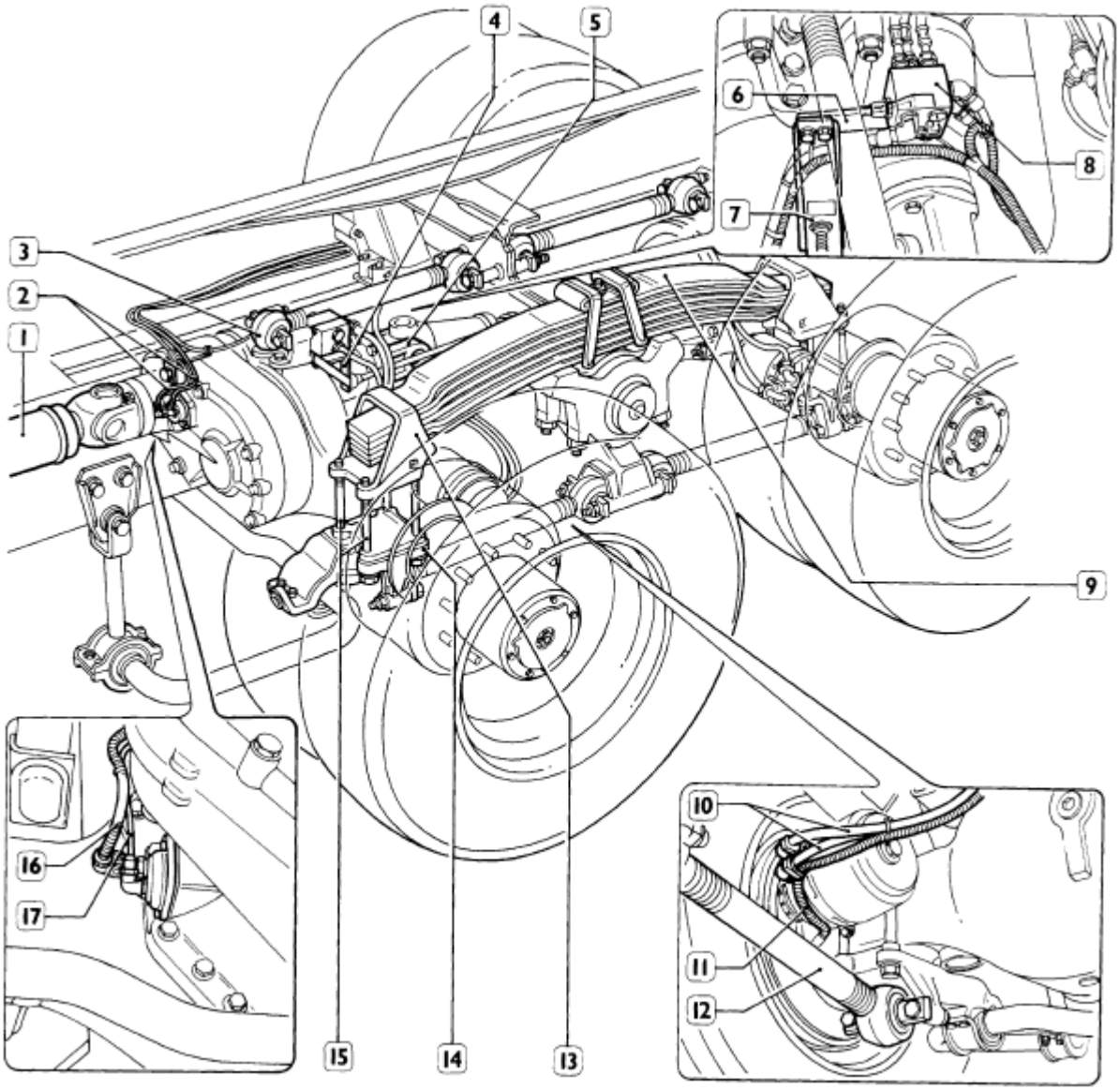

Place the vehicle on flat ground and lock the front wheels.
Remove the nut guards and loosen the nuts.
Lift the rear of the vehicle and rest it on two supporting stands.
Set the hydraulic truck 99321024 under the wheels, remove the wheel nuts then remove the wheels.
Remove the propeller shaft (4) from the rear differential.
Disconnect the air hoses (2) from the differential locking device and electric cable (3) from the differential locking indication switch.
Remove the strap fastening the cables and hoses to the bracket (1).

Disconnect air delivery hoses (14) from the brake cylinders.
Disconnect the brake lining wear indicator cables (13) and (12) ABS transmitter cables.
Remove from the rear of the axle casing : bracket (6) supporting the air hoses multiple coupling and the bracket (7) that secures the braking control tie rod.
Place a hydraulic jack fitted with support 99370617 under the axle.
Remove the upper longitudinal tie rod (5) from the axle casing.
Remove the lower longitudinal tie rods (11) from the brackets (10).
Bring the axle backward so that the shoes (8) withdraw from the leaf springs.

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## REMOVING THE INTERMEDIATE AXLE (6x4 - 6x6 - 8x4x4 Vehicles)

Figure 6




Place the vehicle on flat ground and lock the front wheels.
Remove the nut guards and loosen the nuts.
Lift the rear of the vehicle and rest it on two supporting stands.
Set the hydraulic truck 99321024 under the wheels, remove the wheel nuts then remove the wheels.
Remove the propeller shafts (1-5) from the intermediate differential.
Remove the straps fastening cables and hoses to the brackets.
Remove the bracket (6) securing the air hoses multiple coupling (8).
Remove the braking control tie-rod bracket (4).
Disconnect air delivery hoses (10) from the brake cylinder.
Disconnect the brake lining wear indicator cables (11).
Disconnect the air hoses (16) from the differential locking device and electric cable (17) from the differential locking indication switch.
Disconnect the air hose (2) from the differential reduction gear unit locking device and the locking indicator switch electric cable.
Place a hydraulic jack fitted with support 99370617 under the axle.
Remove the upper longitudinal tie rod (3) from the intermediate axle casing.
Remove the lower longitudinal tie rods from the brackets (14).
Bring the axle backward so that the shoes (13) withdraw from the leaf springs.

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### Instructions to adjust and check the functioning of the transmitter that controls the engagement of differential and reduction gear unit locking

The adjustment and verification of the transmitter (two function type) that checks the engagement of the differential and reduction gear unit is carried out with the axle fitted on the vehicle.
The procedure is as follows:

1) With differential and reduction gear locked, screw down the transmitter until the contacts close, checking in the cab that the indicator light switches on.
2) When the indicator light switches on in the cab, tighten the transmitter by one more turn.
3) Tighten the transmitter locking nut to a torque of 40 Nm (4 kgm)
4= Release the differential and reduction gear unit locking engagement and check that the contacts are closed (the indicator light in the cab switches off).

## REFITTING IN PLACE THE AXLE (Vehicles : all versions)

To re-fit in place, reverse the removal operations taking care to tighten all screws and nuts to the prescribed torques.
When re-fitted in place check that:

- there are no leaks from the air hoses;
- the lubrication oil in the axle casing is at the correct level;
- the differential locking indicator light is working correctly. If it does not, refer to the relevant chapter.

**NOTE** For 6x4 - 6x6 - 8x4x4 vehicles, if the leaf spring shoes have been removed, the procedure to re-fit in place is given in the section "Removal - re-fitting in place the rear leaf spring for CANTILEVER type suspensions".

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## 5228 Front Axle 5985/2D (D1385)


| | Page |
|---|---|
| DESCRIPTION | 15 |
| MAIN DATA | 16 |
| TIGHTENING TORQUES | 18 |
| TOOLS | 20 |
| OVERHAULING THE FRONT AXLE | 26 |
| - Wheel hub disassembly | 26 |
| - Stub axle disassembly | 27 |
| - Drive shaft disassembly | 29 |
| - Fork support disassembly | 29 |
| - Stub axle disassembly | 30 |
| - Wheel hub disassembly | 30 |
| - Epicycloid gear disassembly | 30 |
| CLEANING AND CHECKING PARTS | 31 |
| CHECKING THE AXLE SQUARENESS | 31 |
| ASSEMBLY | 34 |
| - Yoke support assembling | 35 |
| - Drive shaft assembling | 36 |
| - Stub axle assembling | 36 |
| - Epicyclic reduction gear assembling | 41 |
| - Greasing the stub axle pins | 42 |
| - Epicyclic gear unit lubrication | 42 |
| REMOVING THE DIFFERENTIAL (with the axle mounted on stand 99322215) | 43 |
| - Checking the axle housing | 43 |
| REFITTING THE DIFFERENTIAL (with the axle mounted on stand 99322215) | 43 |
| DIFFERENTIAL REPAIR | 45 |

https://truckmanualshub.com/
Aquila Trucks Centres

Page

- Disassembly . . . . . 45
- Disassembling the differential housing . . . . . 46
- Disassembling the bevel pinion . . . . . 47

CHECKING THE DIFFERENTIAL COMPONENTS 47

- Assembling the differential housing . . . . . 48
- Assembling the bevel pinion support . . . . . 49
- Differential . . . . . 51
- Adjusting the rolling torque on the differential housing bearings . . . . . 52

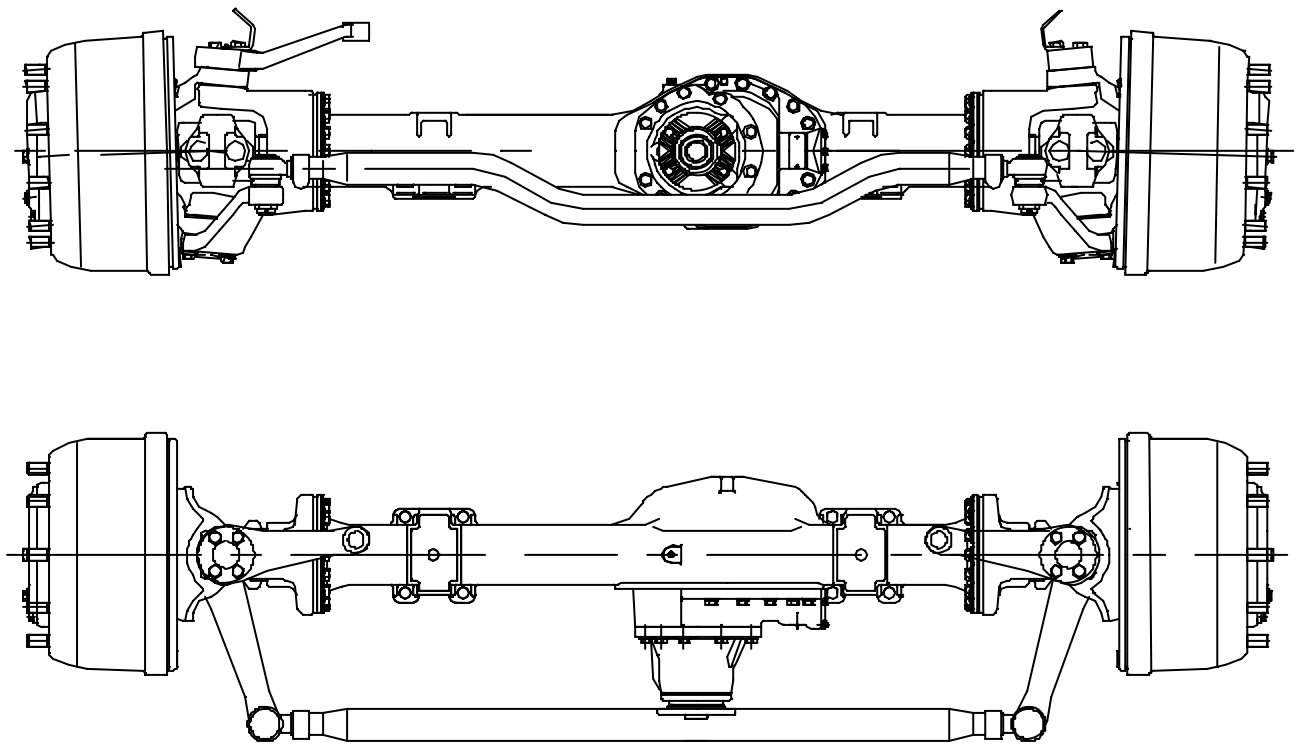
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## DESCRIPTION

The axle is of the load-bearing, double reduction type.
The first reduction is provided by the bevel pinion/ring bevel gear, whereas the second reduction is by means of an epicycloid unit on the wheel hubs.
The differential housing (with ring bevel gear) is supported by taper roller bearings, which can be adjusted by means of two threaded ring nuts.

The bevel pinion is supported by two taper roller bearings, which can be adjusted by means of adjustment rings.
The axle shafts start from the differential and transmit drive to the epicycloid reduction units by means of homo-kinetic couplings.
Two flanges are fitted at each end of the rear axle housing, which serve for stub axle articulation.
The drum brake is of the Duo/Duplex type.

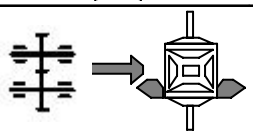
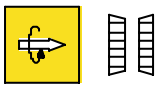
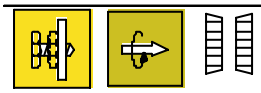
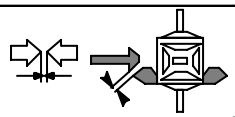
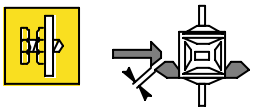
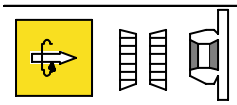
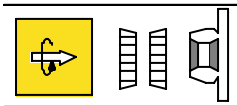
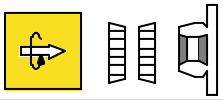
Figure 1



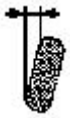
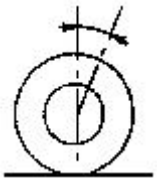
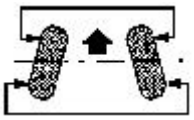
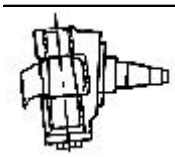
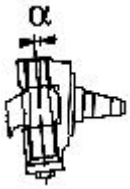
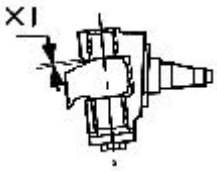
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## MAIN DATA

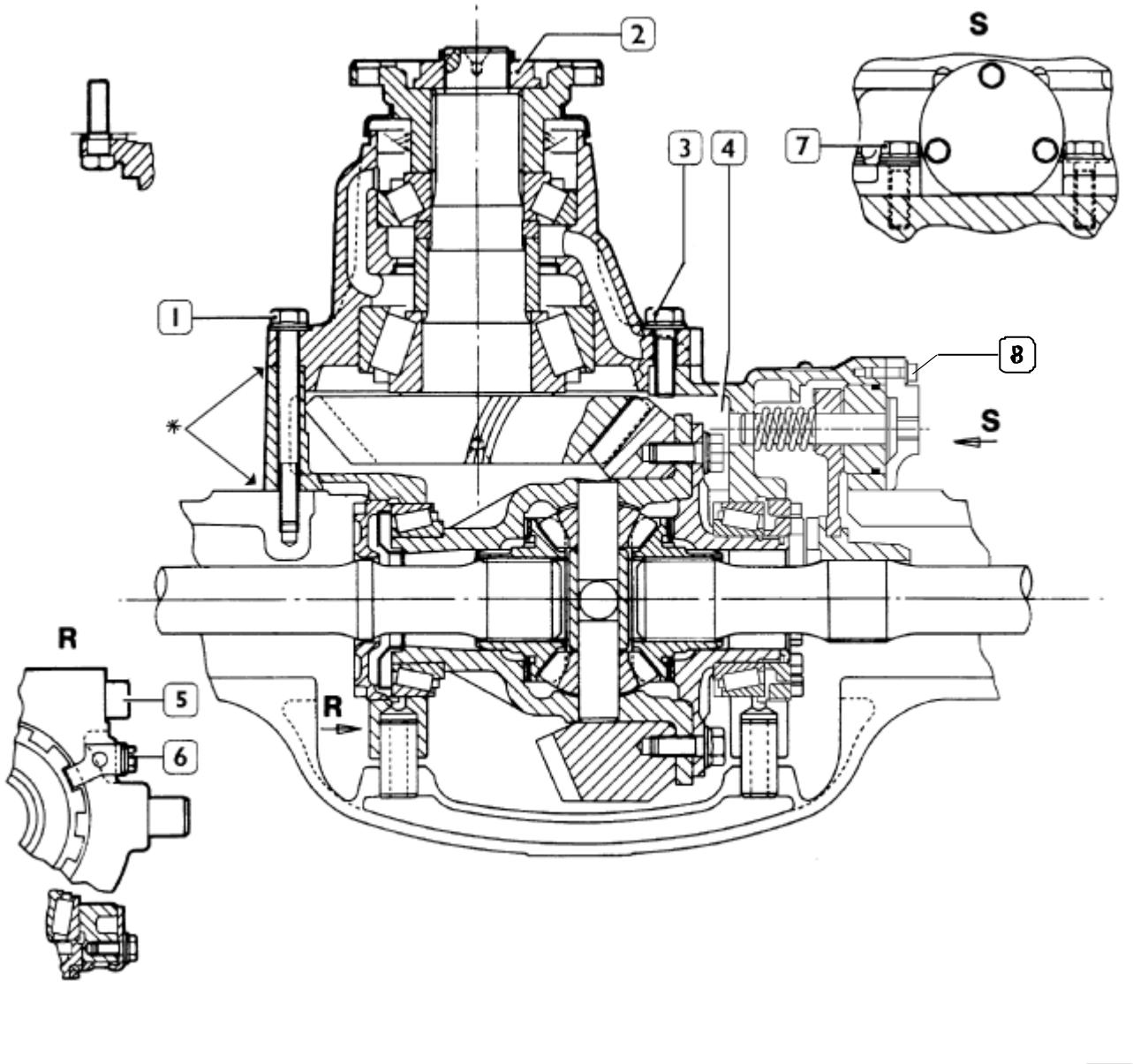
| | |
|---|---|
|  Type of axle: Load-bearing, double reduction | 5985 / 2D (D1385) |
|  Bevel pinion bearings | 2 taper rollers |
|  Bevel gear reduction unit ratio | 27/32 (1.185) - 29/37 (1.276) - 28/37 (1.321) - 27/37 (1.370) - 24/35 (1.458) - 23/36 (1.565) - 21/34 (1.619) - 19/33 (1.737) - 21/40 (1.905) - 17/35 (2.059) - 17/36 (2.118) - 15/34 (2.267) - 13/35 (2.692) |
|  Epicyclic reduction unit/wheels ratio | 3.2 |
|  Bevel pinion bearing rolling torque:<br>without gasket Nm<br>with lubricated gasket Nm | <br>6 ÷ 8<br>7.5 ÷ 9.5 |
|  Bevel pinion bearing rolling torque adjustment | with adjustment shims |
|  Thickness of bevel pinion bearing rolling torque adjustment shims mm | 10 - 10.02 - 10.04 - 10.06 - 10.08 - 10.10 - 10.12 - 10.14 - 10.16 - 10.18 - 10.20 - 10.22 - 10.24 - 10.26 - 10.28 - 10.30 - 10.32 - 10.34 - 10.36 - 10.38 - 10.40 - 10.42 - 10.44 - 10.46 - 10.48 - 10.50 - 10.52 - 10.54 - 10.56 - 10.58 - 10.60 |
|  Thickness of bevel pinion/ring bevel gear position adjustment shims mm | 0.2 - 0.3 - 0.5 - 1 |
|  Clearance between pinion and ring bevel gear mm | 0.15 ÷ 0.35 |
|  Adjustment of clearance between pinion and ring bevel gear | with ring nuts |
|  **WHEEL HUBS** | |
|  Wheel hub bearings | 2 taper rollers |
|  Wheel hub bearings rolling torque: new bearings with surface protection Nm | 6 ÷ 7 + (7.5 ÷ 9) |
|  Wheel hub bearings rolling torque: run in bearings and new, lubricated seals Nm | 6 ÷ 7 + (4 ÷ 5) |
|  Wheel hub bearings rolling torque: run in bearings and seals Nm | 6 ÷ 7 + (3 ÷ 4) |
|  Drive shaft end float mm | 0.5 ÷ 1 |

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| | | | |
|---|---|---|---|
|  | Type of axle:<br>Load bearing, double reduction | 5985 / 2D (D 1385) | |
|  | Axle oil<br>Quantity Litres<br>Oil for wheel hub bearings | TUTELA W 140/MDA<br>4.5 ÷ 5<br>TUTELA W140/MDA | |
| | G.R.W. maximum load kg | 9000 - 10000 | |
|  | **WHEEL ALIGNMENT** | | |
|  | Wheel camber (vehicle with static load) | 1° 30' | |
|  | Wheel caster (vehicle with static load) | 2° 17' | |
|  | Wheel toe-in (unloaded vehicle) mm<br>- adjustment tolerance mm<br>- control tolerance mm | 4x4 - 6x6 models<br>0.5<br>± 0.75<br>± 2 | 8x8 models<br>0<br>± 0.75<br>± 2 |
|  | **STUB AXLE PINS** | | |
|  | King pin angle | 5° | |
|  | Thickness of adjustment shims for clearance between axle and stub axle upper shim X1 mm | 1.75 - 2.00 - 2.25 - 2.50 - 2.75 - 3.00 3.25 - 3.50 | |

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Figure 2



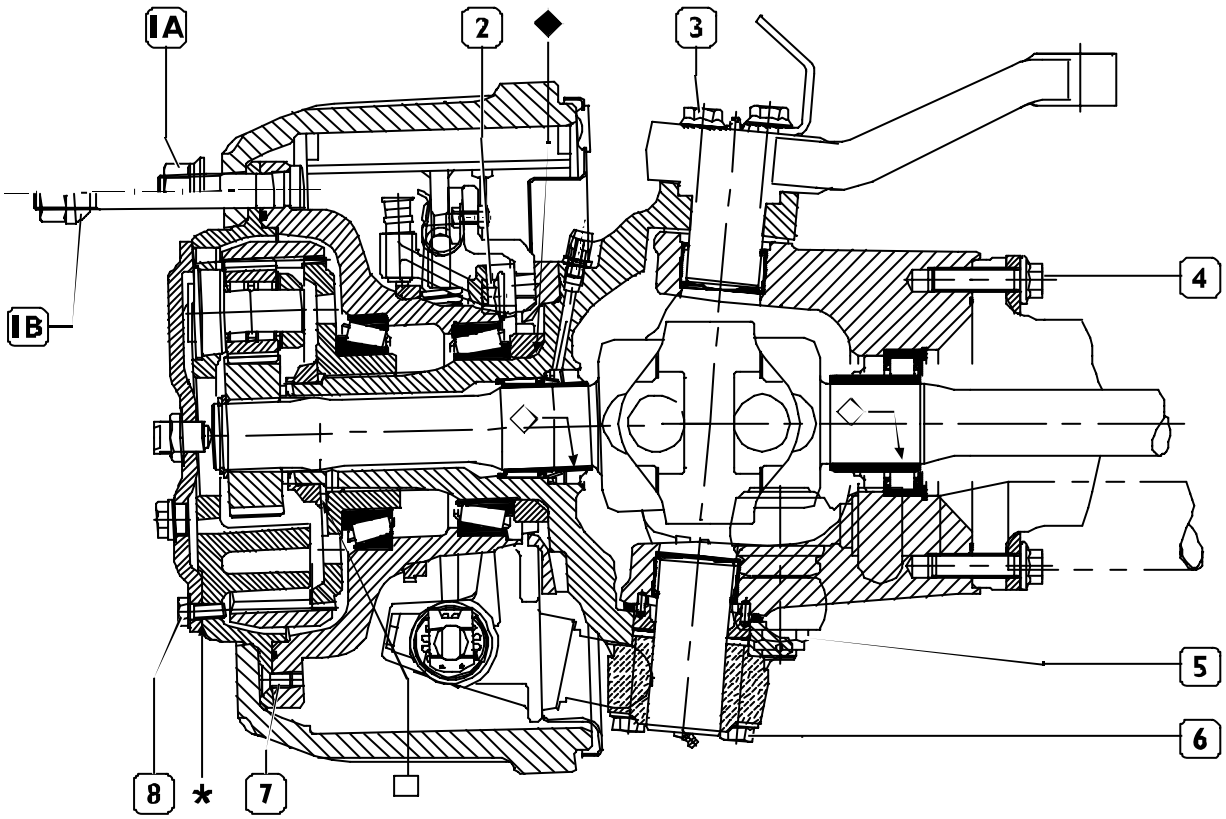

## TIGHTENING TORQUES

| | DESCRIPTION | TORQUE | |
|---|---|---|---|
| | | Nm | kgm |
| 1 | Screw fixing differential housing to axle housing | 180 ± 10 | 18 ± 1 |
| 2 | Locknut for bevel pinion | 700 ± 50 | 70 ± 5 |
| 3 | Screw fixing bevel pinion mounting to differential housing | 180 ± 10 | 18 ± 1 |
| 4 | Screw fixing ring bevel gear to differential housing | 180 ± 10 | 18 ± 1 |
| 5 | Screw fixing bearing mountings ◊ | 180 ± 10 | 18 ± 1 |
| 6 | Self-locking screw fixing safety plate | 51 ± 4 | 5.1 ± 0.4 |
| 7 | Screw with toothed flange | 180 ± 10 | 18 ± 1 |
| 8 | Screw fixing differential lock cover | 19 ± 2 | 1.9 ± 0.2 |

◊ apply LOCTITE AVX
* apply LOCTITE 573

Aquila Trucks Centres

Figure 3




WHEEL HUB LONGITUDINAL SECTION AND EPICYCLIC REDUCTION

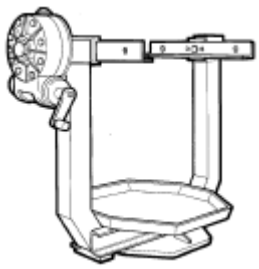
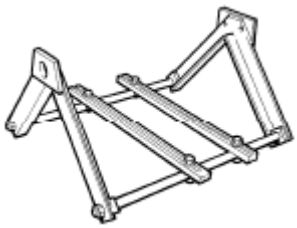
## TIGHTENING TORQUES

| | DESCRIPTION | TORQUE | |
|---|---|---|---|
| | | Nm | kgm |
| 1 | Nut fixing wheel | 615 ± 35 | 61.5 ± 3.5 |
| 2 | Screw fixing brake mounting | 324 ÷ 396 | 32.4 ÷ 39.6 |
| 3 | Screw fixing steering lever pin | 207 ÷ 253 | 20.7 ÷ 25.3 |
| 4 | Screw fixing mounting for stub axle | 324 ÷ 396 | 32.4 ÷ 39.6 |
| 5 | Notched nut fixing swivel head pin | 250 ** | 2.5 ** |
| 6 | Fixing screw | 207 ÷ 233 | 20.7 ÷ 23.3 |
| 7 | Fixing screw for mounting | 22 ÷ 28 | 2.2 ÷ 2.8 |
| 8 | Fixing screw for cover z | 44 ÷ 54 | 4.4 ÷ 5.4 |

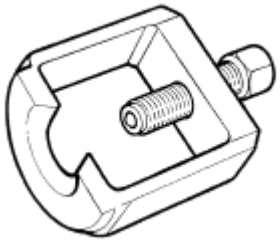
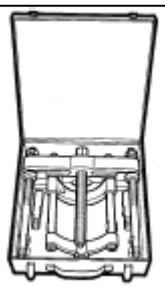
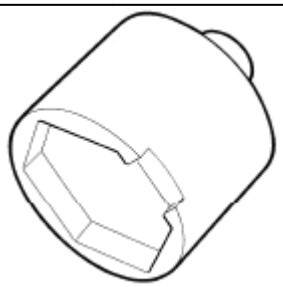
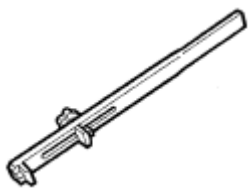
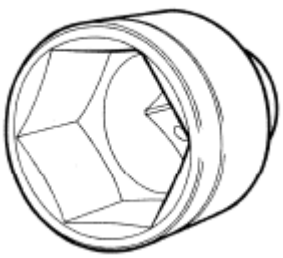
* apply LOCTITE 510
** minimum - maximum torque, tighten to first notch coinciding with hole for split-pin
z apply LOCTITE 573 on the contact surface
j apply MOLYCOTE lubricant on the contact surface before assembly
Z lock with LOCTITE AVX

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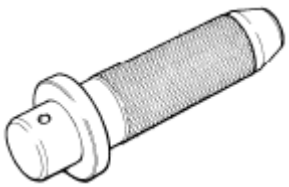
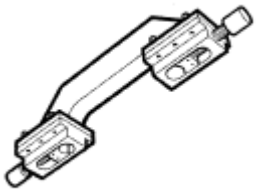
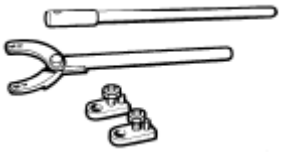
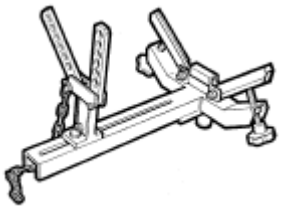
## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99305121** |  | Hot air device |
| **99322205** |  | Rotating stand for assembly overhaul |
| **99322215** |  | Stand for axles overhaul |
| **99322225** |  | Support for assemblies (to be fitted onto stand 99322205) |
| **99345049** |  | Reaction block for extractors |
| **99345053** |  | Reaction block for extractors |

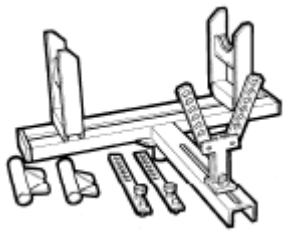
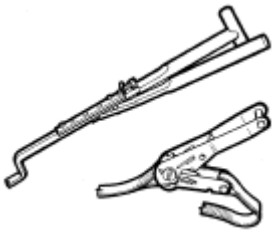
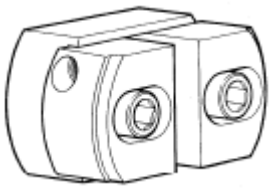
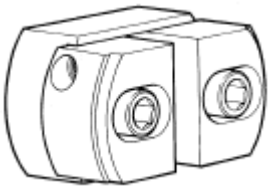
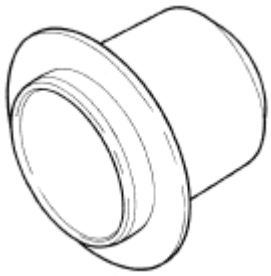
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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99347068** |  | Extractor for steering tie-rod ball joint |
| **99348001** |  | Extractor with locking device |
| **99348004** |  | Universal extractor for 5 to 70 mm (internal) |
| **99354207** |  | Wrench (94.5 mm) for wheel hub bearings adjusting nut |
| **99355025** |  | Wrench for differential gear housing bearing adjustment ring nuts |
| **99355081** |  | Wrench (60 mm) for differential bevel pinion nut (use with 99370317) |

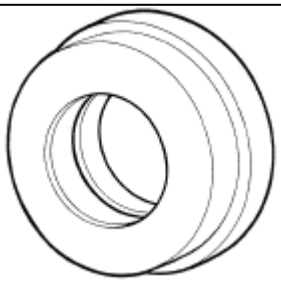
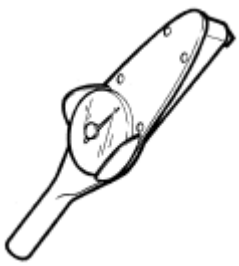
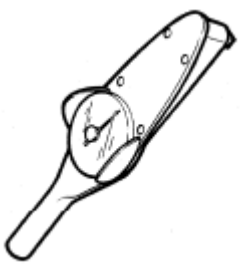
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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99370006** |  | Grip for interchangeable punches |
| **99370007** |  | Grip for interchangeable punches |
| **99370133** |  | Tool for locking differential caps spread |
| **99370317** |  | Reaction lever with extension for flange retaining |
| **99370509** |  | Hook to extract differential gear half-housing |
| **99370616** |  | Support for differential removal and refitting |

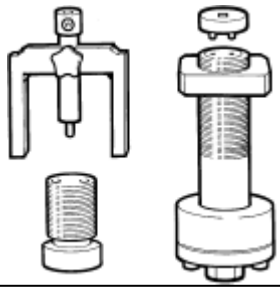
Aquila Trucks Centres

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99370617** |  | Universal mounting to support axles during removal and refitting |
| **99372211** |  | Tool for disassembly and assembly of brake shoe retaining spring |
| **99374093** |  | Punch to fit external races of bearings (diameter 91 - 134 mm use with 99370007) |
| **99374094** |  | Punch to fit external races of bearings (diameter 134 - 215 mm use with 99370007) |
| **99374233** |  | Key to fit differential bevel pinion seal |
| **99374369** |  | Punch to fit taper roller bearings on stub axle (use with 99370006) |

Aquila Trucks Centres

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99374371** |  | Key to fit roller bearings and seal rings on axle fork (use with 99370006) |
| **99374377** |  | Key for assembly of wheel hub internal seals |
| **99374382** |  | Punch to fit roller bearings on stub axle fork (use with 99370006) |
| **99374390** |  | Key to fit seal ring on stub axle (use with 99370006) |
| **99389819** |  | Torque wrench from 0 to 10 Nm with 1/4" square connection |
| **99389821** |  | Torque wrench from 0 to 70 Nm with 3/8" square connection |

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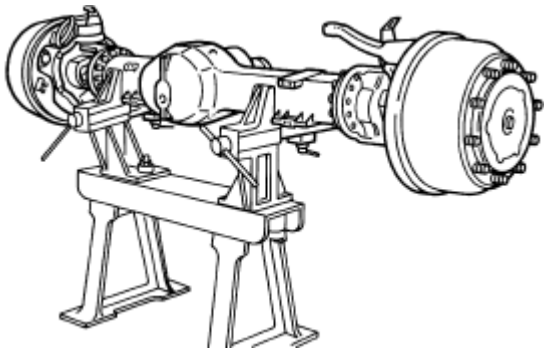
| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99395026** |  | Tool to check rolling torque of hubs (use with torque wrench) |
| **99395027** |  | Tool to determine thickness of differential bevel pinion adjustment shims (use with 99395603) |
| **99395603** |  | Dial gauge (0 - 5 mm) |

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# 522810 OVERHAULING THE FRONT AXLE

## Wheel hub disassembly

Figure 4

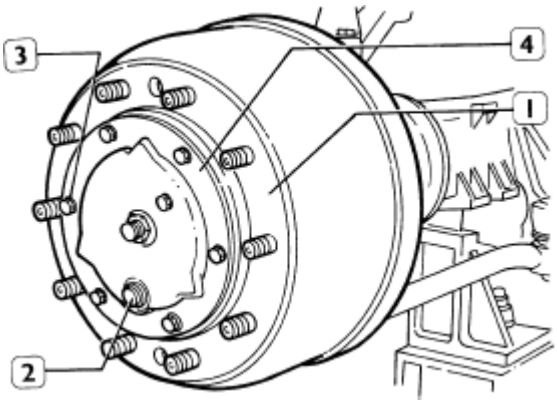


39481

Position the axle on overhaul stand 99322205.

**NOTE** If the axle is fitted with differential locking, secure the engagement sleeve in position by inserting a screw in the cylinder feed hole.

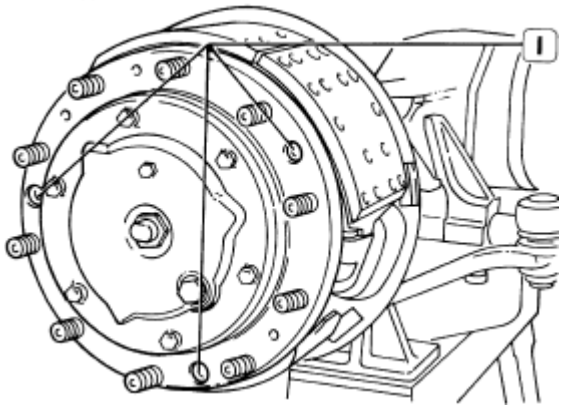
Figure 5




39482

Position the wheel hub (1) so that the oil drainage plug (2) is at the lowest point.
Unscrew the plug and drain off the oil into a container.
To facilitate oil drainage remove a screw (3) on the cover (4).
Drain off the oil from the differential assembly, unscrewing the plug on the axle housing and allowing the oil to drain into a suitable container.
When the oil is fully drained off, tighten the drainage hole plugs by hand.

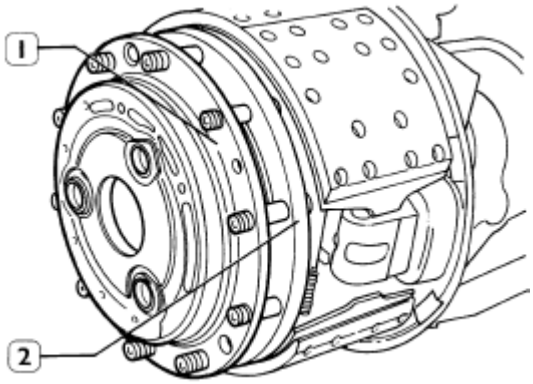
Figure 6




39483

Loosen and remove the three flush-mounted hex screws (1).

Figure 7

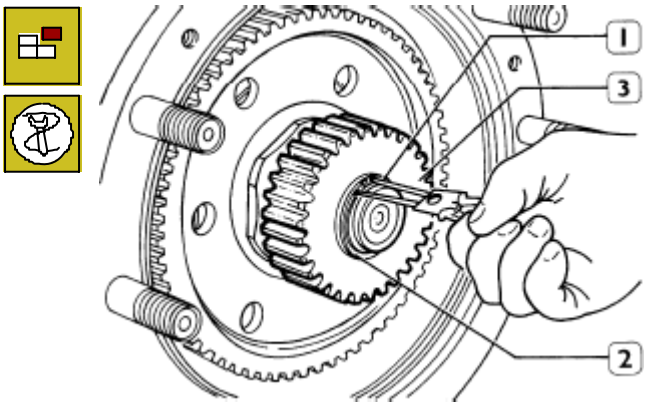



39484

Using a suitable tool, detach the side pinion mounting support (1) from the hub (2) and remove - making sure that the ring gear, which is integral with the side pinions, is not removed.

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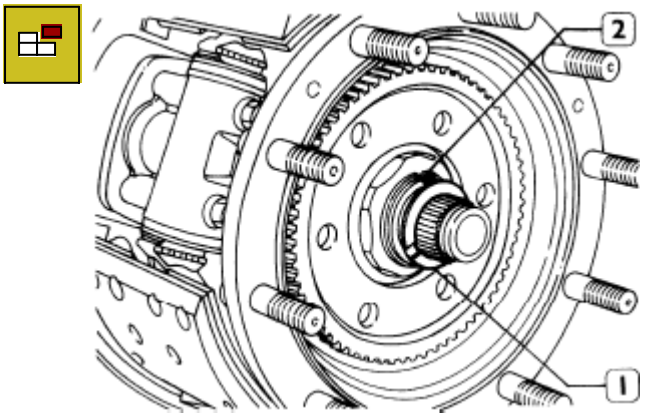
Figure 8




39485

Move the axle shaft outwards.
Remove the seeger ring (2) and the spacer then remove the gear unit (3).

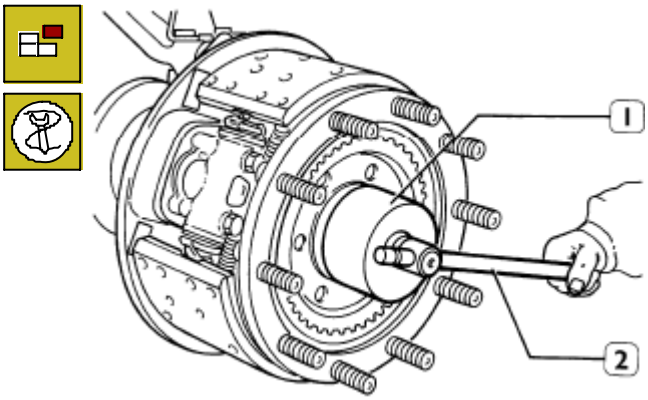
Figure 9




39486

Extract the shim ring (1).
Using a suitable tool, remove the notch on the nut (2).

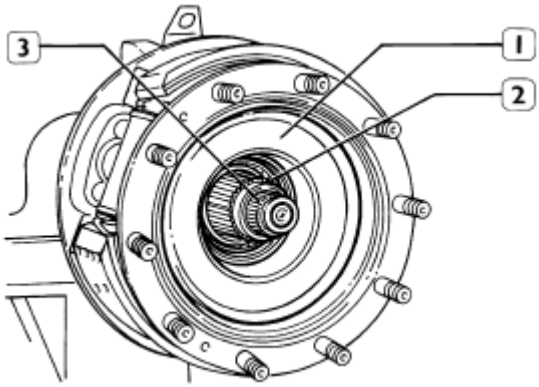
Figure 10




39487

Using wrench 99354207 (1), unscrew the nut (2, Figure 9).
Remove the crown support gear unit (56, Figure 35) together with the bearing internal ring.

Figure 11

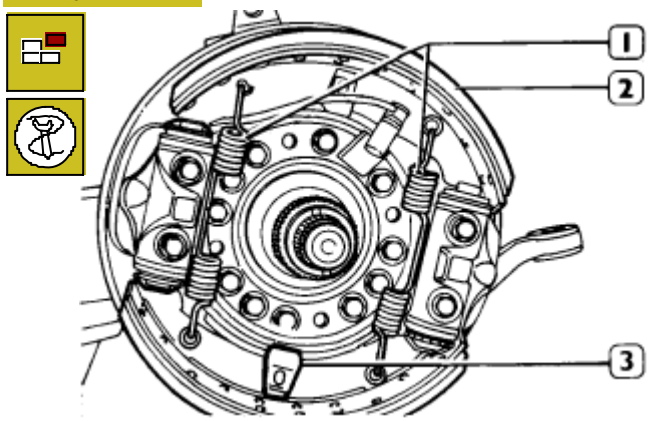



39488

Remove the wheel hub (1) together with the bearing (2) from the stub axle (3).

## Stub axle disassembly

Figure 12

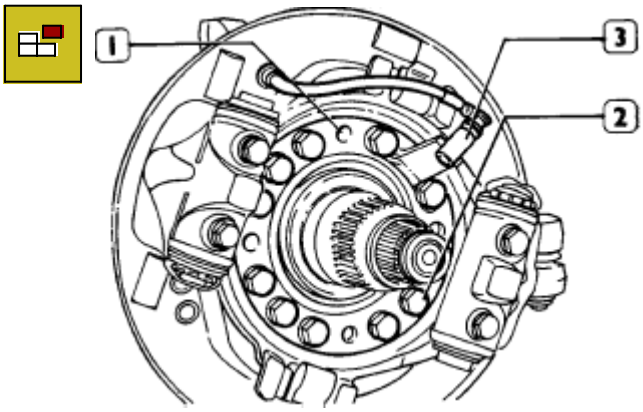



71524

Using tool 99372211, release the shoe (2) retaining springs (1).
Extract both of the shoes from the retaining brackets (3) by moving them first upwards, then downwards.

Aquila Trucks Centres

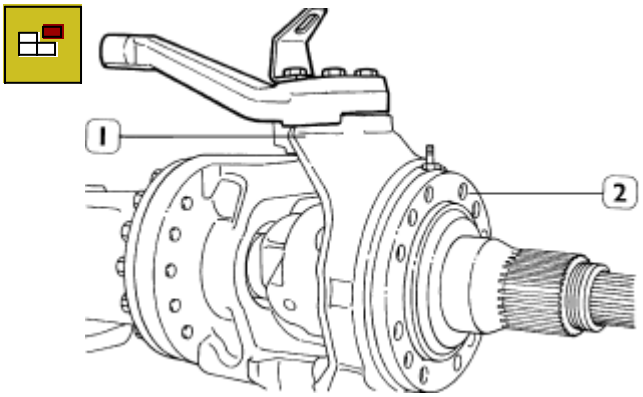
Figure 13




71525

Unscrew the screws (2) on the brake mounting (1) and remove together with the guards. Extract the ABS brakes sensor (3).

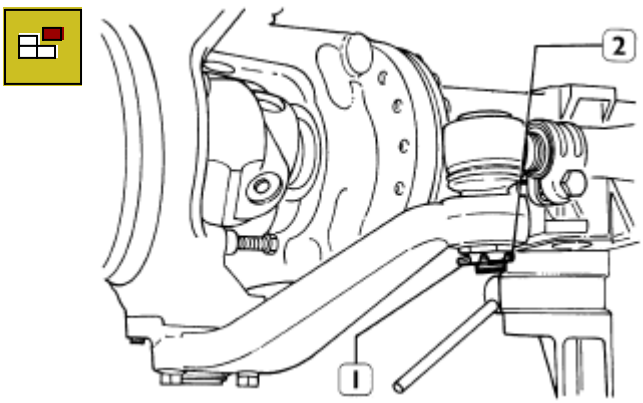
Figure 14




39525

Disassemble the intermediate ring (2) on the stub axle (1).

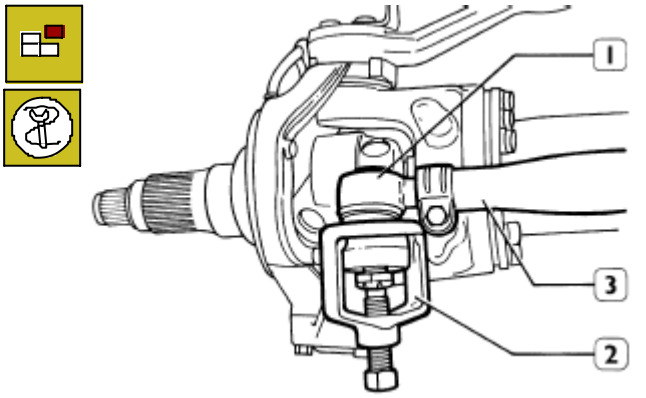
Figure 15




39491

Remove the split pin (1) and unscrew the nut (2) by a few threads, without fully removing.

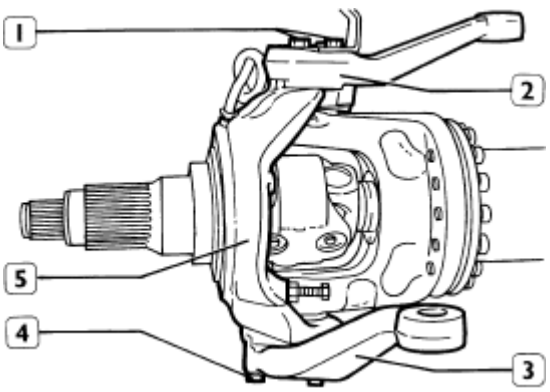
Figure 16




39492

Fit extractor 99347068 (2) and remove the stub axle ball joint. Remove the track rod (3).

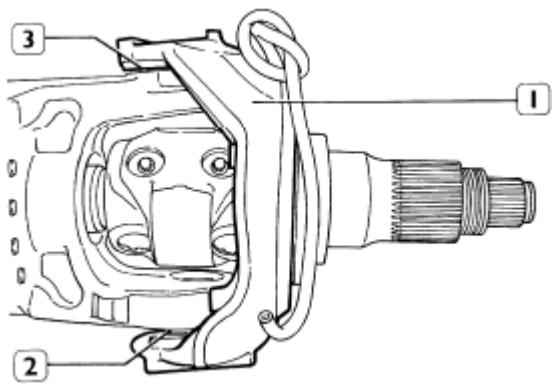
Figure 17




39493

Unscrew the screws (1-4) fixing the pin (2) and knuckle lever (3). Extract the pin (2) and the lever (3) from their seats on the stub axle (5).

Figure 18



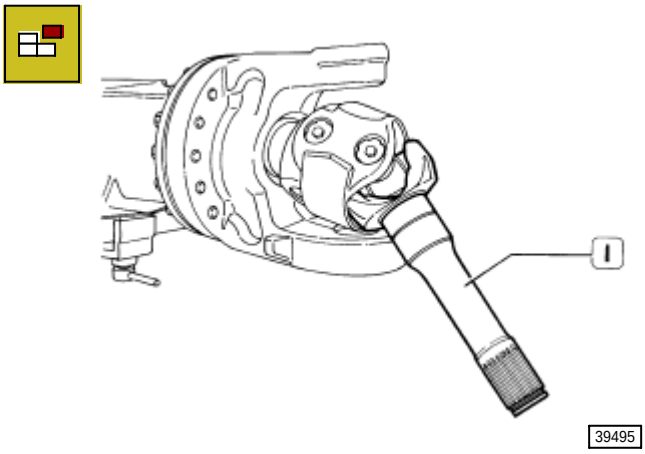

39494

Remove the stub axle (1) and the spacer rings (3) and (2).

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## Drive shaft disassembly

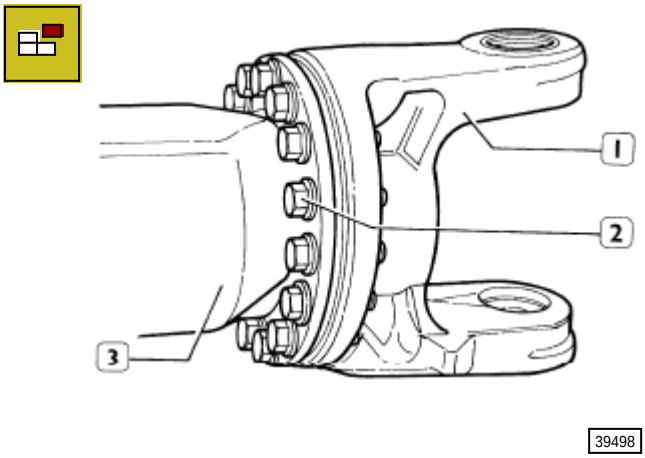
Figure 19




Remove the axle shafts (1).

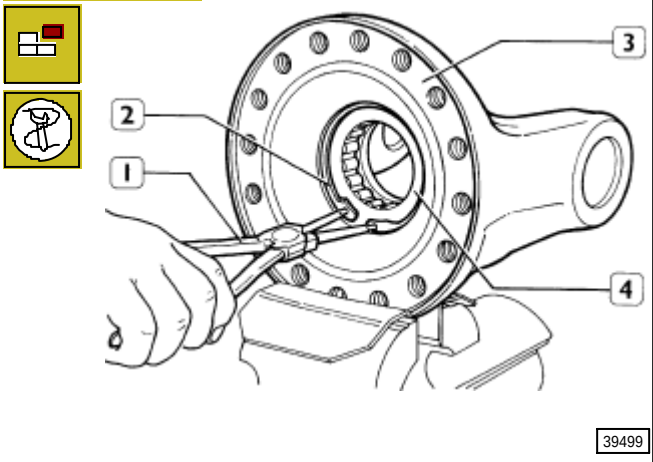
### 552820 Yoke support disassembly

Figure 20



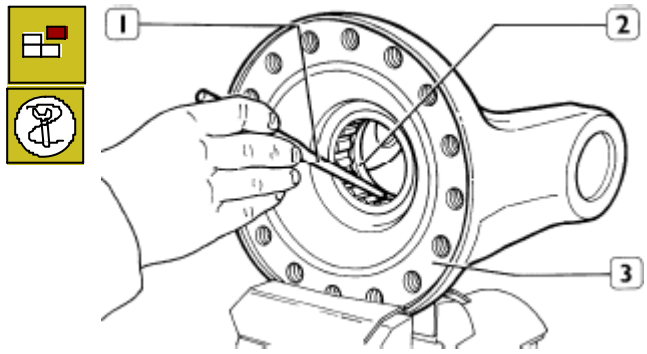

Remove the screws (2) and the yoke (1) from the axle housing (3).
Repeat the same operation on the hub on the opposite side.

Figure 21



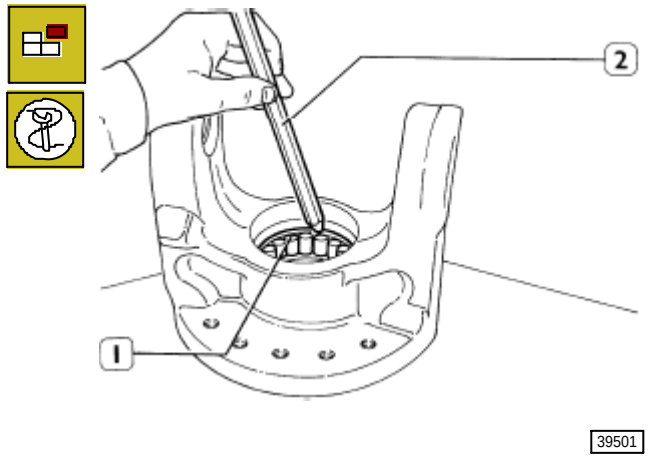

Using suitable pliers (1) remove the retaining ring (2) and the support ring (4) under the yoke support (3).
Remove the seal ring.

Figure 22



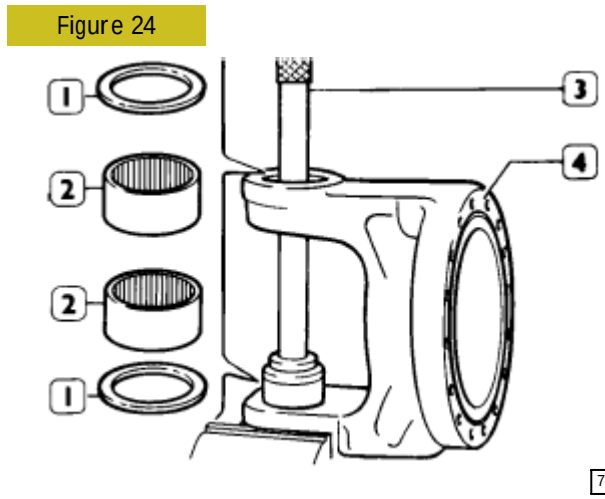

Using a punch (1) extract the seal ring (2) from the yoke support (3).

Figure 23




Remove the roller bearing (1) using a suitable punch (2).

Figure 24

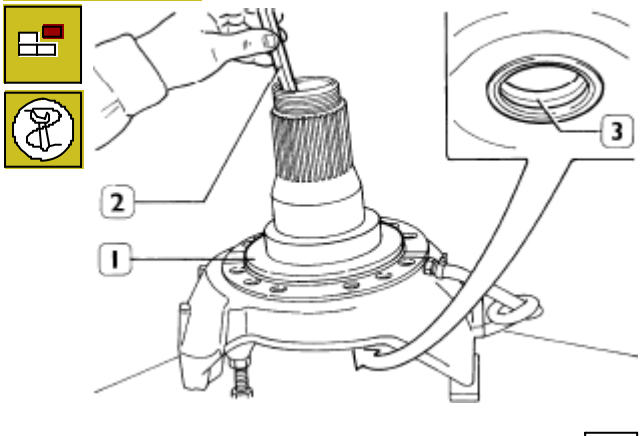



Using a suitable punch (3) on the roller bearing (2), extract the bearings together with the seal rings (1) from the yoke support (4).

Aquila Trucks Centres

## Stub axle disassembly

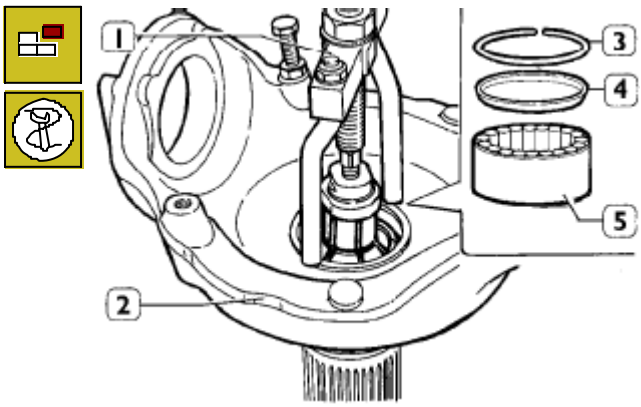
Figure 25




39502

Remove the seal ring (3) from the stub axle (1) using a punch (2).

Figure 26

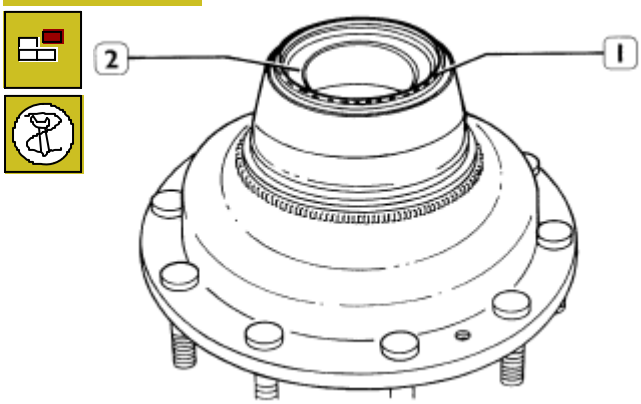



71527

Remove the seeger ring (3) and extract the oil seal ring (4). Using extractor 99348004 (1), extract the roller bearing (5) from the stub axle (2).

## Wheel hub disassembly

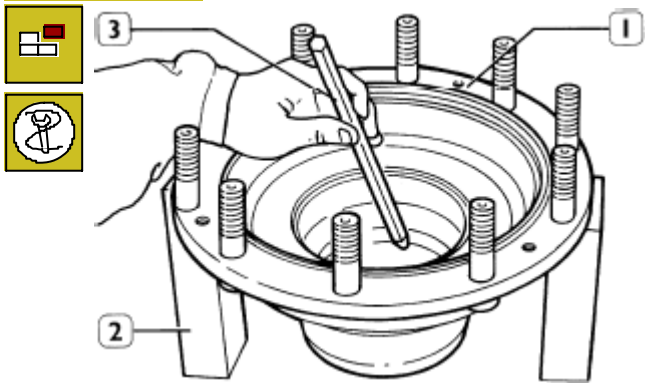
Figure 27




39504

Remove the seal ring (1) and, using a suitable punch, the bearing external ring (2).

Figure 28

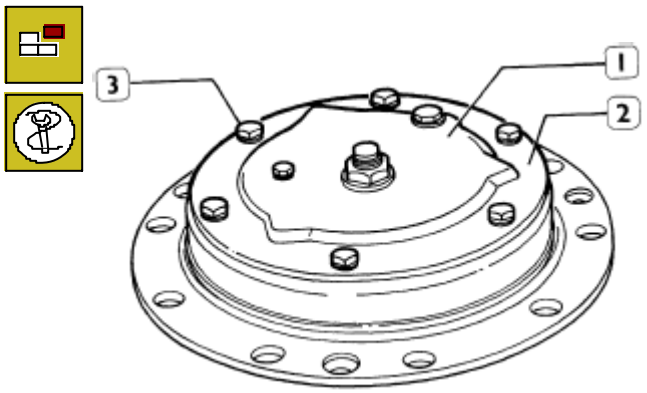



39505

Rest the wheel hub (1) on two supports (2) and extract the bearing external ring and seal using a punch (3).

## Epicyclic gear disassembly

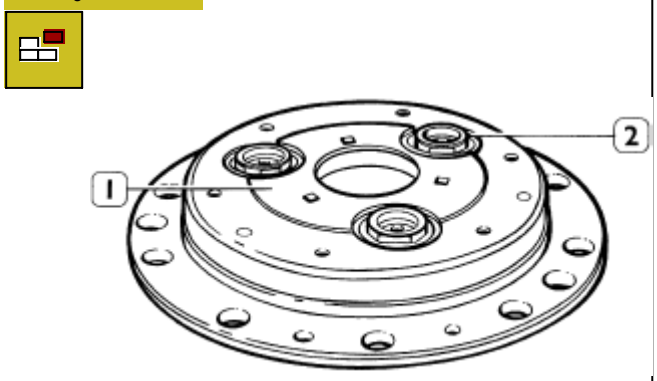
Figure 29




39506

Unscrew the screws (3) and, using a suitable punch, separate the cover (1) from the side pinion support (2).

Figure 30

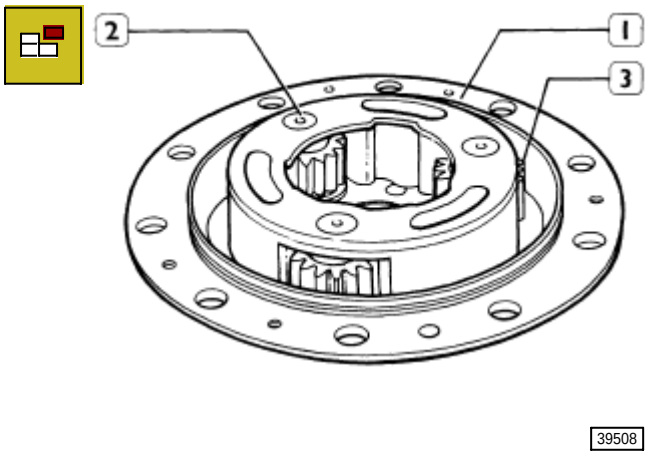



39507

Overturn the support (1) leaving the pins (2) in the seats.

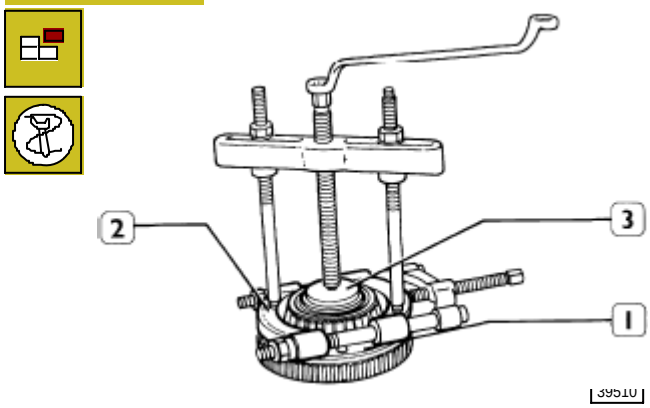
Aquila Trucks Centres

Figure 31




Extract the pins (2) from the support (1) together with the gears (3) and the shims.

Figure 32




Using extractor 99348001 and reaction block (3) 99345049, remove the support bearing (2) from the ring bevel gear-support gear unit (1).

## CLEANING AND CHECKING PARTS

On completion of disassembly operations, immerse all parts (apart from the bearings) in a washing tank containing a solution of water and sodium carbonate, heated to a temperature of 80° ÷ 85° C, until the lubrication residual has dissolved.
Use a metal brush and scraper to remove any further deposits, including residual from the seals, Loctite and sealing compound from the mating surfaces, taking care not to damage the parts.
Wash the parts again and dry with compressed air.
On the workbench, using an electric cleaning machine with rotating metal brushes, eliminate any residuals of Loctite or sealing compound on the threads of the screws.
The bearings must be immersed in an oil bath and carefully cleaned with a brush in order to remove all traces of lubrication.
Dry the bearings with compressed air, making sure that the air jet does not make the bearings rotate.
Lubricate the bearings with the same type of oil used for the epicycloid gear unit.
Press down on the bearings with your hand and rotate them slightly in both directions. Bearing movement should be both smooth and silent.
Carefully check that the rollers and cages, as well as the external and internal rolling tracks, are not worn. Check all parts to see whether they can be re-used or replaced. Check the axle housing, the yoke supports and relative stub axles for signs of cracking or damage.
Replace any worn parts.
Check the studs fixing the wheel: if the threads are damaged or deformed they must be replaced. Work under a press to extract and re-assemble the studs. On completion of assembly operations, check that the orthogonal deviation is no greater than 0.3 mm.

## CHECKING THE AXLE SQUARENESS

In order to read the angle with the gauge proceed as follows:

- position the two support rods (1, Figure 33), complete with centering cones (4), in the seats of the kingpins, securing in position with the rods;
- fit the gauge assembly and read the angle values on the goniometers (2).

The angle of the holes should be 5°.

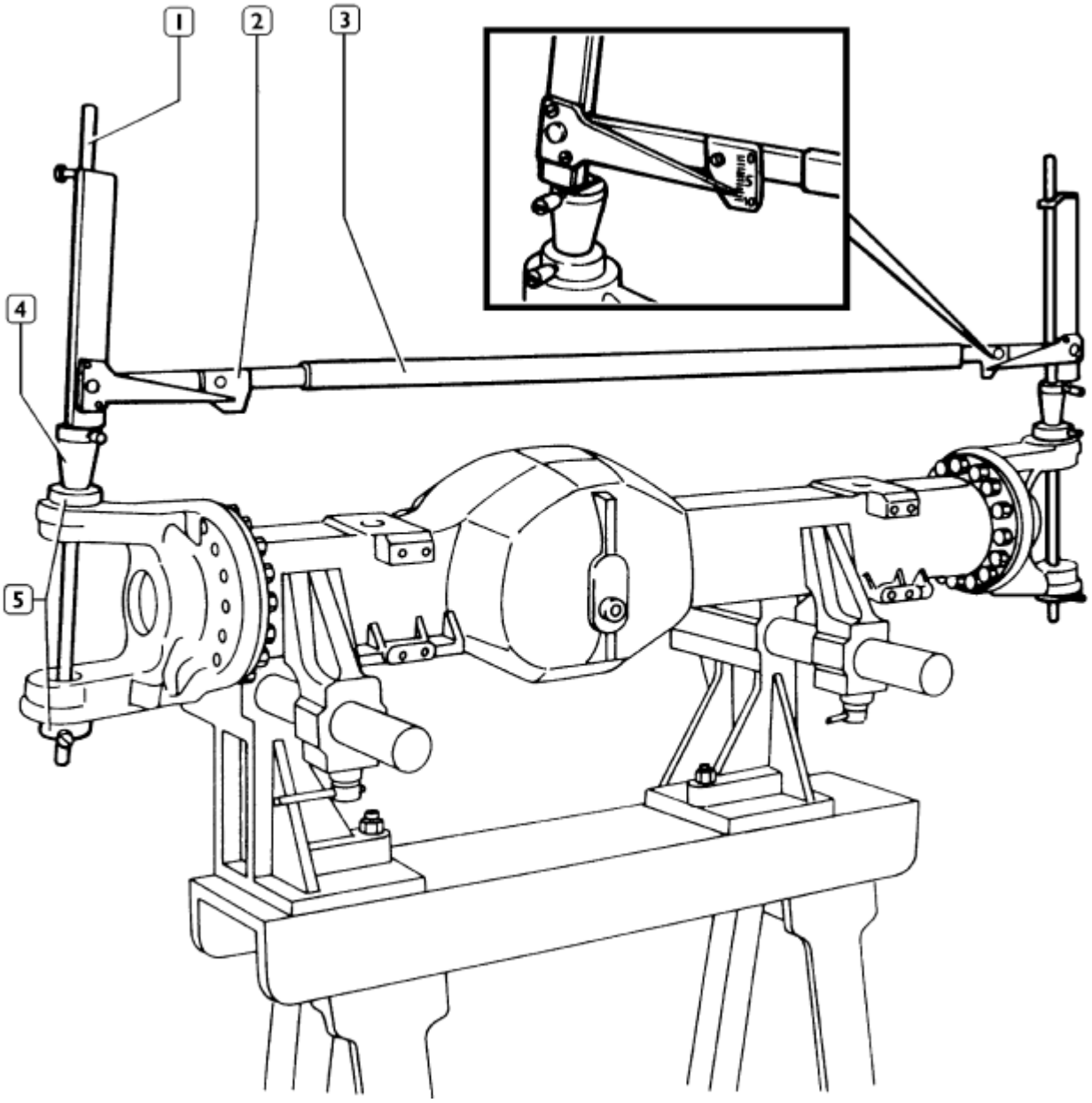
Check the levelness of the leaf spring contact surfaces.
In order to read the angle with the gauge proceed as follows:

- insert two centering pins (4, Figure 34) on the leaf spring surfaces;
- using the centering pins, position two goniometers (2) on the leaf spring surfaces;
- fit the transverse rods (1) on the support rods (3) and the goniometers (2), and read the incidence angle values on the relative goniometers.

The axle caster angle should be 2° 17'.

Aquila Trucks Centres

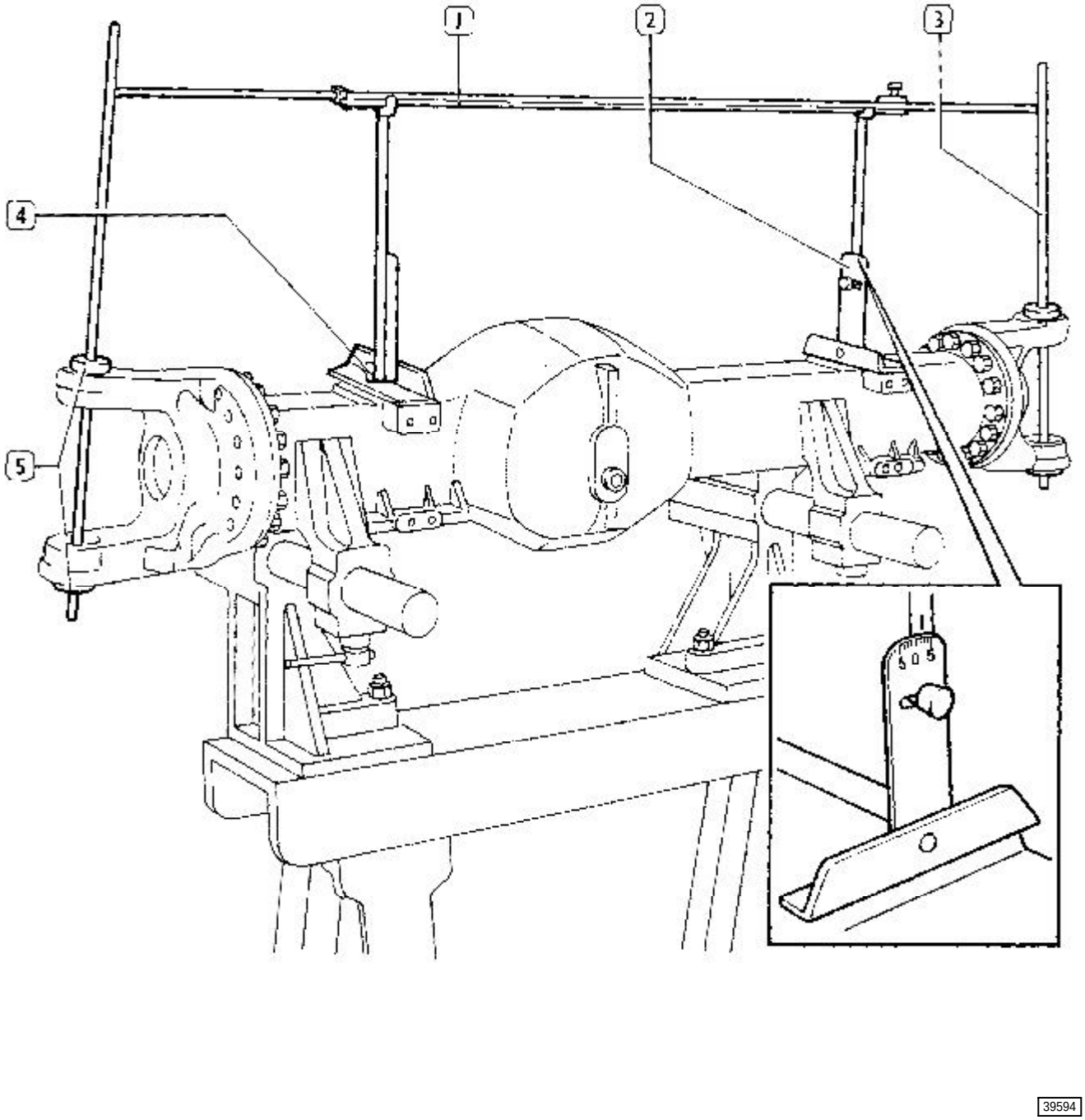
Figure 33




CHECKING THE ANGLE
1. Support rod - 2. Goniometer - 3. Transverse rod - 4. Centering cones - 5. Spacer

Aquila Trucks Centres

Figure 34

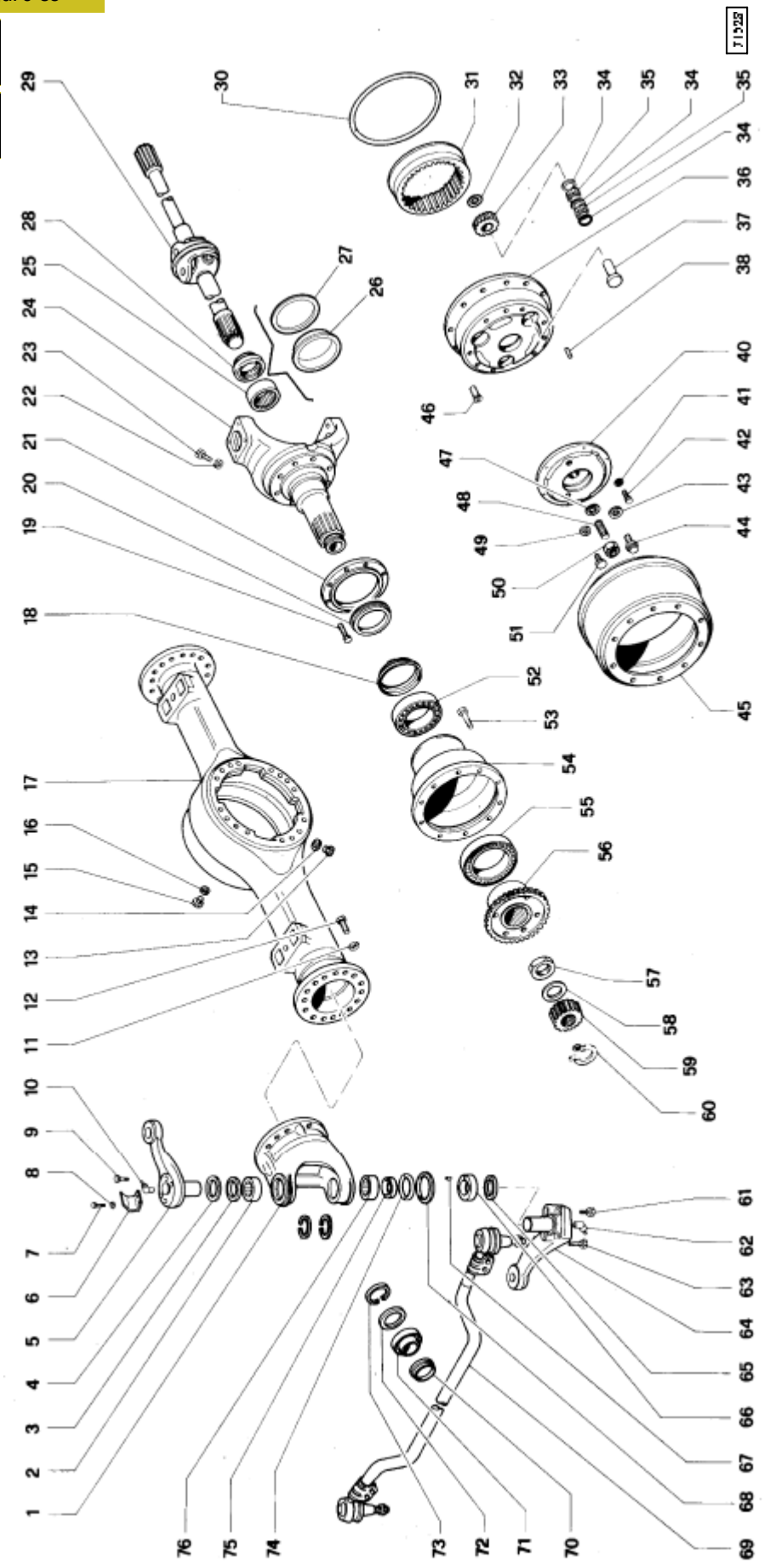



CHECKING THE CASTER ANGLE
1. Transverse rod - 2. Goniometer - 3. Support rod - 4. Centering pin - 5. Spacer

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## ASSEMBLY

Figure 35



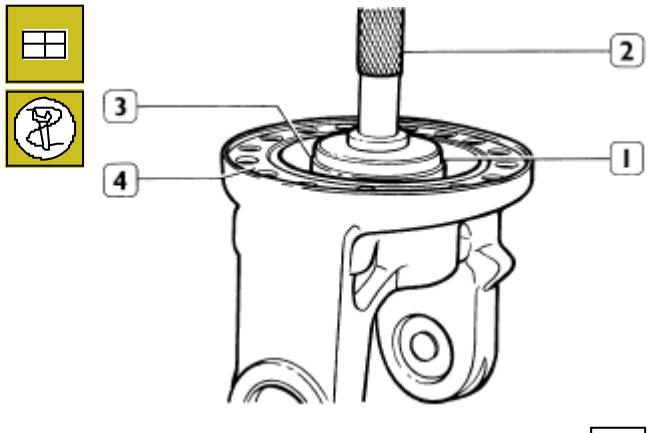

REAR AXLE AND FINAL DRIVE COMPONENTS

1. Yoke - 2. Roller bearing - 3. Seal ring - 4. Compensation ring - 5. Steering lever - 6. Bracket - 7. Lever fixing screw - 8. Washer - 9. Lever fixing screw - 10. Grease nipple - 11. Washer - 12 Yoke support fixing screw - 13. Oil drainage plug - 14. Seal washer - 15. Oil filler plug - 16. Seal washer - 17. Axle housing - 18. Seal ring - 19. Brake support fixing screw - 20. Shim ring - 21. Intermediate ring - 22. Screw locknut (23) - 23. Steering stop adjustment screw - 24. Stub axle - 25. Roller bearing - 26. Oil seal ring - 27. Circlip - 28. Seal ring - 29. Axle shaft with homo-kinetic coupling - 30. Seal ring - 31. Ring gear - 32. Shim washer - 33. Crown wheel gears - 34. Shim rings - 35. Bearing rollers - 36. Side pinion support - 37. Bearing mounting pin - 38. Parallel pin - 40. Crown wheel support cover - 41. Washer - 42 Screw fixing cover - 43 Seal washer - 44. Oil induction plug - 45. Brake drum - 46. Screw fixing crown wheel support - 47. Seal washer - 48. Spacer screw - 49. Seal washer - 50. Safety nut - 51. Oil level plug - 52 Tapered roller bearing - 53. Screw fixing wheel - 54. Wheel hub - 55. Tapered roller bearing - 56. Crown support gear unit - 57. Nut fixing wheel hub - 58. Support ring - 59. Gear unit - 60. Safety ring - 61. Screw fixing lever - 62 Grease nipple - 63. Screw fixing lever - 64. Connecting lever - 65. Support ring - 66. Spacer ring - 67. Stop pin - 68. Guard ring - 69. Transverse tie-rod - 70. Seal ring - 71. Roller bearing - 72. Support ring - 73. Safety ring - 74. Seal ring - 75. Seal ring - 76. Roller bearing

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## Yoke support assembly

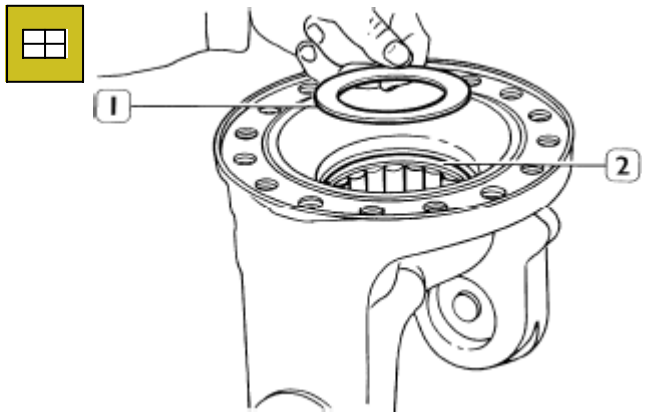
Figure 36




39511

Using punch 99374371 (1) and grip 99370006 (2), fit the roller bearing (3) in the seat on the yoke support.

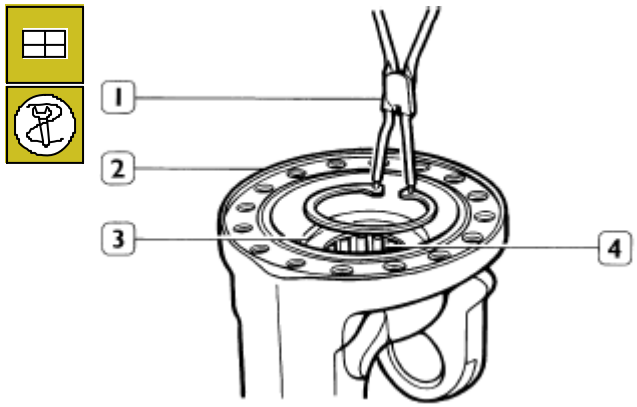
Figure 37




39512

Fit the spacer (1) in the seat (2) on the yoke support.

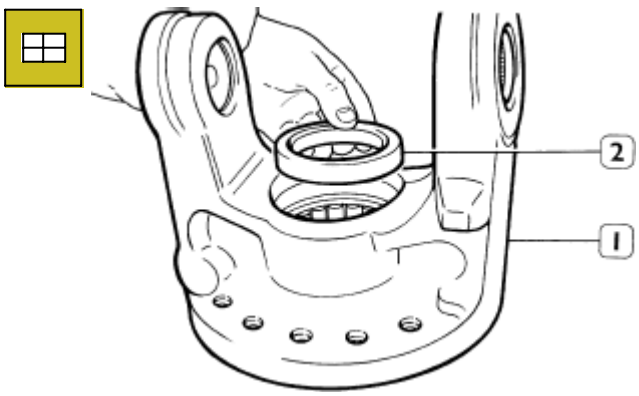
Figure 38




39513

Using suitable pliers (1) position the retaining ring (3) in the seat on the yoke support (2).

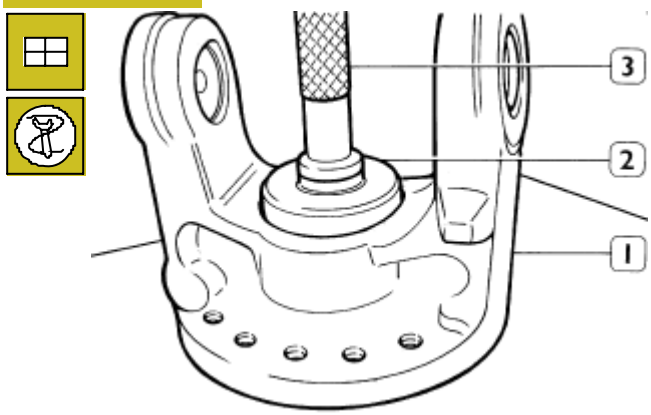
Figure 39




39514

Overturn the support (1) and fit the seal (2).

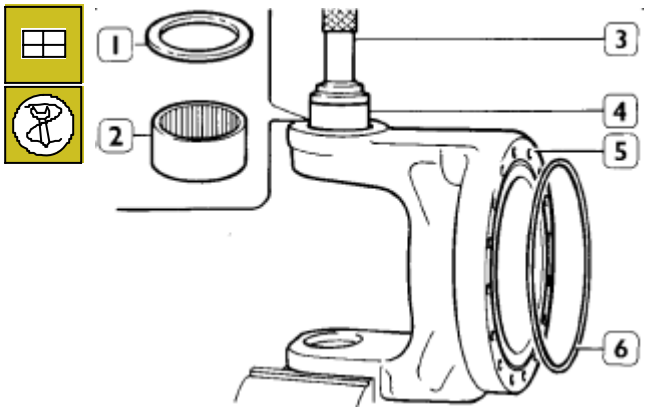
Figure 40




39515

Using key 99374371 (2) and grip 99370006 (3), fit the seal in the seat on the yoke support (1).

Figure 41

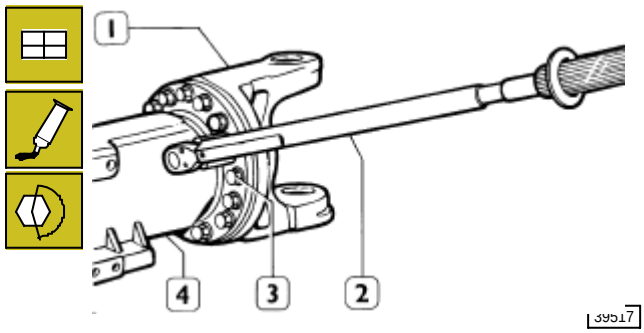



71529

Using punch 99374382 (4) and grip 99370006 (3), fit the roller bearing (2) in the yoke support (5); then fit the seal ring (1). Repeat the same operation on the opposite side. Position the seal ring (6) in the seat on the yoke support (5).

Aquila Trucks Centres

Figure 42

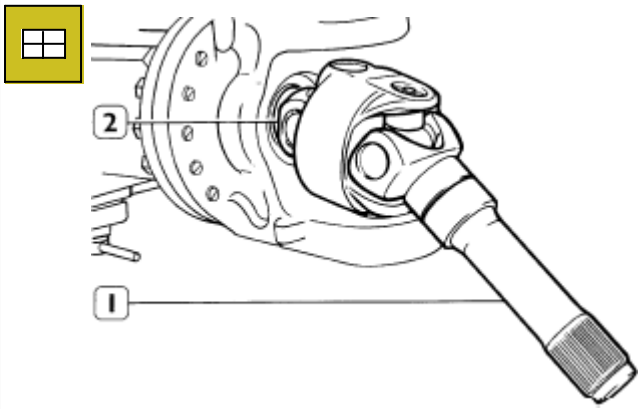



39517

Fit the yoke support (1) on the axle housing (4), remembering to fit the mechanical steering stop stud in the correct position.
Align the holes for the fixing screws.
Gradually and fully tighten the screws (3).
Use a torque wrench to tighten to the correct value.

## Drive shaft assembly

Figure 43

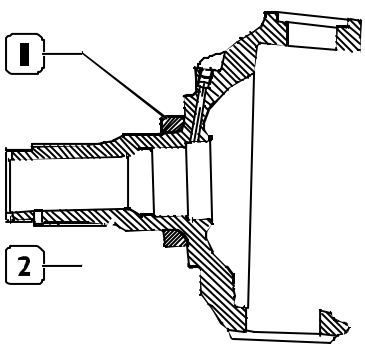



39519

Lubricate the internal ring on the bearing (2) and then insert the drive shaft (1), taking care not to damage the seal ring.

## Stub axle assembly

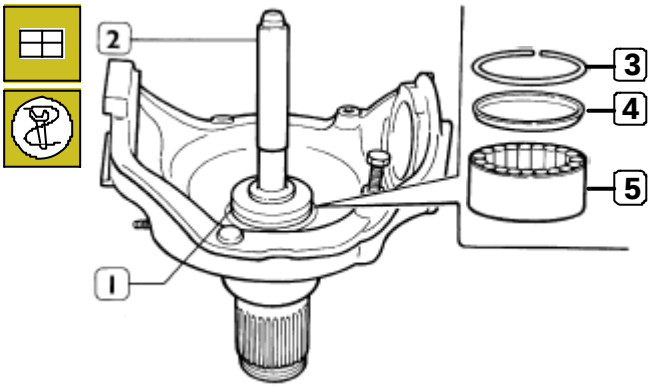
Figure 44




71530

Check that the surface of the ring (1), that houses the hub seal ring, is not damaged or worn. Replace the ring (1) if necessary.
When assembling the ring (1), apply LOCTITE 573 on the stub axle (2) pin contact surface (⇒).

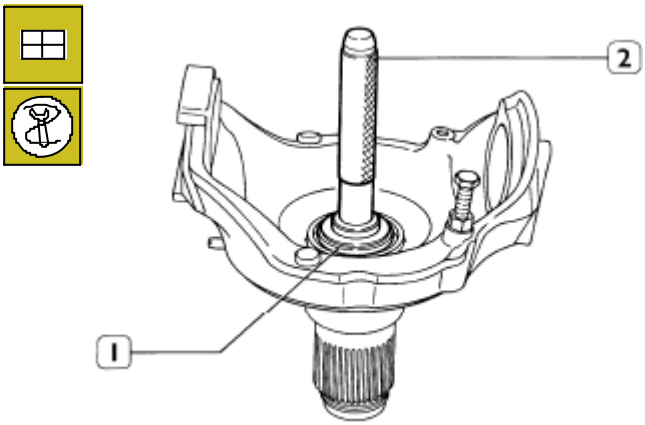
Figure 45




72457

Using key 99374369 (1) and grip 99370006 (2), fit the roller bearing (5). Fit the oil seal ring (4) and secure to the stub axle with the circlip (3).

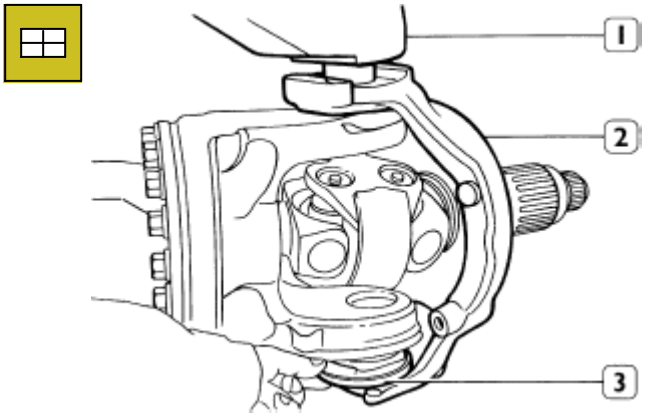
Figure 46




39518

Using key 99374390 and grip 99370006 (2), fit the seal ring (1) in the stub axle seat.

Figure 47

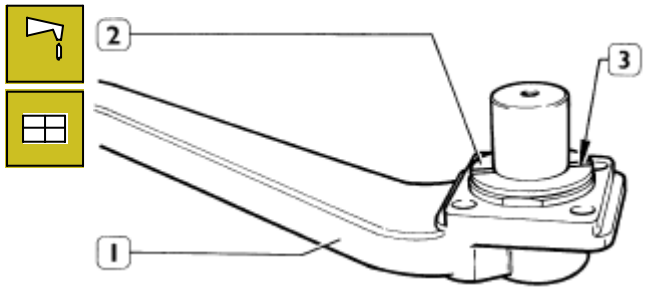



39520

Fit the stub axle (2) and provisionally insert the upper pin (1) with the shim (3).

Aquila Trucks Centres

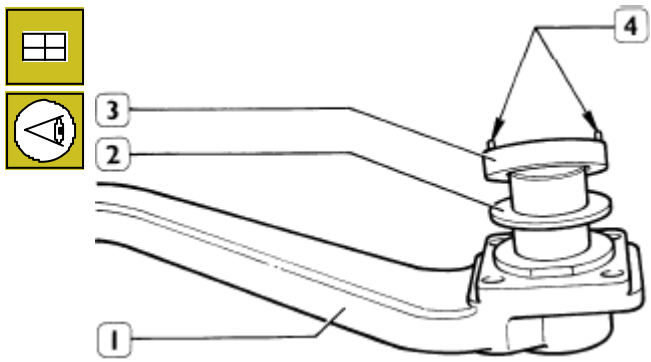
Figure 48




39521

Lubricate the shoulder ring (2) and fit on the steering return lever (1) in the position indicated by the arrow (3).

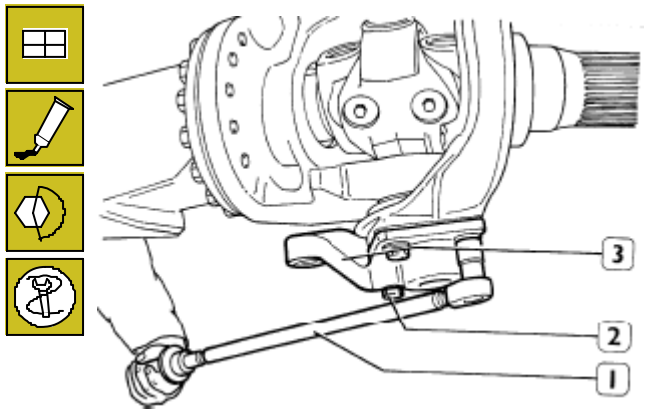
Figure 49




39522

Fit the spacer (3) with the pins (4) positioned as shown in the drawing; fit the seal ring in the safety ring and insert between the yoke support and the stub axle.

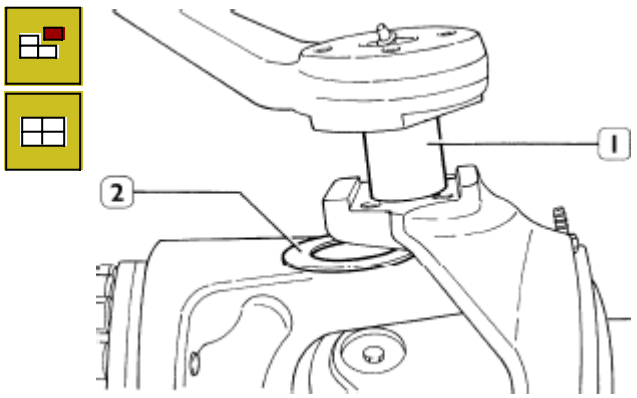
Figure 50




39523

Fit the lever (3) on the stub axle.
Tighten the screws (2) and use the torque wrench (1) to tighten to the correct value.

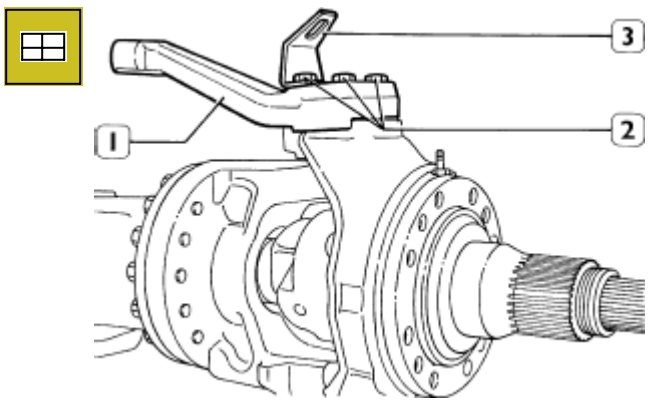
Figure 51




39524

Partially extract the upper pin (1) and insert the shim (2).

Figure 52

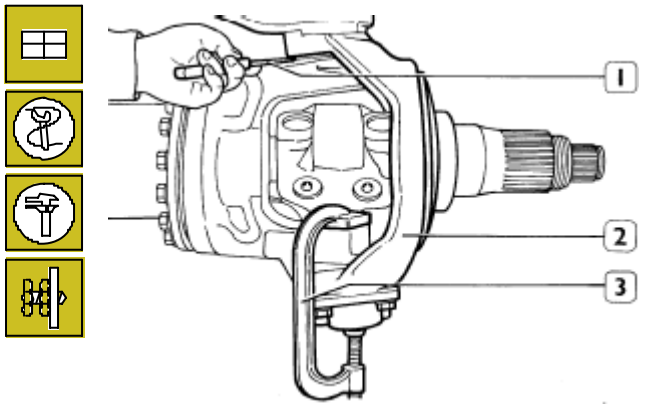



39525

Insert the upper pin (1).
Assemble the brake air piping union support bracket (3) and secure in position with the screws (2).

Aquila Trucks Centres

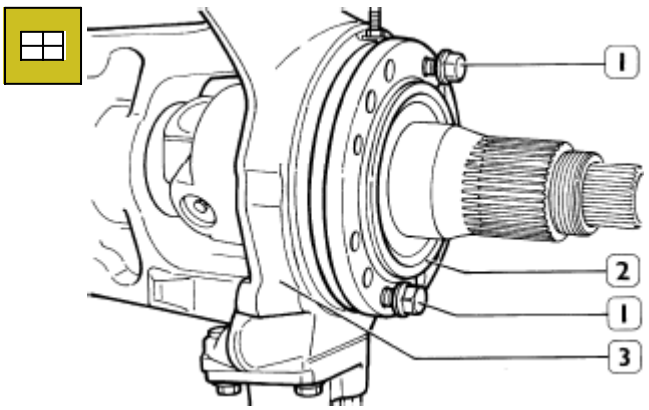
Figure 53




39526

Fit a clamp (3) in order to raise the stub axle (2); check that there is no clearance with a feeler gauge (1).
If clearance is detected, replace the shim with a suitably dimensioned shim and check that the clearance has been eliminated.
The shims are available in various thicknesses: 1.75; 2; 2.25; 2.5; 2.75; 3; 3.25; 3.5.
Remove the upper pin fixing screw, smear with Loctite and refit, tightening to a torque of 230 Nm (23 kgm).

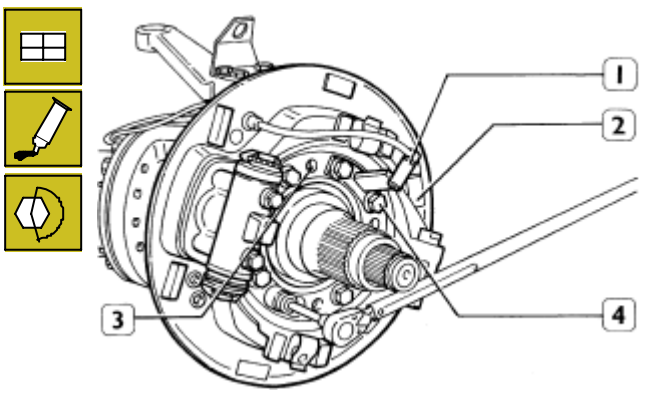
Figure 54




39527

Using two screws (1) insert the flange (2) on the stub axle (3), with the oil drainage plug facing downwards.

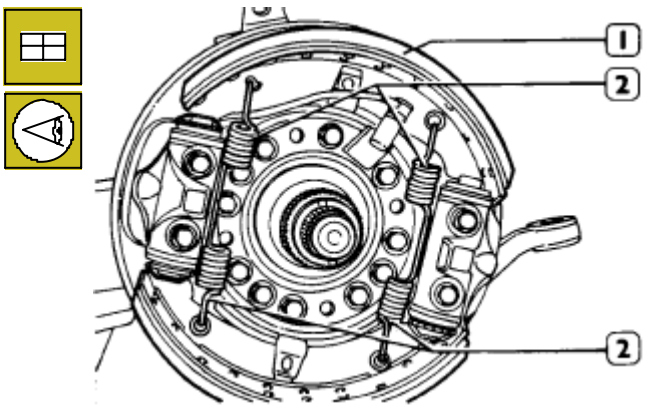
Figure 55




39528

Assemble the brake body (3) and guard (2) on the stub axle; smear the screws (4) with Loctite and tighten to a torque of 360 Nm. Fit the ABS sensor (1).

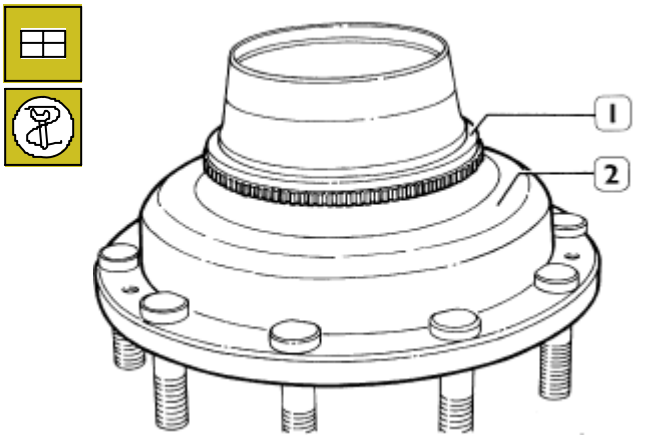
Figure 56




71531

Fit the jaws (1) so that the marked arrow is facing towards the direction of forward movement; using tool 99372211 fit the return springs (2).

Figure 57

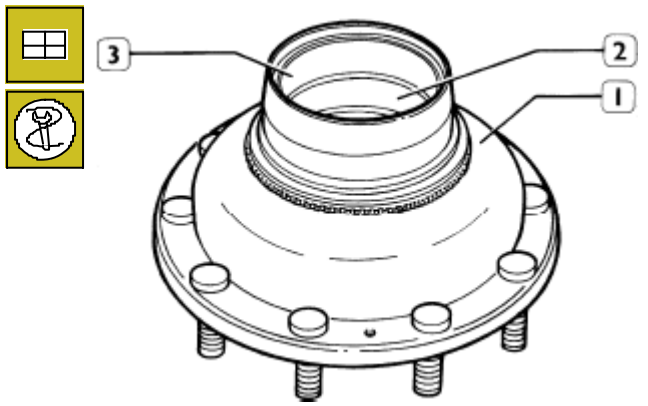



39530

Slightly heat the phonic wheel (1) with an electric drier and fit on the wheel hub (2).

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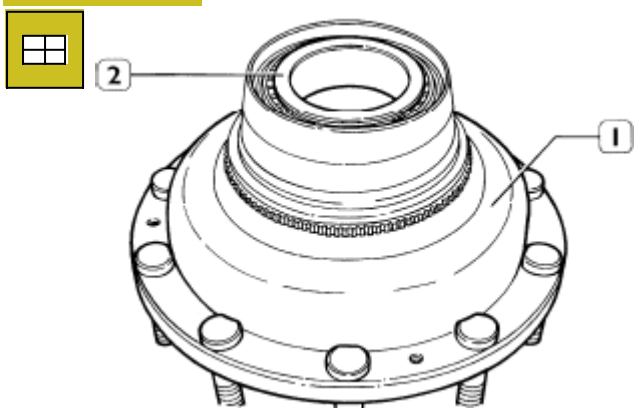
Figure 58




39531

Fit the bearing external races (2 and 3) on the wheel hub (1) using punch 99374094.

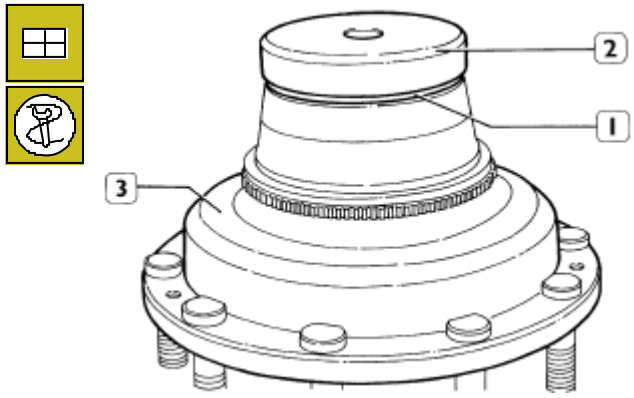
Figure 59




39532

Insert the external bearing internal race (2) on the wheel hub (1).

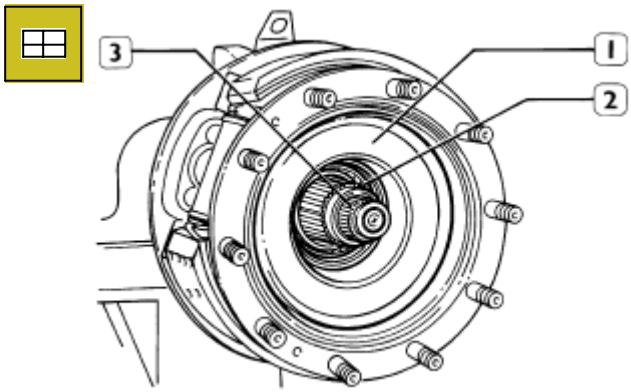
Figure 60




39533

Using key 99374377 (2) fit the seal (1) on the wheel hub (3).

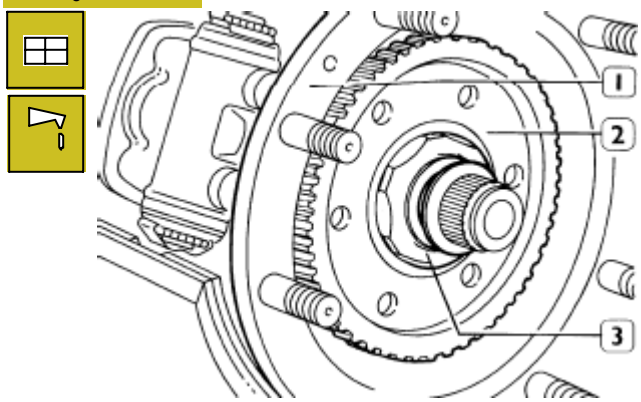
Figure 61




39488

Fit the wheel hub (1) on the stub axle shank (1).

Figure 62

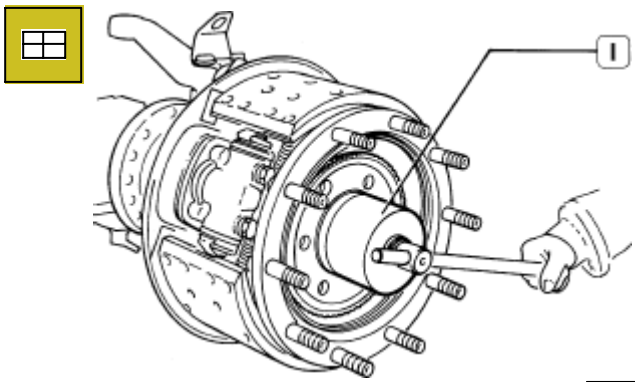



39534

Fit the crown support gear unit (2) and bearing on the hub (1). Tighten the nut (3) with the contact surface pre-lubricated with Molycote.

**NOTE** The oil flow milling on the crown support gear unit (2) must be positioned perpendicularly on the lower part.

Figure 63

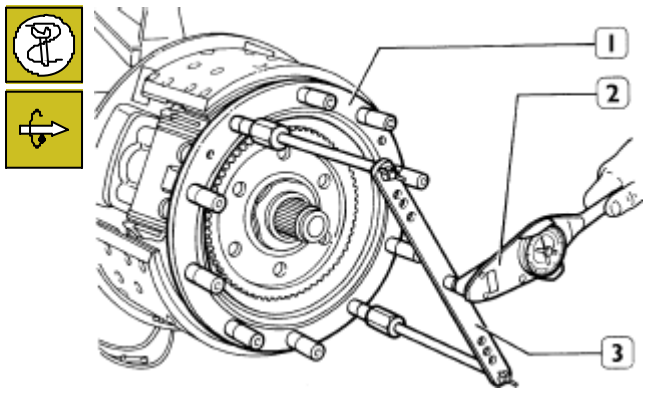



39535

Using key 99354207 (1) tighten the wheel hub fixing nut until the assembly rotates with difficulty.
Strike the hub (axially) a few times with a rubber mallet to correctly settle the bearings.

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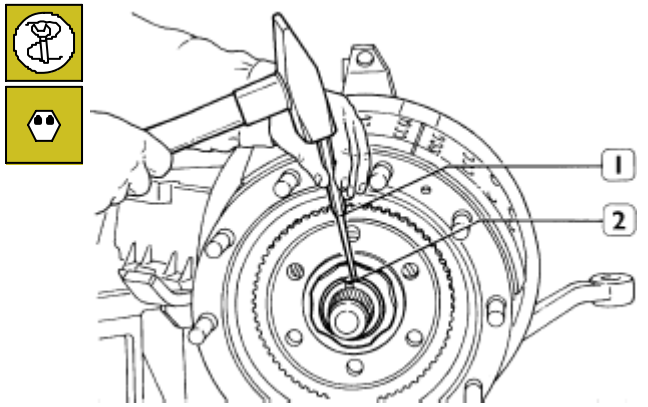
Figure 64




39536

Apply tool 99389819 (3) to the wheel hub (1) and rotate the hub with the torque wrench (2).
Zero-set the torque wrench (2) index and rotate the wheel hub at approx. 25 to 30 rpm.
Read the rolling torque on the tool scaled index.
This value must correspond with the data on the SPECIFICATIONS AND DATA table on page 18.
If different values are detected, tighten or loosen the nut until the required values are obtained.

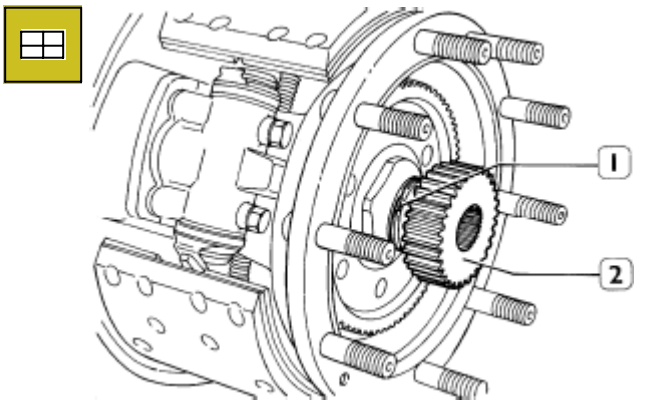
Figure 65




39537

Using a punch (1) secure the nut (2).

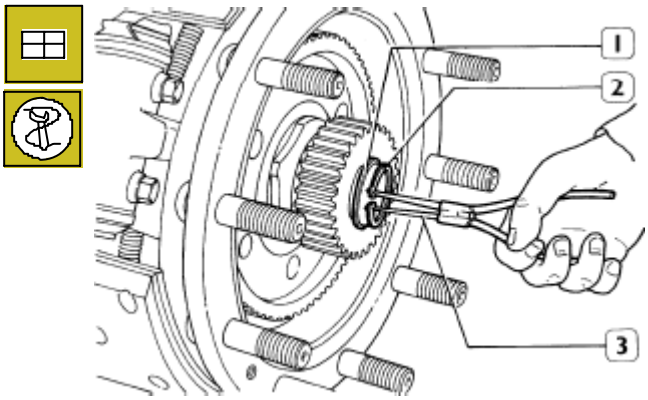
Figure 66




39538

Assemble the shoulder ring (1) and the gear unit (2).

Figure 67



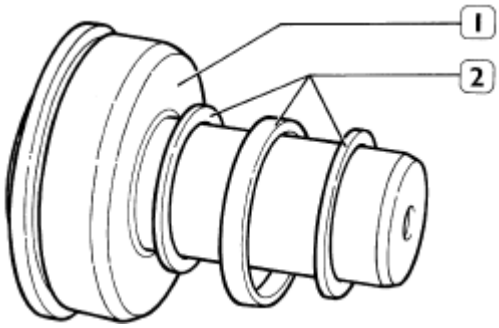

39539

Using pliers, fit the shoulder ring (1) and the seeger ring (2) on the axle shaft.

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## 522870 Epicyclic reduction gear assembly

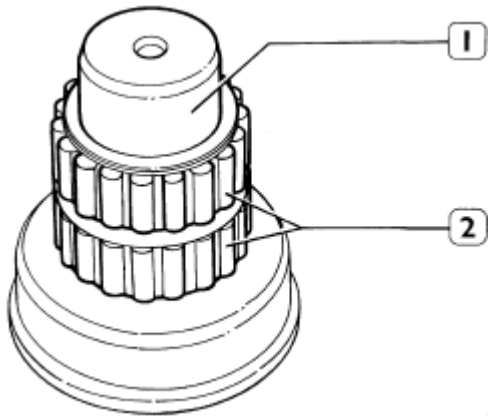
Figure 68




39541

Assemble the shim rings (2) on the pin (1).

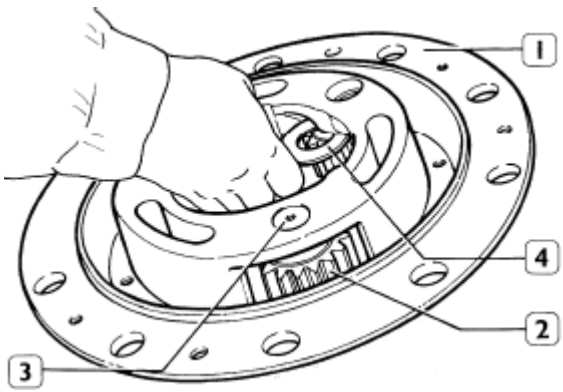
Figure 69




39542

Using grease, fit the rollers (2) on the pin (1).

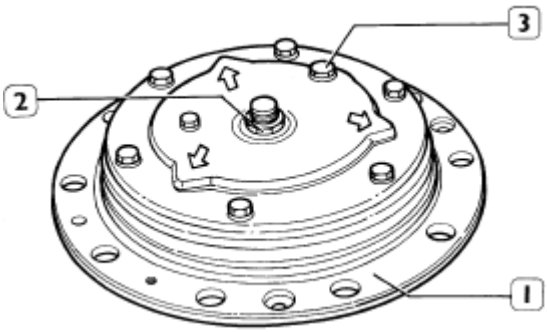
Figure 70




39543

Insert the gears (2), washers (4), spacers and pins (3) in the support (1).

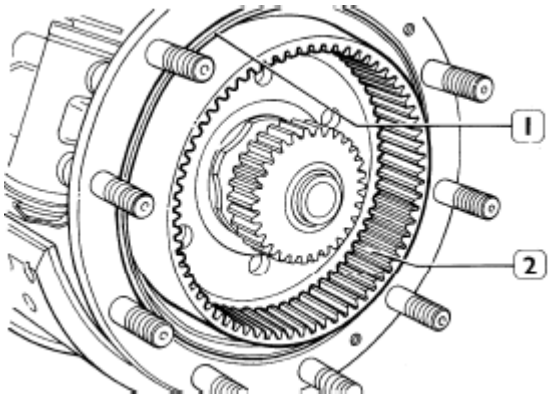
Figure 71




39544

Smear sealing compound on the mating surfaces of the support cover (1), fit the seal and position the cover so that the parts indicated by the arrows coincide with the pins.
Before fitting the seal, it is advised to position the pins according to seats on the cover, then fit the seal.
Tighten the fixing screw to a torque of 25 Nm (2.5 kgm).
Loosen the nut (2) and slightly unscrew the screw (3).

Figure 72

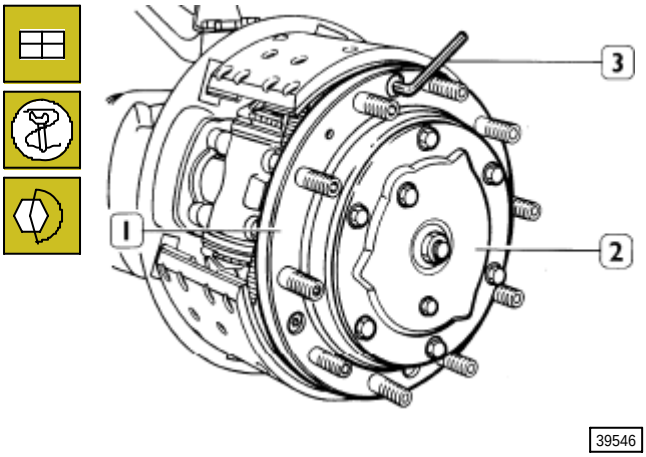



39545

Fit the crown (2) with the external bevel facing towards the operator, grease the circlip (1) and fit in the seat.

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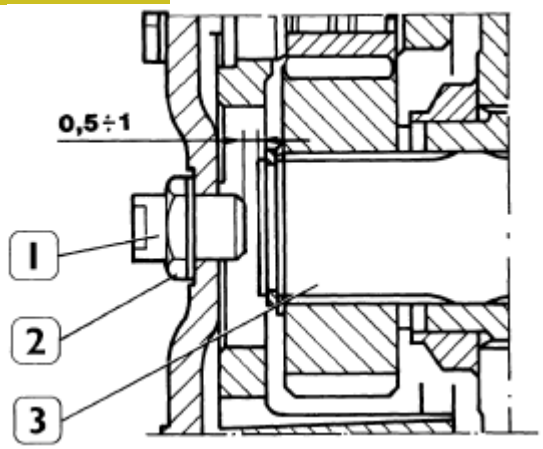
Figure 73




39546

Fit the side pinion support (2) on the wheel hub (1), using an Allen wrench (3), tighten the three sunken hex screws to a torque of 25 Nm (2.5 kgm).

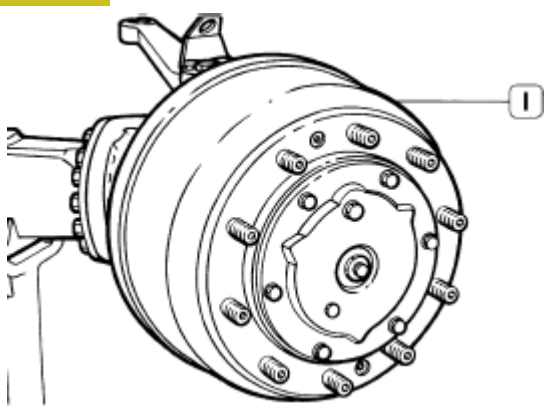
Figure 74




39705

Tighten the screw (1) until it makes contact with the axle shaft (3), then loosen by 1/3 to 1/2 of a turn, thereby obtaining an assembly clearance of 0.5 to 1mm.
Tighten the nut (2).
Replace the washer each time the axle shaft axial clearance is adjusted.

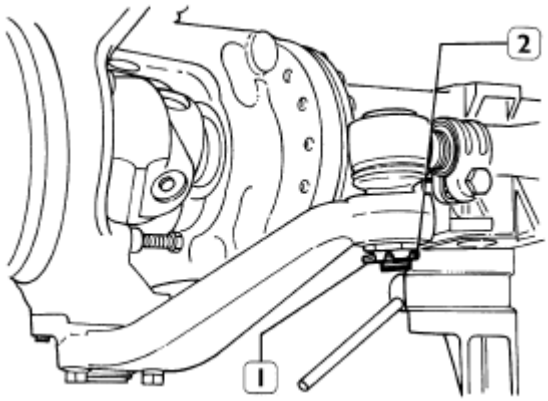
Figure 75




39547

Fit the brake drum (1) on the wheel hub and secure in position with the two screws.

Figure 76




39491

Fit the transverse tie-rod and tighten the nut (1) to the pre-stabilised torque value, position the split-pin (2) and bend to secure in position.

## Greasing the stub axle pins

Using a grease pump, insert grease into the grease nipples. Pump grease into the roller bearing sleeves until they are full, and the pressure forces the grease past the seal rings and out of the gap between the stub axle upright and the yoke support. Eliminate the excess grease.

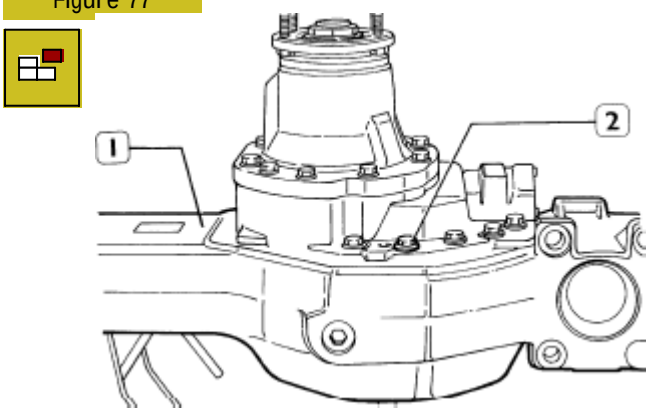
## Epicyclic gear unit lubrication

Introduce approx. 0.75 litres (0.68 kg) of TUTELA W 140/M-DA oil, through the hole on the cover of the epicycloid gear unit.

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## 525910 REMOVING THE DIFFERENTIAL (with the axle mounted on stand 99322215)

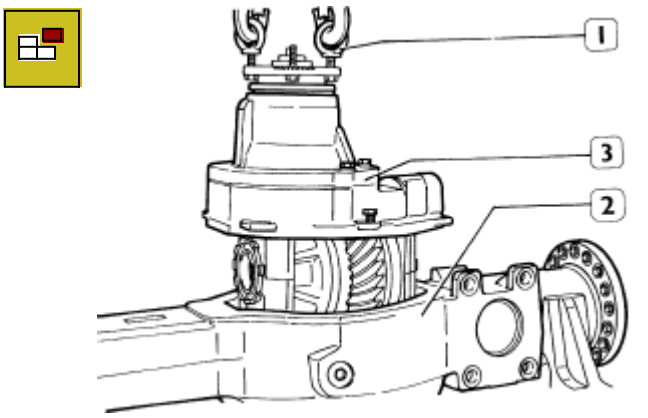
Figure 77




39548

Position the axle housing (1) as shown in the drawing.
Remove the wheel hubs, stub axles and extract the drive shafts as described in the relevant chapter.
Tighten the differential carrier fixing screws (2).

Figure 78




39549

Fit two eyebolts (1) to the differential output flange.
Using a suitable hoist and cables, remove the differential (3) from the axle housing (2).

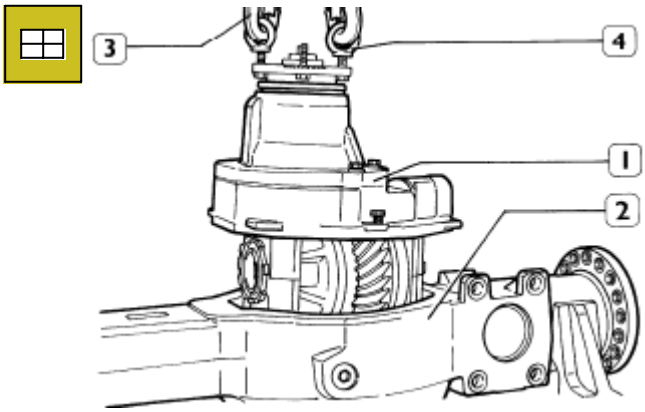
### Checking the axle housing

Check the alignment of the axle housing, as any eventual deformation will lead to unnecessary stress and make the assembly noisy (see page 32).

## REFITTING THE DIFFERENTIAL (with the axle mounted on stand 99322215)

To keep the circlip seal in its seat, located between the axle housing and the differential housing, apply a light covering of grease. The mating surfaces on the axle housing (2) and the differential housing (1) must be smeared with Loctite 573.

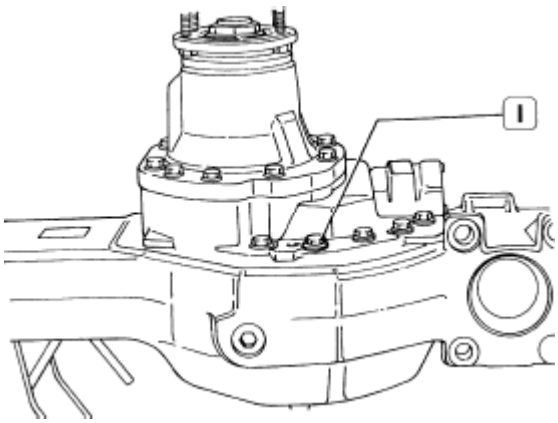
Figure 79




39550

Using a hydraulic hoist with cables and hooks (3), position the differential housing (1) in the axle housing (2).

Figure 80

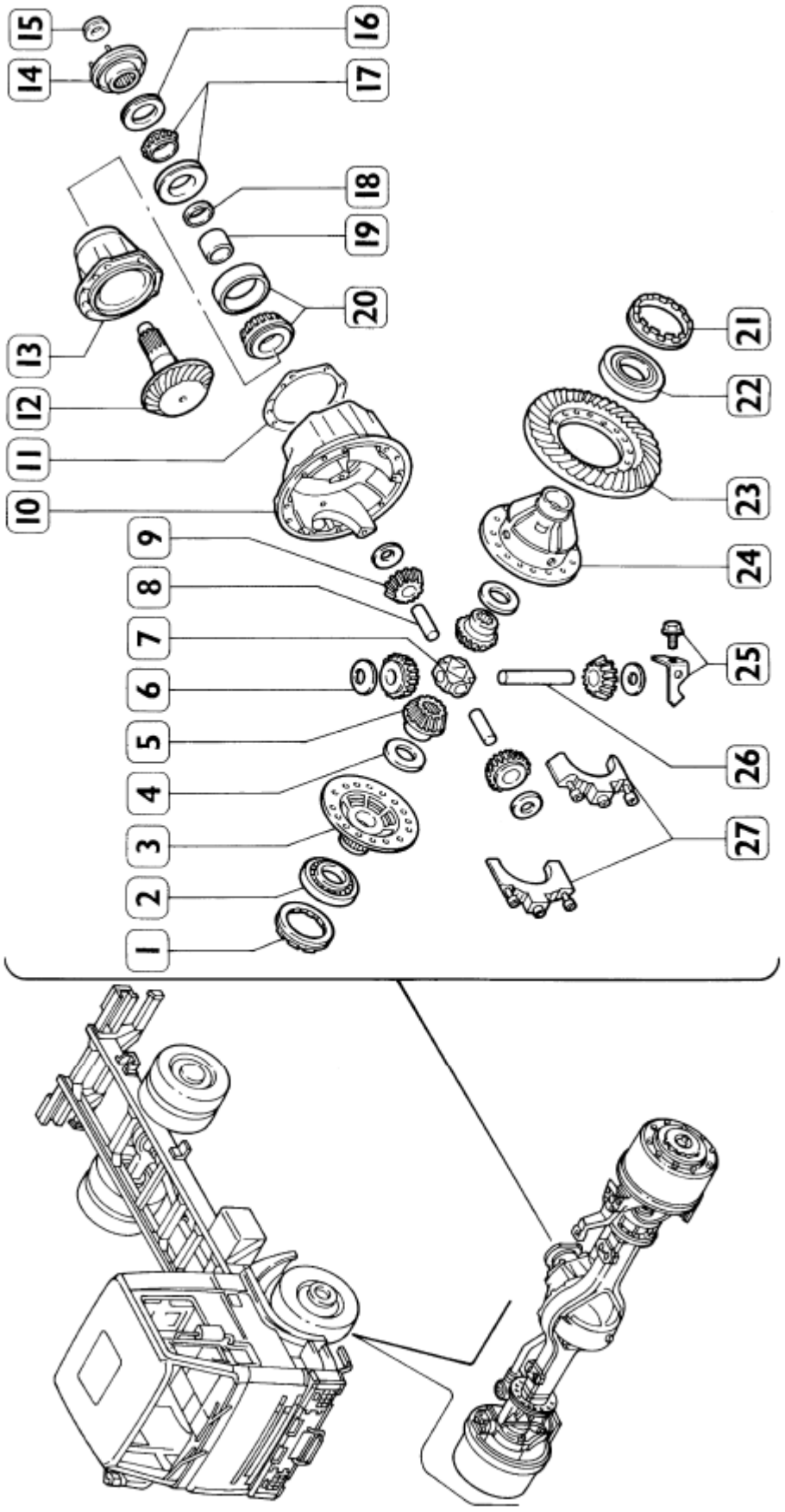



39551

Insert the screws (1) and tighten to the pre-stabilised torque value with a torque wrench.

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Figure 81



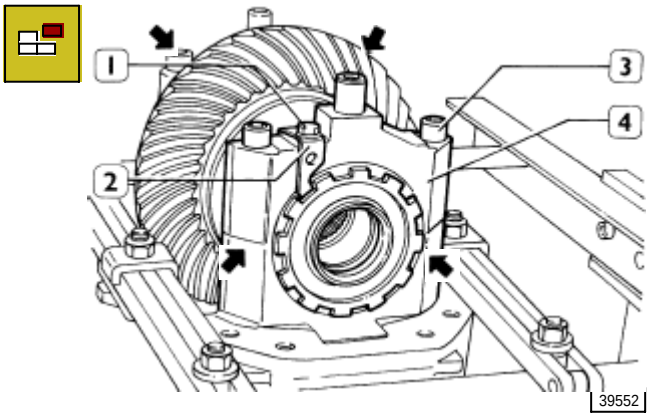

DIFFERENTIAL COMPONENTS

1. Ring nut - 2. Bearing - 3. Gear housing cover - 4. Shoulder washer - 5. Crown wheel - 6. Washer - 7. Spider - 8. Short pin - 9. Side pinion - 10. Differential carrier - 11. Adjustment shim - 12. Pinion - 13. Pinion support - 14. Flange - 15. Nut - 16. Seal ring - 17. Bearing - 18. Adjustment ring - 19. Spacer - 20. Bearing - 21. Ring nut - 22. Bearing - 23. Crown - 24. Differential housing - 25. Long pin - 26. Caps

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## 525910 DIFFERENTIAL REPAIR
### Disassembly

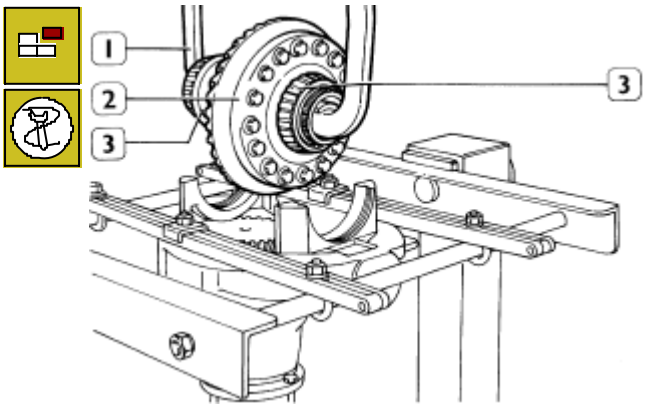
Figure 82




39552

Unscrew the screws (1) and remove the safety plate (2).
Heat the points indicated by the arrows with electric drier 99305121 and unscrew the screws (3) sealed with LOCTITE.
Remove the caps (4) and ring nuts.

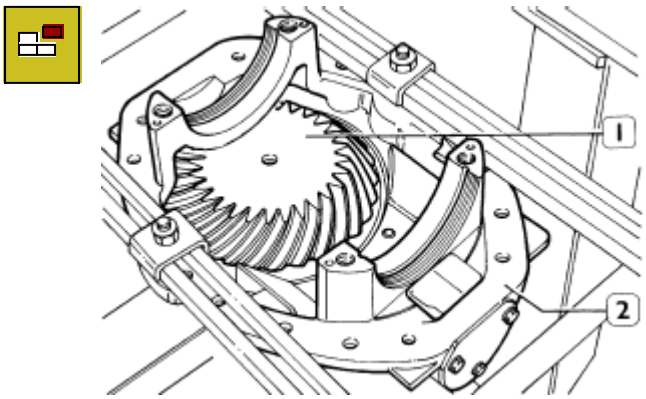
Figure 83




39553

Raise the differential housing (2) and bearings (3) using a hoist (1).

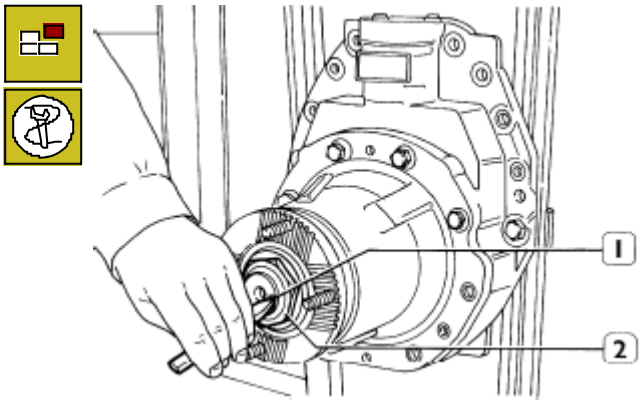
Figure 84




39554

View of pinion (1) inside the differential carrier (2).

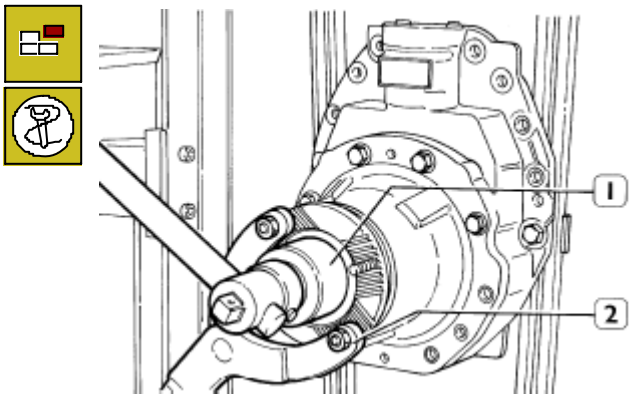
Figure 85




39555

Use a punch to remove the securing (1) notch and unscrew the nut (2) as described below.

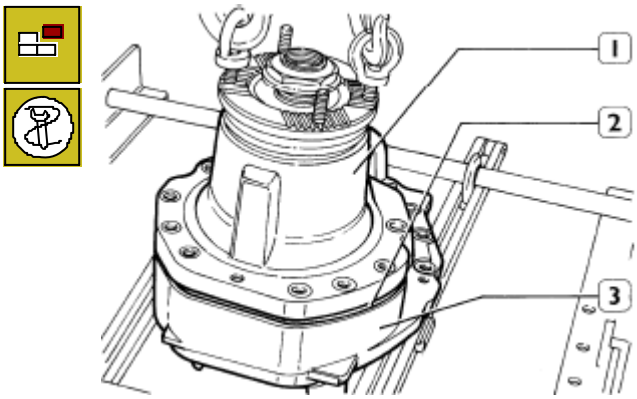
Figure 86




39556

Block the rotation of the drive coupling flange with the reaction lever 99370317 (2), and loosen the drive coupling flange fixing nut using the Allen wrench 99355081 (1).

Figure 87



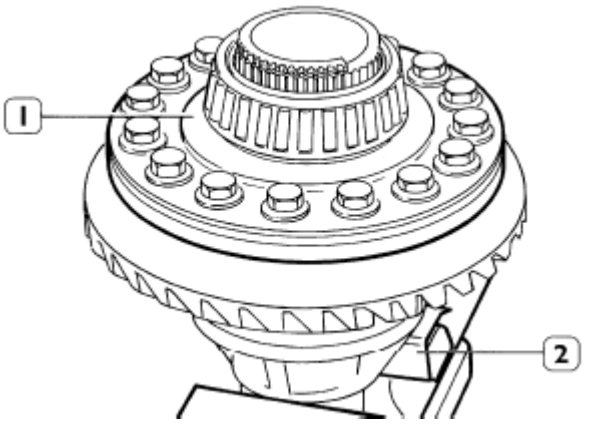

39557

Unscrew the bolts that fix the bevel pinion support to the differential carrier.
Extract the support (1) and bevel pinion from the differential carrier (3); remove the pinion/bevel gear positioning shims (2).

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## Disassembling the differential housing

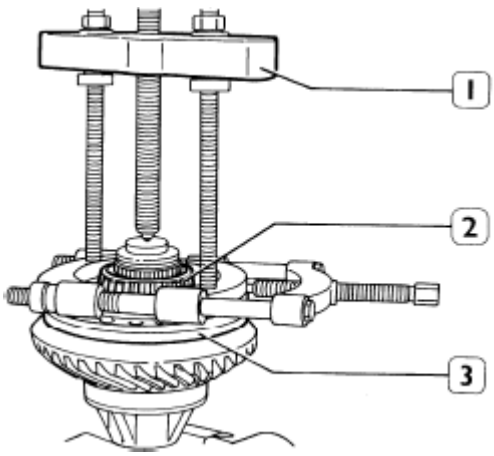
Figure 88




39558

Fit the gear housing (1) in a vice (2).

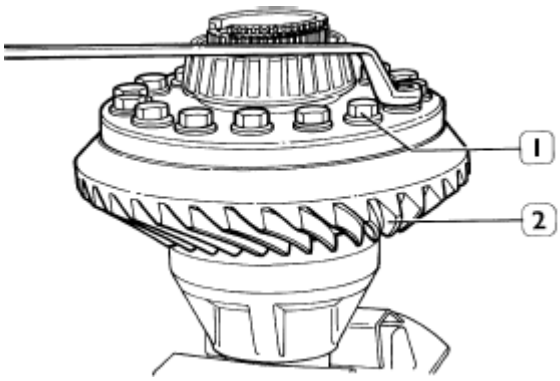
Figure 89




39559

Using extractor 99348001 (1), extract the support bearing (2) on the toothed side from the differential housing (3).

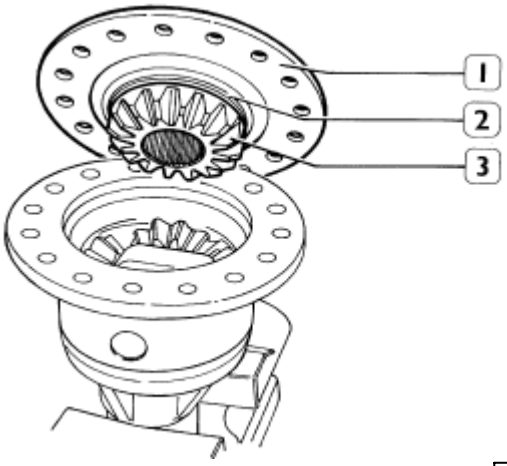
Figure 90




39560

Loosen and remove the screws (1).
Detach the ring bevel gear (2) using a punch.

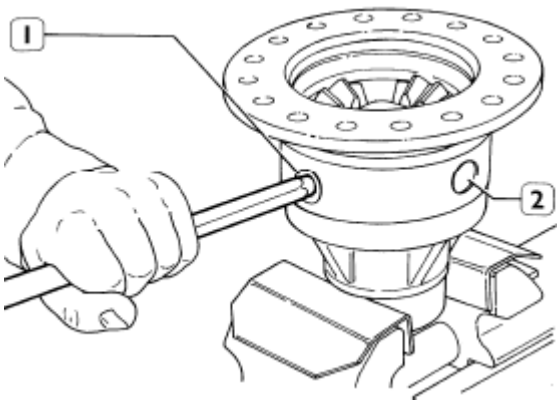
Figure 91




39561

Remove the differential housing cover (1).
Remove the crown wheel (3) from the gear housing, together with the shoulder washer (2).

Figure 92




39562

Using a punch, first extract the long pin (1) and then the two short pins (2).

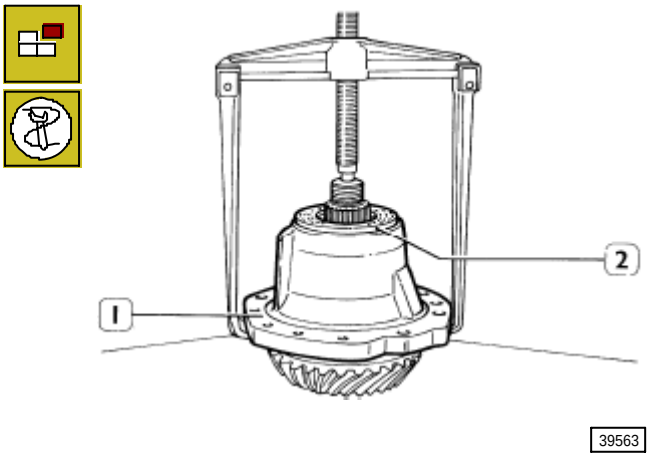
**NOTE** The exact position of the pins is marked on the spider body by a long stripe for the long pin, and by two short stripes for the short pins.

Remove the spider and the four side pinions with the relative shoulder washers.
Remove the crown wheel and shoulder washer.

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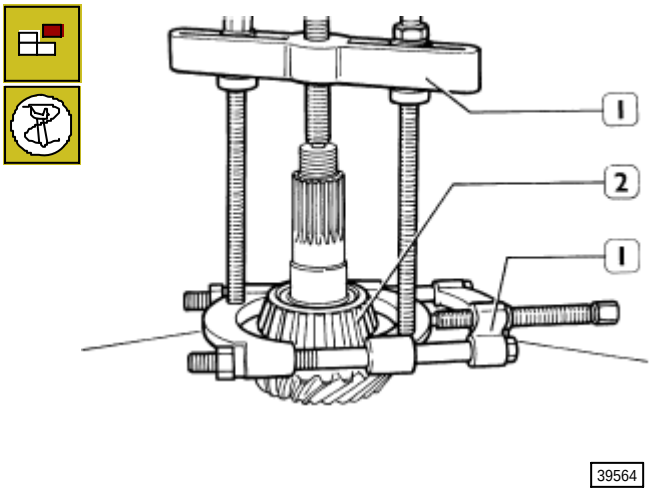
## Disassembling the bevel pinion support

Figure 93



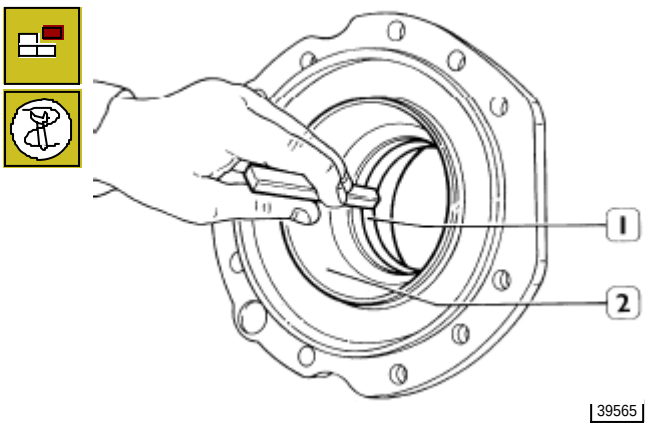

Using an extractor, positioned as shown in the drawing, extract the bevel pinion with bearing and support adjusting ring (1).
Extract the seal ring (2).

Figure 94




Using extractor 99348001 (1), extract the bearing (2) from the bevel pinion.

Figure 95




Using a punch, remove the front and intermediate bearing external rings (1 and 2) from the support.
Remove the oil baffle.

## CHECKING THE DIFFERENTIAL COMPONENTS

Carefully clean all of the individual differential components. Lubricate the bearings and make sure that the roller support cage rotates freely, without sticking. Check the ring bevel gear and half-casing contact surfaces, making sure that the bevel gear matches perfectly. Any eventual deformation on these surfaces would cause screw vibration on the bevel gear, leading to incorrect assembly operation.

**NOTE** Carefully clean all the threads to ensure exact adjustments and precise tightening torque values.

Check that the splined section used to key the flange on the pinion is not worn. Replace the pinion if necessary.

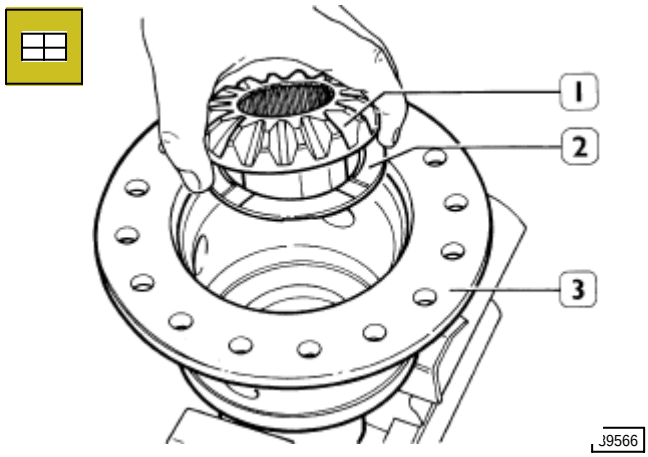
**NOTE** If either the bevel gear or pinion need to be changed, both parts must be replaced as they are provided as coupled spare parts.

Check the side pinions with relative shoulder washers, and the spider and crown wheels with relative shoulder washers.
Replace all sealing elements and safety washers with new parts.

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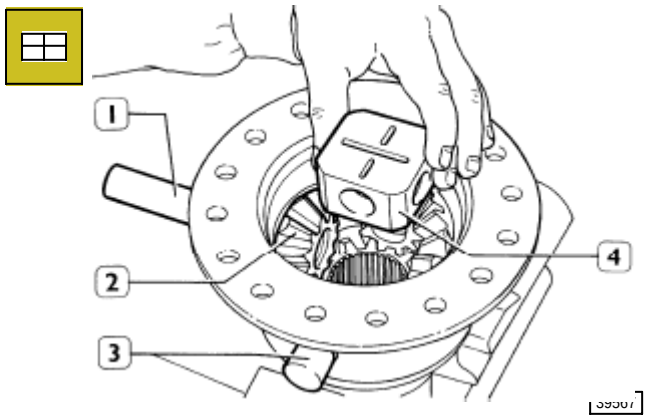
## Assembling the differential housing

Figure 96



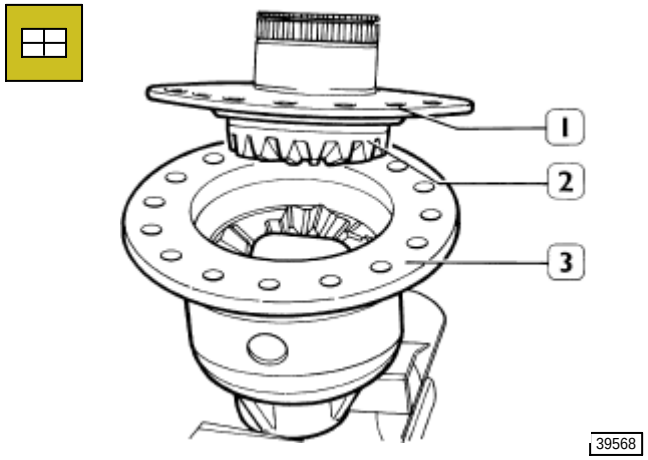

Set the gearing box (3) on a suitable support, place in the seat crown wheel (1) comprising shoulder washer (2).

Figure 97



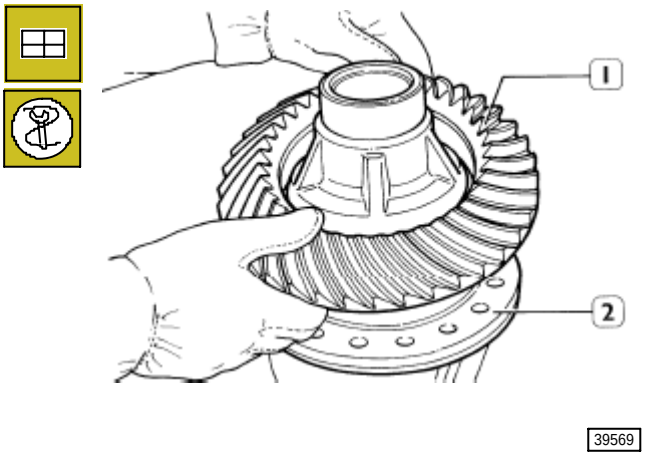

Assemble the four side pinions (2) with the shoulder washers and insert the spider (4). Insert the long pin (1) and the two short pins (3).
The exact position of the pins is marked on the spider body (4) by a long stripe for the long pin, and by two short stripes for the short pins.

Figure 98



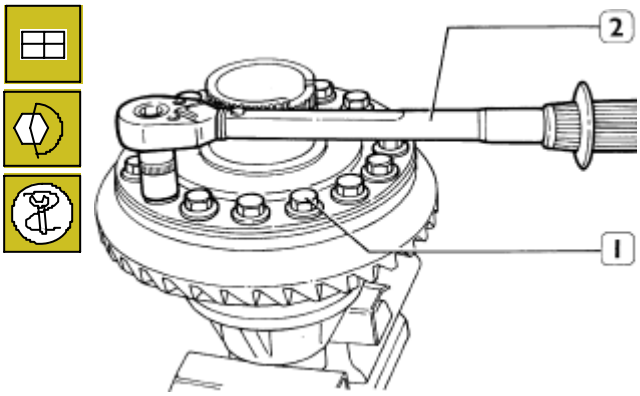

Position the crown wheel (2) and shoulder washer on the side pinion gear unit.
Fit the cover (1) on the differential housing (3) by centering the fixing screw holes.

Figure 99




Heat the ring bevel gear (1) to approx. 80°C, fit in position in the differential housing (2) and secure with the two fixing screws.

Figure 100

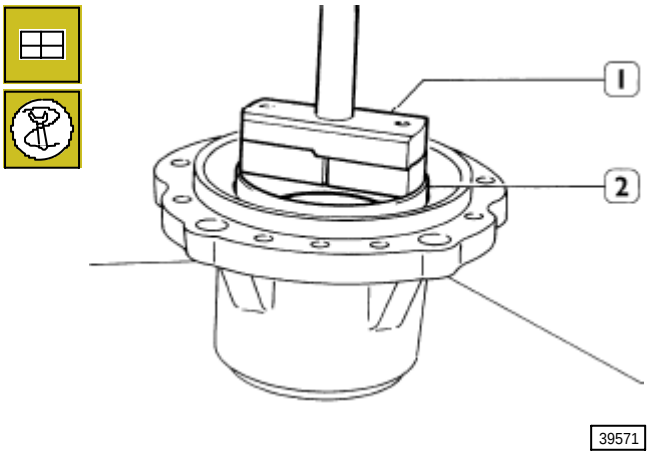



Fit the other screws (1) and tighten with a torque wrench (2) to 180 Nm.
Heat the support bearings with electric drier 99305121 and assemble in the gear housing.

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## Assembling the bevel pinion support

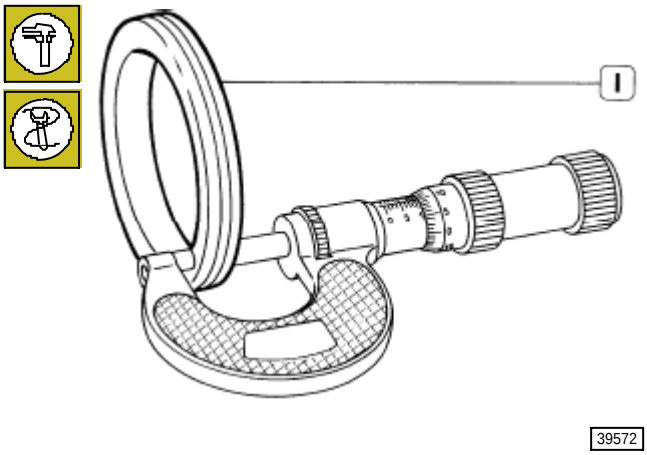
Figure 101




Fit a new oil baffle on the pinion support.
Fully fit the external ring (2) for the front bearing into the seat, using punch 99374093 (1), and the external ring for the rear bearing, using punch 99374094, into the seat.

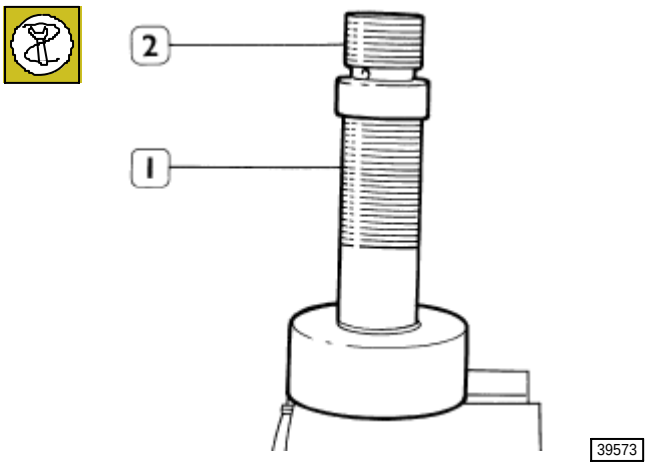
Procedure to follow to determine the thickness of the bevel pinion rolling torque adjusting ring.

Figure 102



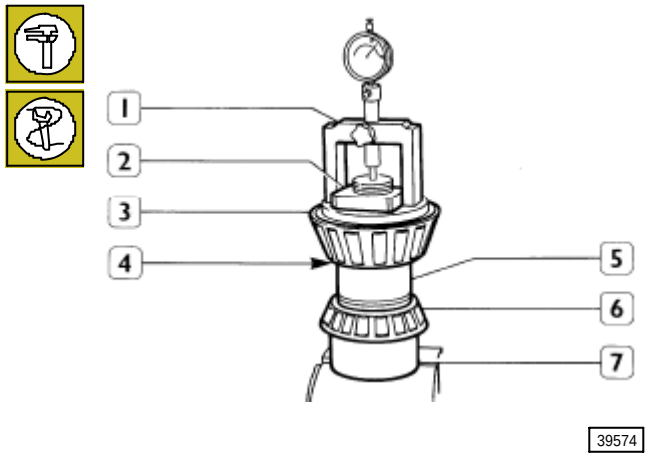

Measure and note the thickness (value A) of the adjusting ring (1) on disassembly.

Figure 103




Secure tool 99395027 (1) and extension (2) in a vice.

Figure 104



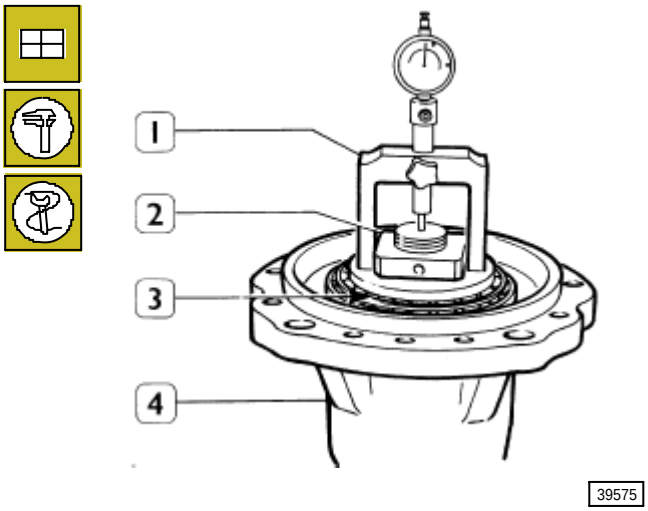

Fit the following parts on tool 99395027:

- the bearing (6) on the pinion-side;
- the spacer ring (5), the previously measured adjusting ring (4) and the bearing (3).

Fully tighten the ring nut (2).
Position part (1) of tool 99395027 (7) on the bearing (3), fitted with a zero-set dial gauge on the end of the tool (7).
Then remove:

- the part (1);
- the ring nut (2);
- the bearing (3);
- the adjusting ring (4) on the tool (7).

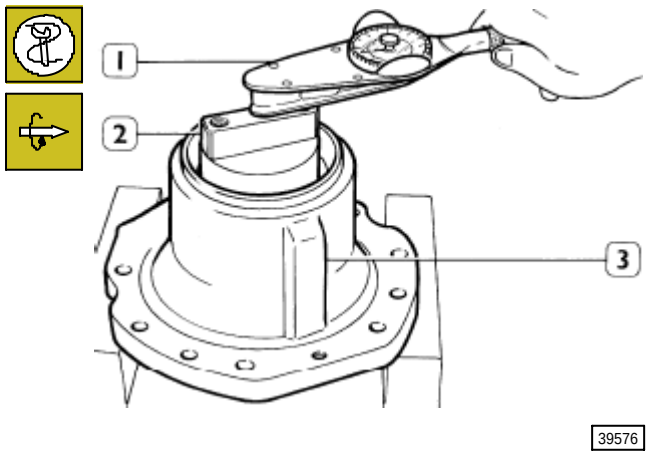
Figure 105




Position the support (4, Figure 105) on the bearing (6, Figure 104) and assemble the bearing (3) on the support.
Tighten the ring nut (2) by hand. Check the rolling torque as indicated in Figure 106.

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Figure 106




39576

Position the complete support (3) on two parallel blocks; using the torque wrench (1) applied on tool 99395027 (2) and read the rolling torque. This value should be:

- 6 to 8 Nm; if not, adjust by means of the ring nut (2, Figure 104).

Position the part (1, Figure 104), with the dial gauge zero-set, on the bearing (3) and read the eventual deviation (value B).

Thickness **S** on the adjusting ring is provided by the following formula:

S = A - (± B) + C

Where:

**A** = thickness of the adjusting ring assembled for dial gauge zero-setting;

**B** = deviation value read;

**C** = 0.05 mm coefficient which takes into account the expansion of the bearings as a result of the assembly negative allowance on the bevel pinion.

**First example:**

**A** = 10.12 mm
**B** = + 0.13 mm
**C** = 0.05 mm

**S = 10.12 - (+ 0.13) + 0.05 =**
**S = 10.12 - 0.13 + 0.05 = 10.04 mm.**

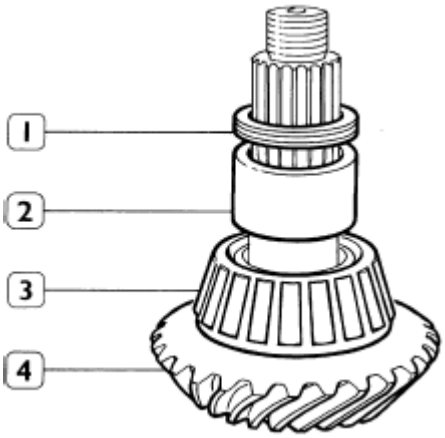
**Second example:**

**A** = 10.12 mm
**B** = - 0.13 mm
**C** = 0.05 mm

**S = 10.12 - (- 0,13) + 0.05 =**
**S = 10.12 + 0.13 + 0.05 = 10.30 mm.**

On completion of the operation, remove the parts of tool 99395027.

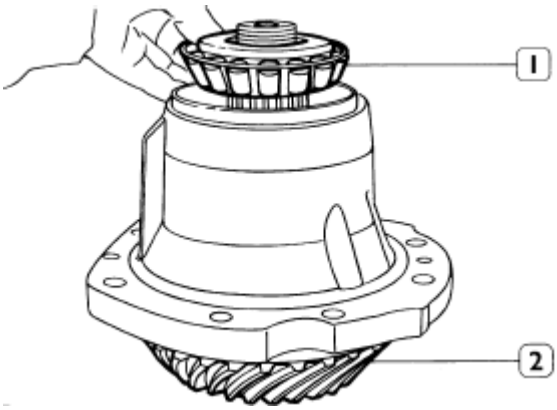
Figure 107




39577

Heat the bearing (3) with electric drier 99305121 and fit on the bevel pinion (4).
Fit the spacer (2).
Assemble the adjusting ring (1) with the same thickness as previously noted, and position on the bevel pinion.
Fit the bevel pinion on the support, complete with external rings for bearings.

Figure 108

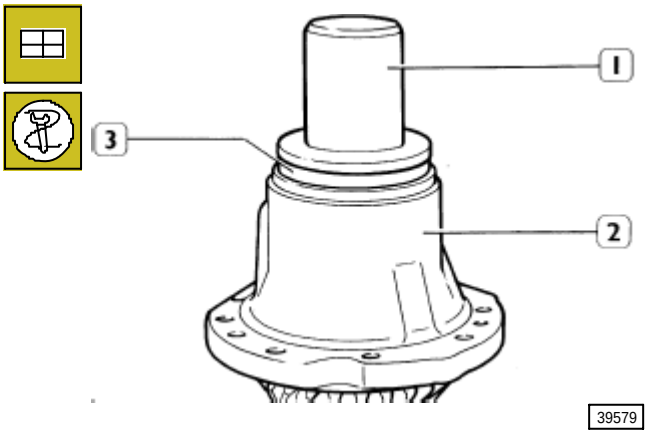



39578

Heat the bearing (1) with electric drier 99305121 and position in the bevel pinion (2) seat using a punch.

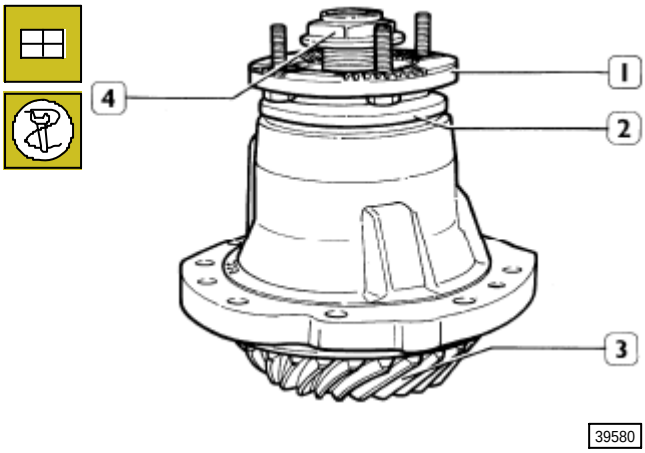
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Figure 109




Using key 99374233 (1) fit the new seal (3) on the support (2). Spare part seals are supplied pre-lubricated and with grease between the lips.

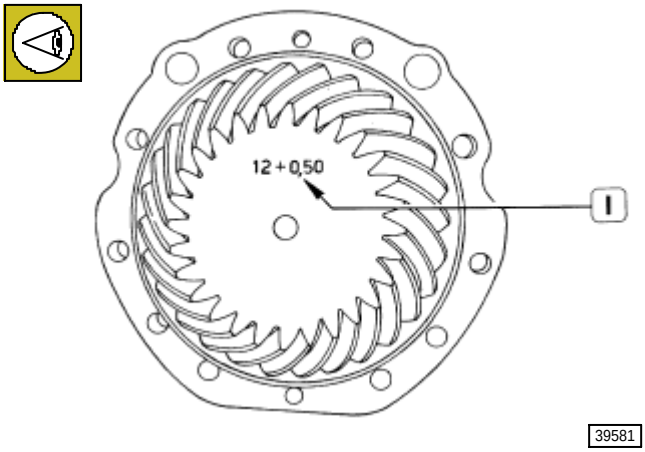
Figure 110




Position the drive coupling flange (1), complete with baffle (2), on the splined section of the bevel pinion (3) and settle in the seat with a punch.
Provisionally tighten the fixing nut (4).

## Differential

Figure 111



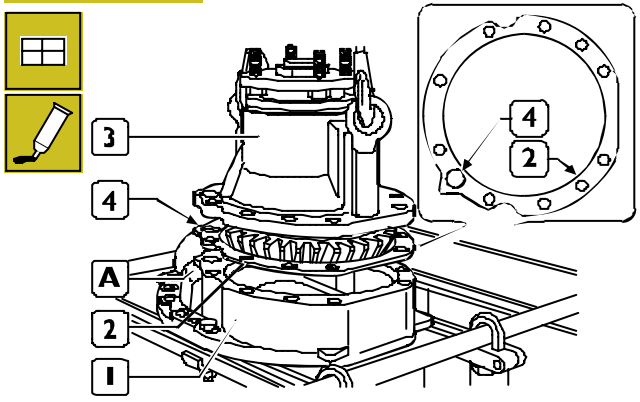

Before fitting the bevel pinion support assembly on the differential housing, check the value (1) marked on the bevel pinion and, by consulting the table in Figure 112, the thickness of the adjusting ring to be positioned between the support and the housing will be given.
Example:
If the reference value (1) marked on the bevel pinion is + 0.5, the thickness of the adjusting ring must be 1.5 mm.
The adjusting rings are available in the following dimensions: 0.2, 0.3, 0.5, 1 mm.

Figure 112

| Value marked on the bevel pinion | Total thickness of adjusting ring |
|---|---|
| 0 | 0.5 |
| 0.1 | 0.6 |
| 0.2 | 0.7 |
| 0.3 | 0.8 |
| 0.4 | 0.9 |
| 0.5 | 1.0 |
| 0.6 | 1.1 |
| 0.7 | 1.2 |
| 0.8 | 1.3 |
| 0.9 | 1.4 |
| 1.0 | 1.5 |

SUMMARY TABLE TO DETERMINE THE THICKNESS OF THE BEVEL PINION POSITION ADJUSTING RING

Figure 113

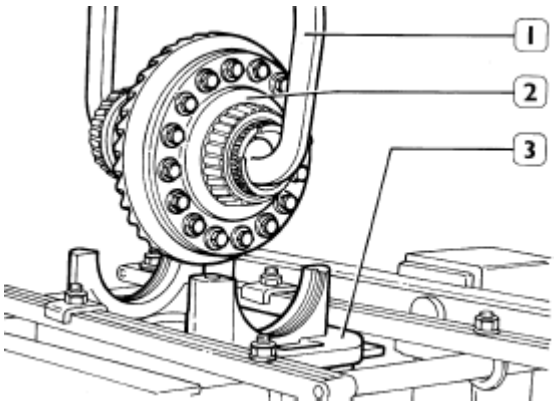



Apply LOCTITE 573 on the differential carrier (1) contact surface, adding LOCTITE 510 around the holes indicated by the arrows. Fit the adjusting ring (2) on the differential carrier (1), so that the hole (4) faces towards upper part A of the differential carrier. Using eyebolts and cables, fit the bevel pinion assembly support (3) on the differential carrier (1). Tighten the fixing screws to the correct torque value.

Apply LOCTITE 573 on the threads of the screws that pass through the holes on the differential carrier (1).

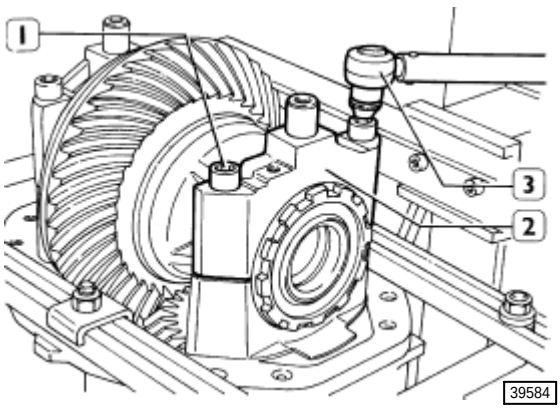
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Figure 114




Using the hook (1), raise the previously assembled differential housing (2) and position on the differential housing (3).

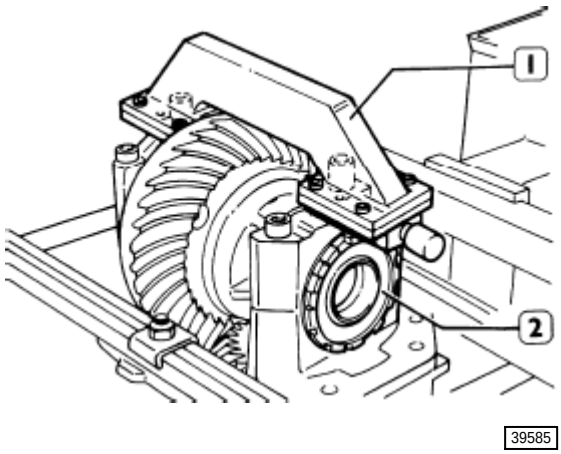
Figure 115




Fit the external bearing rings and position the caps (2). Apply LOCTITE AVX on the threads of the screws (1), and tighten without fully screwing down. Fit the adjusting ring nuts, making sure that they screw on easily. Using a torque wrench (3), tighten the screws (1) to the correct torque value.

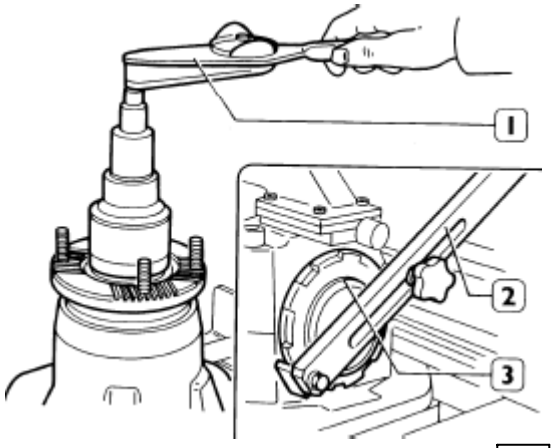
## Adjusting the rolling torque on the gear housing bearings

Figure 116




Position tool 99370133 (1) as shown in the drawing to avoid excessive spread on the caps during adjustment operations.

Figure 117




The total rolling torque reading is carried out when the clearance between the teeth on the bevel gear pair is as near to the pre-stabilised value as possible.
However, the total rolling torque value varies according to the reduction bevel gear pair ratio (see table in Figure 118).
Using torque wrench 99389819 (1) and the appropriate Allen wrench, read the pre-stabilised torque value, adjusting the bearing adjustment ring nuts (3) with wrench 99355025 (2).

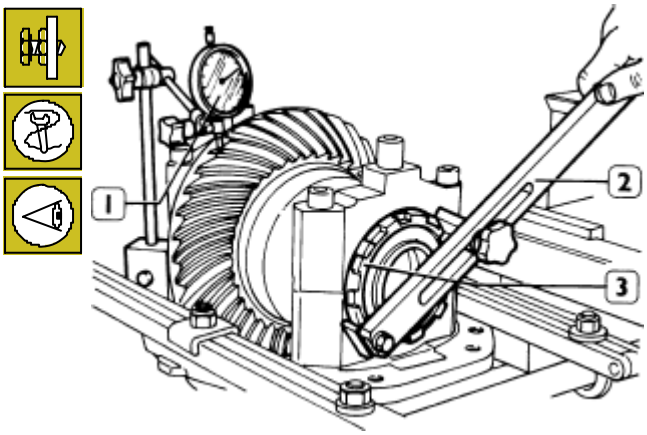
Figure 118

| No. of teeth | Ratio | Total rolling torque Nm |
|---|---|---|
| 13/35 | 2.692 | a + (1.1 - 1.5) |
| 15/34 | 2.267 | a + (1.3 - 1.8) |
| 17/36 | 2.118 | a + (1.4 - 1.9) |
| 17/35 | 2.059 | a + (1.5 - 1.9) |
| 19/33 | 1.737 | a + (1.7 - 2.3) |
| 21/34 | 1.619 | a + (1.9 - 2.5) |
| 21/40 | 1.905 | a + (1.6 - 2.1) |
| 23/36 | 1.565 | a + (1.9 - 2.6) |
| 24/35 | 1.458 | a + (2.1 - 2.7) |
| 27/32 | 1.185 | a + (2.5 - 3.4) |
| 27/37 | 1.370 | a + (2.2 - 2.9) |
| 28/37 | 1.321 | a + (2.3 - 3.0) |
| 29/37 | 1.276 | a + (2.4 - 3.1) |

a = 7.5 ÷ 9.5 Nm

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Figure 119

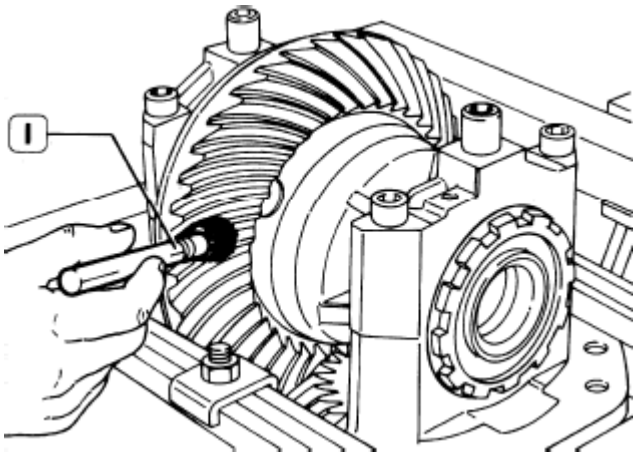



39586

Adjust the axial clearance between the teeth on the pinion/bevel gear, which should be 0.15 to 0.35 mm, proceeding as follows:

- Position a magnetic stand dial gauge (1) as shown in the drawing.
- Using wrench 99355025 (2), tighten the bearing adjustment ring nut (3) whilst loosening the ring nut on the opposite side by the same amount. This prevents the previously measured rolling torque from varying.

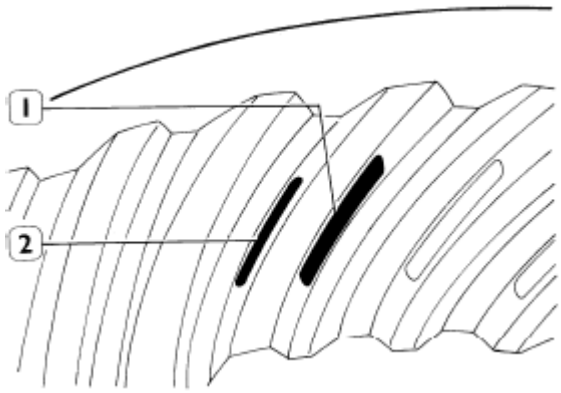
Figure 120




39588

Using a brush (1) apply a light covering of Prussian blue on the teeth of the bevel gear.
Rotate the pinion and check the coloured contact marks that the pinion teeth have made on the bevel gear teeth.
The following drawings illustrate possible contact marks and the operations required in order to correct the faults.

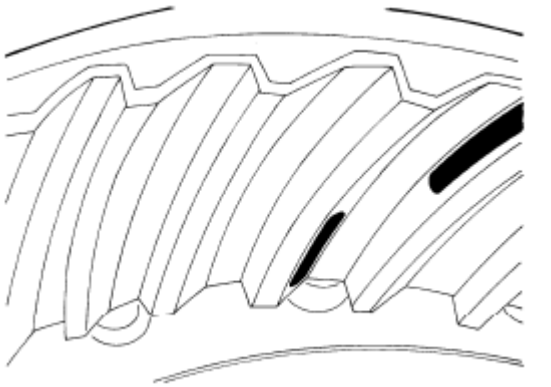
Figure 121




40160

The contact marks should be on both the leading face (1) and the pushing face (2), more or less in the centre between the teeth. When working without a load, both contact zones should be slightly out of position in relation to the external diameter of the bevel gear.

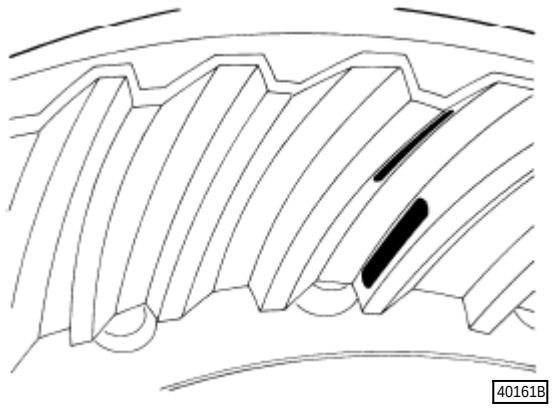
Figure 122



40161A

If the mark on the leading face (towards the external diameter) and on the pushing face (towards the internal diameter) is out of position, the pinion is located too close to the bevel gear.
- Solution: increase the thickness of the adjusting ring between the intermediate bearing and the bevel pinion.

Figure 123

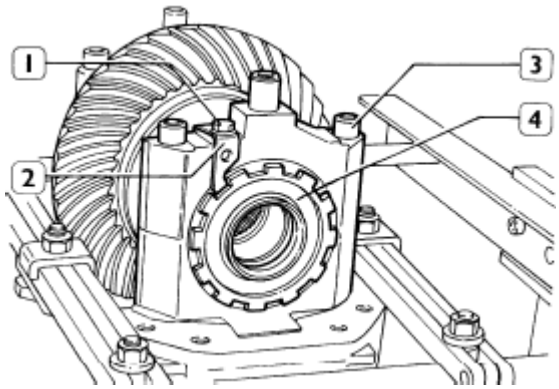


40161B

If the mark on the leading face is positioned towards the internal diameter, and on the pushing face it is located towards the external diameter of the bevel gear, the pinion is located too far away from the bevel gear axis.
- Solution: decrease the thickness of the adjusting ring between the intermediate bearing and the bevel pinion.

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Figure 124




Position the plate (2) and tighten the fixing screws (1) to the correct torque value.
If the plate (2) does not coincide with the notch on the ring nut (4), slightly rotate the ring nut until the plate and ring nut notch coincide. Repeat this operation on the opposite side.

Aquila Trucks Centres

# 5251 Intermediate axles 452191/2D (R9274) 453291/2D (R9189)


Page

DESCRIPTION . . . . . 57

MAIN DATA . . . . . 58

TIGHTENING TORQUES . . . . . 59

TOOLS . . . . . 61

REMOVING-REFITTING THE INTERAXLE DIFFERENTIAL (with the axle mounted on the vehicle) . . . . . 68

- Removal . . . . . 68
- Refitting . . . . . 68

INTERMEDIATE AXLE ASSEMBLY REPAIRS . . . 69

- Disassembly . . . . . 69
- Epicyclic reduction gear disassembly . . . . . 69
- Wheel hub disassembly . . . . . 70
- Wheel hubs disassembly . . . . . 73
- Assembling the epicyclic reduction gear . . . . . 75

REMOVING - REFITTING THE FLOW DIVIDER DIFFERENTIAL (with the axle mounted on stand 99322215) . 77

- Removal . . . . . 77
- Refitting . . . . . 77

REPAIRING THE INTERAXLE DIFFERENTIAL . . 78

- Interaxle differential unit disassembly . . . . . 78
- Differential housing disassembly . . . . . 81
- Interaxle differential disassembly . . . . . 83
- Interaxle differential unit assembly . . . . . 87
- Differential housing assembly . . . . . 88
- Interaxle differential unit assembly . . . . . 90

https://truckmanualshub.com/
Aquila Trucks Centres

Page

- Procedure to follow to determine the thickness of the bevel pinion rolling torque adjusting ring . . . . . 90

- Adjusting the rolling torque on the differential housing bearings . . . . . 94

DRIVE SHAFT . . . . . 98

- Disassembly . . . . . 98

- Checking parts . . . . . 99

- Assembly . . . . . 99

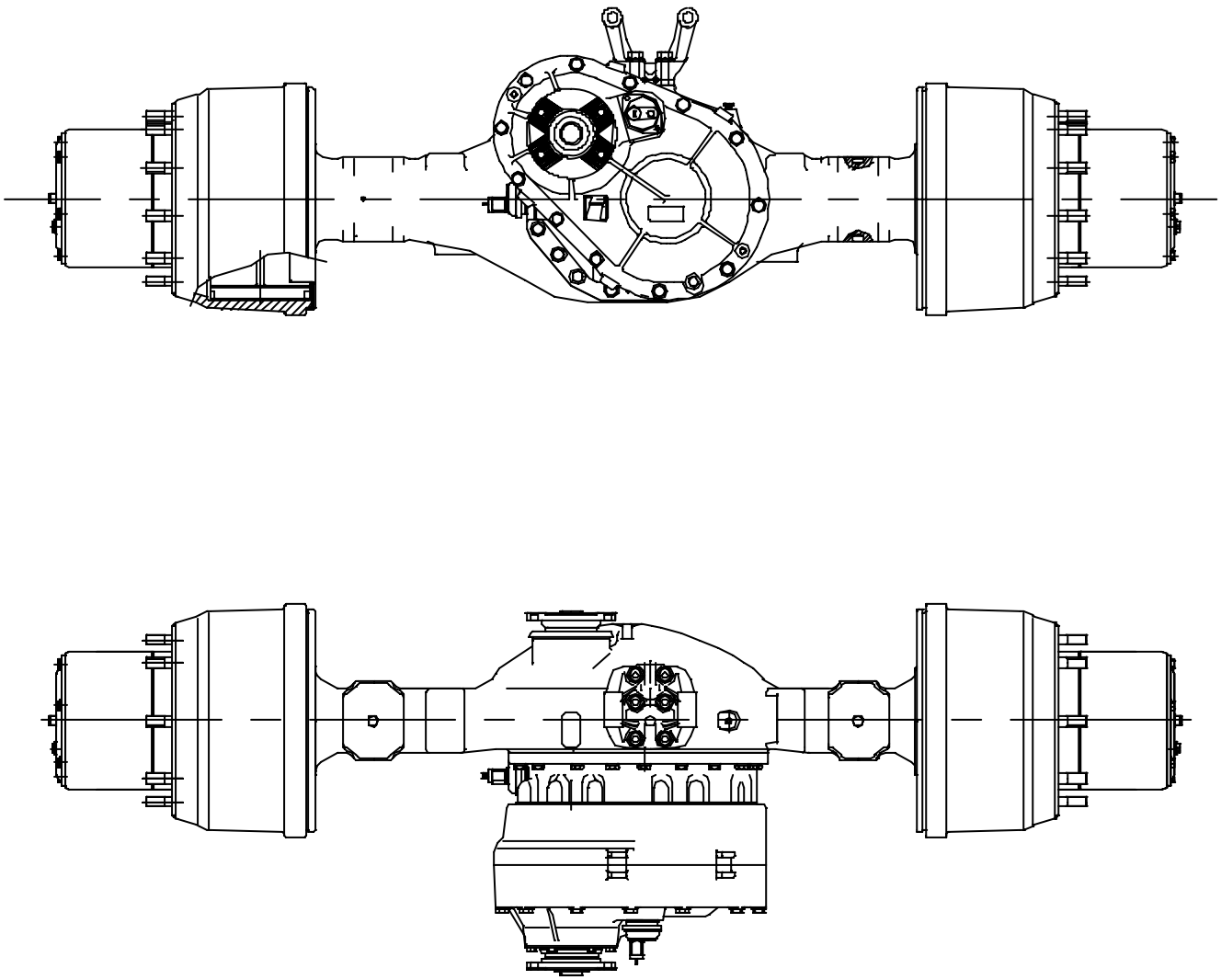
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## DESCRIPTION

The intermediate axle is of the load-bearing, double reduction type.
The first reduction is provided by the bevel pinion/ring bevel gear, whereas the second reduction is by means of an epicycloid unit on the wheel hubs.
The differential housing (with ring bevel gear) is supported by taper roller bearings, which can be adjusted by means of two threaded ring nuts.
The bevel pinion is supported by two taper roller bearings, which can be adjusted by means of adjustment shims.

The intermediate axle is fitted with a flow divider unit that distributes the torque between the two axles.
The axle is also provided with a pneumatic device for differential locking and another device for flow divider locking.
The drum brake is of the Duo/Duplex type.

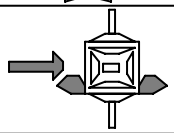
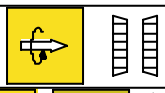
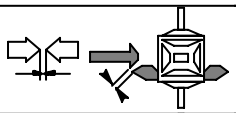
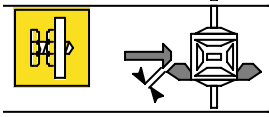
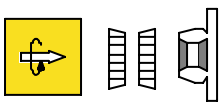
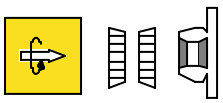
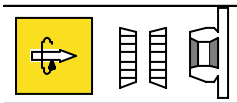
Figure 1



71847

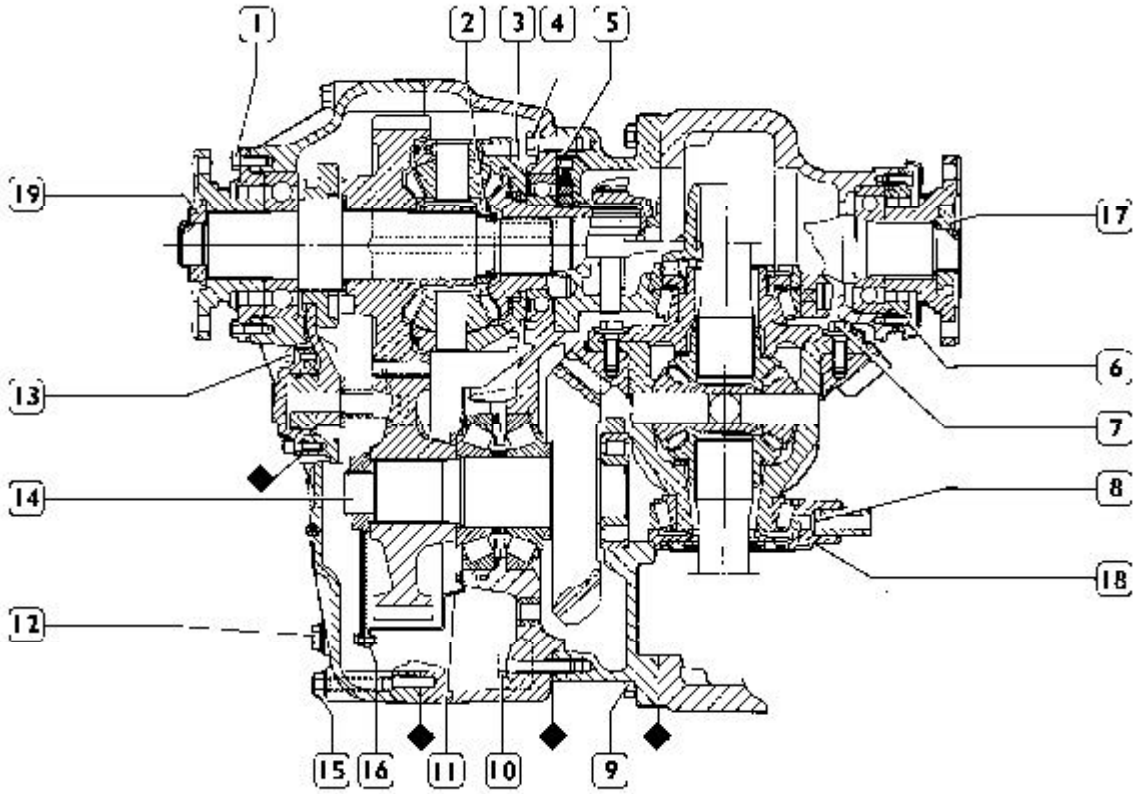
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## MAIN DATA

| | | | |
|---|---|---|---|
|  | Type of axle:<br>Load-bearing, single reduction with pneumatically controlled differential locking and flow divider unit | 452191/2D (R9274) | 453291/2D (R9189) |
|  | Bevel pinion bearings | 2 taper rollers and 1 straight roller | |
|  | Bevel gear reduction unit ratio | 27/32 (1.185) - 29/37 (1.276) - 27/37 (1.370) - 28/37 (1.321) - 24/35 (1.458) - 23/36 (1.565) - 21/34 (1.619) - 19/33 (1.737) - 21/40 (1.905) - 17/35 (2.059) | |
| | Epicyclic reduction unit/wheels ratio | 3.2 | |
|  | Bevel pinion bearing rolling torque Nm | 1.5 ÷ 3.5 | |
|  | Bevel pinion bearing rolling torque adjustment | with adjustment rings | |
|  | Thickness of bevel pinion bearing rolling torque adjustment rings mm | 1.000 ÷ 2.500 (series of increased thicknesses = 0.02 mm) | |
|  | Thickness of bevel pinion/ring bevel gear position adjustment rings mm | 3.6-3.7-3.8-3.9-4.0-4.1-4.2-4.3-4.4-4.5-4.6 | |
|  | Clearance between pinion and ring bevel gear mm | 0.20 ÷ 0.33 | |
|  | Adjustment of clearance between pinion and ring bevel gear | with ring nuts | |
| Bearing total rolling torque S | | with ring nut | |
|  | **WHEEL HUBS** | | |
|  | Wheel hub bearings | 2 taper rollers | |
|  | Wheel hub bearings rolling torque:<br>new bearings with surface protection Nm | 6 ÷ 7 + (12 ÷ 16) | |
|  | Wheel hub bearings rolling torque:<br>run in bearings and new, lubricated seals Nm | 6 ÷ 7 + (5 ÷ 7) | |
|  | Wheel hub bearings rolling torque:<br>run in bearings and seals Nm | 3 Nm + (2.5 ÷ 4.5 Nm) | |
|  | Drive shaft end float mm | 0.5 ÷ 1 | |
|  | Axle oil<br>Quantity Litres<br>kg | TUTELA W140/MDA<br>27<br>24.3 | |
| | G.R.W. maximum load kg | 11000 | 16000 |

Aquila Trucks Centres

Figure 2




## TIGHTENING TORQUES

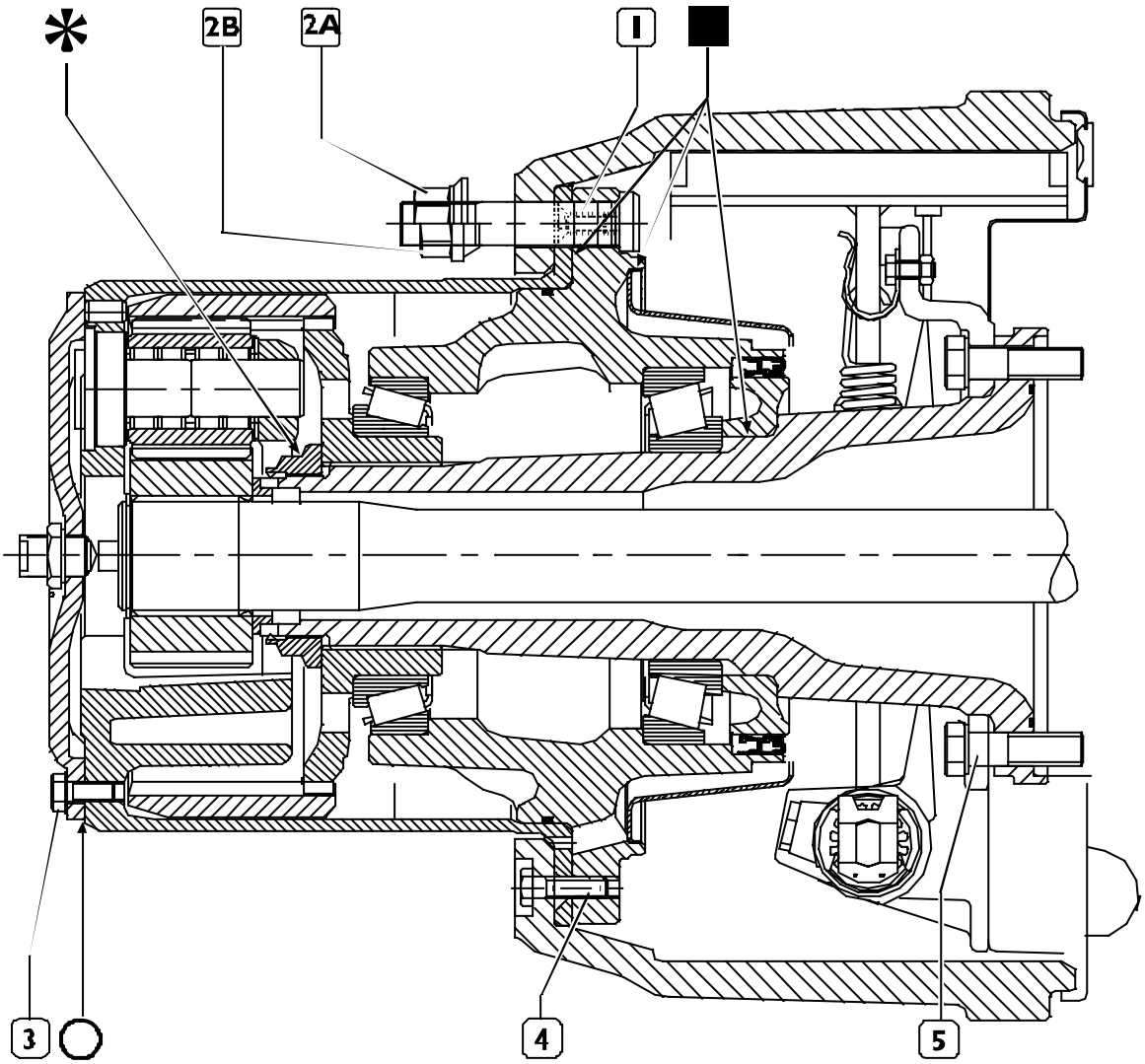
| | DESCRIPTION | TORQUE | |
|---|---|---|---|
| | | Nm | kgm |
| 1 | Hex screw for cover | 62 ± 6 | 6.2 ± 0.6 |
| 2 | Ring nut | 230 ± 20 | 23 ± 2 |
| 3 | Hex screw | 67 ± 8 | 6.7 ± .0.8 |
| 4 | Self-locking screw | 260 ± 25 | 26 ± 2.5 |
| 5 | M12 x 1.5 threaded plug | 21.5 ± 1.5 | 2.1 ± 0.1 |
| 6 | Hex screw for cover | 33 ± 3 | 3 ± 0.3 |
| 7 | Self-locking screw { 1st stage | 100 | 10 |
| | 2nd stage | 300 ± 10 | 30 ± 1 |
| 8 | Self-locking screw fixing safety plate | 51 ± 5 | 5 ± 0.5 |
| 9 | Self-locking screw | 260 ± 25 | 26 ± 2.5 |
| 10 | Self-locking screw | 260 ± 25 | 26 ± 2.5 |
| 11 | Self-locking screw fixing oil feed | 16 ± 2 | 1.6 ± 0.2 |
| 12 | Threaded plug | 110 ± 10 | 11 ± 1 |
| 13 | Cheese-headed screw | 25 ± 2 | 2.5 ± 0.2 |
| 14 | Self-locking nut | 1250 ± 50 | 125 ± 5 |
| 15 | Screw fixing cover | 182.5 ± 17.5 | 18.2 ± 1.7 |
| 16 | Nut for screw fixing oil feed | 16 ± 2 | 1.6 ± 0.2 |
| 17 | Self-locking nut | 700 ± 50 | 70 ± 5 |
| 18* | M16 screw fixing caps to gear housing | 270 ± 25 | 27 ± 2.5 |
| 19 | Self-locking nut | 825 ± 25 | 82.5 ± 2.5 |

z apply LOCTITE 573 sealant on contact surface

* apply LOCTITE AVX on thread

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Figure 3




98970

SECTION ON EPICYCLIC REDUCTION AND WHEEL HUB

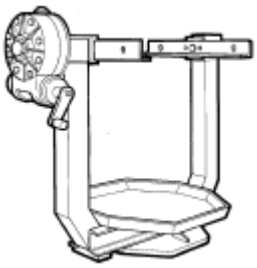
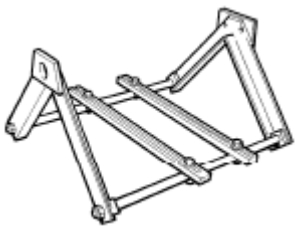
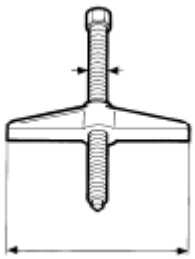
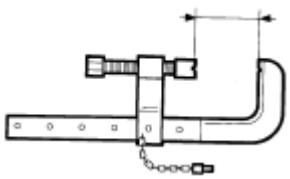
## TIGHTENING TORQUES

| DESCRIPTION | | TORQUE | |
|---|---|---|---|
| | | Nm | kgm |
| 1 | Countersunk screw fixing drum | 25 ± 3 | 2.5 ± 0.3 |
| 2A | Nut fixing wheel | 615 ± 35 | 61.5 ± 3.5 |
| 2B | Nut fixing wheel | 415 ± 35 | 41.5 ± 3.5 |
| 3 | Screw fixing cover to side pinion support V | 50 ± 5 | 5 ± 0.5 |
| 4 | Screw | 50 ± 5 | 5 ± 0.5 |
| 5 | Screw fixing load bearing sleeve | 295 ± 30 | 29.5 ± 0.3 |

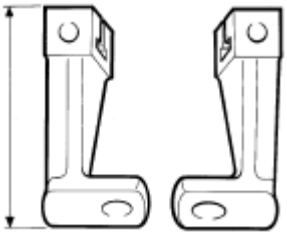
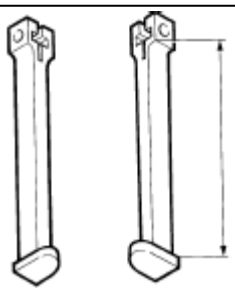
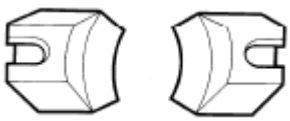
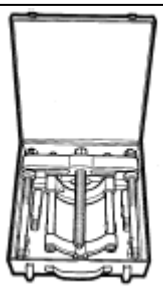
d apply LOCTITE 5970 on the contact surface
V apply LOCTITE 573 on thread
H apply LOCTITE 573 on mating surface
* Before mounting, slightly smear MOLYCOTE on nut rest surface

Aquila Trucks Centres

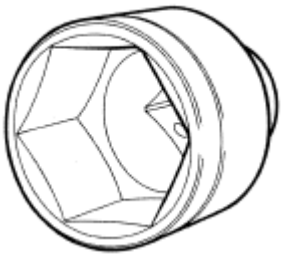
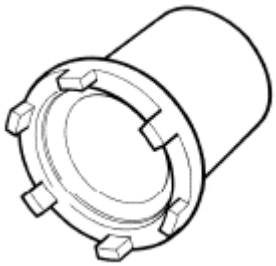
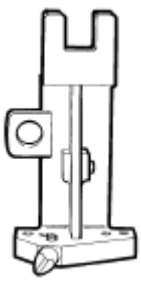
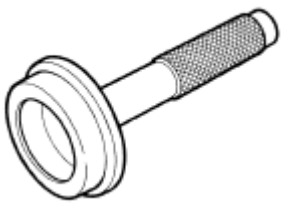
## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99305121** |  | Hot air device |
| **99322205** |  | Rotating stand for assembly overhaul (1000 N load bearing capacity, 120 da Nm torque) |
| **99322215** |  | Stand for axles overhaul |
| **99322225** |  | Support for assemblies (to be fitted onto stand 99322205) |
| **99341003** |  | Single-acting bridge |
| **99341015** |  | Press |

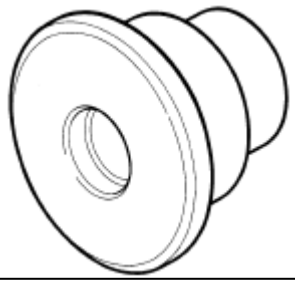
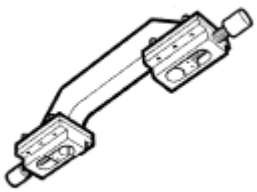
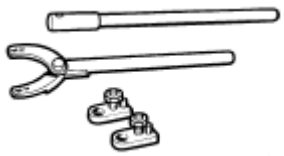
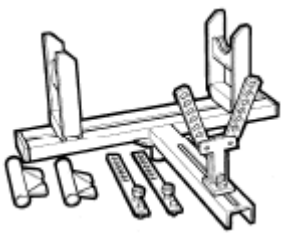
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Aquila Trucks Centres

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99341017** |  | Pair of brackets with hole |
| **99341020** |  | Pair of tie rods for grips |
| **99341023** |  | Grips |
| **99345053** |  | Reaction block for extractors |
| **99348001** |  | Extractor with locking device |
| **99354001** |  | Wrench for differential gear housing bearing adjustment ring nuts |

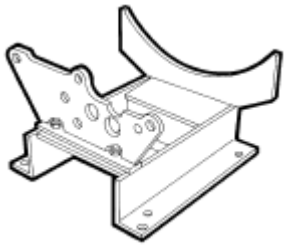
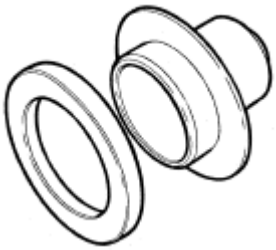
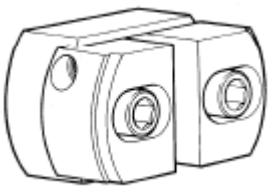
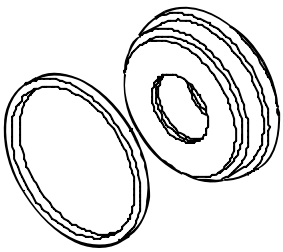
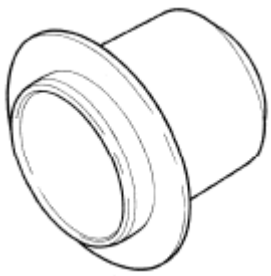
Aquila Trucks Centres

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99354207** |  | Wrench (94.5 mm) for wheel hub bearings adjusting nut |
| **99355081** |  | Wrench (60 mm) for drive infeed flange retaining nut and flow divider spur gear unit retaining nut |
| **99355121** |  | Wrench for flow divider main shaft ring nut |
| **99363310** |  | Tool for retaining spur gear on flow divider bevel pinion |
| **99370005** |  | Interchangeable grip for punches |

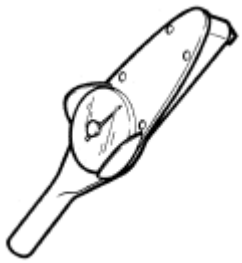
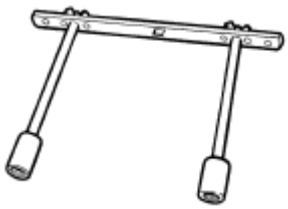
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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99370007** |  | Interchangeable grip for punches |
| **99370122** |  | Punch for fitting flow divider main shaft crown wheel bushings |
| **99370133** |  | Tool for locking differential caps spread |
| **99370317** |  | Reaction lever with extension for flange retaining |
| **99370509** |  | Hook to extract differential gear half-housing |
| **99370617** |  | Universal mounting to support axles during removal and refitting |

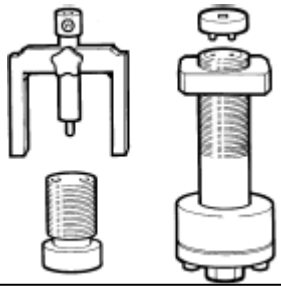
Aquila Trucks Centres

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99370630** |  | Mounting for removal and refitting of flow divider between axles |
| **99374013** |  | Key to fit flow divider drive infeed shaft seal (use with 99370006) |
| **99374094** |  | Punch to fit external races of bearings (diameter 134 - 215 mm use with 99370007) |
| **99374161** |  | Key for assembly of wheel hub internal seals |
| **99374233** |  | Key to fit flow divider drive shaft seal |
| **99374235** |  | Key to fit shaft crown wheel gear front seal |

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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99389816** |  | x 4 torque multiplier with 3/4 " infeed and 1" square connection (max. 2745 Nm) |
| **99389819** |  | Torque wrench from 0 to 10 kgm with 1/4" square connection |
| **99389821** |  | Torque wrench from 0 to 70 kgm with 3/8" square connection |
| **99395026** |  | Tool to check rolling torque of hubs (use with torque wrench) |
| **99374451** |  | Tool for drive shaft disassembly-assembly |

Aquila Trucks Centres

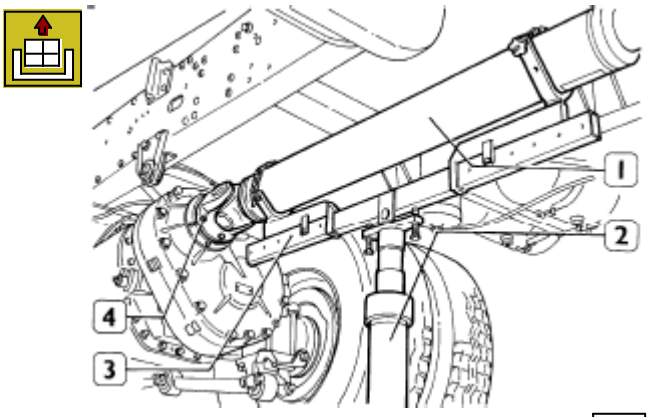
| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99395027** |  | Tool to determine thickness of differential bevel pinion adjustment shims (use with 99395603) |
| **99395603** |  | Dial gauge (0 - 5 mm) |

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## 526210 REMOVING-REFITTING THE INTERAXLE DIFFERENTIAL (with the axle mounted on the vehicle)

### Removal

Figure 4

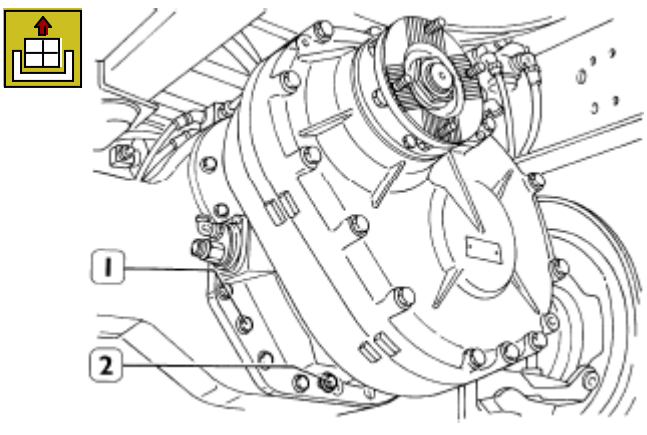



40156

Position a hydraulic jack (2), fitted with support 99370618 (3), under the propeller shaft (1).
Disconnect the propeller shaft (1) from the intermediate axle by unscrewing the screws and nuts fixing the flange (4).
Fully lower the hydraulic jack, thereby detaching the transmission shaft.
Disconnect the air piping and electrical connections from the differential lock and flow divider controls.
Unscrew the lower plug and drain off the oil.
Extract the drive shafts as described under the relative heading.

**NOTE** The drive shaft on the differential lock side must not be removed, but only extracted by approx. 120 mm. This is to prevent differential lock engagement inner sleeve without any more half shaft guide from inhibiting that rear axle box transfer box differential is taken out.

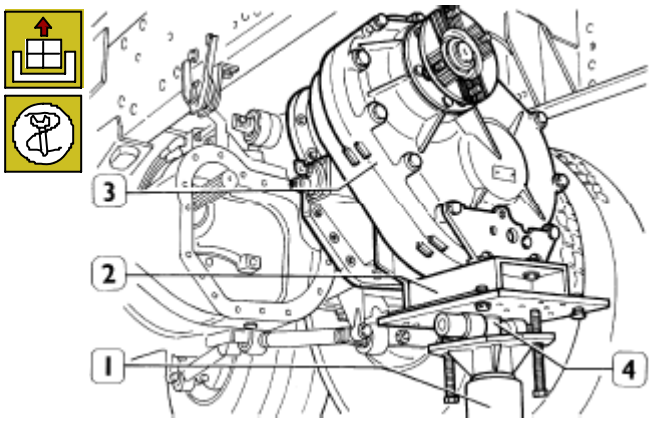
Figure 5




40157

Insert suitable screws in the two threaded holes (2) to act as extractors for the interaxle differential unit.

Figure 6




40158

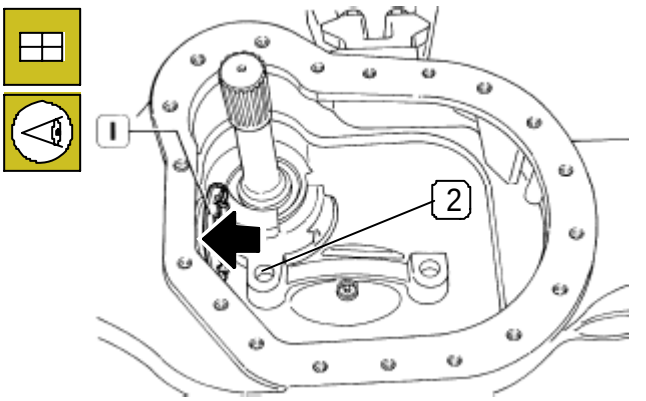
Using the hydraulic jack (1) place bracket 99370630(2) with device 99370629 (4) underneath the differential-reduction gear unit (3); remove the fastening screws, tighten the two counteracting screws to pull out the unit from the axle casing.

### Refitting

Carry out refitting operations by reversing the order of the removal procedure, bearing in mind the following points.

- Carefully clean and smear LOCTITE 573 on the contact surfaces of the differential housing and the drive shaft covers. Replace the seal.

Figure 7




40075

Check that the interaxle differential engagement sleeve (1) is correctly positioned on the drive shaft, with the internal side of the groove (=>) flush with the axle housing.
Check:

- that the differential lock fork engages on the sleeve and that the differential centering pins enter the holes (2);
- tighten all the screws to the pre-stabilised torque;
- connect the air piping and electrical connections;
- fill up the axle housing with oil.

Aquila Trucks Centres

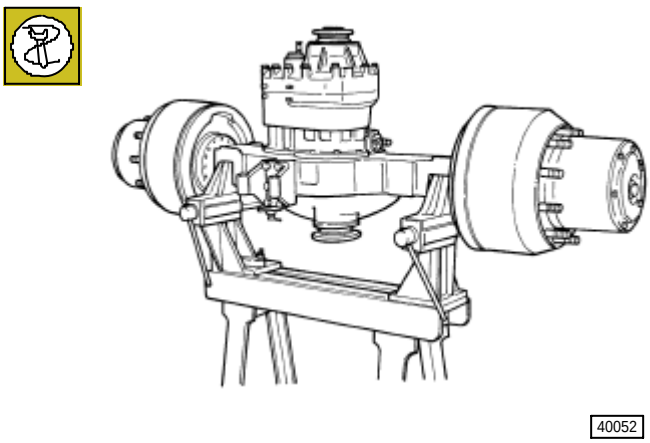
# 525110 INTERMEDIATE AXLE ASSEMBLY REPAIRS

## Disassembly

**NOTE** The drive shafts - brake drums and jaws - air breather - interaxle differential - wheel hubs and epicycloid reduction units removal-refitting operations, can all be carried out with the unit fitted on the vehicle.

Before positioning the axle assembly on the overhaul stand, drain off the oil by unscrewing the lower plug on the axle housing.

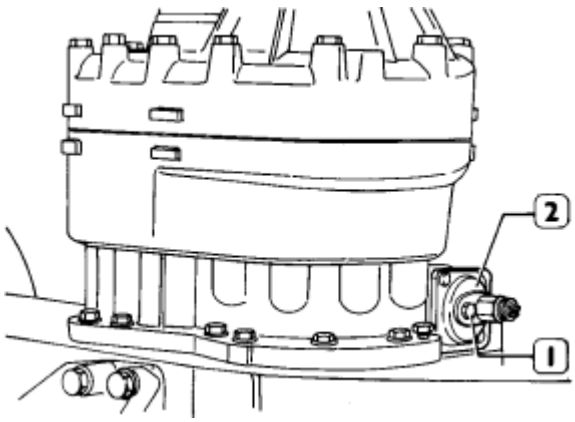
Figure 8



40052

Position the axle assembly on stand 99322215.

Figure 9

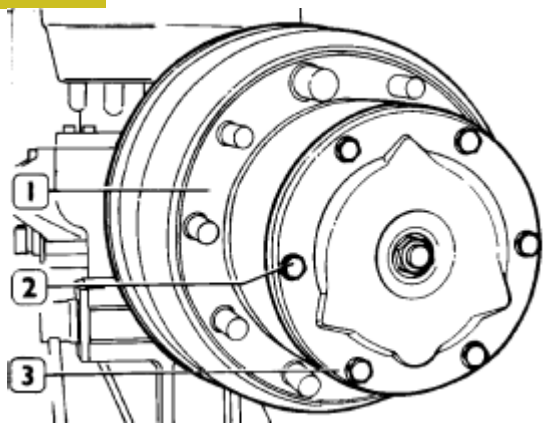



71533

Block the differential locking device sliding sleeve with a screw. Remove the control cylinder threaded coupling (2) and replace with a screw (1) (M 14 x 1.5).
Rotate the axle mechanism to facilitate engagement between the sliding sleeve and the engagement sleeve; this will avoid involuntary sleeve movement whilst the drive shaft is being extracted.

## 525140 Epicyclic reduction gear disassembly

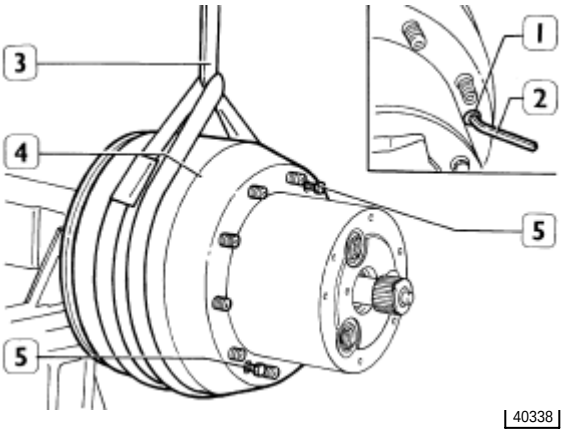
Figure 10




71534

Position a container under the wheel hub (1). Unscrew the screws (2), remove the cover (3) and drain off the oil into a container.

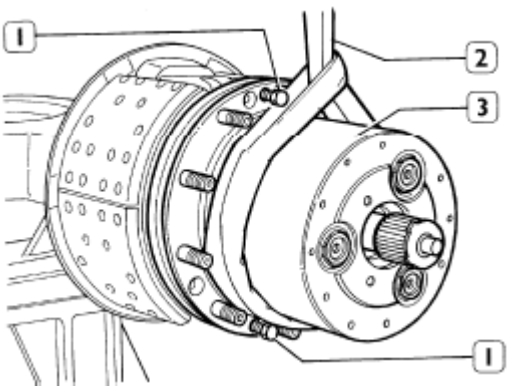
Figure 11




40338

Using an Allen wrench (2) unscrew the two screws (1) fixing the drum; replace with the reaction screws (5). Tighten the reaction screws and remove the drum (4) from the hub and, using a sling (3), raise and remove.

Figure 12

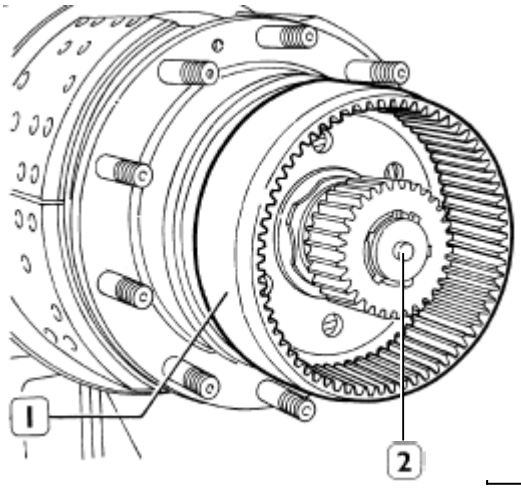



40054

Unscrew the 3 side pinion (3) fixing screws; tighten the reaction screws (1) and, using a sling (2), remove the support (3).

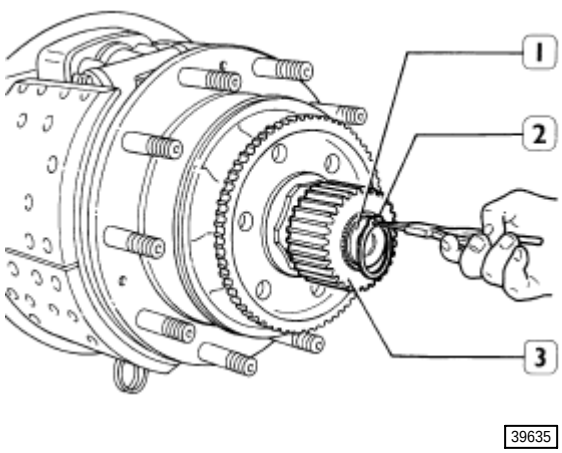
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Figure 13



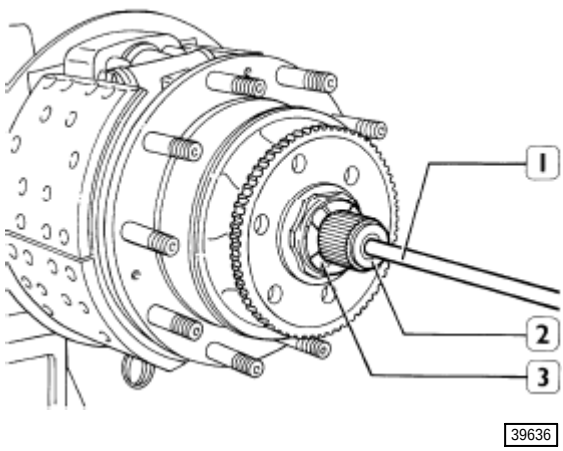

Remove the bevel gear (1) from the mounting.
Remove the shoulder pin (2).

Figure 14



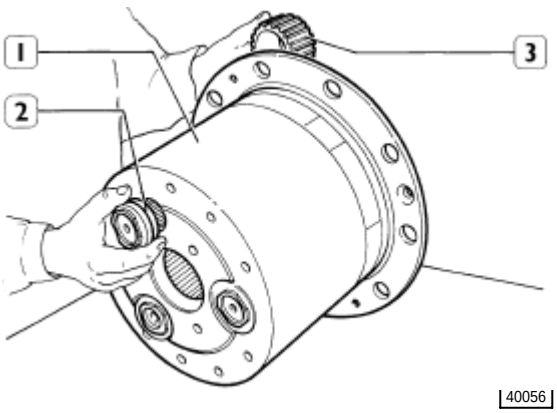

Using suitable pliers, remove the safety ring (2), extract the gear unit (3) from the drive shaft (1).

Figure 15




Fit tool 99374451 (1) in the shoulder pin seat and extract the drive shaft (2) from the load bearing sleeve.
Remove the spacer ring (3).

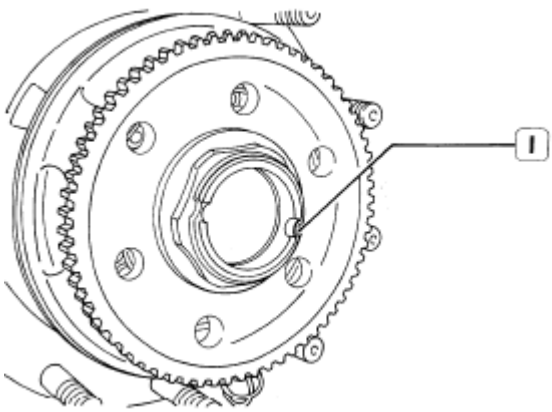
Figure 16




Extract the support pins (2) from the side pinion support (1).
Remove the side pinions (3) from the support (1) and recover the rollers and the spacer rings.

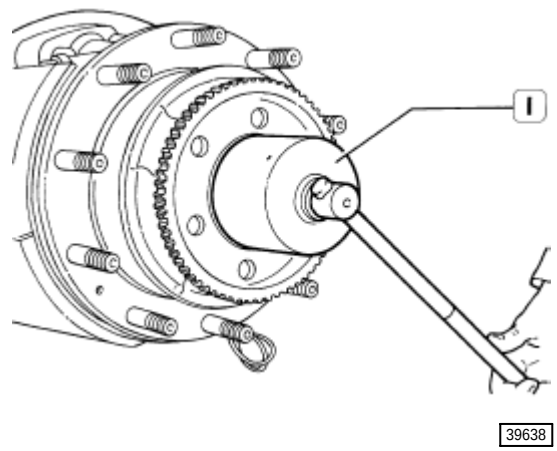
## 525130 Wheel hub disassembly

Figure 17




Using a punch, remove the notch (1) on the adjusting nut.

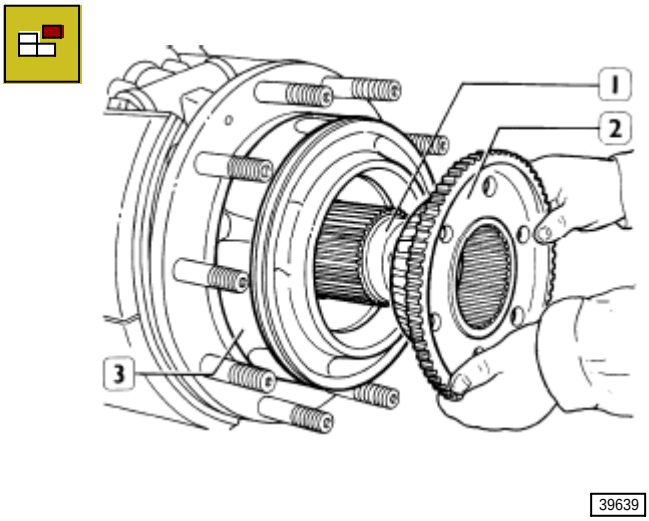
Figure 18




Using Allen wrench 99354207 (1), unscrew the adjusting nut.

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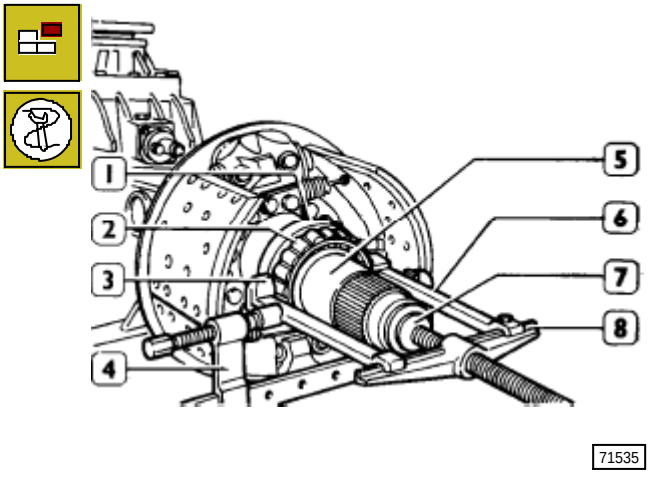
Figure 19




39639

Extract the bevel gear mounting (2), together with the bearing and wheel hub (3), from the load bearing sleeve (1).

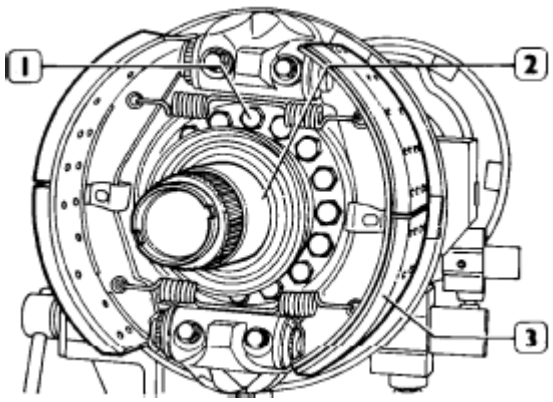
Figure 20




71535

Check the surface of the ring (1), on which the hub seal ring rotates, is not damaged or worn.
If necessary, replace the ring (1).
Using the extractor [comprising bridge 99341003 (8), grips 99341023 (3), tie rods 99341003 (6), press 99341015 (4) and reaction block 99345053 (7)], extract the ring (replacing if necessary) and/or the internal ring (2) of the sleeve (5) taper bearing.

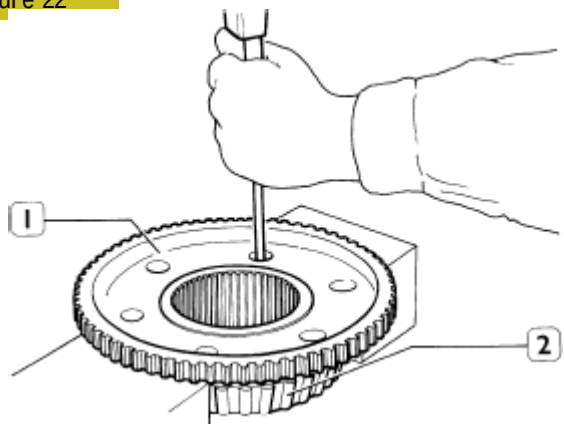
Figure 21




71536

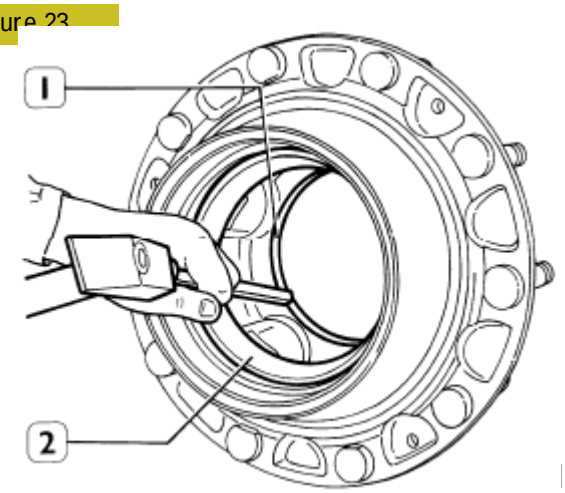
Check the load bearing sleeve (2). If damaged, replace as follows.
Unscrew the screws (1), remove the brake support plate (3) and the axle casing sleeve (2).

Figure 22




Push out of the crown holder (1) the taper roller external bearing (2) by means of a special beater inserted through the holes obtained from the crown holder.

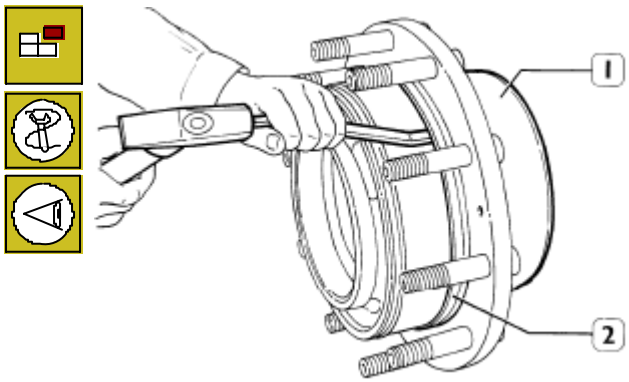
Figure 23




Using the appropriate tools, extract the external and internal seal rings from the wheel hub. With a universal bronze punch, extract the external rings (1 and 2) of the internal and external bearings.

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Figure 24




40063

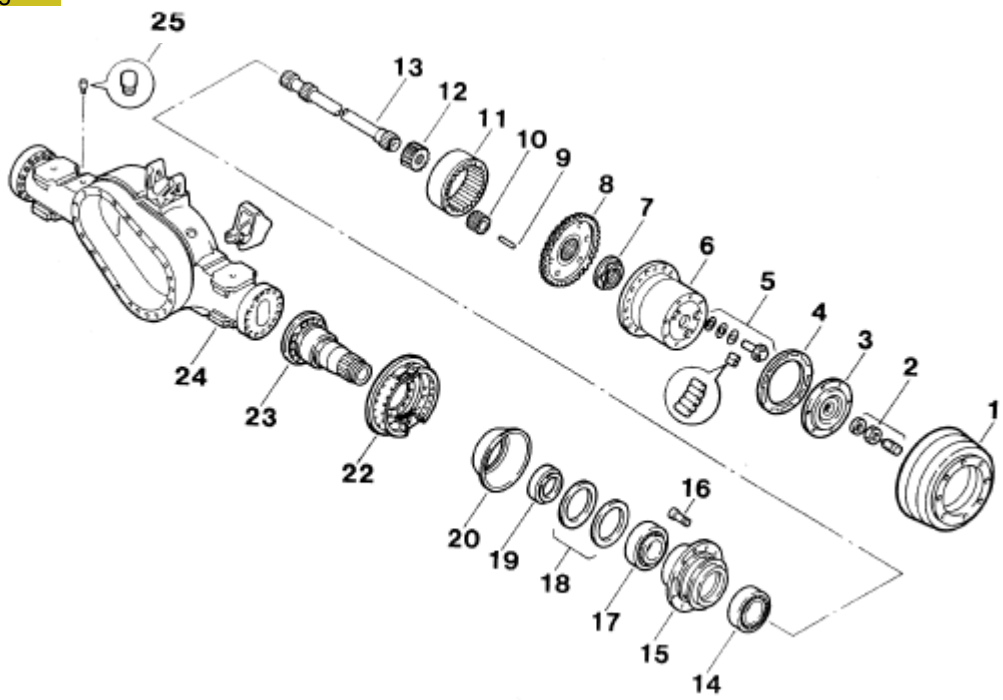
Check the oil manifold (1) and replace if damaged. Extract with a punch inserted in the slots on the hub (3).

## CLEANING AND CHECKING WHEEL HUB AND EPICYCLIC GEAR PARTS

Carefully clean the wheel hub parts. Check the drive shafts for deformation. If necessary, straighten the drive shafts using a hydraulic press; if this does not provide satisfactory results, replace the drive shafts. Check the studs fixing the wheel: if the threads are damaged or deformed they must be replaced. Work under a press to extract and re-assemble the studs. On completion of assembly operations, check that the orthogonal deviation is no greater than 0.3 mm.
Lubricate the bearings and make sure that the roller support cage rotates freely, rotation should be smooth, without hardening.

Check the threads on the hub bearings adjustment nuts and on the load bearing sleeves; replace the nuts if necessary.
Check the oil manifold and replace if damaged.
Replace all seals with new parts.
Carefully clean all the epicycloid gear unit parts. Visually check the toothing on the bevel gear support, the bevel gear, the crown wheel gears and the open gear unit.
Check the spacer rings, distance ring, bearing rollers and support pins.
Replace any damaged or worn parts.

Figure 25




40063

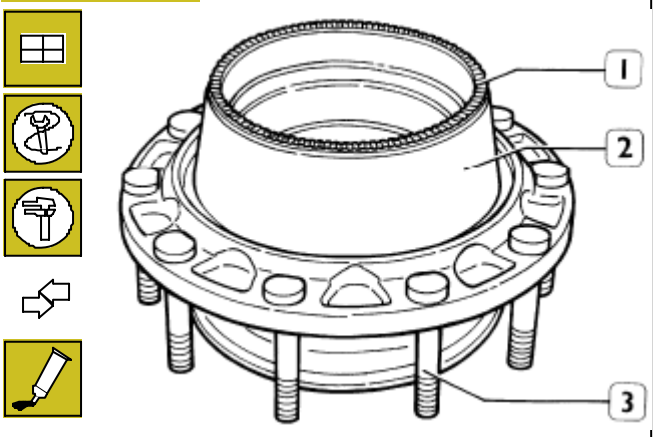
WHEEL HUB PARTS

1. Brake drum - 2. Adjusting nut and screw - 3. Cover - 4. Seal - 5. Pin and roller for side pinions - 6. Side pinion support - 7. Adjusting nut - 8. Ring bevel gear support - 9. Shoulder pin - 10. Side pinion - 11. Ring bevel gear - 12. Gear unit - 13. Drive shaft - 14. Bearing - 15. Wheel hub - 16. Stud - 17. Bearing - 18. Seal rings - 19. Support ring - 20. Oil sump - 22. Brake unit - 23. Load bearing sleeve - 24. Axle housing - 25. Breather

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## 525030 Wheel hub disassembly

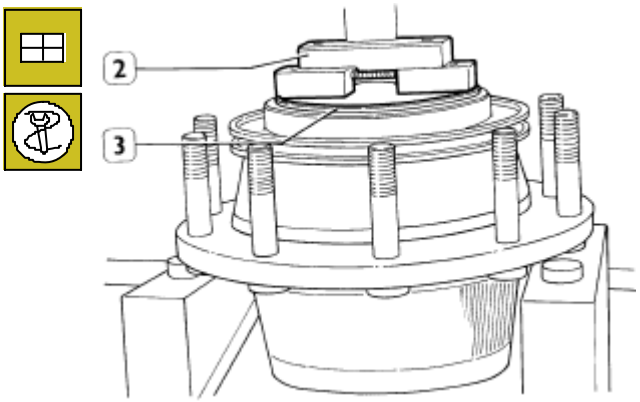
Figure 26




39645

If the studs (3) need to be replaced, before fitting new studs, make sure that the contact surface on the head is free of slag, burr, blisters.
After fitting, check that the studs are fully inserted on the hub and that the right angle error does not exceed 0.3 mm.
If the oil collecting sump (2) needs to be replaced, before assembly, smear the contact surface on the hub/sump and hub/hub seat with LOCTITE 573 sealing compound.

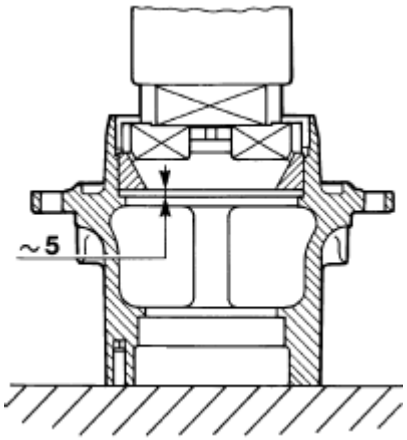
Figure 27




40064

Using punch 99374094 (2) and a press, fit the external ring on the external bearing (3), stopping approx. 5 mm from the fully fitted position (see Figure 28).

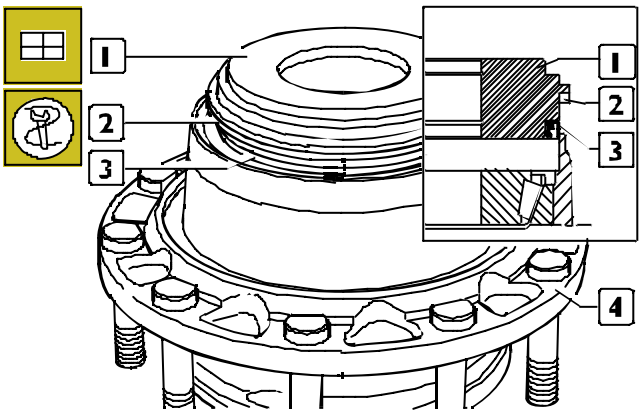
Figure 28




40410

Complete fitting operations manually, using grip 99370007, then turn the hub over and carry out the same operation with the external ring of the internal bearing.

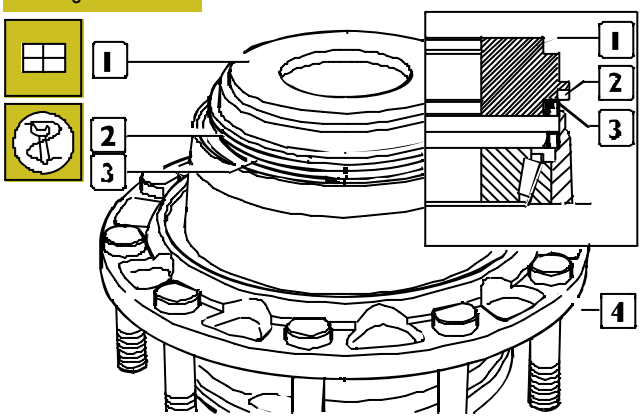
Figure 29




71537

Using a hydraulic press and key 99374161 (1), with the ring (2) positioned as shown in the drawing, fit the brown internal seal ring (3) on the wheel hub (4).

Figure 30

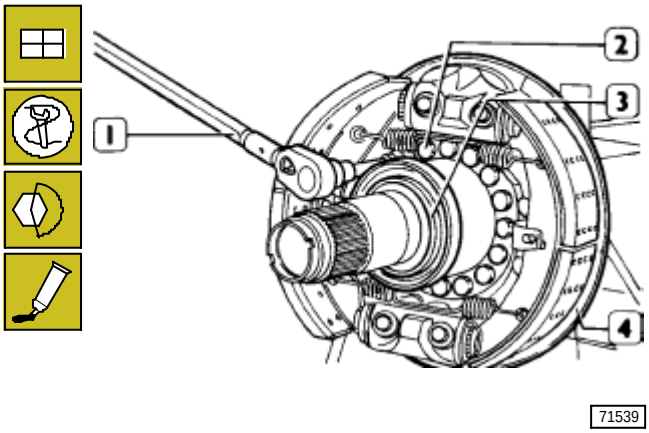



71538

Using a hydraulic press and key 99374161 (1), with the ring (2) positioned as shown in the drawing, fit the blue external seal ring (3) on the wheel hub (4).

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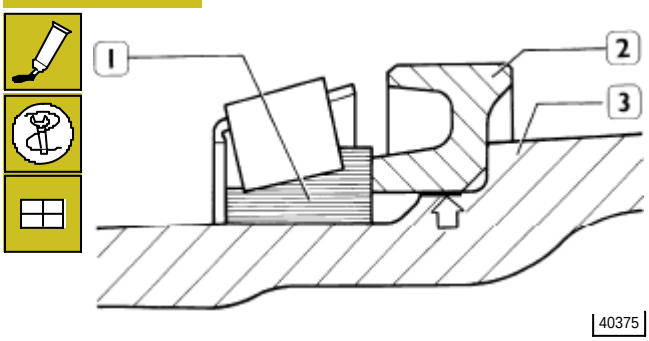
Figure 31




71539

Position the seal ring on the load bearing sleeve.
Fit the load bearing sleeve (3), the brake support plate (4) and dust seal disk. Smear the screws (2) and tighten to the correct value with a torque wrench (1).

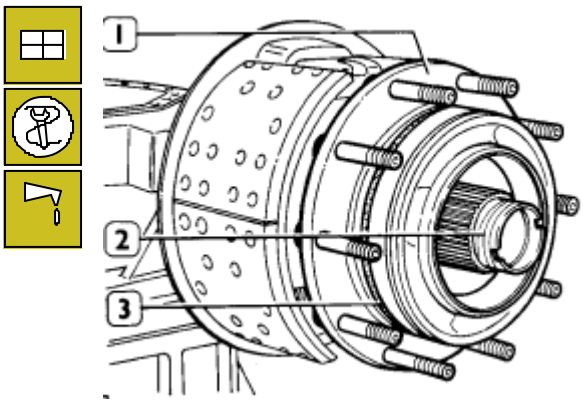
Figure 32




40375

Smear LOCTITE 573 on the seat (=>) of the load bearing sleeve (3) on the seal rings support ring (2). Heat the ring (2) with an electric drier and key on the load bearing sleeve (3). Heat the taper bearing internal ring (1) to 100°C and fit on the load bearing sleeve.

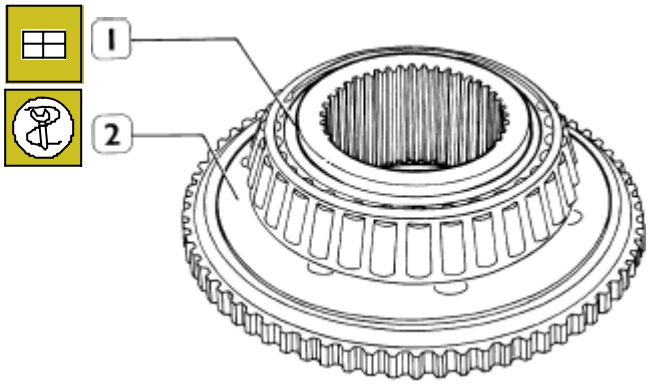
Figure 33




71540

Lubricate the lip of the seal rings and sleeve.
Fit the hub (1) on the load bearing sleeve (2).
Lubricate the seal ring (3) and fit on the wheel hub.

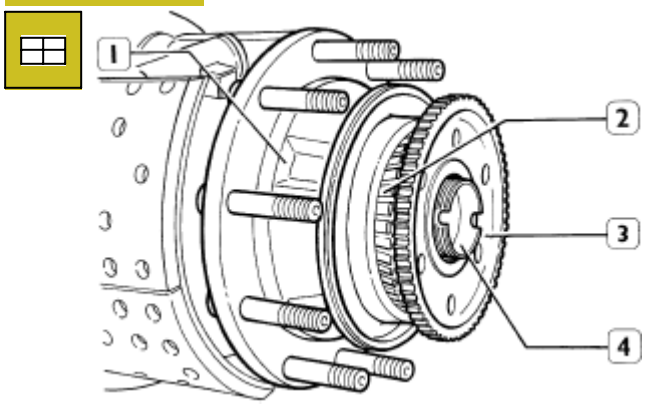
Figure 34




40377

Using an electric drier, heat the taper roller bearing (1) to 100°C and fit on the bevel gear support (2) with a punch.

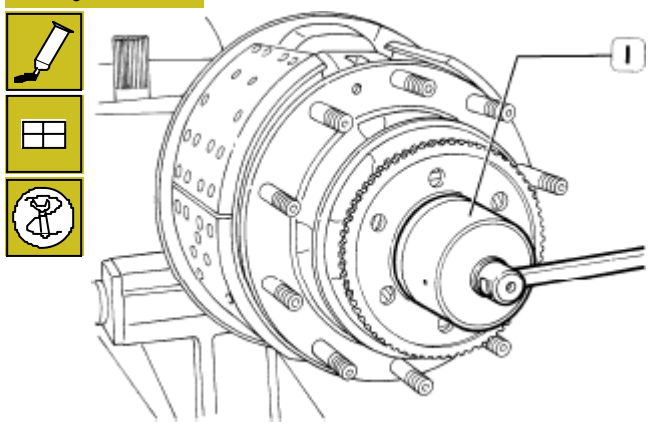
Figure 35




39650

Fit the bevel gear support (3) and the taper roller bearing (2) on the load bearing sleeve (4)

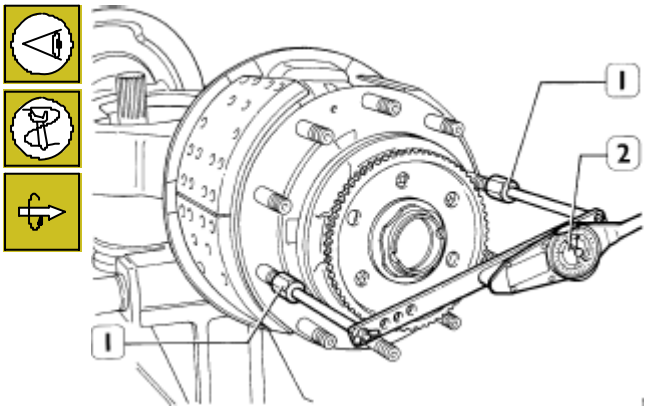
Figure 36




Apply a thin layer of MOLYKOTE on the contact surface of the adjusting nut and tighten with wrench 99354207 (1) until the hub rotates with difficulty. Release the hub with a few blows from a hammer in the direction of the axis and in both directions.

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Figure 37




40071

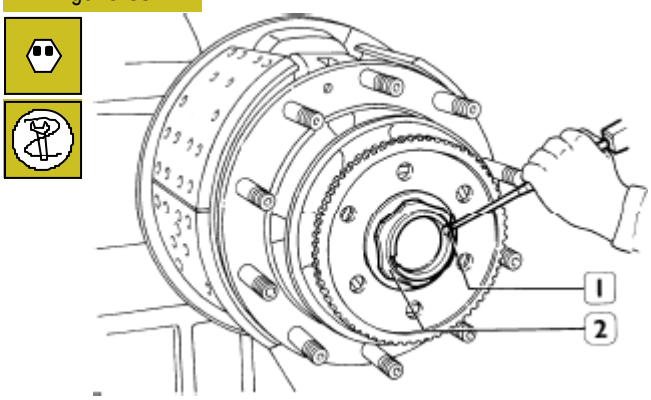
Position tool 99395026 (1) and, using a torque wrench (2), read the wheel hub rolling torque.

During hub rolling torque detection, hub rotation speed must not exceed 40 rpm.

Wheel hub rolling torque values vary according to the following conditions:

- new bearings with surface protection — 6 ÷ 7 + (12 ÷ 16) Nm
- run in bearings and new, lubricated seals — 6 ÷ 7 + (5 ÷ 7) Nm
- run in bearings and seals — 6 ÷ 7 + (2.5 ÷ 4.5) Nm

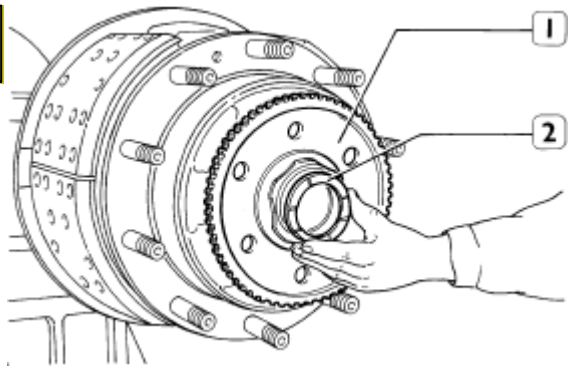
Figure 38




40072

Once the required rolling torque has been achieved, secure the adjusting nut (2) with a punch in the two grooves on the load bearing sleeve (1).

Figure 39

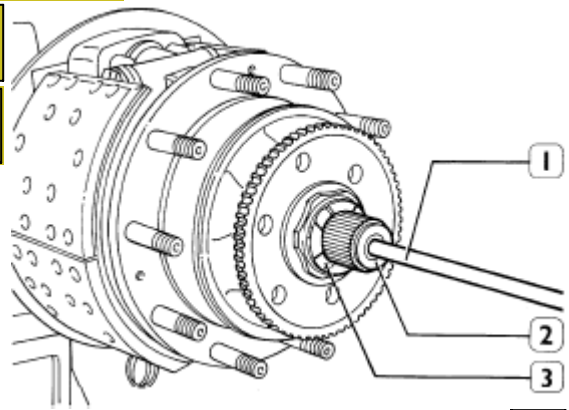



40069

Position the spacer ring (2) on the load bearing sleeve.

## 525140 Assembling the epicyclic reduction gear

Figure 40

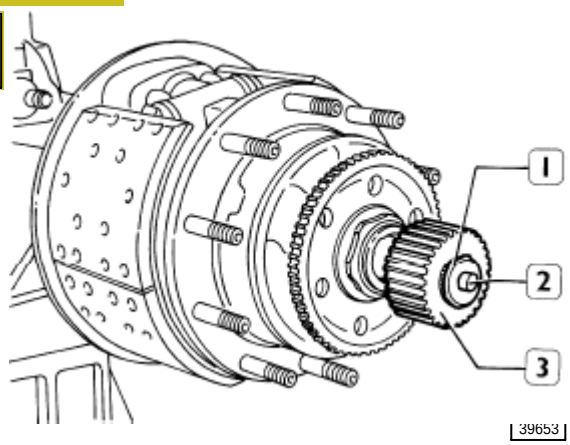



39636

Using tool 99374451 (1) introduce the drive shaft (2) on the load bearing sleeve (3).

**NOTE** Fit the short drive shaft, with double toothing, on the load bearing sleeve on the differential lock side.

Figure 41

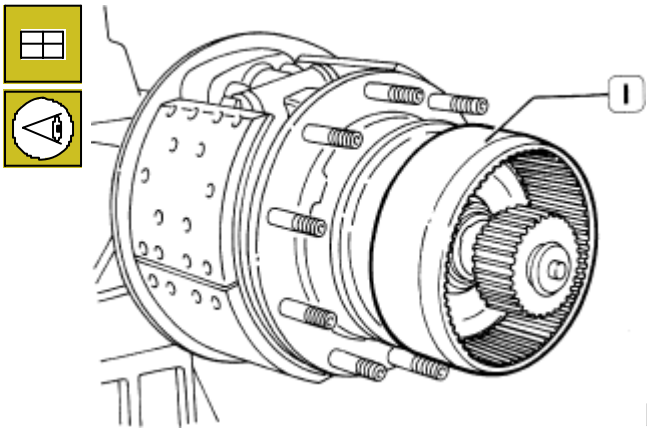



39653

Position the gear unit (3) on the grooved section of the drive shaft and the safety ring (1) in the seat. Drive the shoulder pin (2) into the seat on the drive shaft.

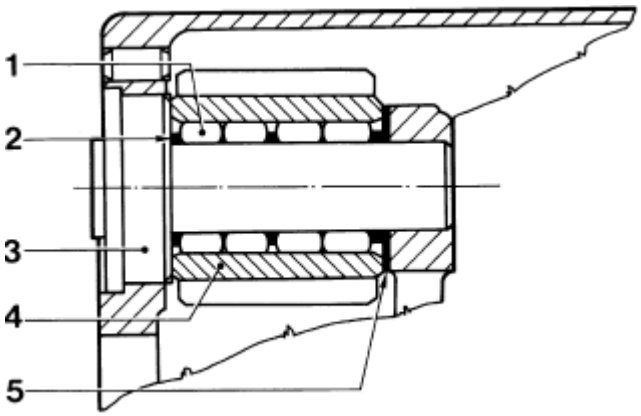
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Figure 42




Position the bevel gear (1) with the external bevel facing outwards and then fit on the bevel gear support.

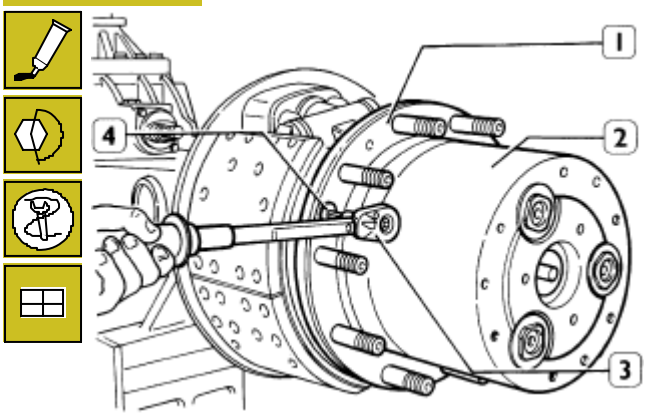
Figure 43




26916

Smear the rollers (1) with grease and position, together with the three spacer rings (2) on the side pinion (4), as shown in the drawing.
Position the side pinion (4) and the spacer washer (5) in the side pinion support.
Introduce the support pin (3) from the cover side, pushing it fully into position.
Repeat the same operation for the remaining two side pinion units.

Figure 44

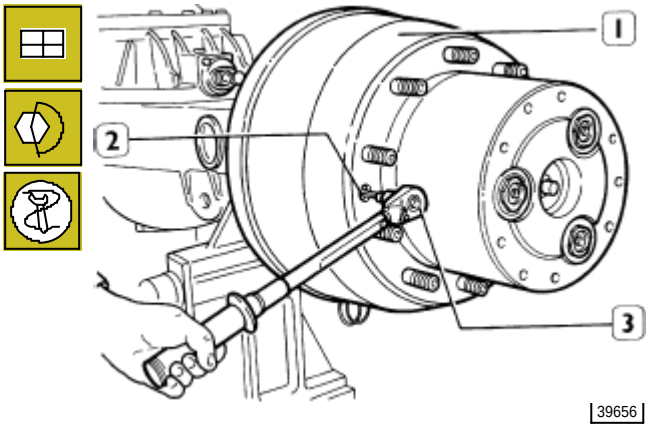



39655

Smear a thin layer of LOCTITE 573 on the contact surfaces of the side pinion support (2) and the wheel hub (1).

Push the side pinion support (2) onto the hub by moving the drive coupling flange in both directions to facilitate toothing engagement. Make sure that the fixing holes on the side pinion support and the hub coincide.
Position the three cheese-headed screws (4) and tighten to a torque of 50 ± 5 Nm with a torque wrench (3 ).

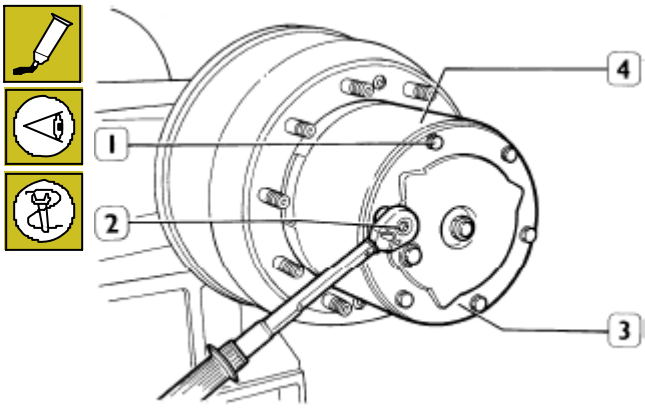
Figure 45




39656

Fit the brake drum (1) on the side pinion support. Secure the brake drum with the two cheese-headed screws (2) and tighten to a torque of 50 ± 5 Nm with a torque wrench (3).

Figure 46

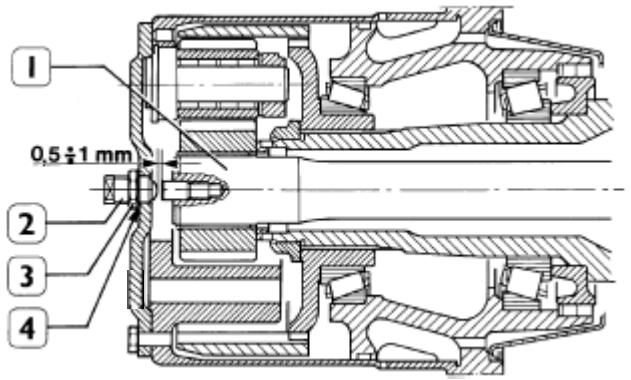



40073

Smear a thin layer of LOCTITE 510 on the cover (3) and side pinion support (4) contact surfaces.
Position the cover so that the bevels of the support pins coincide with the holes on the cover.
Smear LOCTITE 573 sealing compound on the screw (1) thread and tighten to a torque of 50 +/- 5 Nm with a torque wrench (2).

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Figure 47




26924

The end float on the drive shaft (1) must be between 0.5 and 1 mm.
To carry out this adjustment fully tighten the adjusting screw (2), then unscrew by half a turn and secure with the hex nut (3).

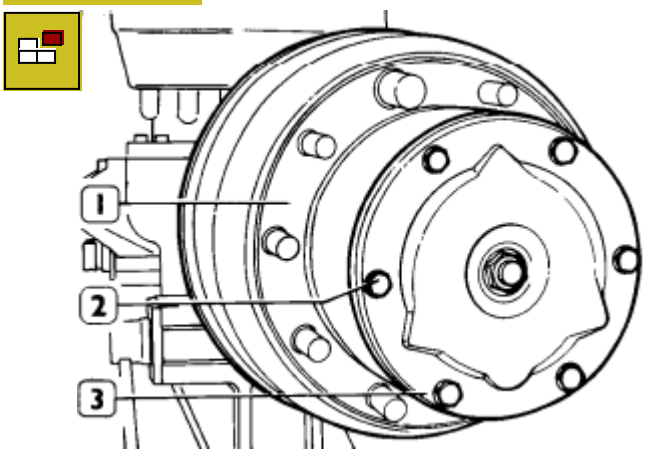
**NOTE** The flat face of the hex nut must be positioned towards the seal ring (4).

## 526210 REMOVING - REFITTING THE INTERAXLE DIFFERENTIAL (with the axle mounted on stand 99322215)

### Removal

Position the axle assembly on stand 99322215.

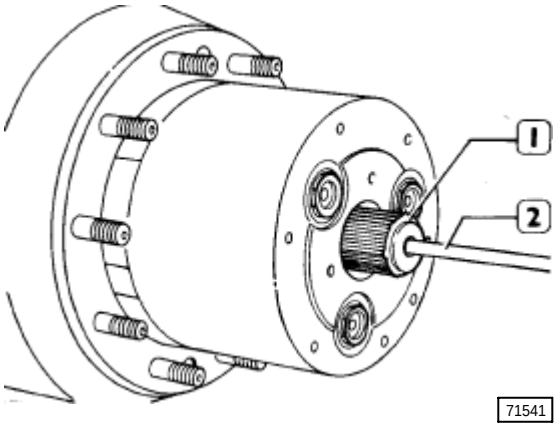
Figure 48




71534

Position a container under the wheel hub (1); unscrew the screws (2), remove the cover (3) and drain off the oil.

Figure 49

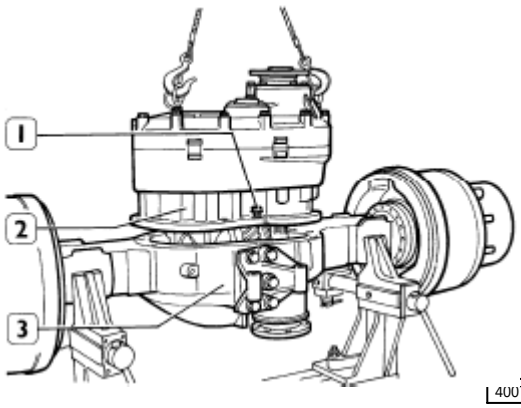



71541

Remove the shoulder pin and fit tool 99374451 (2) in the shoulder pin seat, then partially extract the drive shaft (1). Repeat this operation on the opposite side.

**NOTE** The drive shaft on the differential lock side must not be removed, but only extracted by approx. 120 mm. This is to prevent differential lock engagement inner sleeve without any more half shaft guide from inhibiting that rear axle box transfer box differential is taken out.

Figure 50




40074

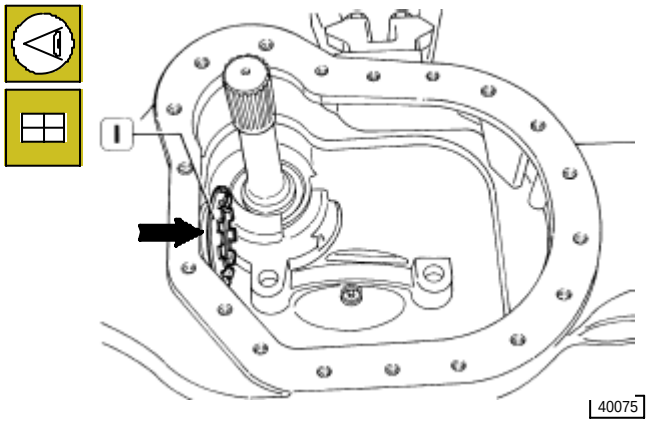
Unscrew the screws fixing the flow divider-differential unit (2) to the axle housing (3). Insert the reaction screws (1) and, with eyebolts, steel slings and a hoist, extract the unit from the axle housing.

### Refitting

For refitting, carry out the operations described for removal in reverse order, whilst observing the following instructions.

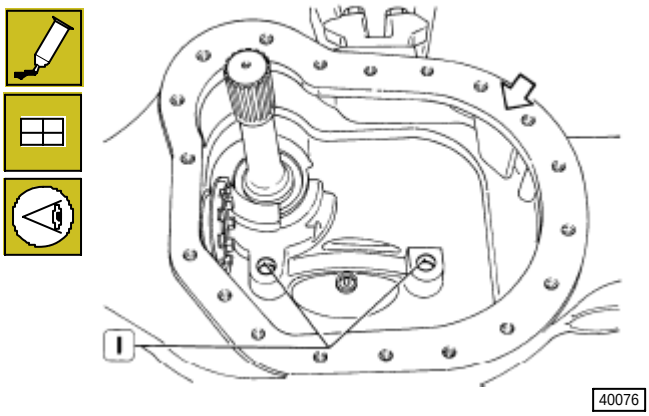
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Figure 51



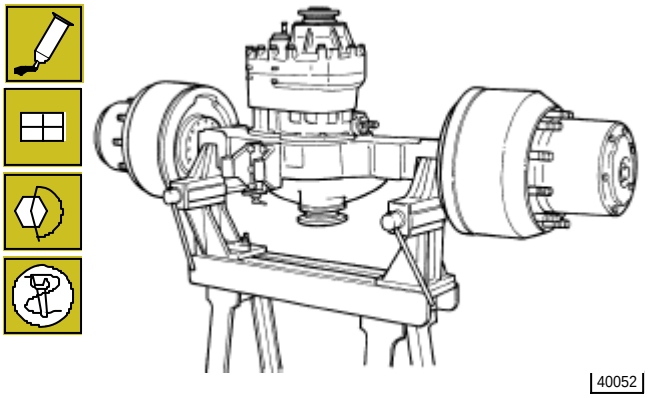

- the load bearing sleeve (1), for differential lock engagement, must be positioned on the drive shaft, with double toothing, with the internal side of the groove flush with the axle housing.

Figure 52




- clean carefully and smear LOCTITE 573 sealing compound on the contact surface (=>). Position the flow divider-differential unit, making sure that the fork engages on the sleeve (1, Figure 51) and that the centering pins enter the holes (1, Figure 52).

Figure 53

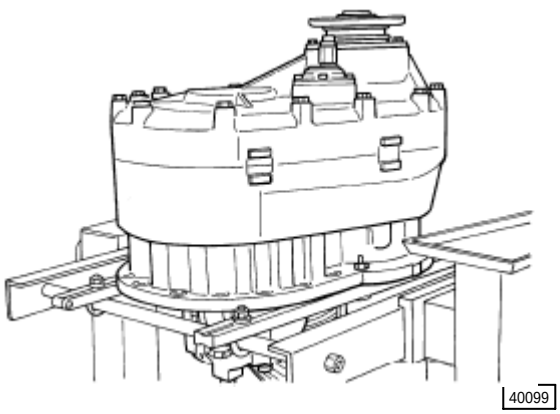



- Smear the thread and contact surface of the screws with LOCTITE 573 and tighten to a torque of 260 +/- 25 Nm using a torque wrench.
- refit the drive shafts and shoulder pins; apply LOCTITE 573 on the covers and tighten to the correct torque value. Adjust the end float on the drive shafts as described in Figure 47.

## 526010 REPAIRING THE INTERAXLE DIFFERENTIAL

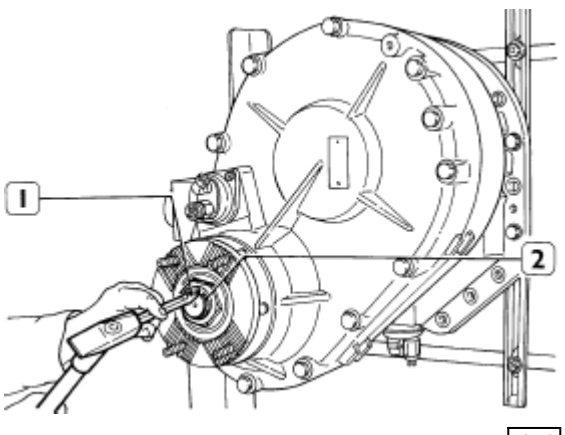
### Interaxle differential unit disassembly

Figure 54




Position the interaxle differential unit on stand 99322205, with the appropriate brackets.

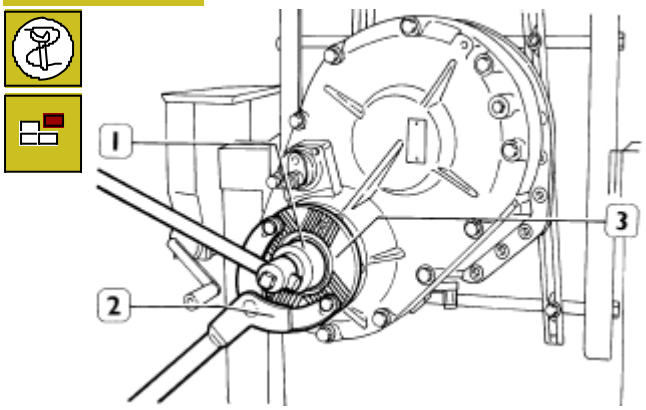
Figure 55




Using a punch (1) remove the safety notch on the nut (2).

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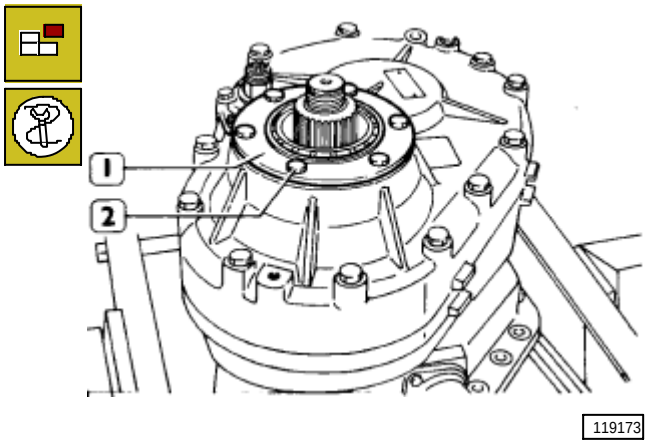
Figure 56




40117

Apply reaction lever 99370317 (2), heat the nut and loosen the drive coupling flange (3) fixing nut using Allen wrench 99355081 (1).

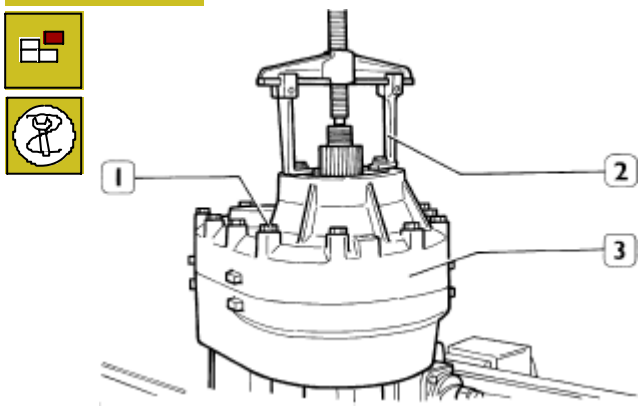
Figure 57




119173

Unscrew the screws (2) and remove the cover (1), complete with seal ring.

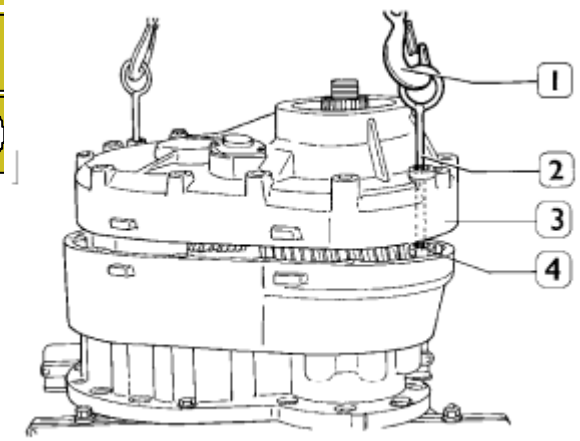
Figure 58




40119

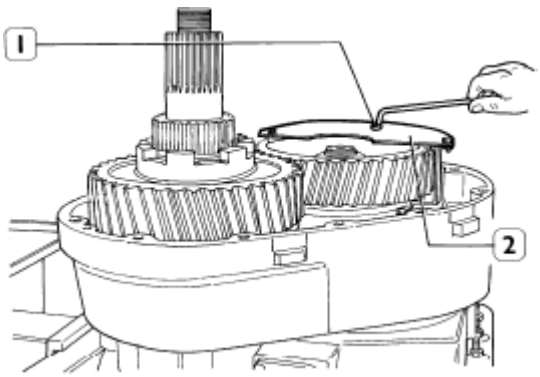
Unscrew the screws (1) and, using an extractor (2) raise the cover (3) until the shaft bearing can be extracted.

Figure 59




Lift box (3) so as to obtain sufficient space to insert the two nuts (4) in which eyebolts (2) are fastened.
Using eyebolts (2) and slings with hooks (1), remove the half-housing (3) by moving the flow divider lock engagement fork, taking care not to damage parts.

Figure 60

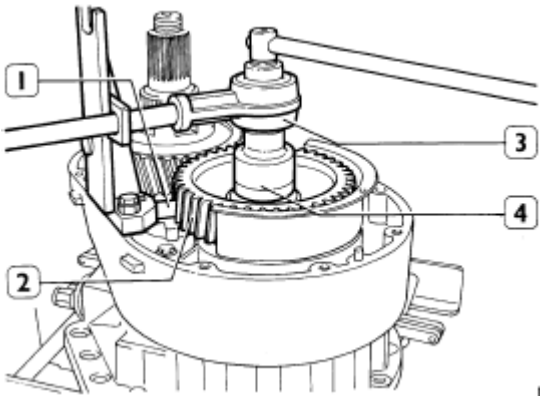



40121

Unscrew the screws (1) and remove the upper part of the oil feed (2).

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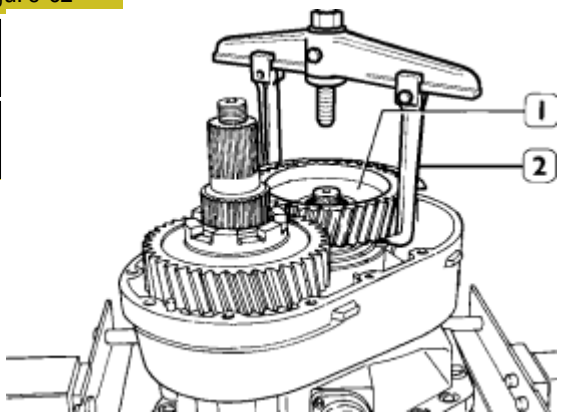
Figure 61




40122

Unscrew the gear unit (2) nut.
Fit tool 99363310 (1), blocking gear unit (2) rotation.
Using Allen wrench 99355038 (4) and multiplier 99389816 (3) unscrew the fixing nut.

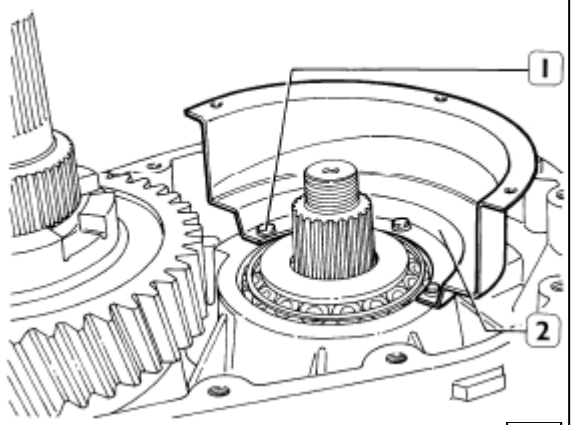
Figure 62




119175

Using appropriate extractor (2) remove driven gear (1) from taper pinion.

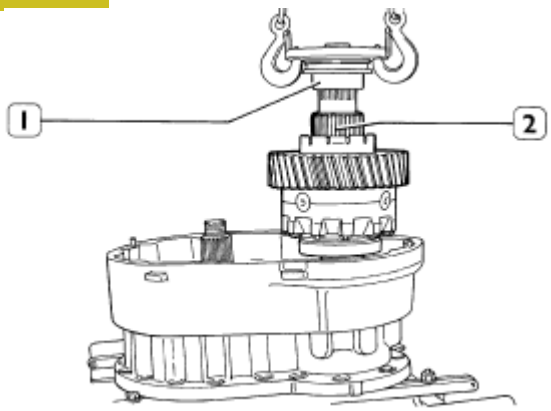
Figure 63




40115

Unscrew the three screws (1) and remove the oil feed (2).

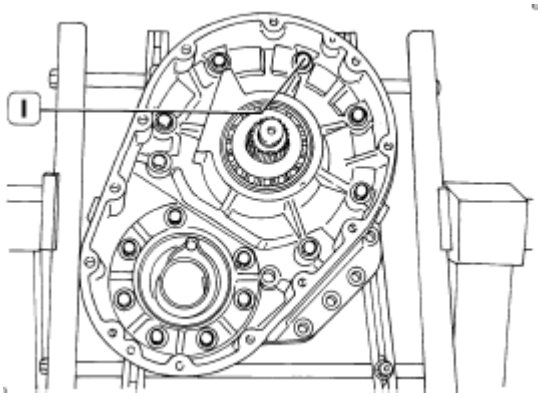
Figure 64




40116

Refit the flange (1) and secure with the nut; using hooks and slings, raise the flow divider differential unit (2).

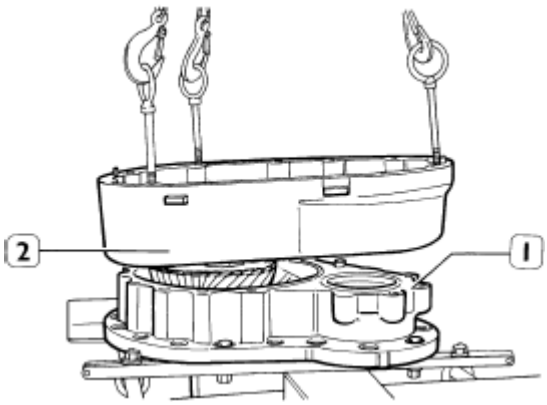
Figure 65




40117A

Unscrew the fourteen screws (1) fixing the half-housing to the differential housing.

Figure 66



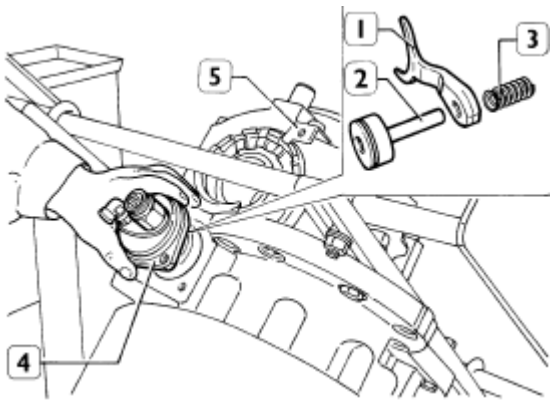

40119A

Using eyebolts, hooks and slings, remove the half-housing (2), complete with bevel pin, from the differential housing (1).

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## Differential housing disassembly

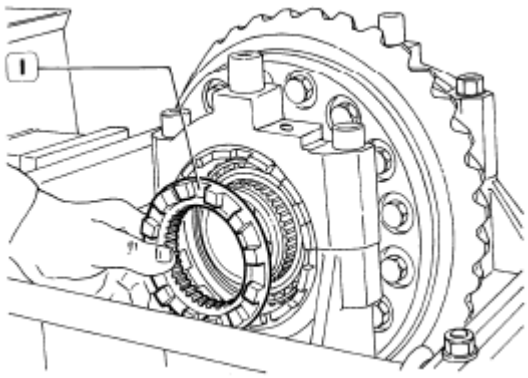
Figure 67




40113

Rotate the stand through 180°.
Unscrew the two screws and remove the cover (4), the piston (2), the fork (1) and the spring (3). Unscrew the screw and remove the safety plate (5).

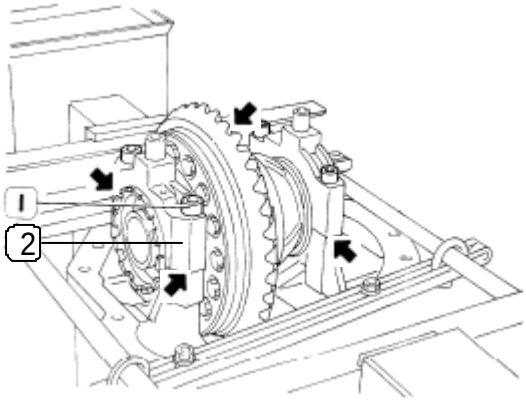
Figure 68




40111A

Remove the seeger ring and extract the differential lock fixed sleeve (1).
Mark the assembly position of the caps in relation to the differential carrier.

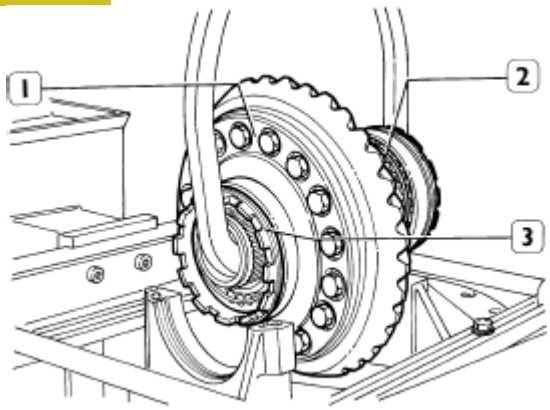
Figure 69




40102

Slightly loosen the adjusting ring nut, heat the points indicated by the arrows with drier 99305121 and unscrew the screws (1) secured with LOCTITE.
Remove the caps (2).

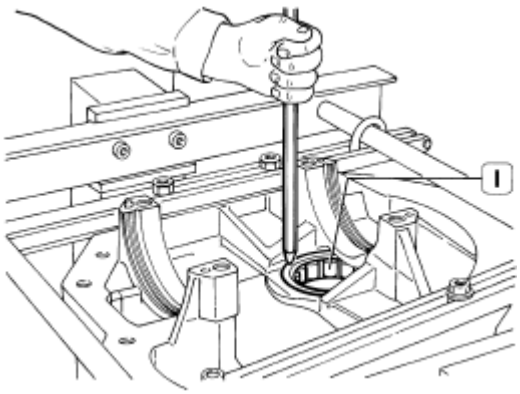
Figure 70




40108

Using a hook, remove the differential housing (1), together with the bearings (2) and adjusting ring nut (3).

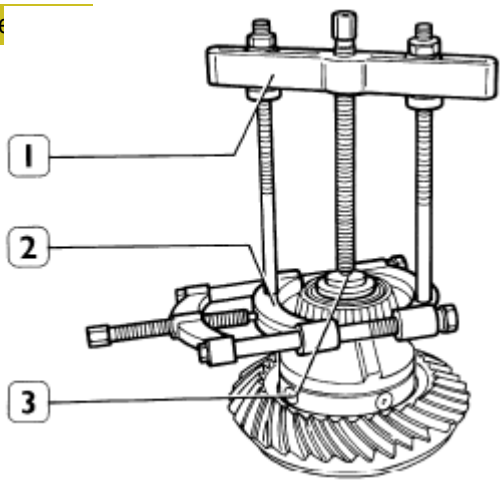
Figure 71




40104

Using a universal punch, extract the taper roller bearing (1) from the differential carrier.

Figure

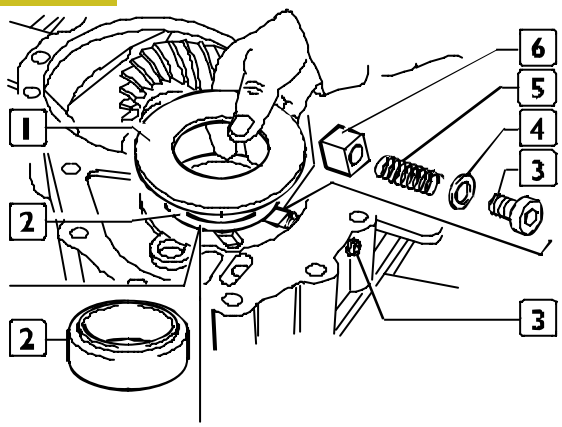



086

Using extractor 99348001 (1-2) and reaction block 99345053 (3), extract the taper roller bearing from the differential housing. Repeat the same operation on the opposite side.

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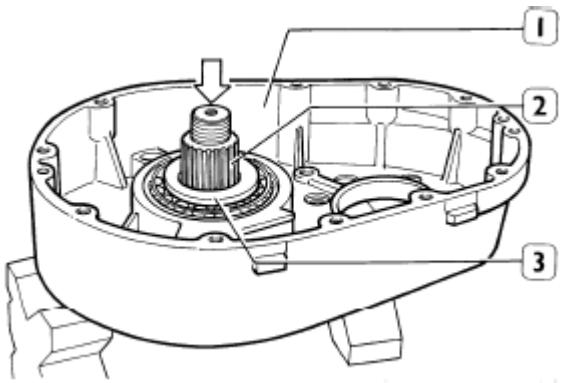
Figure 73




71544

Remove the guard disk (1).
Remove the plug (3), complete with washer (4), and extract the spring (5) and piston (6).
Remove the eccentric (2).

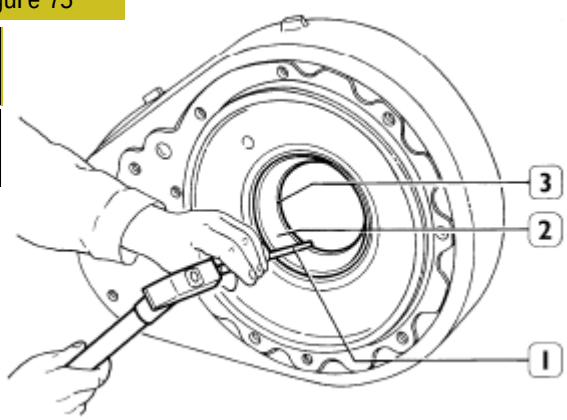
Figure 74




40376

Position the half-housing (1) on two parallel blocks and, using a punch, extract the bevel pinion (2) and remove the taper roller bearing (3).

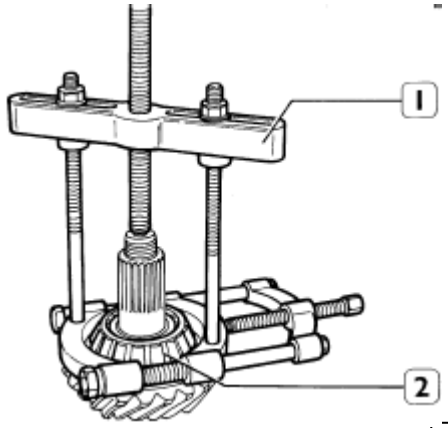
Figure 75




40079

Using a punch (1), extract the external rings (2-3) from the half-housing taper roller bearings.

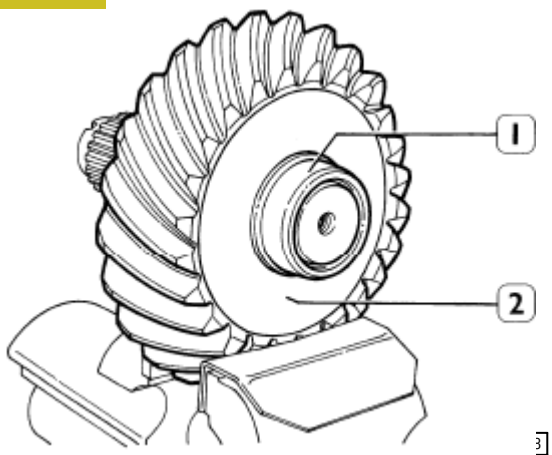
Figure 76




470077

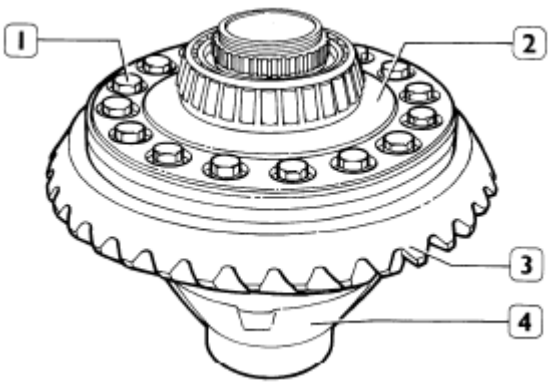
Using extractor 99348001 (1), extract the intermediate bearing (2) from the bevel pinion.

Figure 77




Using suitable tools, extract the internal ring (1) from the rear bearing of the bevel pinion (2). This is a destructive operation.

Figure 78

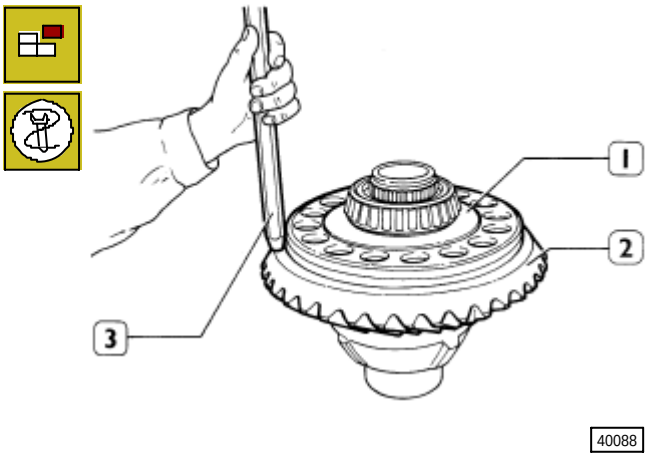



40087

Loosen and extract the screws (1) fixing the ring bevel gear (3) and cover (2) to the half-housing (4).

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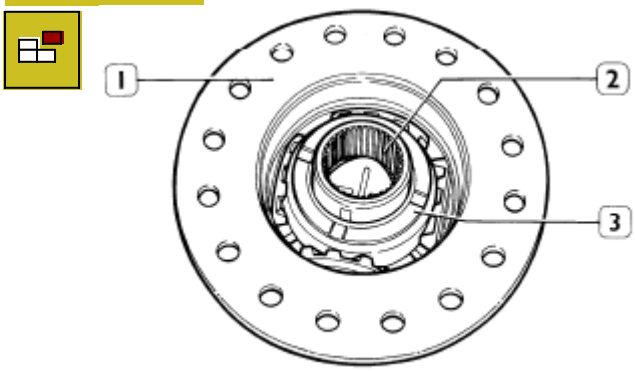
Figure 79




40088

Counter-mark the cover and gear housing.
Remove the gear housing cover (1) and release the ring bevel gear (2) using a punch (3).

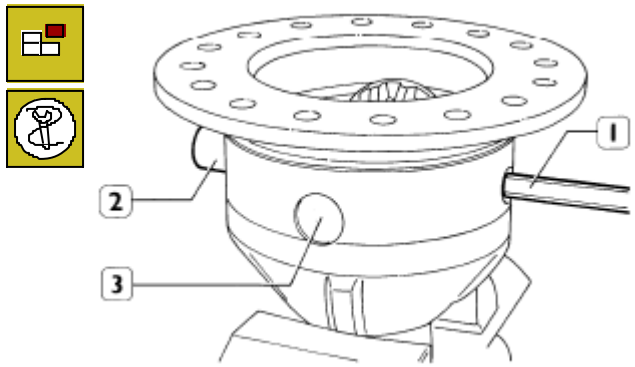
Figure 80




40089

Remove the crown wheel (2), together with the shoulder washer (3), from the gear housing (1).

Figure 81

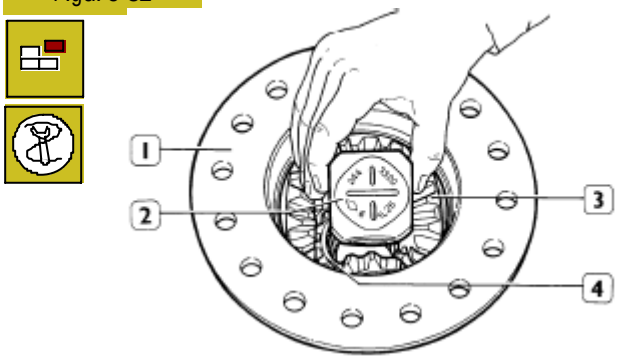



400910

Using a punch (1), first extract the long pin (2) and then the two short pins (3).

**NOTE** The exact position of the pins is marked on the spider body (2, Figure 82) by a long stripe for the long pin, and by two short stripes for the short pins.

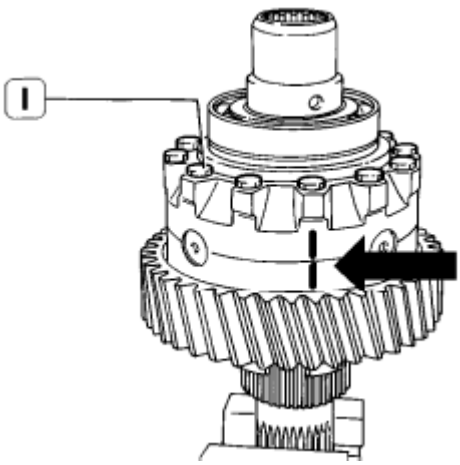
Figure 82




Remove the spider (2) and the side pinions (3) with the relative shoulder washers and crown wheel (4) from the gear housing (1).

## Interaxle differential disassembly

Figure 83

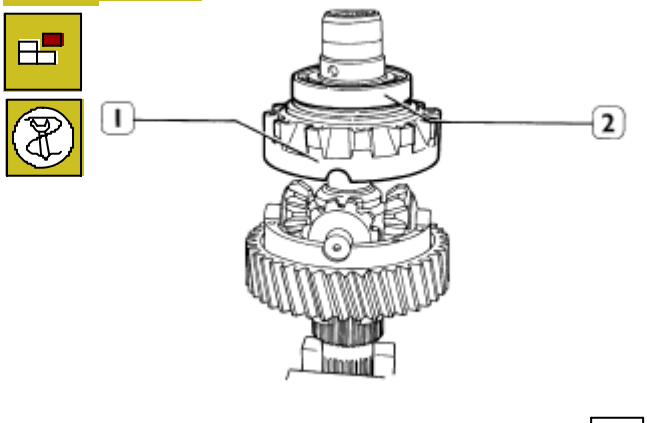



119176

Fit the interaxle differential in a vice; unscrew the screws (1). Mark half boxes as shown →.

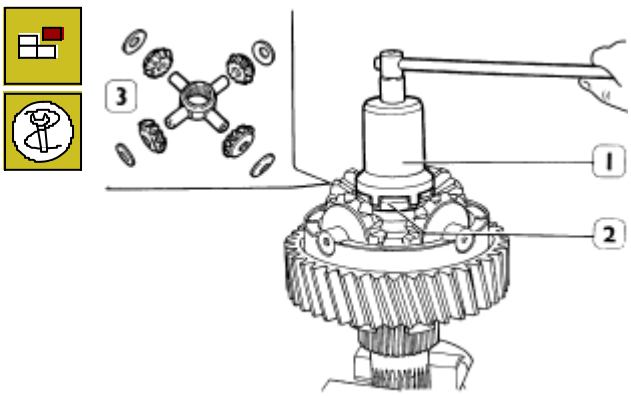
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Figure 84



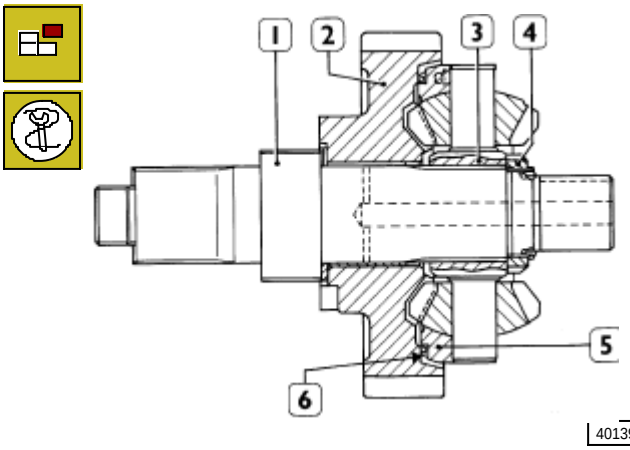

Remove the half-housing (1) and bearing (2).

Figure 85



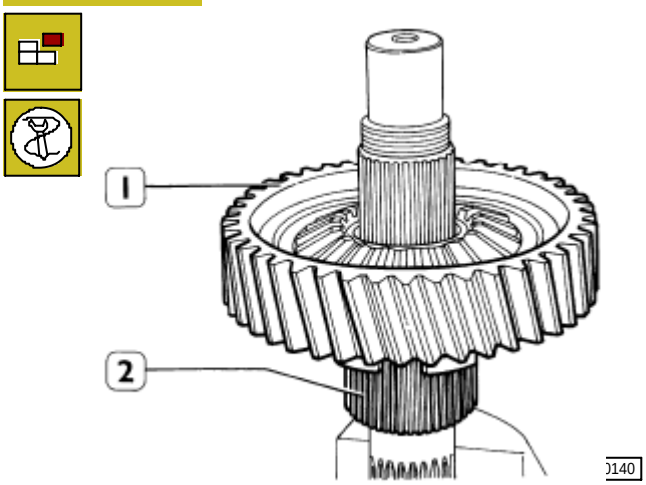

With appropriate punch, remove rivets from ring nut (2). Use spanner 99355121 (1) to unlock ring nut (2), remove spider (3) complete with planetary gears, thrust washers and seal (6, Fig. 86).

Figure 86



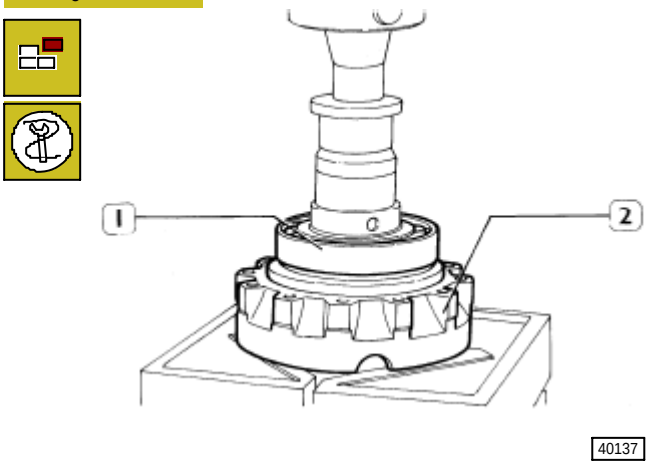

1. Input shaft - 2. Driving gear - 3. Spider - 4. Ring nut - 5. Differential half-housing - 6. Seal ring

Figure 87




Extract the driving gear (1) from the input shaft and remove the shoulder washer.

Figure 88




Using a hydraulic press, extract the bearing (1) from the half-housing (2) using the crown wheel gear unit.

## CHECKING THE DIFFERENTIAL COMPONENTS

Carefully clean all of the individual differential-flow divider components, replacing worn parts and all sealing elements.

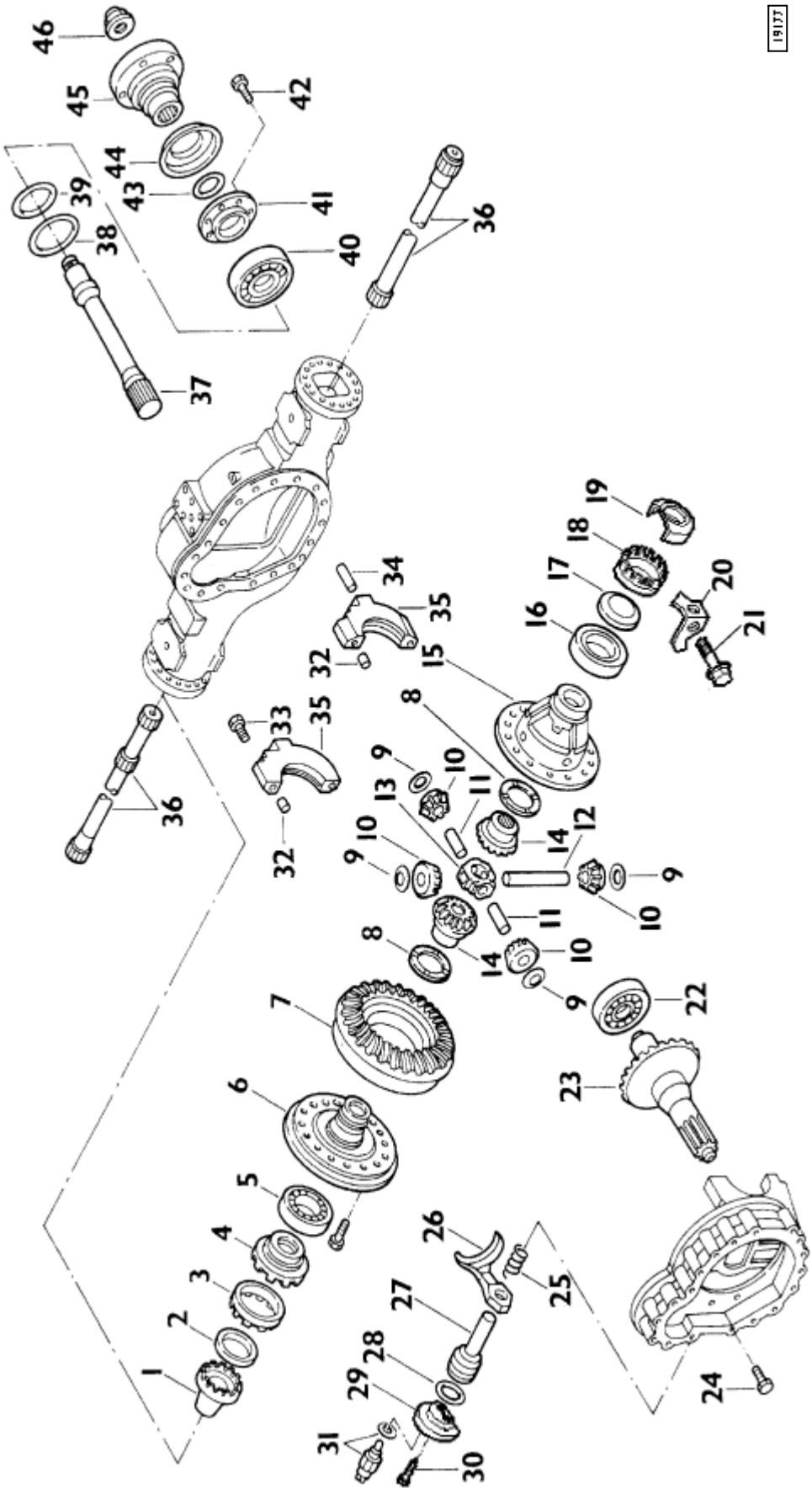
**NOTE** Carefully clean all the threads to ensure exact adjustments and precise tightening torque values.

**NOTE** If either the bevel gear or pinion need to be changed, both parts must be replaced as they are provided as coupled spare parts.

**NOTE** Check the bushings mounted in the driven gear and crown wheel unit. Replace if worn using a press.

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Figure 89

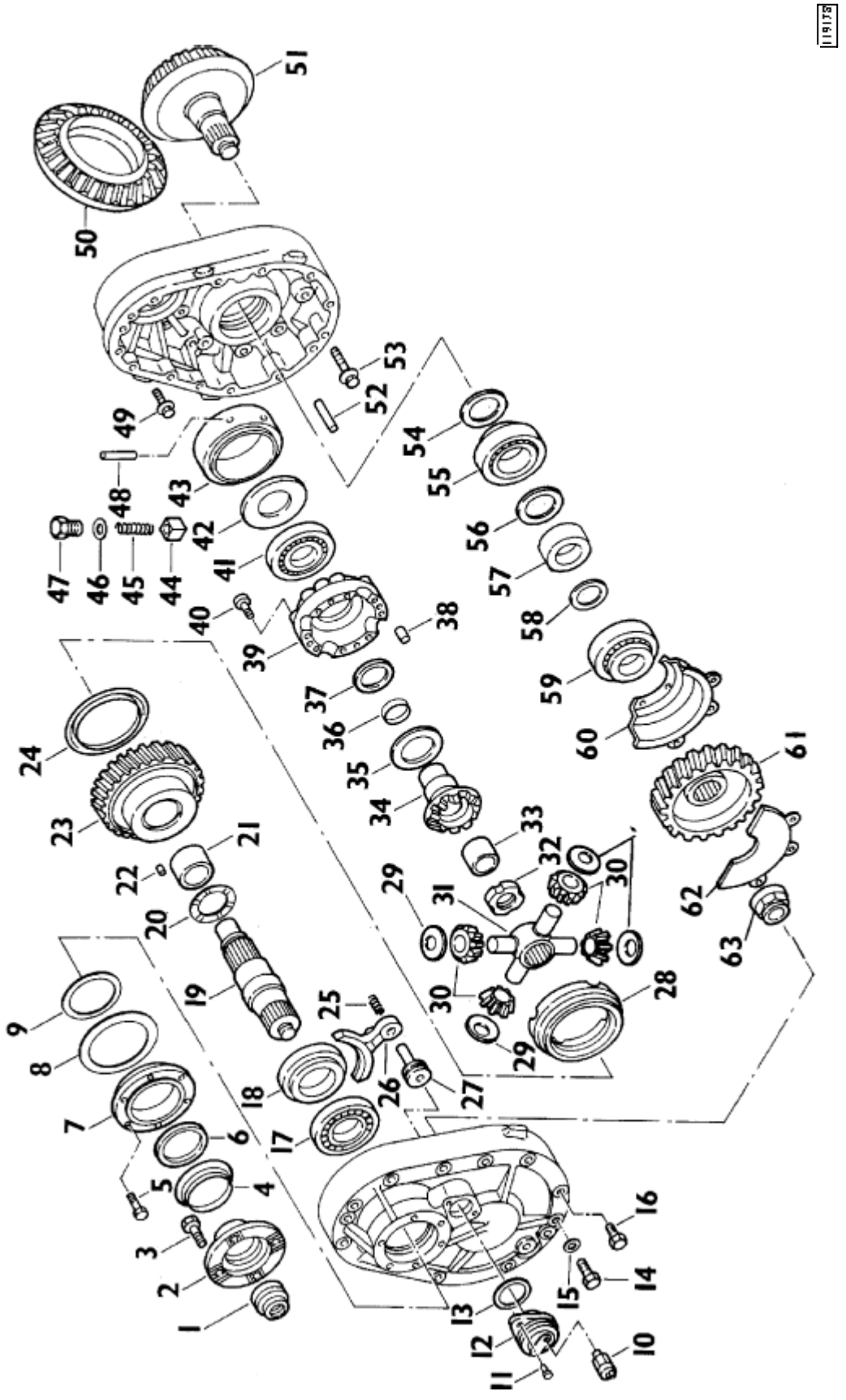



DIFFERENTIAL COMPONENTS

1. Sleeve - 2. Ring - 3. Ring nut - 4. Ring nut - 5. Oil seal - 6. Cover - 7. Crown - 8. Washer - 9. Fifth wheel - 10. Side pinion - 11. Pin - 12. Pin - 13. Spider - 14. Side pinion - 15. Differential housing cover - 16. Bearing - 17. Ring nut - 18. Bearing - 19. Oil baffle - 20. Screw - 21. Plate - 22. Bearing - 23. Pinion - 24. Screw - 25. Spring - 26. Fork - 27. Piston - 28. Ring - 29. Cover - 30. Screw - 31. Switch - 32. Pin - 33. Screw - 34. Pin - 35. Caps - 36. Drive shafts - 37. Shaft - 38. Seal ring - 39. Seal ring - 40. Bearing - 41. Cover - 42. Screw - 43. Seal ring - 44. Oil splash plate - 45. Flange - 46. Nut

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Figure 90



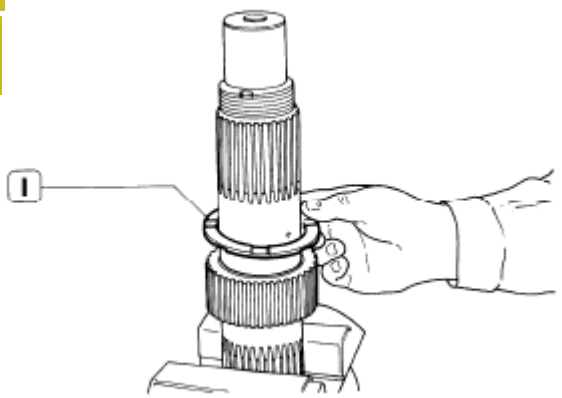

FLOW DIVIDER-DIFFERENTIAL COMPONENTS

1. Nut - 2. Control side flange - 3. Hex screw - 4. Oil splash plate - 5. Screw - 6. Seal - 7. Cover - 8. Seal ring - 9. Seal ring - 10. Switch - 11. Screw - 12. Cover - 13. Ring - 14. Plug - 15. Ring - 16. Screw - 17. Bearing - 18. Sleeve - 19. Shaft - 20. Washer - 21. Bushing - 22. Pin - 23. Gears - 24. Seal ring - 25. Spring - 26. Fork - 27. Piston - 28. Half-housing - 29. Washer - 30. Side pinions - 31. Spider - 32. Ring nut - 33. Bushing - 34. Crown wheel - 35. Washer - 36. Oil guard - 37. Seal ring - 38. Pin - 39. Half-housing - 40. Side pinions - 41. Bearing - 42. Washer - 43. Eccentric ring - 44. Adjusting piston - 45. Compression spring - 46. Ring - 47. Threaded plug - 48. Pin - 49. Self-locking screw - 50. Crown - 51. Pinion - 52. Pin - 53. Self-locking screw - 54. Adjusting shim - 55. Bearing - 56. Adjustment thickness - 57. Spacer ring - 58. Spacer ring - 59. Bearing - 60. Oil feed - 61. Gears - 62. Oil feed cover - 63. Nut

Aquila Trucks Centres

## Interaxle differential unit assembly

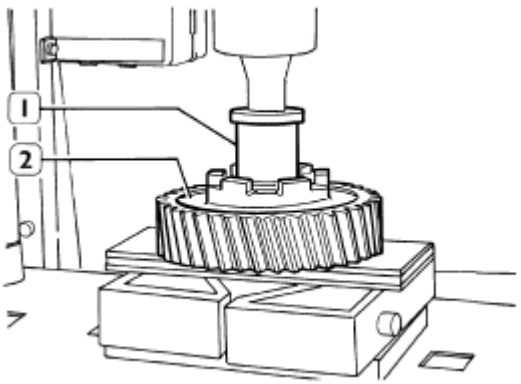
Figure 91




40141

Position the input shaft in a vice and fit the shoulder ring (1).

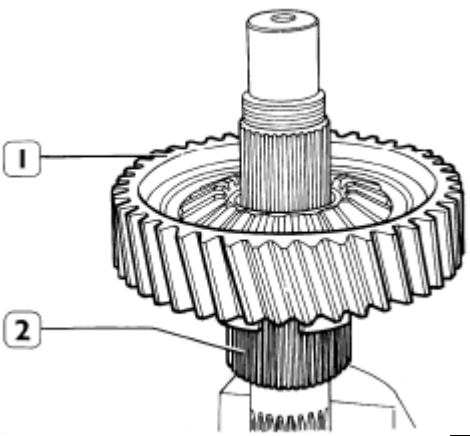
Figure 92




40411

If disassembled, assemble the bushing in the driven gear (2) using a suitable keying device (1).

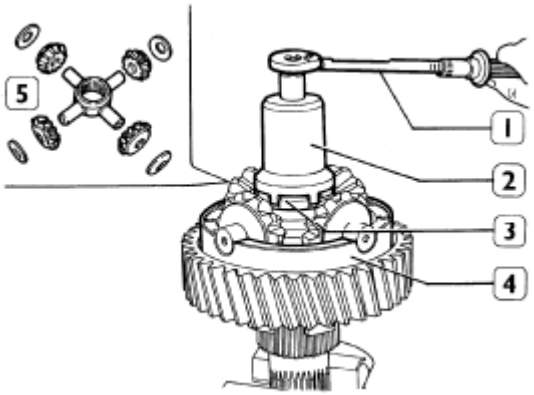
Figure 93




40140

Fit the driven gear (1) on the input shaft (2).

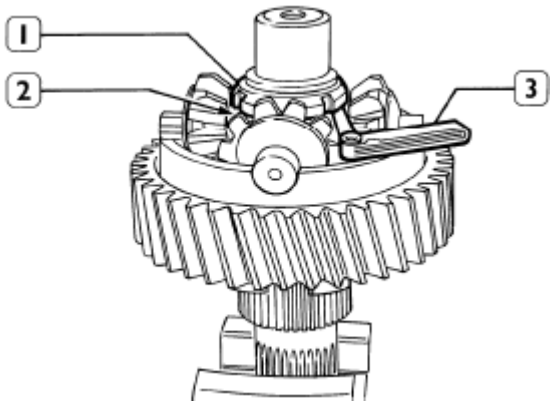
Figure 94




40138

Assemble the half-housing (4) and the seal ring.
Fit the spider (5) and side pinions, using wrench 99355121 (2) and torque wrench (1), tighten the ring nut (3) to a torque value of 230 ± 20 Nm.

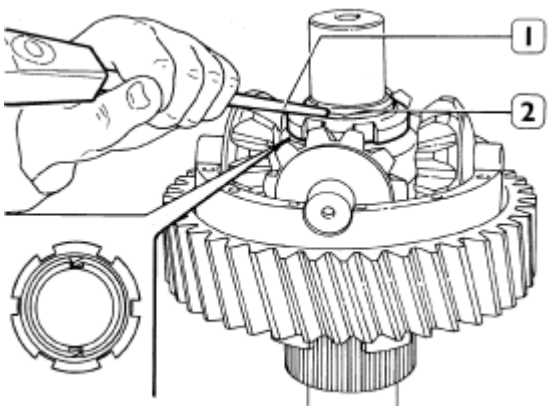
Figure 95




40142

After tightening the ring nut (1) check (with a feeler gauge (3)) that there is a clearance of 0.40 to 0.55 mm between the ring nut (1) and the spider (2). If not, replace the necessary parts.

Figure 96

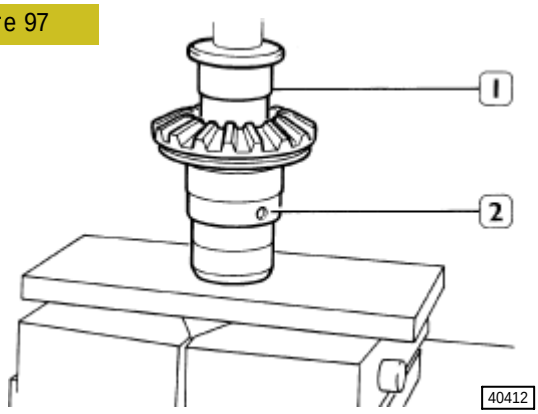



40143

Using a punch (1) secure the ring nut (2) as shown in the drawing.

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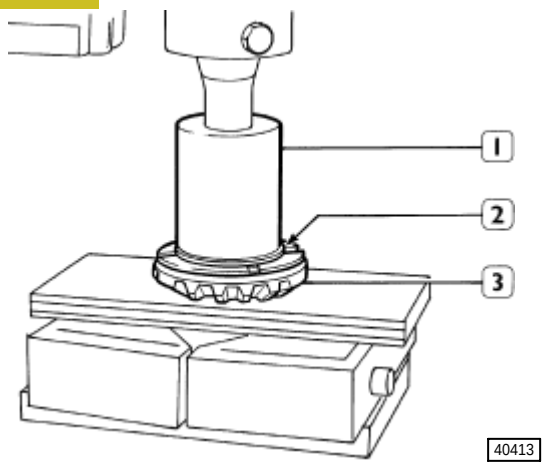
Figure 97




Using key 99370122 (1) and press, fit the bushing in the crown wheel gear unit (2).

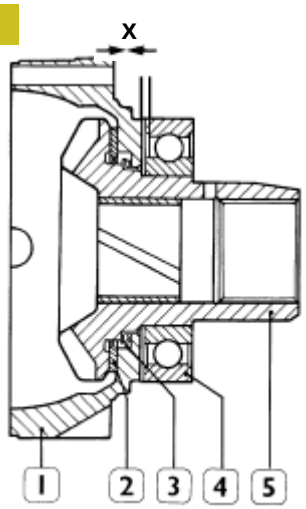
**NOTE** After assembling the bushing, make sure that it is keyed correctly on the input shaft.

Figure 98



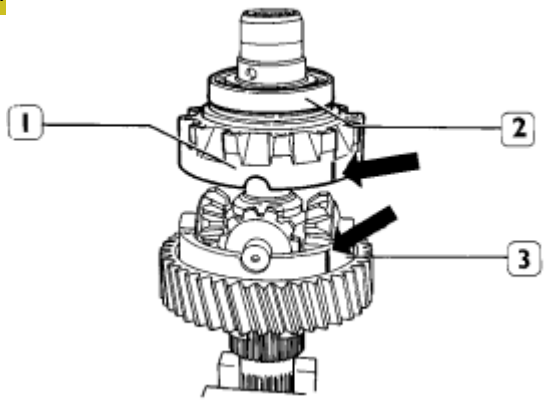

Fit the shoulder ring in the crown wheel gear unit (3), then fit the seal ring (2) using a keying device (1).

Figure 99




Fit the crown wheel gear unit (5) and parts (2 and 3) in the half-housing (1).
Heat the ball bearings (4) to 100° - 110°C and fit on the crown wheel gear unit (5). Check that the half-housing (3) and the bearing (4) are at a distance of X = 1.05 to 1.60 mm.

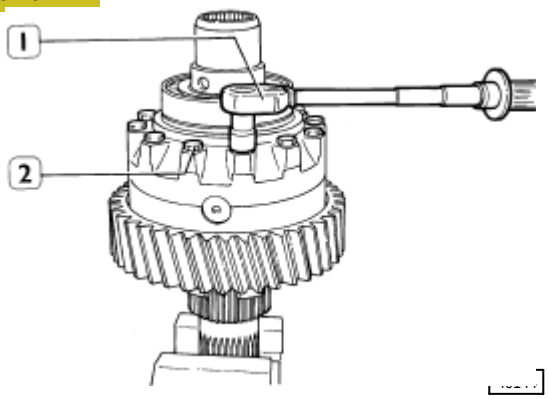
Figur




Fill the inner chamber of the half-housing (3) with 100g of lubricating oil.
Fit the half-housing assembly (1), bearing (2) and the crown wheel gear unit on the lower half-housing (3).

**NOTE** Check alignment of marks drawn during removal →.

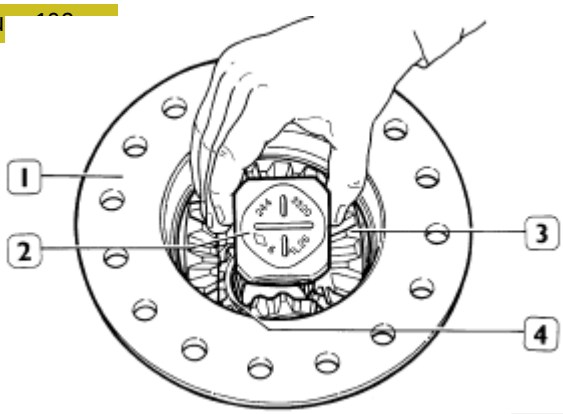
Figure 101




Insert the fixing screws (2) and tighten to a torque of 67 ± 8 Nm with a torque wrench (1).

## Differential housing assembly

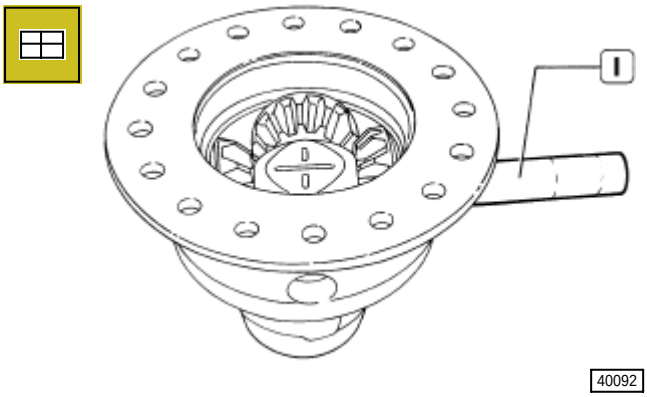
Figu




Place the differential housing (1) on a support. Position the crown wheel (4) and shoulder washer in the seat. Fit the 4 side pinions (3), complete with shoulder washer, and insert in the spider (2).

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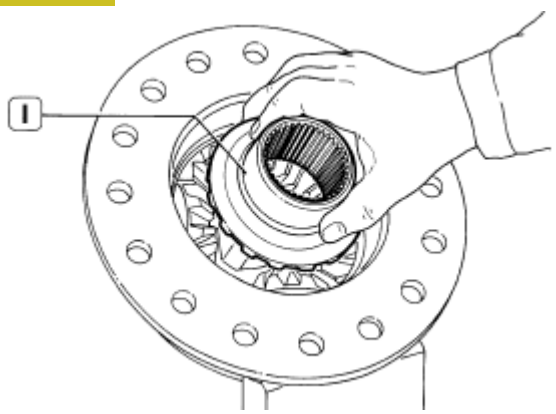
Figure 103




Insert the long pin (1) and the two short pins.

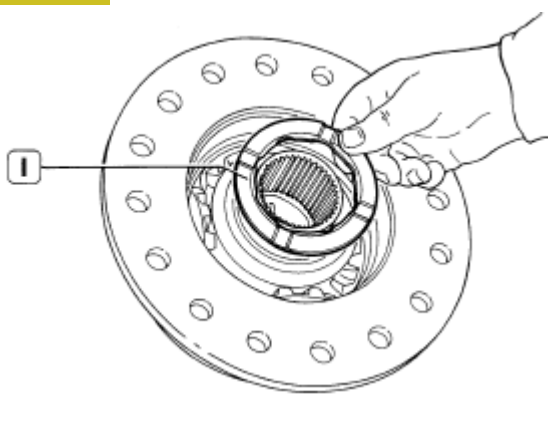
**NOTE** First insert the long (through) pin. The exact position of the pins is marked on the spider body by a long stripe for the long pin, and by two short stripes for the short pins

Figure 104



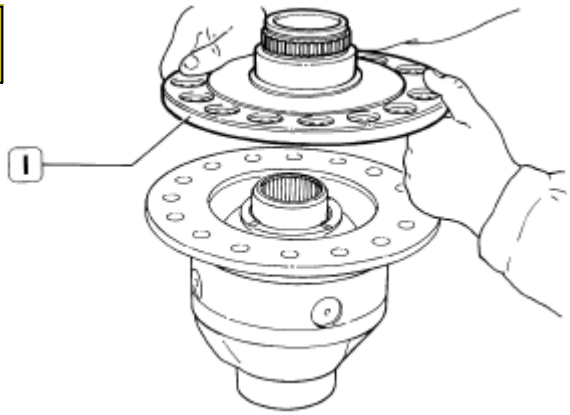

Assemble the crown wheel (1).

Figure 105



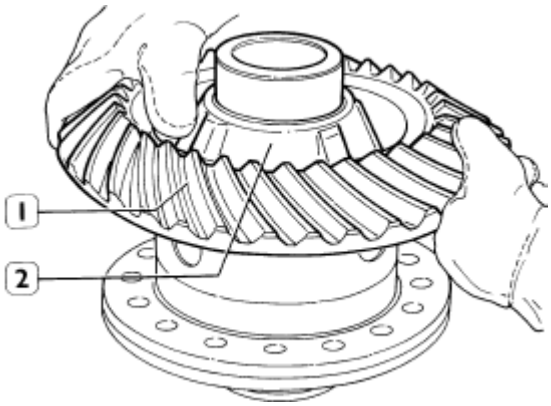

Fit the shoulder washer (1).

Figure 106



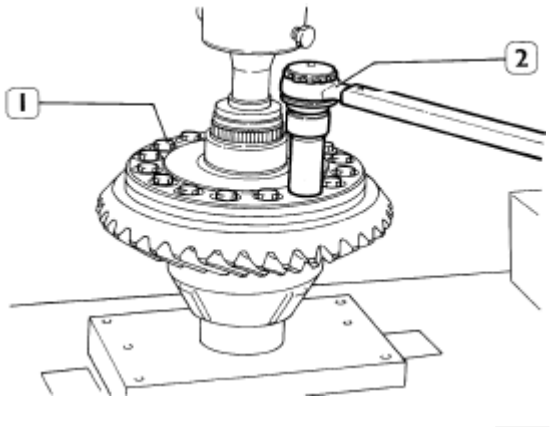

Fit the gear housing cover (1).

Figure 107




Heat the ring bevel gear (1) to approx. 80ºC, fit in position in the gear housing (2) and secure with two screws.

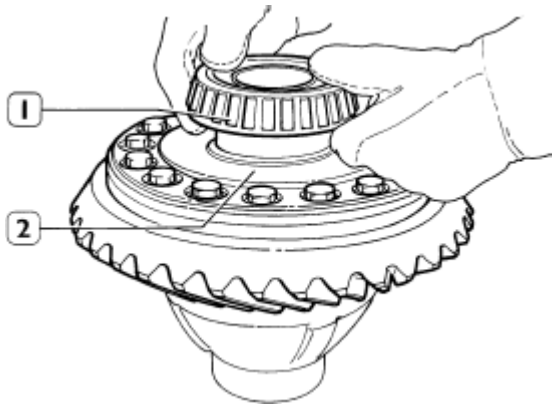
Figure 108




Introduce the remaining screws (1); lock gear unit rotation using a press and tighten the screws (1) to a torque of 300 ± 10 Nm with a torque wrench (2).

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Figure 109

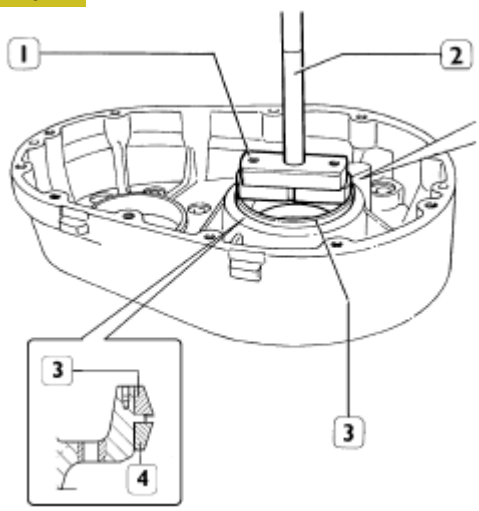



40098

Using an electric heater, heat the support bearing (1) for 15' at a temperature of 100°C and fit on the gear housing (2). Repeat the same operation on the opposite side.

## Interaxle differential unit assembly

Figure 110

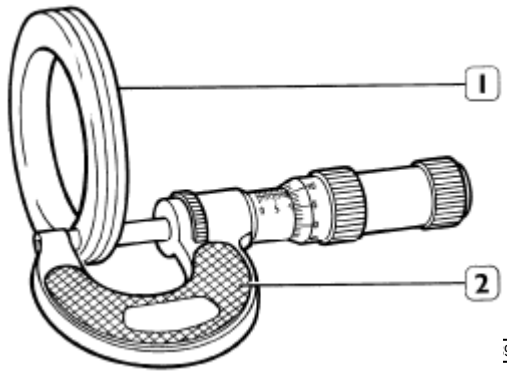



120448

Fully fit the external rings (3) of the intermediate and external bearings in their seats, using punch 99374094 (1) and grip 99370007 (2).

## Procedure to follow to determine the thickness of the bevel pinion rolling torque adjusting ring

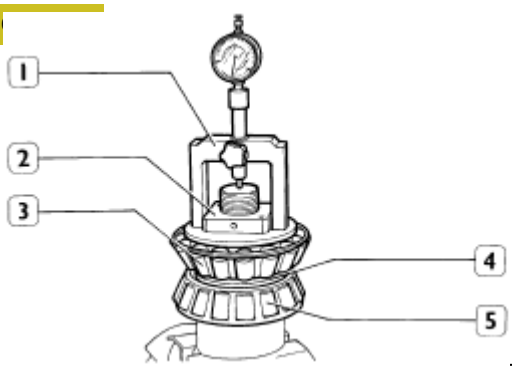
Figure 111




9572

Using a feeler gauge (2) measure and note the thickness of the adjusting ring (1) on disassembly (value A).

Figur




40083

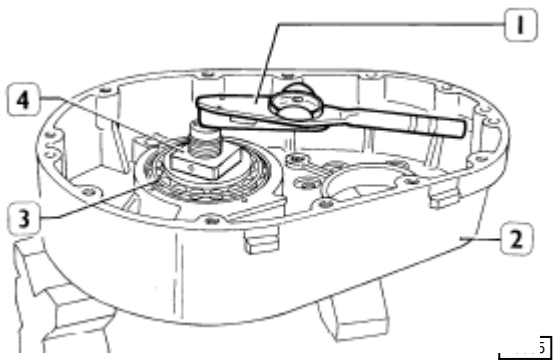
Secure tool 99395027 in a vice and fit the following parts:

- the bearing (5) on the pinion-side;
- the previously measured adjusting ring (4), the spacer and the bearing (3).

Fully tighten the ring nut (2).
Position part (1) of tool 99395027 (6) on the bearing (3), fitted with a zero-set dial gauge on the end of the tool. Then remove:

- the part (1), the ring nut (2), the bearing (3), the adjusting ring (4) and the spacer;

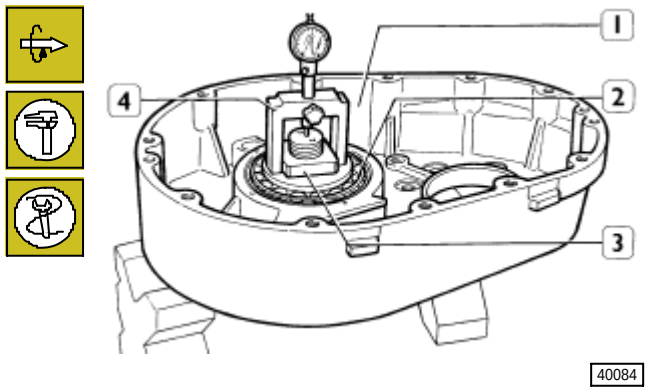
Figure 113




- position tool 989395207 and bearing (5, Figure 112) in the half-housing (2) and position the bearing (3, Figure 113);
- tighten the ring nut (4) by hand and check (using a torque wrench (1)) the rolling torque, which should be 1.5 - 3.5 Nm; if necessary, adjust by means of the ring nut.

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Figure 114




Position the part (4), with the dial gauge zero-set, on the bearing (2) and read the eventual deviation (value B). Disassemble the parts on tool 99395027.

Thickness S on the adjusting ring is provided by the following formula:

S = A - (± B) + C

Where:

A = thickness of the adjusting ring assembled for dial gauge zero-setting;

B = deviation value read;

C = 0.05 mm coefficient which takes into account the expansion of the bearings as a result of the assembly negative allowance on the bevel pinion.

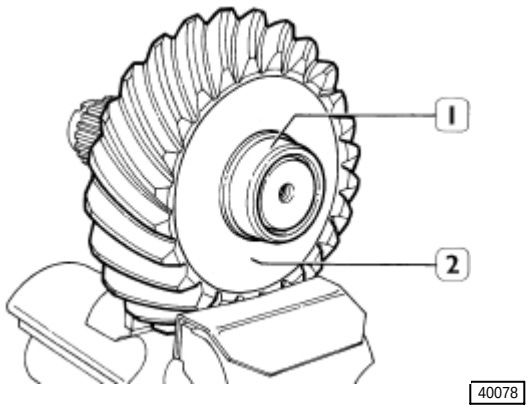
Standard version
First example
A = 10.12 mm
B = + 0.13 mm
C = 0.05 mm
S = 10.12 - (+ 0.13) + 0.05 =
S = 10.12 - 0.13 + 0.05 = 10.04 mm.

Second example
A = 10.12 mm
B = - 0.13 mm
C = 0.05 mm
S = 10.12 - (-0.13) + 0.05 =
S = 10.12 + 0.13 + 0.05 = 10.30 mm

Reinforced version
First example
A = 1.85 mm
B = + 0.13 mm
C = 0.05 mm
S = 1.85 - (+ 0.13) + 0.05 =
S = 1.85 - 0.13 + 0.05 = 1.77 mm.

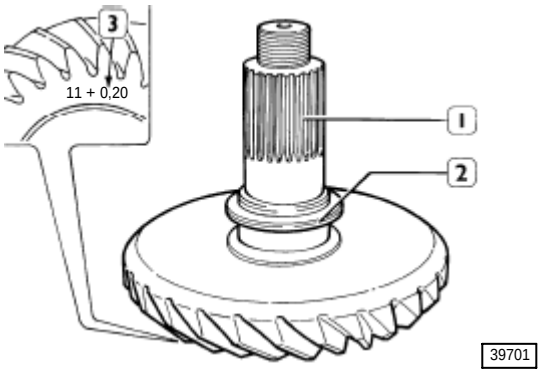
Second example
A = 1.85 mm
B = - 0.13 mm
C = 0.05 mm
S = 1.85 - (- 0.13) + 0.05 =
S = 1.85 + 0.13 + 0.05 = 2.03 mm.

Figure 115




Heat the internal ring (1) of the rear bearing and fit on the bevel pinion (2).

Figure 116




Fit the adjusting ring (2), in order to position the pinion in relation to the bevel gear, on the bevel pinion (1). The thickness of the adjusting ring is determined by the reference value (3) marked on the bevel pinion.
See the table in Figure 117.

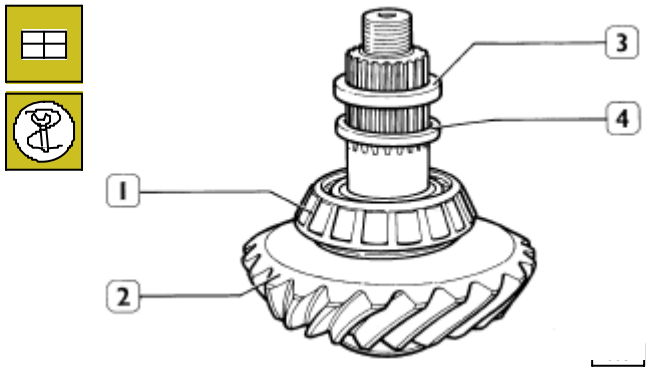
Figure 117

| Value marked on the bevel pinion | Total thickness of adjusting ring |
|---|---|
| - 0.5 | 4.6 |
| - 0.4 | 4.5 |
| - 0.3 | 4.4 |
| - 0.2 | 4.3 |
| - 0.1 | 4.2 |
| 0 | 4.1 |
| + 0.1 | 4.0 |
| + 0.2 | 39.9 |
| + 0.3 | 3.8 |
| + 0.4 | 3.7 |
| + 0.5 | 3.6 |

Summary table to determine the thickness of the bevel pinion position adjusting ring.

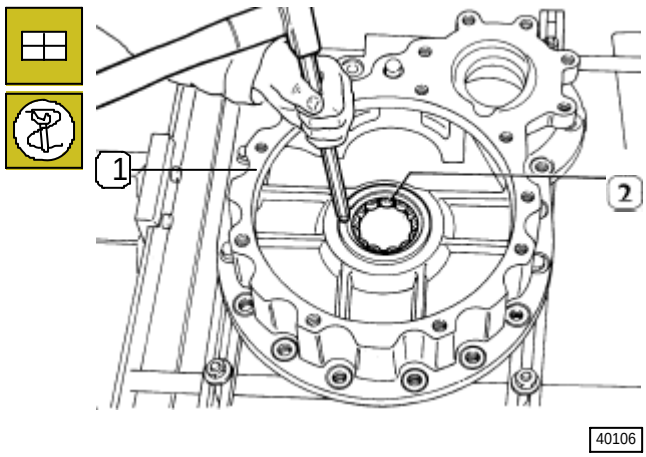
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Figure 118



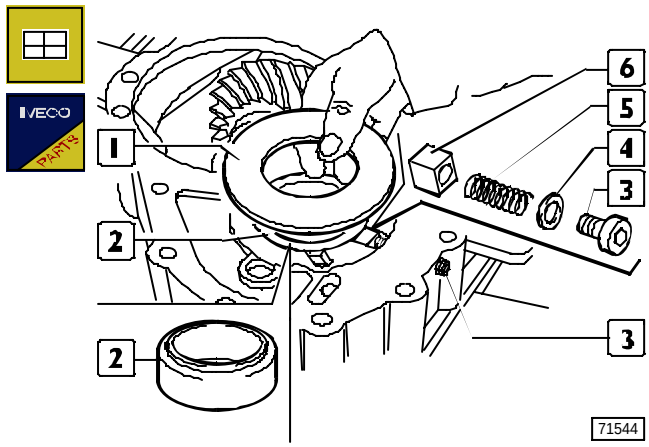

Heat the intermediate bearing (1) with an electric drier to ~100°C, and position in the bevel pinion (2).
Fit adjustment ring (4) and spacer (3) with previously measured thickness.

Figure 119



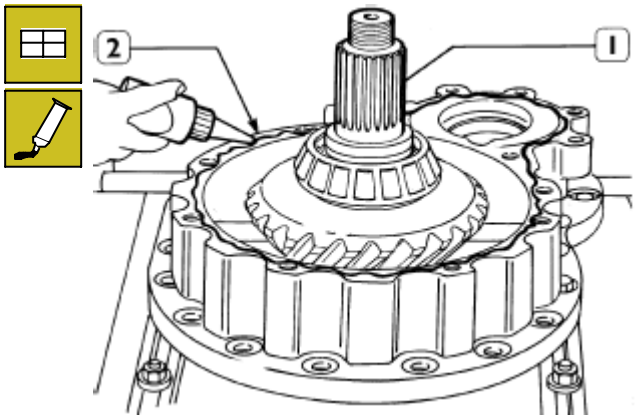

Position the differential housing (1) on the stand.
Using a punch, fit the roller bearing (2).

Figure 120



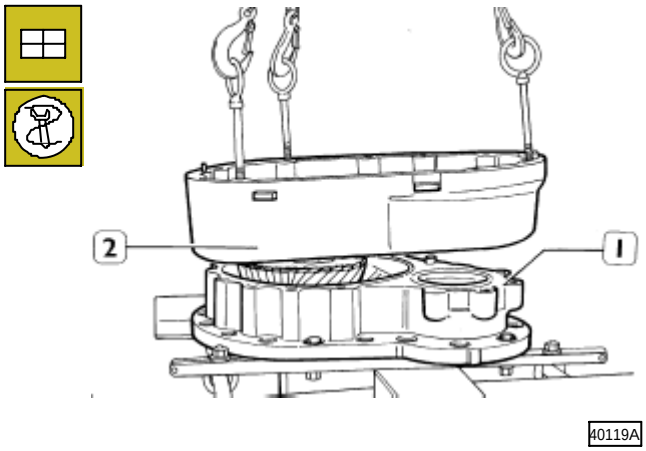

Fit the eccentric (2).
Insert the piston (6) and the spring (5) in the differential housing.
Tighten the plug (3) with a new washer (4) and tighten to the correct torque.
Fit the guard disk (1).

Figure 121



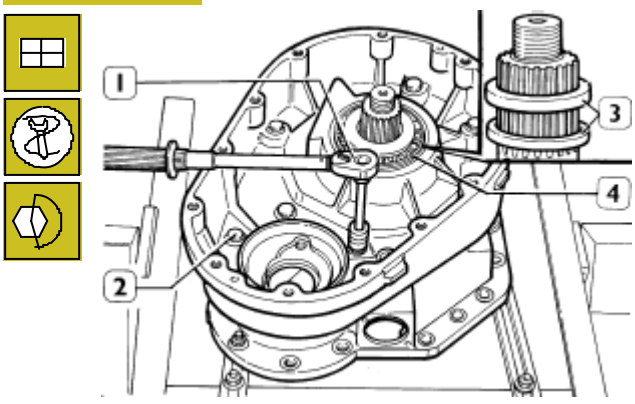

Fit the bevel pinion (1) on the roller bearing (2, Figure 119).
Smear LOCTITE 573 (2) on the contact surface.

Figure 122




Raise and fit the half-housing (2) on the differential housing (1).

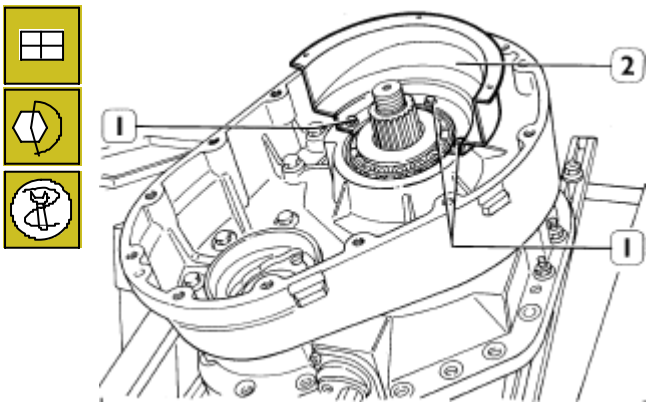
Figure 123




Using the torque wrench (1), tighten the screws (2) to a torque of 260 ± 25 Nm. Fit the spacer ring and the adjusting ring (3) on the bevel pinion. Heat bearing (4) using hot air blower at ~100 °C and secure it on taper pinion.

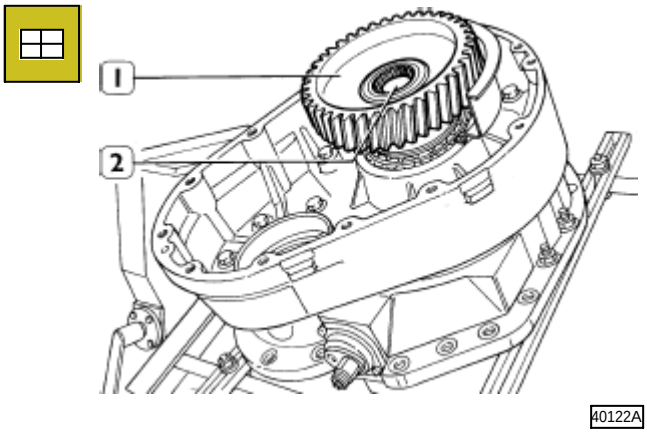
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Figure 124



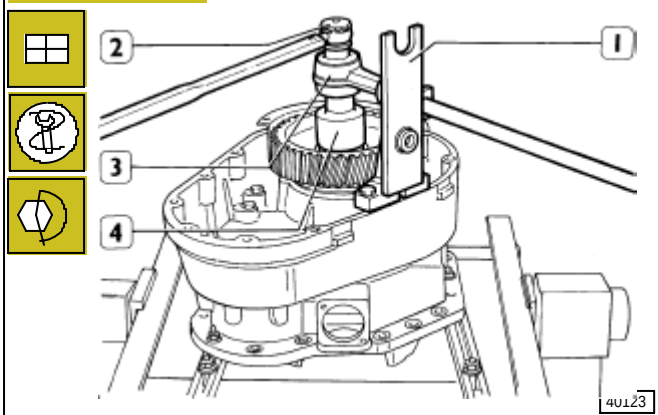

Assemble the oil feed (2) and tighten the screws (1) to a torque of 16 ± 2 Nm.

Figure 125



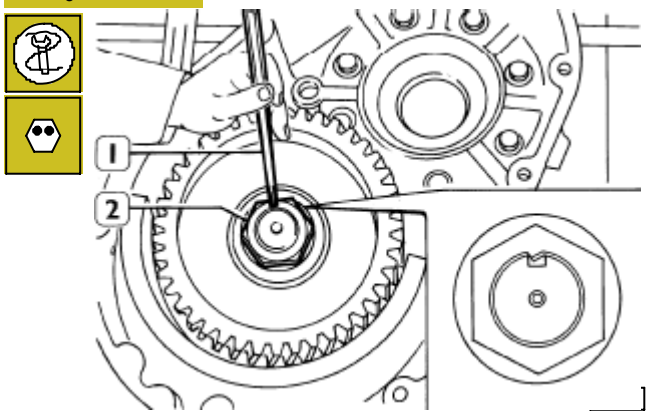

Heat gear (1) at a temperature of ~150°C and secure it on taper pinion (2).

Figure 126




Position tool 99363310 (1) and, using Allen wrench 99355038 (4), multiplier 99389816 (3) and torque wrench (2) tighten the driven gear nut to a torque of: 1200 to 1300 Nm

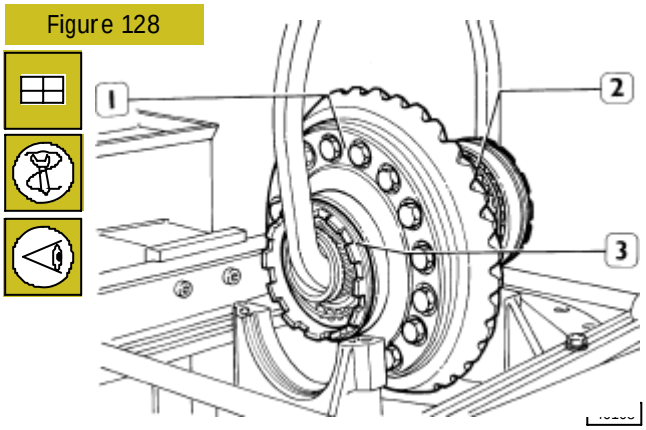
Figure 127




Using a punch (1), secure the driven gear nut (2).

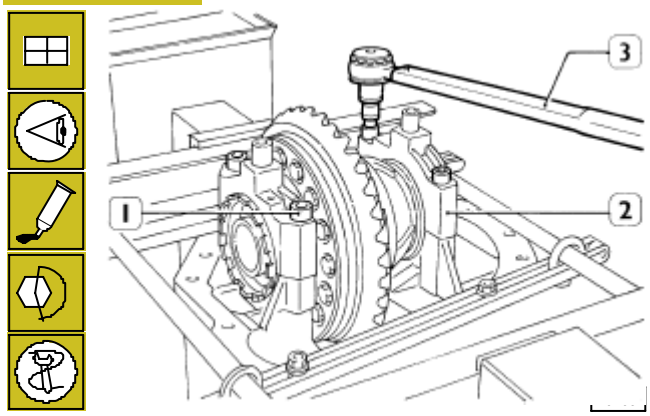
**NOTE** If the nut (2) used is of the Numeyer type, it does not need to be secured.

Figure 128




Using the hook, raise the differential housing (1), bearings (2) and adjusting ring nut (3). Position on the differential carrier. Carefully position the adjusting ring nuts on the threads of the differential carrier.

Figure 129

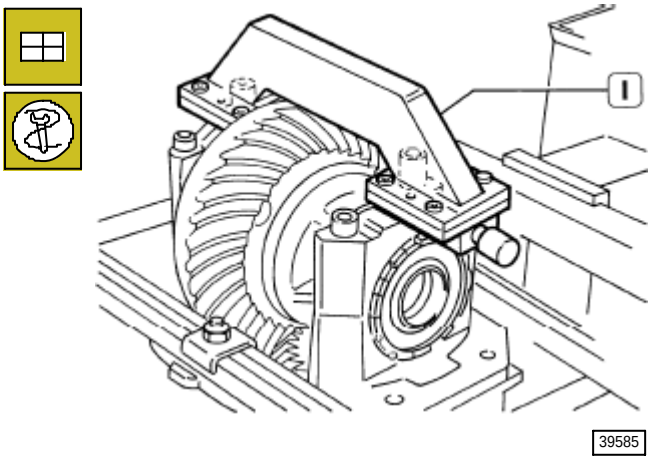



Fit the caps (2) and provisionally tighten the screws (1). Check that the adjusting ring nuts screw on easily. Remove the screws, one at a time, apply LOCTITE AVX and tighten with a torque wrench (3) to a value of 270 ± 25 Nm.

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## Adjusting the rolling torque on the differential housing bearings

Figure 130

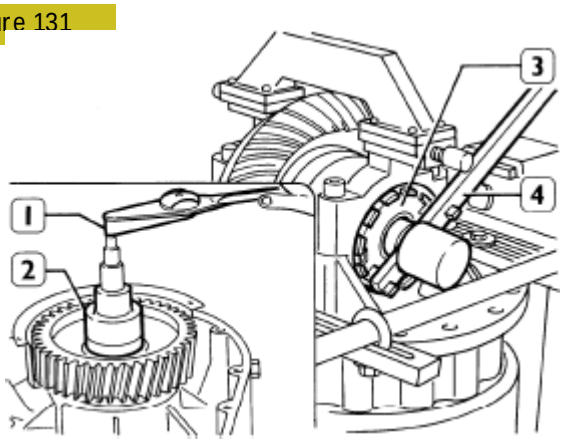



39585

Position tool 99370133 (1) as shown in the drawing to avoid excessive spread on the caps during adjustment operations.

**NOTE** The total rolling torque reading is carried out when the clearance between the teeth on the bevel gear pair is as near to the pre-stabilised value as possible. However, the total rolling torque value varies according to the reduction bevel gear pair ratio (see table in Figure 132).

Figure 131




40417

Using torque wrench 99389819 (1) and the appropriate Allen wrench (2), read the pre-stabilised torque value, adjusting the bearing adjustment ring nuts (3) with wrench 99354001 (2).

Figure 132

| No. of teeth | Ratio | Total rolling torque (Nm) |
|---|---|---|
| 17/35 | 2.059 | 3 ÷ 5,9 |
| 21/40 | 1.905 | 3.1 ÷ 6.1 |
| 19/33 | 1.737 | 3.3 ÷ 6.4 |
| 21/34 | 1.619 | 3.4 ÷ 6.6 |
| 23/36 | 1.565 | 3.4 ÷ 6.7 |
| 24/35 | 1.458 | 3.6 ÷ 6.9 |
| 27/37 | 1.370 | 3.7 ÷ 7.1 |
| 28/37 | 1.321 | 3.8 ÷ 7.3 |
| 29/37 | 1.276 | 3.0 ÷ 5.0 |
| 27/32 | 1.185 | 4 ÷ 7.7 |

To adjust the endfloat between the bevel gear pair pinion -ring bevel gear teeth, proceed as follows:

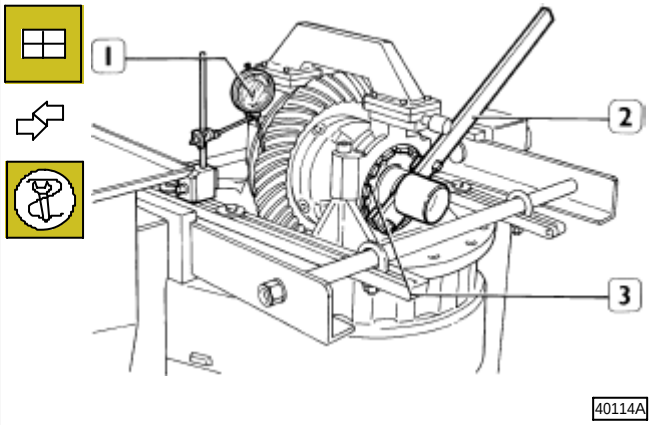
- Read the clearance value between the teeth, which varies according to the bevel gear pair ratio, in the table in Figure 135;

Figure 133

| No. of teeth | Ratio | Clearance between teeth |
|---|---|---|
| 17/35 | 2.059 | 0.2 ÷ 0.33 |
| 21/40 | 1.905 | 0.2 ÷ 0.33 |
| 19/33 | 1.737 | 0.2 ÷ 0.33 |
| 21/34 | 1.619 | 0.2 ÷ 0.33 |
| 23/36 | 1.565 | 0.2 ÷ 0.33 |
| 24/35 | 1.458 | 0.2 ÷ 0.33 |
| 27/37 | 1.370 | 0.2 ÷ 0.33 |
| 28/37 | 1.321 | 0.2 ÷ 0.33 |
| 29/37 | 1.276 | 0.2 ÷ 0.33 |
| 27/32 | 1.185 | 0.2 ÷ 0.33 |

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Figure 134



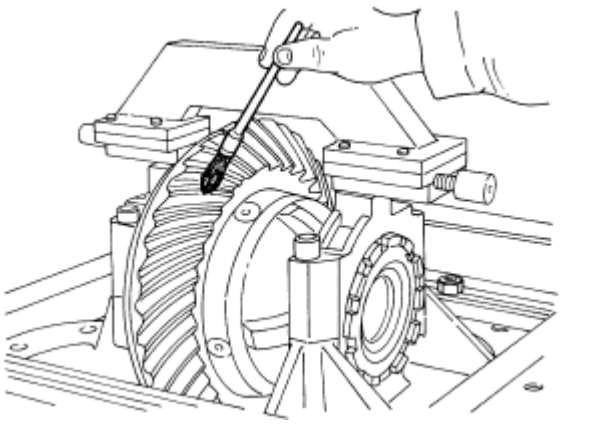

40114A

- Position a magnetic stand dial gauge (1) as shown in Figure 136.
- Prevent the bevel pinion from rotating whilst alternately rotating the bevel gear and, using a gauge (1), read the clearance between the teeth on the two gear units. If not, using wrench 99354001 (2), adjust the adjusting ring nut (3).

In order to prevent the previously measured rolling torque from varying, during adjustments of the coupling clearance between the pinion and the bevel gear teething, tighten the ring nut with wrench 99354001 by the same amount as the ring nut on the opposite is loosened.

On completion of operations, check that the two adjusting ring nuts are suitably positioned to allow the safety plate to be fitted.

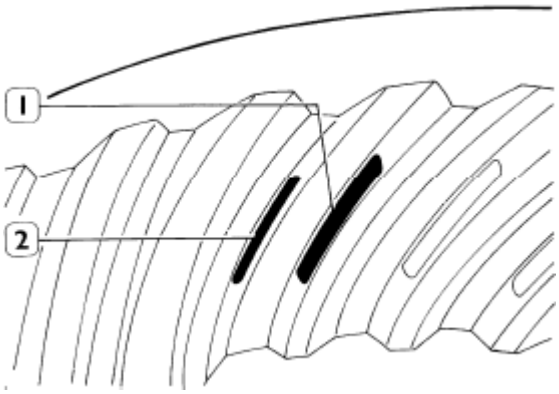
Figure 135



40159

Using a brush, apply a light covering of Prussian blue on the teeth of the bevel gear.
Rotate the bevel gear in both directions.

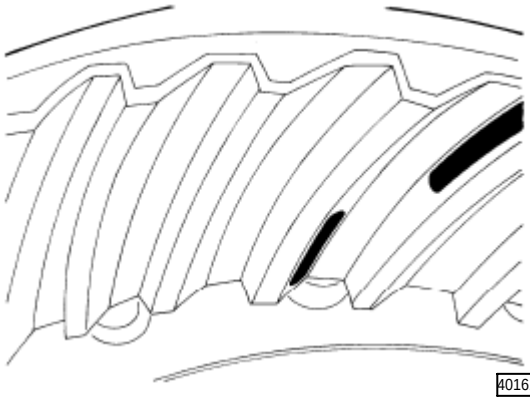
Figure 136




40160

The contact marks should be on both the leading face (1) and the pushing face (2), more or less in the centre between the teeth. When working without a load, both contact zones should be slightly out of position in relation to the external diameter of the bevel gear.

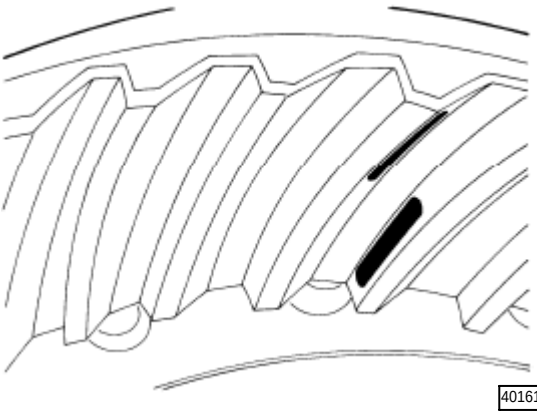
Figure 137



40161A

If the mark on the leading face (towards the external diameter) and on the pushing face (towards the internal diameter) is out of position, the pinion is located too close to the bevel gear.
- Solution: increase the thickness of the adjusting ring (2, Figure 116).

Figure 138

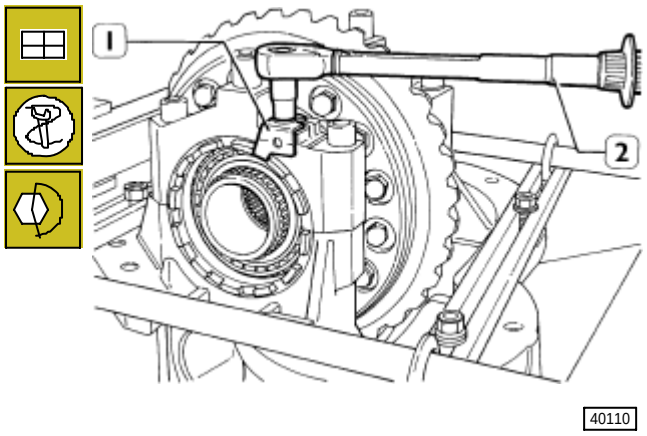


40161B

If the mark on the leading face is positioned towards the internal diameter, and on the pushing face it is located towards the external diameter of the bevel gear, the pinion is located too far away from the bevel gear axis.
- Solution: decrease the thickness of the adjusting ring (2, Figure 116).

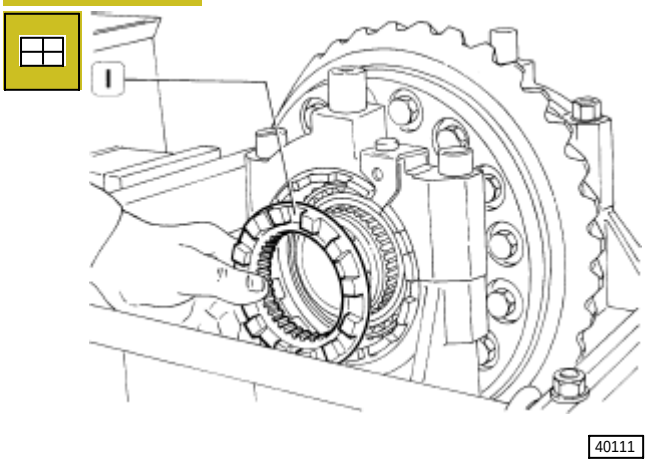
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Figure 139



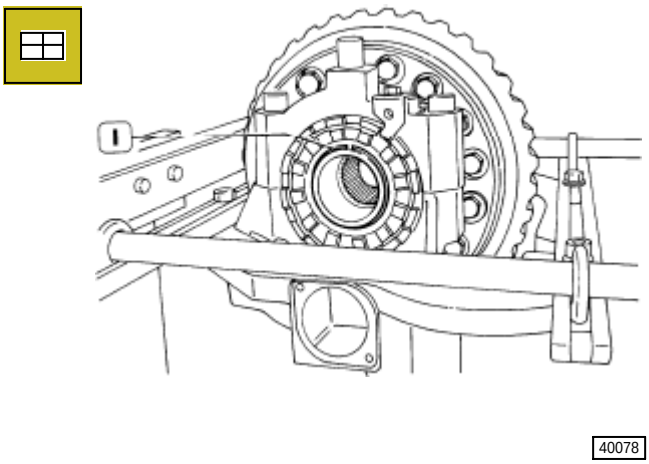

Assemble the safety plate (1); tighten the screw with a torque wrench (2) to a torque of 51 ± 5 Nm.

Figure 140



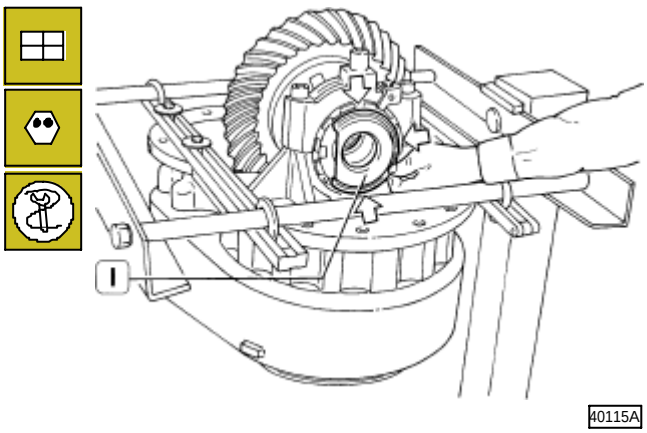

Fit the differential locking sleeve (1).

Figure 141



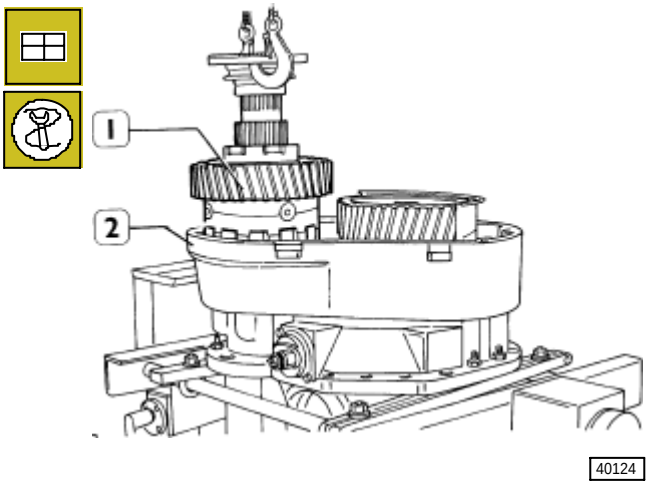

Secure in position with the safety ring (1).

Figure 142




Fit the oil baffle (1) with the straight side in the vertical position, as indicated in Figure 146.
Secure in the three points indicated by the arrows to prevent counter-rotation.

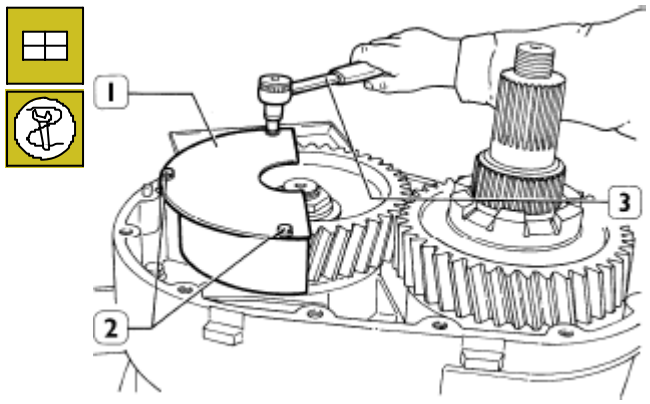
Figure 143




Fit the differential-flow divider unit (1) in the half-housing (2).

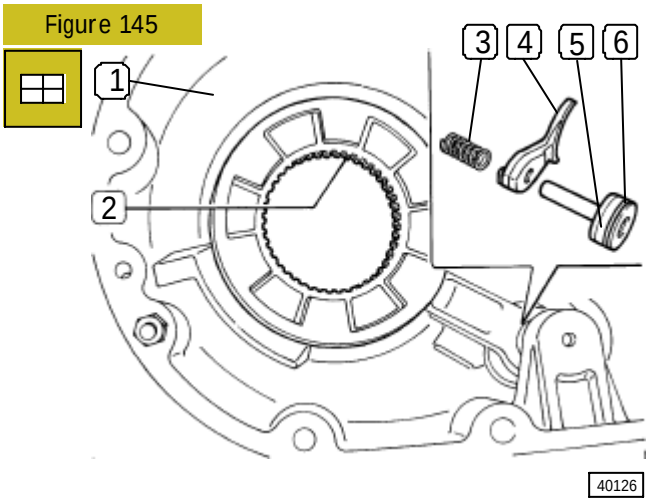
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Figure 144



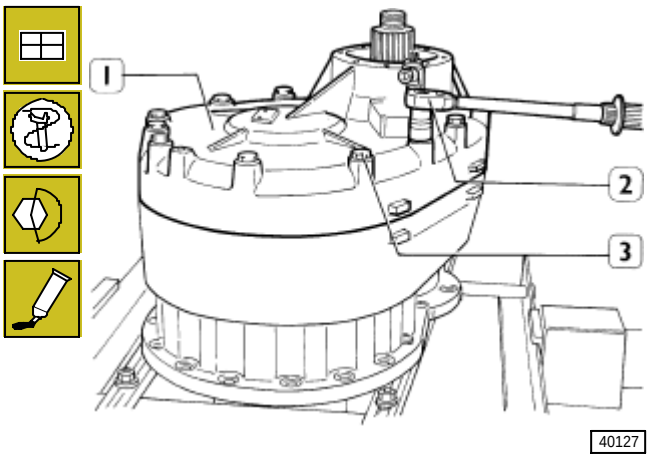

Assemble the upper part (1) of the oil feed and tighten the screws (2) with a wrench (3).

Figure 145



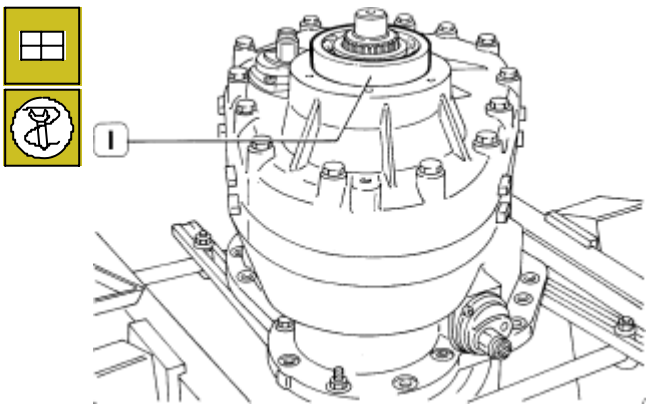

In the lower part of the cover (1), fit the flow divider differential engagement sleeve (2) and the control unit comprising: the spring (3), fork (4) and the piston (5) with a new seal ring (6).

Figure 146



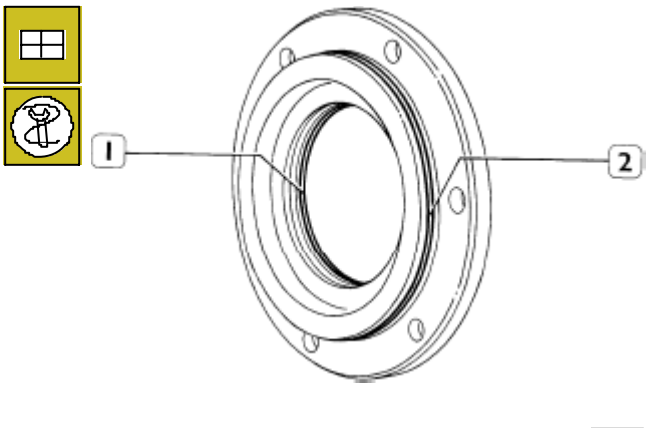

Smear LOCTITE AVX on the contact surface.
Fit the cover (1) and tighten the screws (3) to a torque of 182.5 Nm using the torque wrench (2).

Figure 147



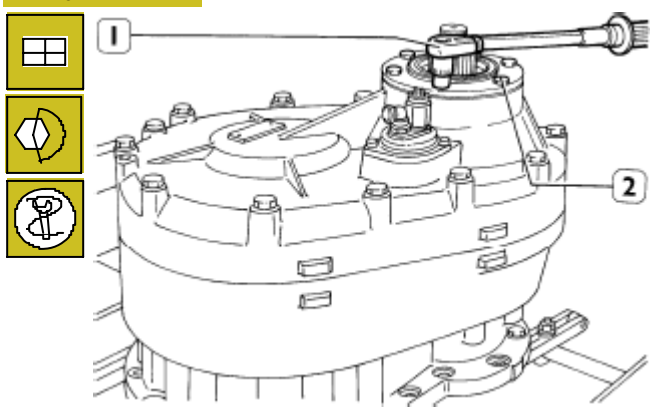

Using a punch, fit the ball bearing (1) on the input shaft.

Figure 148




Using key 99374233, fit the seal ring (1) in the cover; replace the seal ring (2).

Figure 149



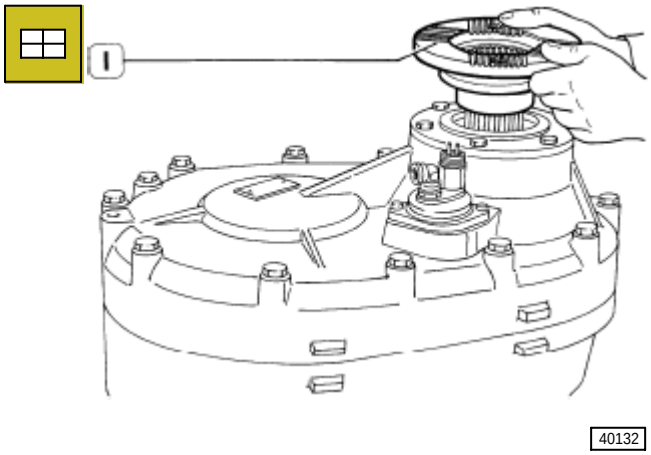

Fit the cover and tighten the screws (2) to a torque of 62 ± 6 Nm with a torque wrench (1).

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## 526064 DRIVE SHAFT

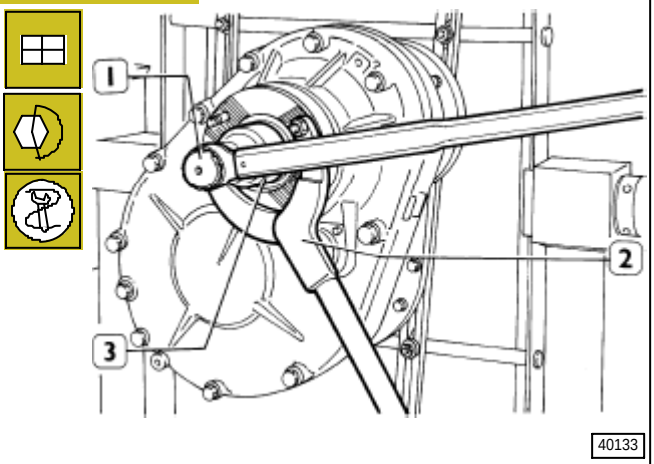
### Disassembly

Figure 150



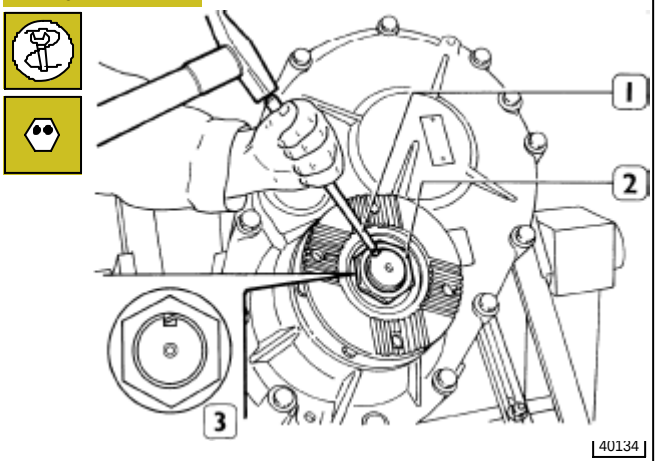

Fit the flange (1) on the input shaft.

Figure 151



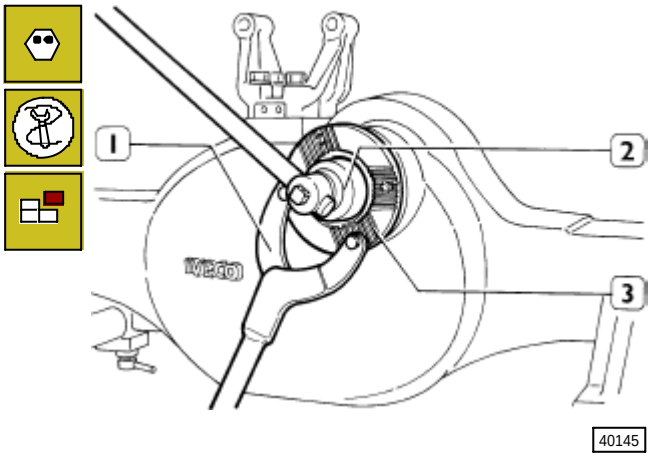

Rotate the unit and, using: a torque wrench (1), reaction lever (2) and Allen wrench 99355081 (3), tighten the nut to a torque of 800 to 850 Nm.

Figure 152



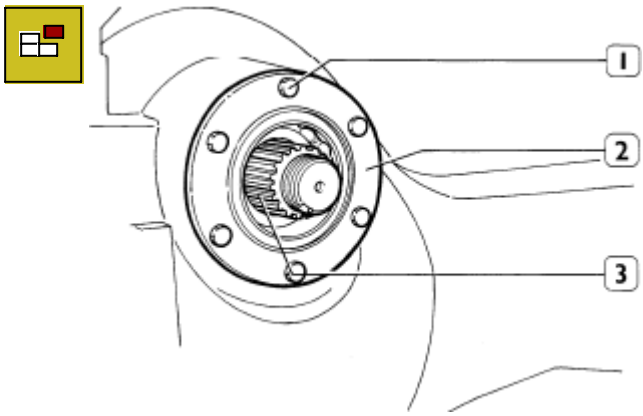

Using a punch (1), secure the nut (2) as shown in the detail (3).

Figure 153



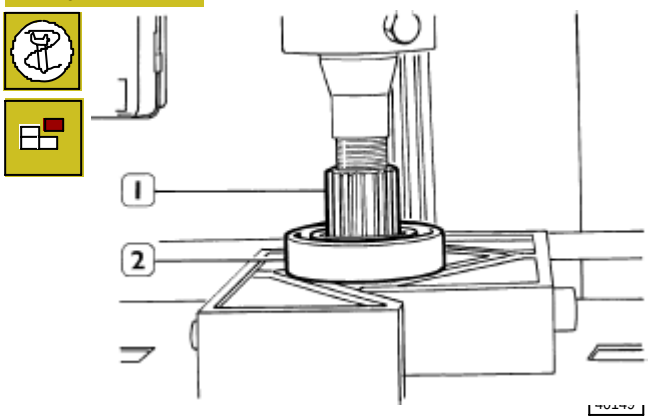

Remove the flange (3) nut safety notch. Position the reaction lever (1) and unscrew the nut (2) using Allen wrench 99355081. Extract the flange (3).

Figure 154




Unscrew the screws (1), remove the cover (2) and extract the drive shaft (3) and bearing.

Figure 155




Using a press, extract the ball bearing (1) from the drive shaft (2).

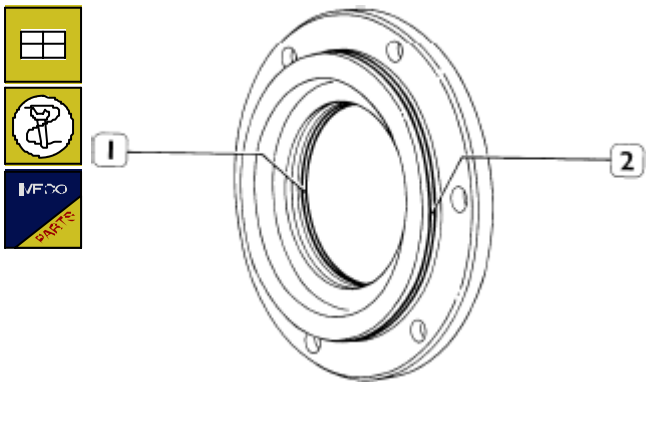
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## Checking parts

Clean and check all drive shaft parts, replacing any worn or damaged components. Always replace the seal rings.

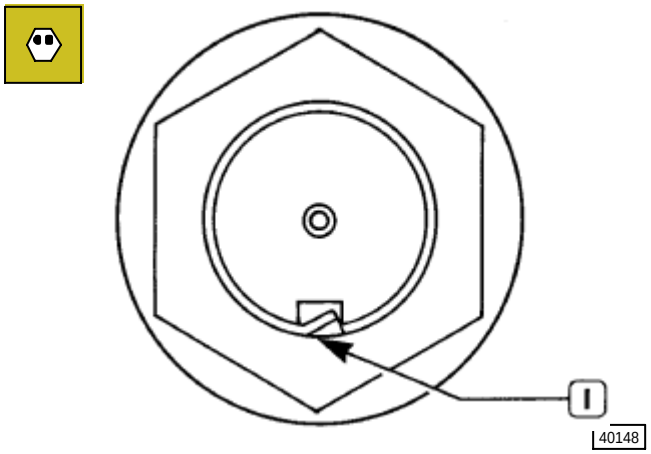
## Assembly

Figure 156




Using key 99374013, fit the internal seal ring (1) in the cover and replace the external seal ring (2).

Figure 157




Refit the drive shaft by reversing the order of the disassembly operations, and tighten the screws (1, Figure 157) to the correct torque.
Tighten the nut (1) to a torque of 650 to 750 Nm.
After having tightened the nut (1), secure the collar.

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# Intermediate axle 452146/2D (R 9174)


| | Page |
|---|---|
| DESCRIPTION | 103 |
| MAIN DATA | 104 |
| TIGHTENING TORQUES | 105 |
| TOOLS | 107 |
| INTERMEDIATE AXLE ASSEMBLY REPAIRS | 113 |
| - Disassembly | 113 |
| REPAIRING THE INTERAXLE DIFFERENTIAL | 113 |
| - Flow divider differential unit disassembly | 113 |
| - Removing the bevel pinion from the support | 116 |
| - Gear housing disassembly | 116 |
| - Interaxle differential disassembly | 117 |
| CHECKING THE INTERAXLE DIFFERENTIAL PARTS | 121 |
| - Interaxle differential assembly | 121 |
| - Differential housing assembly | 123 |
| - Assembling the bevel pinion support | 124 |
| - Procedure to follow to determine the thickness of the bevel pinion rolling torque adjusting ring | 124 |
| - Differential housing assembly | 126 |
| - Differential housing bearings rolling torque adjustment | 128 |

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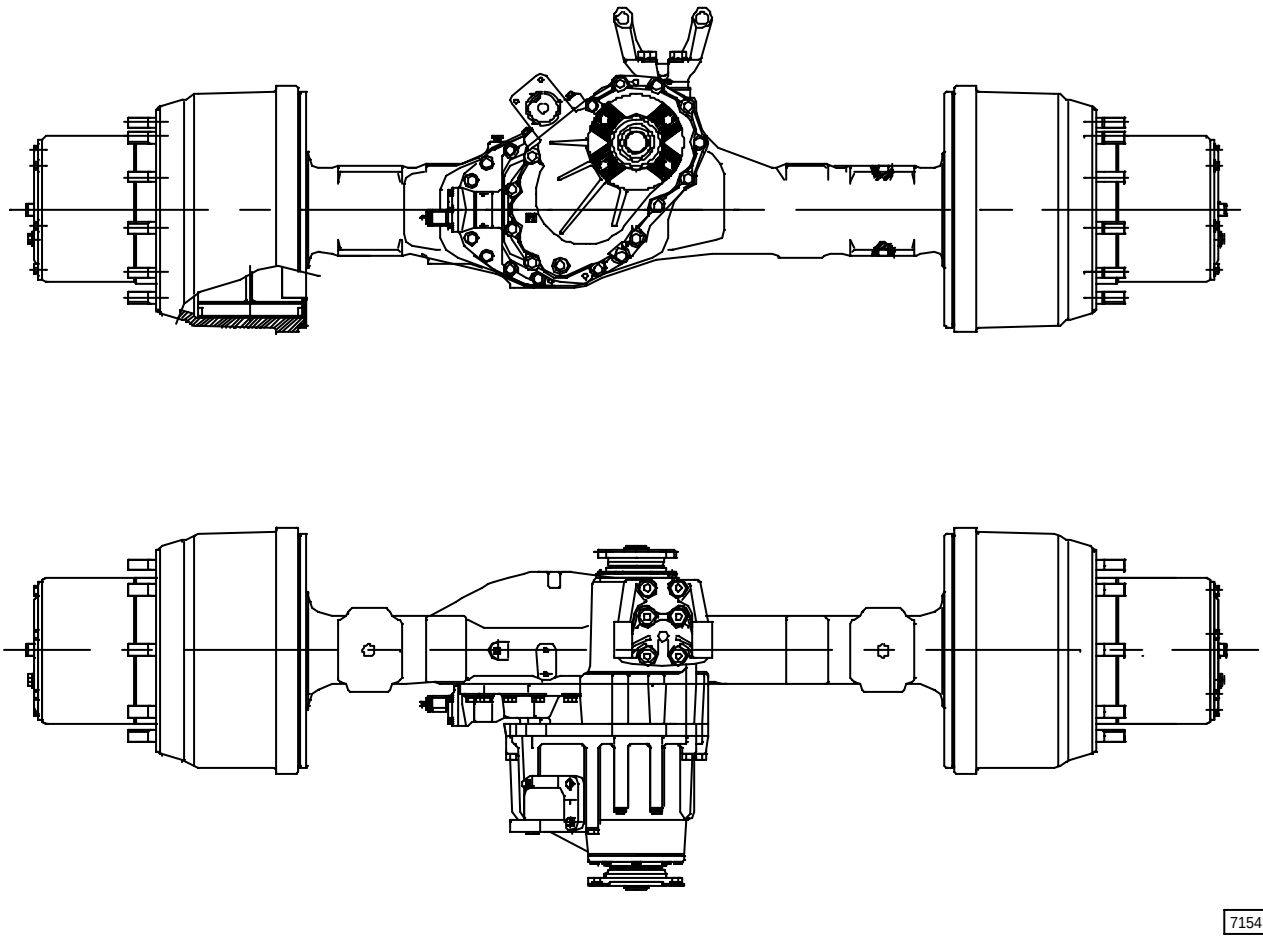
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## DESCRIPTION

The intermediate axle is of the load-bearing, double reduction type.
The first reduction is provided by the bevel pinion/ring bevel gear, whereas the second reduction is by means of an epicycloid unit on the wheel hubs.
The differential housing (with ring bevel gear) is supported by taper roller bearings, which can be adjusted by means of two threaded ring nuts.
The bevel pinion is supported by two taper roller bearings, which can be adjusted by means of adjustment rings.

The intermediate axle is fitted with an interaxle unit that distributes the torque between the two axles.
The axle shafts start from the differential and transmit drive to the epicycloid reduction units located in the wheel hubs.
The axle is also provided with a pneumatic device for differential locking and another device for flow divider locking.
The drum brake is of the Duo/Duplex type.

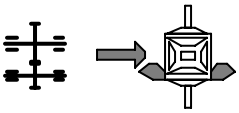
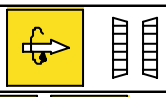
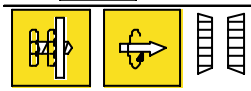
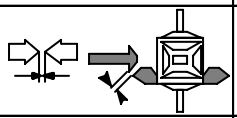
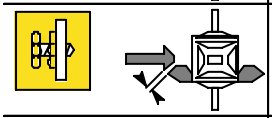
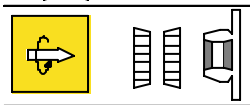
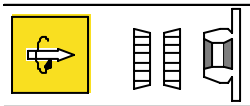
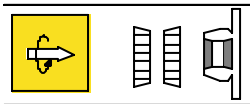
Figure 1




LONGITUDINAL PICTORIAL SECTION OF DIFFERENTIAL REDUCTION GEAR UNIT

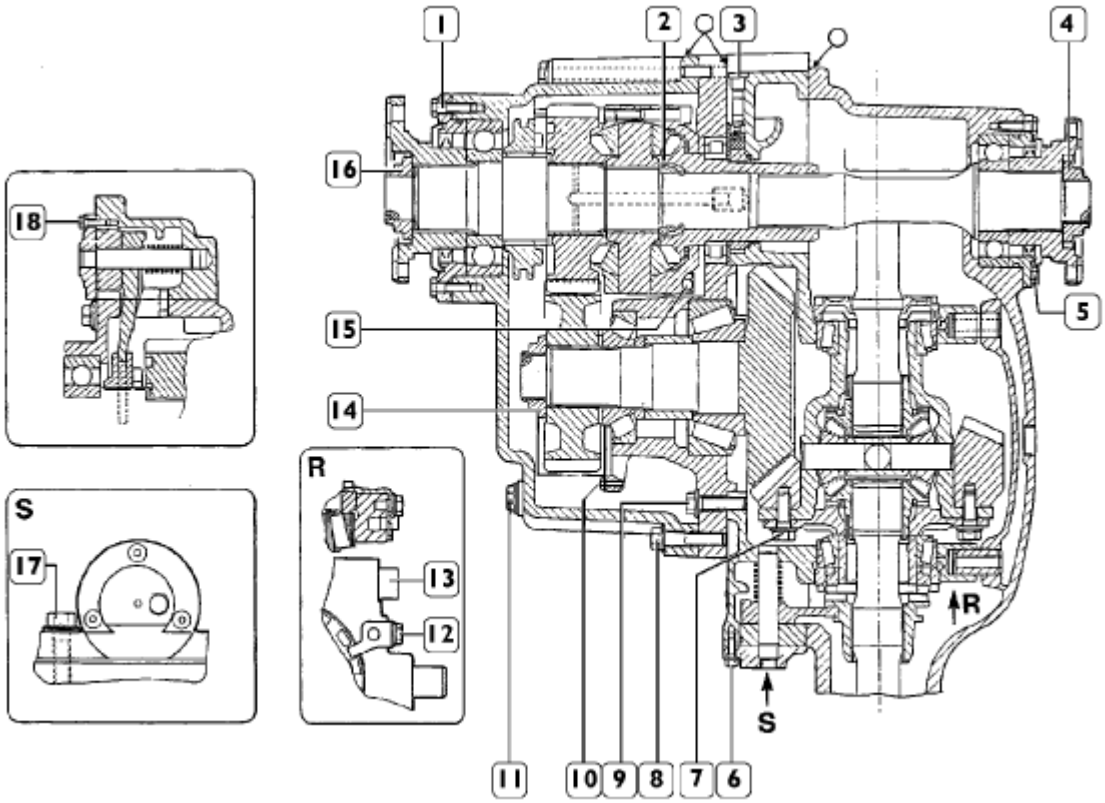
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## MAIN DATA

| | | |
|---|---|---|
|  | Type of axle:<br>Load-bearing, double reduction with pneumatically controlled differential locking and flow divider unit | 452146/2D (R 9174) |
|  | Bevel pinion bearings | 2 taper rollers |
|  | Bevel gear reduction unit ratio | 34/37 (1.088) - 27/32 (1.185) - 28/37 (1.321) - 29/37 (1.276) - 27/37 (1.370) - 24/35 (1.458) - 23/36 (1.565) - 21/34 (1.619) - 19/33 (1.737) - 21/40 (1.905) - 17/35 (2.059) - 15/34 (2.267) - 17/36 (2.118) |
|  | Epicyclic reduction unit/wheels ratio | 3.2 |
|  | Bevel pinion bearing rolling torque without seal Nm | 6 ÷ 8 |
|  | Bevel pinion bearing rolling torque adjustment | with adjustment rings |
|  | Thickness of bevel pinion bearing rolling torque adjustment ring mm | 10 - 10.02 - 10.04 - 10.06 - 10.08 - 10.10 - 10.12 - 10.14 - 10.16 - 10.18 - 10.20 - 10.22 - 10.24 - 10.26 - 10.28 - 10.30 - 10.32 - 10.34 - 10.36 - 10.38 - 10.40 - 10.42 - 10.44 - 10.46 - 10.48 - 10.50 - 10.52 - 10.54 - 10.56 - 10.58 - 10.60 |
|  | Thickness of bevel pinion/ring bevel gear position adjustment rings mm | 0.2 - 0.3 - 0.5 - 1 |
|  | Clearance between pinion and ring bevel gear mm | 0.15 ÷ 0.35 |
|  | Adjustment of clearance between pinion and ring bevel gear | with ring nuts |
|  | WHEEL HUBS | |
|  | Wheel hub bearings | 2 taper rollers |
|  | Wheel hub bearings rolling torque: new bearings with surface protection Nm | 6 ÷7 Nm + (12 ÷16 Nm) |
|  | Wheel hub bearings rolling torque: run in bearings and new, lubricated seals Nm | 6 ÷7 Nm + (5 ÷7 Nm) |
|  | Adjustment of clearance between pinion and ring bevel gear Nm | 3 Nm + (2.5 ÷4.5 Nm) |
|  | Drive shaft end float mm | 0.5 ÷ 1 |
|  | Axle oil<br>Quantity Litres kg | **TUTELA W140/MDA**<br>13 |
| | G.R.W. maximum load kg | 11000 |

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Figure 2




115269

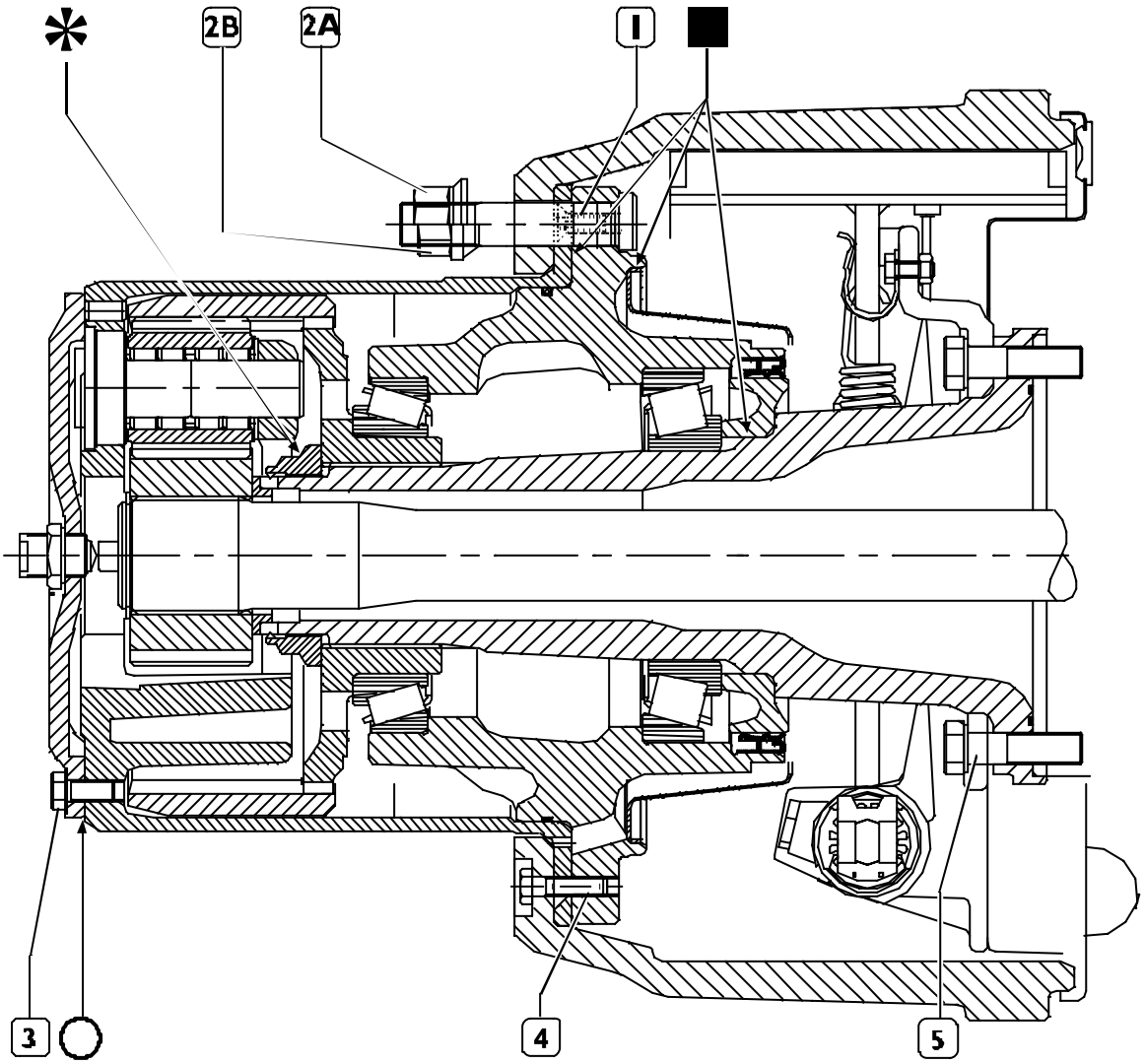
## TIGHTENING TORQUES

| | DESCRIPTION | TORQUE Nm | TORQUE kgm |
|---|---|---|---|
| 1 | Screw for input shaft cover H | 33 ± 3 | 3.3 ± 0.3 |
| 2 | Ring nut for flow divider spider | 220 ± 20 | 22 ± 2 |
| 3 | Oil pump cap | 21.5 ± 1.5 | 2.2 ± 0.2 |
| 4 | Nut for drive shaft flange | 700 ± 50 | 70 ± 5 |
| 5 | Screw for drive shaft cover H | 33 ± 3 | 3.3 ± 0.3 |
| 6 | Screw for differential lock cover | 19 ± 2 | 1.9 ± 0.2 |
| 7 | Self-locking screw fixing ring bevel gear | 170 ± 10 | 17 ± 1 |
| 8 | Screw fixing flow divider half-housing H | 110 ± 10 | 11 ± 1 |
| 9 | Screw fixing bevel pinion support | 170 ± 10 | 17 ± 1 |
| 10 | Screw fixing oil manifold | 9 ± 1 | 0.9 ± 0.1 |
| 11 | Oil plug | 80 ± 8 | 8 ± 0.8 |
| 12 | Screw for safety plate | 51 ± 4 | 5.1 ± 0.4 |
| 13 | Screw fixing gear housing caps H | 180 ± 10 | 18 ± 1 |
| 14 | Nut locking gear on bevel pinion shaft | 700 ± 50 | 70 ± 5 |
| 15 | Screw fixing bearing retaining plate | 120 ± 10 | 12 ± 10 |
| 16 | Nut for input shaft flange | 700 ± 50 | 70 ± 5 |
| 17 | Screw fixing housing | 170 ± 10 | 17 ± 1 |
| 18 | Screw for flow divider locking control cover H | 19 ± 2 | 1.9 ± 0.2 |

H apply LOCTITE AVX
○ apply LOCTITE 573

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Figure 3




98970

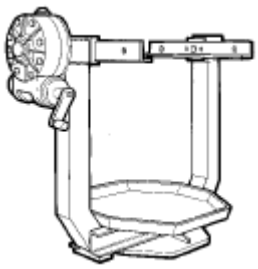
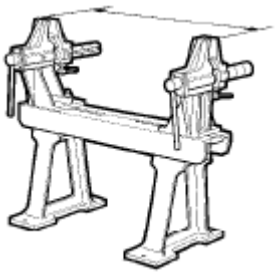
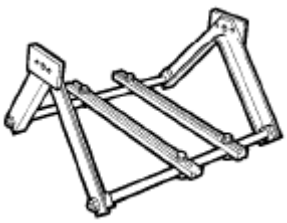
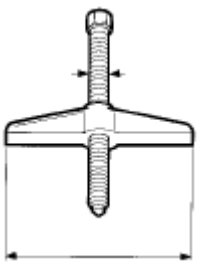
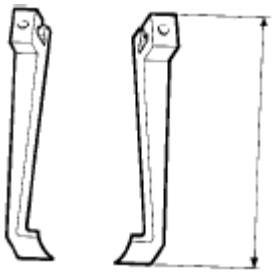
## TIGHTENING TORQUES

| | DESCRIPTION | TORQUE Nm | TORQUE kgm |
|---|---|---|---|
| 1 | Countersunk screw fixing drum | 25 ± 3 | 2.5 ± 0.3 |
| 2A | Nut fixing wheel | 615 ± 35 | 61.5 ± 3.5 |
| 2B | Nut fixing wheel | 415 ± 35 | 41.5 ± 3.5 |
| 3 | Screw fixing cover to crown wheel support h | 50 ± 5 | 5 ± 0.5 |
| 4 | Screw | 50 ± 5 | 5 ± 0.5 |
| 5 | Screw fixing load bearing sleeve | 295 ± 30 | 29.5 ± 3 |

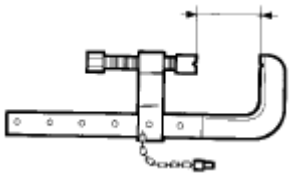
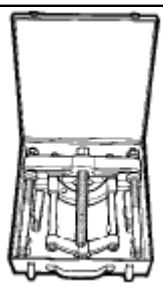
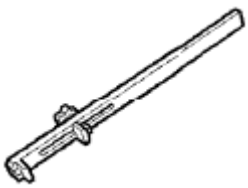
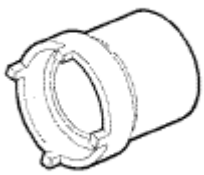
d apply LOCTITE 5970 on the contact surface
h apply LOCTITE 573 on thread
H apply LOCTITE 573 on mating surface
: before mounting, slightly smear MOLYCOTE on nut rest surface

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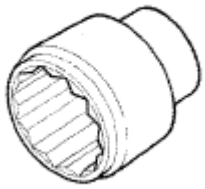
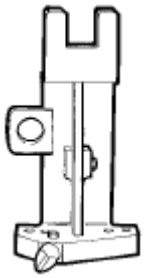
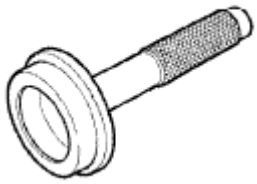
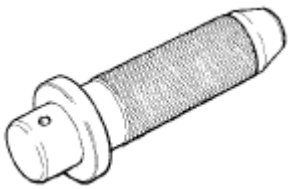
## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99305121** |  | Hot air device |
| **99322205** |  | Rotating stand for assembly overhaul |
| **99322215** |  | Stand for axles overhaul |
| **99322225** |  | Support for assemblies (to be fitted on stand 99322205) |
| **99341003** |  | Single-acting bridge |
| **99341012** |  | Pair of brackets |

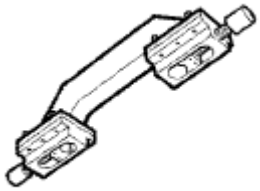
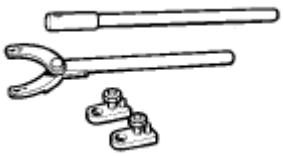
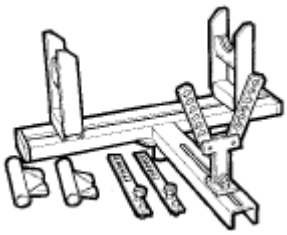
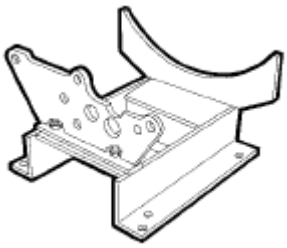
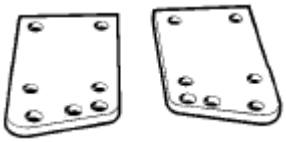
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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99341015** |  | Press |
| **99345053** |  | Reaction block for extractors |
| **99348001** |  | Extractor with locking device |
| **99354207** |  | Wrench (94.5 mm) for wheel hub bearings adjusting nut |
| **99355025** |  | Wrench for differential gear housing bearing adjustment ring nuts |
| **99355086** |  | Wrench for flow divider main shaft ring nut |

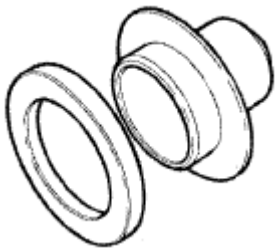
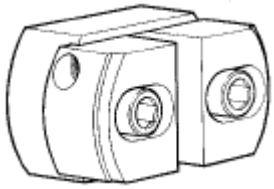
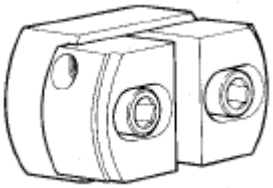
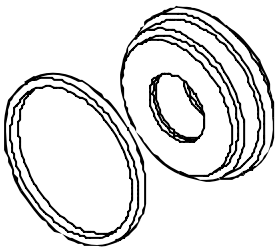
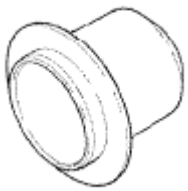
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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99355131** |  | Wrench (55 mm) for drive infeed flange nut |
| **99363310** |  | Tool for retaining spur gear on flow divider bevel pinion |
| **99370005** |  | Grip for interchangeable punches |
| **99370006** |  | Interchangeable grip for punches |
| **99370007** |  | Interchangeable grip for punches |
| **99370121** |  | Punch for fitting crown wheel bushings (use with 99370006) |

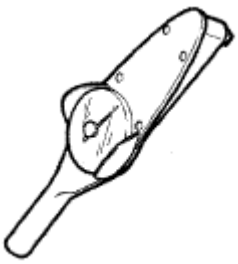
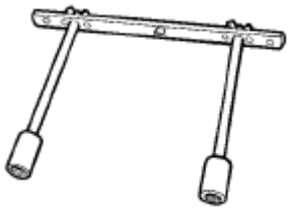
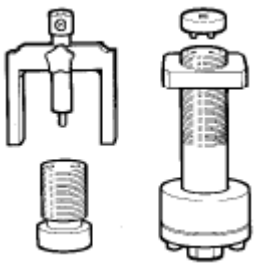
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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99370133** |  | Tool for locking differential caps spread |
| **99370317** |  | Reaction lever with extension for flange retaining |
| **99370509** |  | Hook to extract differential gear half-housing |
| **99370617** |  | Universal mounting to support axles during removal and refitting |
| **99370630** |  | Mounting for removal and refitting of flow divider |
| **99371022** |  | Pair of differential support brackets for use during overhaul (use with 99322205-99322225) |

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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99374013** |  | Key to fit differential bevel pinion seal (use with 99370006) |
| **99374093** |  | Punch to fit external races of bearings (use with 99370007) |
| **99374094** |  | Punch to fit external races of bearings (134 - 215) (use with 99370007) |
| **99374161** |  | Key for assembly of wheel hub internal seals |
| **99374233** |  | Key to fit flow divider drive shaft seal |
| **99374451** |  | Tool for axle shaft disassembly-assembly |

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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99389816** |  | x 4 torque multiplier with 3/4 " infeed and 1" square connection (max. 2745 Nm) |
| **99389819** |  | Torque wrench from 0 to 10 Nm with 1/4" square connection |
| **99389821** |  | Torque wrench from 0 to 70 Nm with 3/8" square connection |
| **99395026** |  | Tool to check rolling torque of hubs (use with torque wrench) |
| **99395027** |  | Tool to determine thickness of differential bevel pinion adjustment shims (use with 99395603) |
| **99395603** |  | Dial gauge (0 - 5 mm) |

Aquila Trucks Centres

## 526110 INTERMEDIATE AXLE ASSEMBLY REPAIRS

### Disassembly

**NOTE** The drive shafts - brake drums and jaws - air breather - interaxle differential - wheel hubs and epicyclic reduction units removal-refitting operations, can all be carried out with the unit fitted on the vehicle.

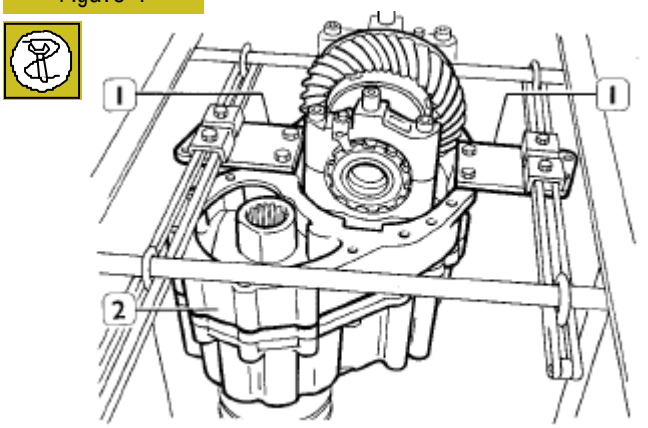
Before positioning the axle assembly on the overhaul stand, drain off the oil by unscrewing the lower plug on the axle housing.

**NOTE** For repairs on the wheel hubs, epicyclic reduction units, drive shaft and flow divider differential removal-refitting operations, follow the instructions for the 451391/2D - 452191/2D intermediate axles.

## 526110 REPAIRING THE INTERAXLE-DIFFERENTIAL

### Flow divider differential unit disassembly

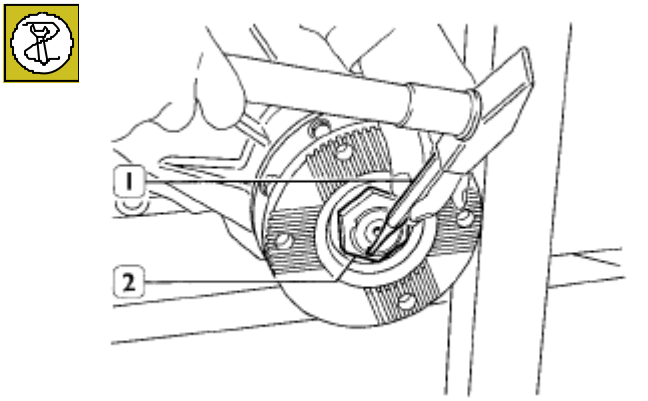
Figure 4




42533

Position the interaxle differential unit (2) on stand 99322205, with brackets 99371022 (1).

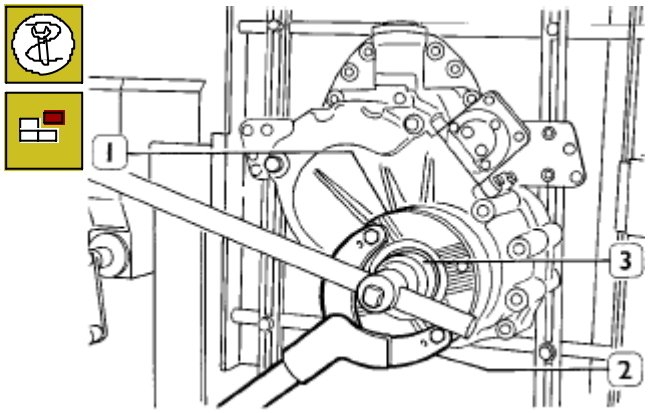
Figure 5




42534

Using a punch (1) remove the safety notch on the nut (2).

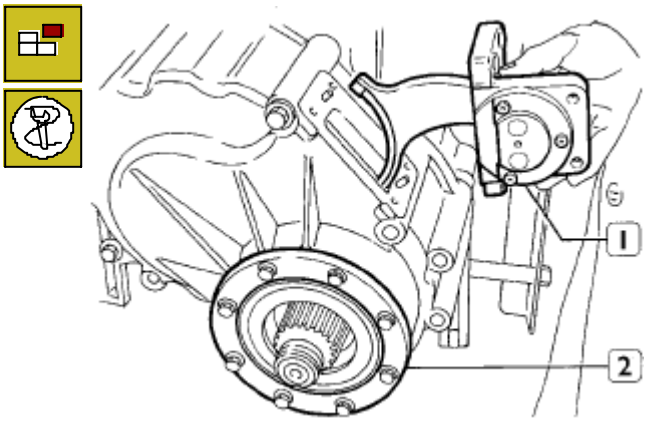
Figure 6




42535

Apply reaction lever 99370317 (2), using Allen wrench 99355131 (1), unscrew the nut and extract the drive coupling flange (3).

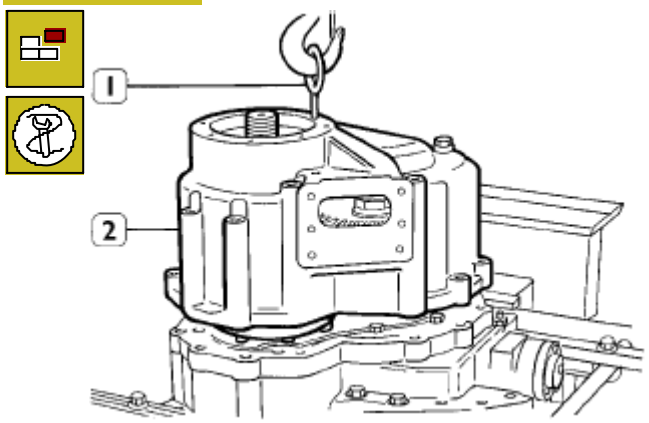
Figure 7




43536

Unscrew the screws and remove the interaxle control assembly (1).
Unscrew the screws and remove the cover (2).

Figure 8

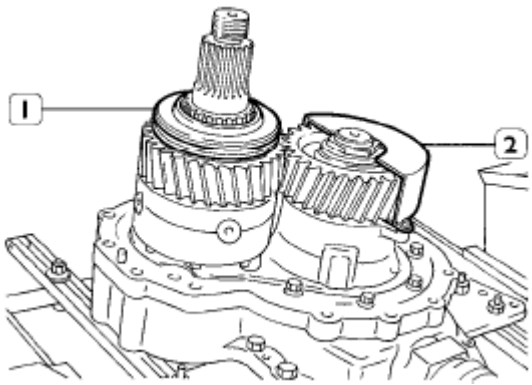



42537

Remove the screws on the cover (2) and, using an eyebolt (1), remove the cover (2).

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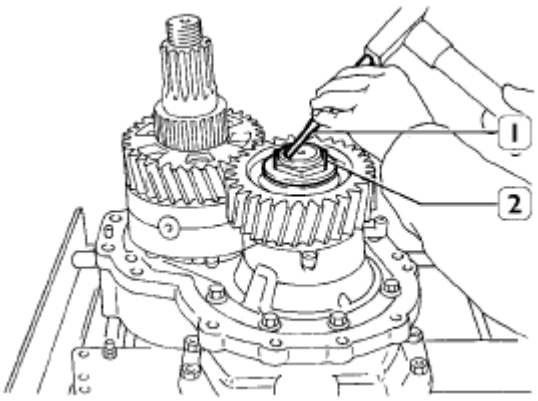
Figure 9




42538

Extract the sliding sleeve (1) and remove the oil feed (2).

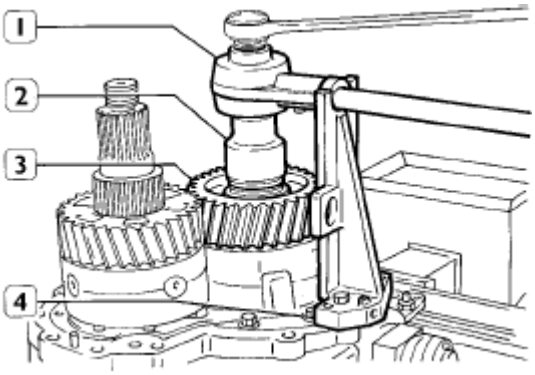
Figure 10




42539

Using a punch (1) remove the safety notch on the nut (2).

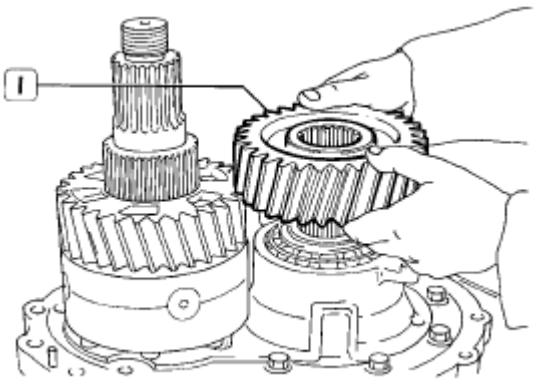
Figure 11




42540

Fit tool 99363310 (4), blocking gear unit (3) rotation. Using Allen wrench 99355131 (2) and multiplier 99389816 (1) unscrew the bevel pinion fixing nut.

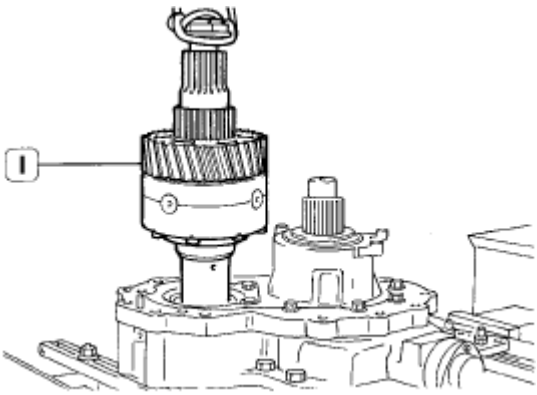
Figure 12




42541

Extract the driven gear (1) and the spacer.

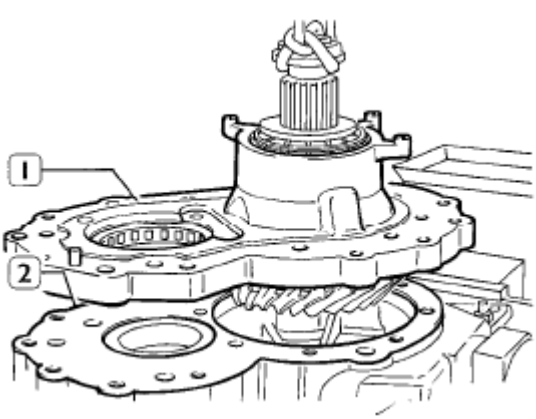
Figure 13




42542

Using slings, raise and remove the flow divider differential unit (1).

Figure 14

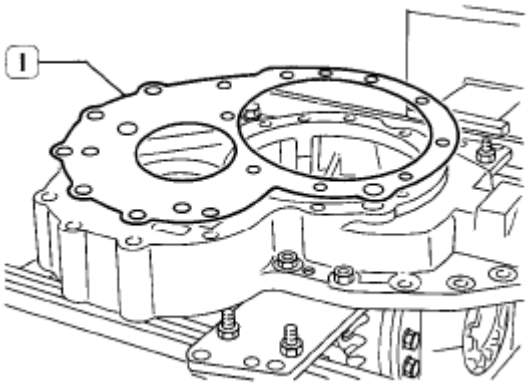



42543

Unscrew the screws fixing the bevel pinion support (1) to the housing (2) and, using slings, disassemble together with the bevel pinion.

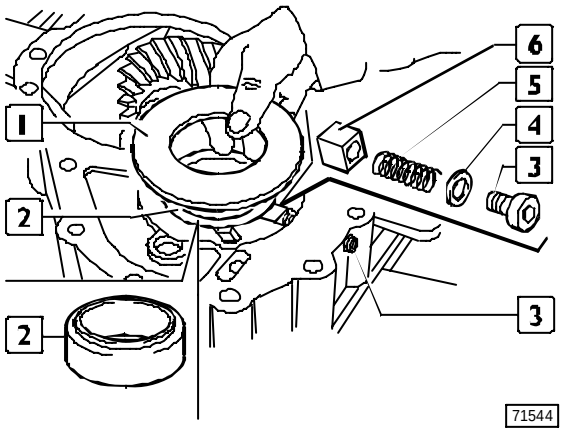
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Figure 15



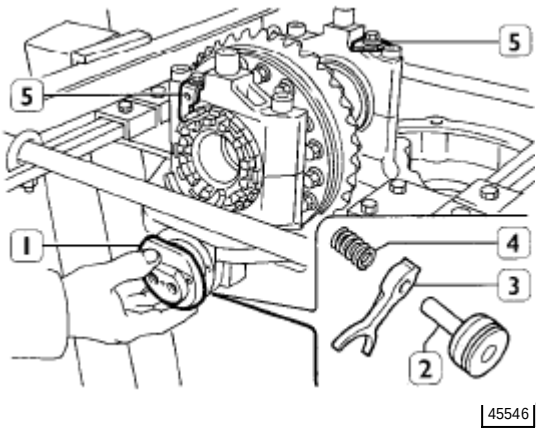

Remove adjustment shim (1).

Figure 16



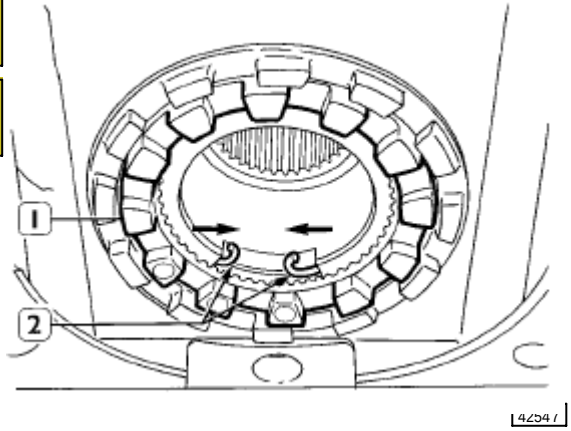

Remove the guard disk (1). Remove the plug (3), complete with washer (4), and extract the spring (5) and piston (6). Remove the eccentric (2).

Figure 17



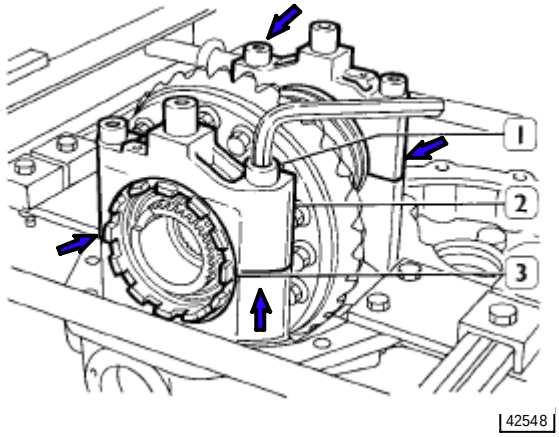

Rotate the stand through 180°.
Unscrew the two screws and remove the cover (1), the piston (2), the fork (3) and the spring (4). Unscrew the screw and remove the safety plate (5).

Figure 18



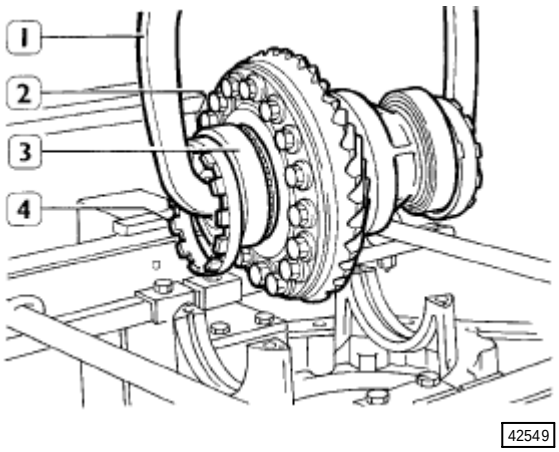

Using suitable pliers, acting on the retaining circlip (2) in the direction indicated by the arrows, then extract the differential lock fixed sleeve (1).

Figure 19




Slightly loosen the adjusting ring nut (3). Heat the points indicated by the arrows with drier 99305121 and unscrew the screws (1) secured with LOCTITE. Counter-mark and the remove the caps (2).

Figure 20

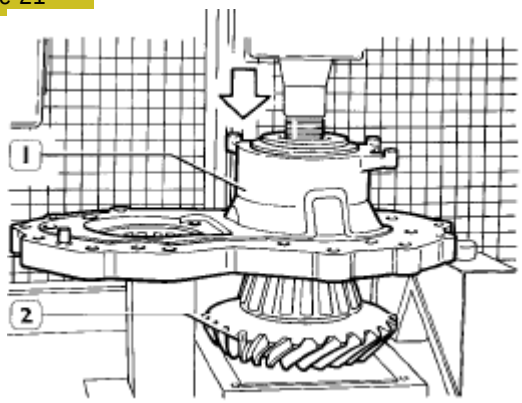



Using hook 99370509 (1), remove the differential housing (2), together with the bearings (3) and ring nut (4).

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## Removing the bevel pinion from the support

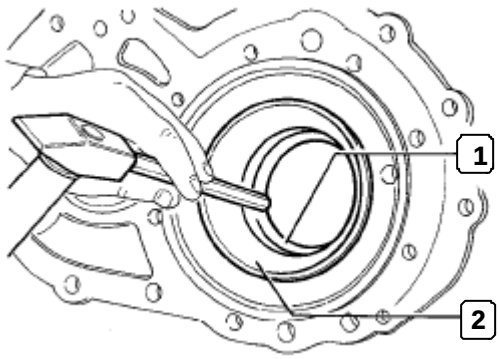
Figure 21




42550

Disassembly of the bevel pinion (2) from the support (1) must be carried out under a press.

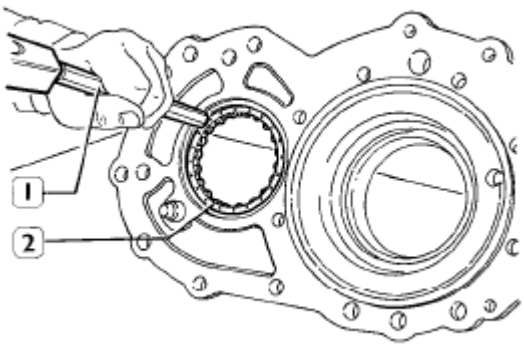
Figure 22




42551

Using a punch, extract the external rings (1-2) of the bearings.

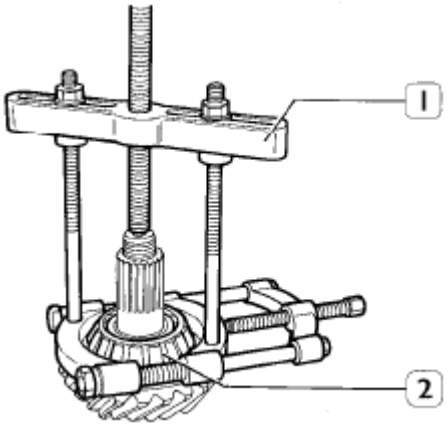
Figure 23




42552

Using a punch (1), extract the roller bearing (2).

Figure 24

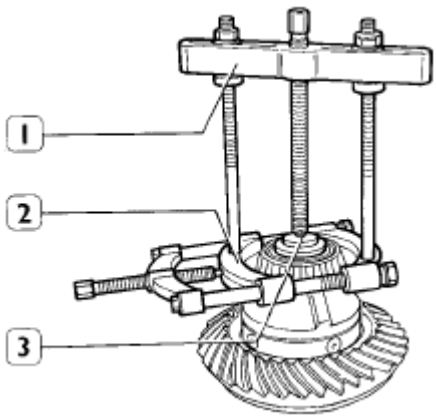



40077

Using extractor 99348001 (1), extract the bearing (2) from the bevel pinion.

## Gear housing disassembly

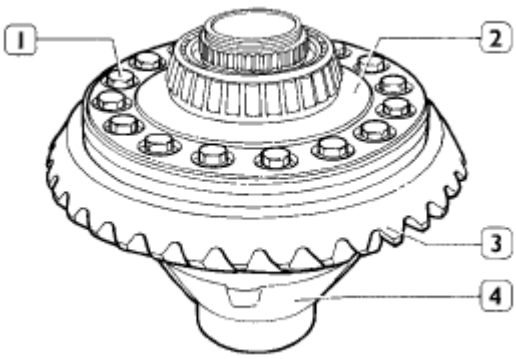
Figure 25




40086

Using extractor 99348001 (1-2) and reaction block 99345055 (3), extract the taper roller bearing from the gear housing. Repeat the same operation on the opposite side.

Figure 26

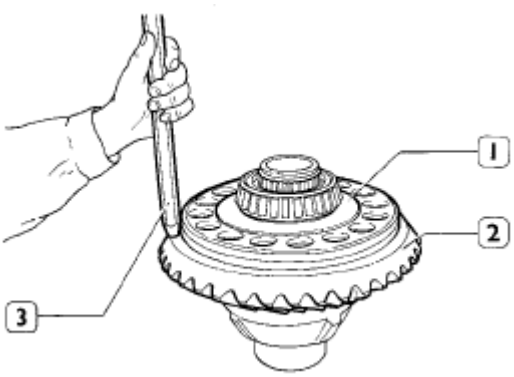



40087

Loosen and extract the screws (1) fixing the ring bevel gear (3) and cover (2) to the half-housing (4).

Aquila Trucks Centres

Figure 27

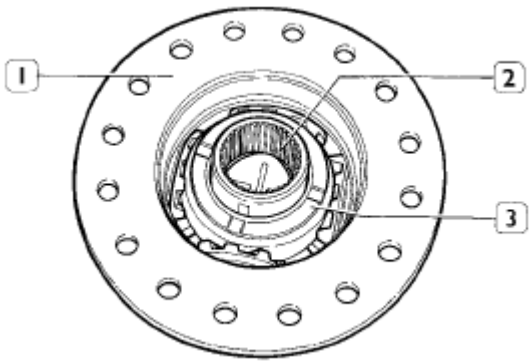



40088

Counter-mark the cover and gear housing.

Remove the gear housing cover (1) and release the ring bevel gear (2) using a punch (3).

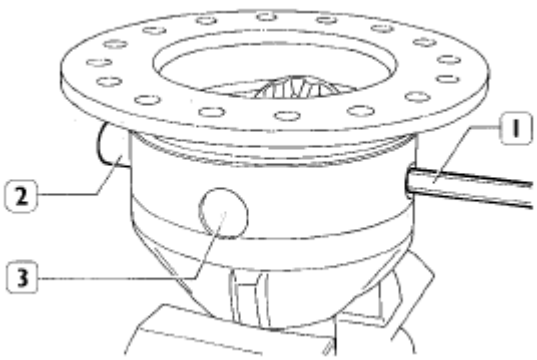
Figure 28




40089

Remove the crown wheel (2), together with the shoulder washer (3), from the gear housing (1).

Figure 29

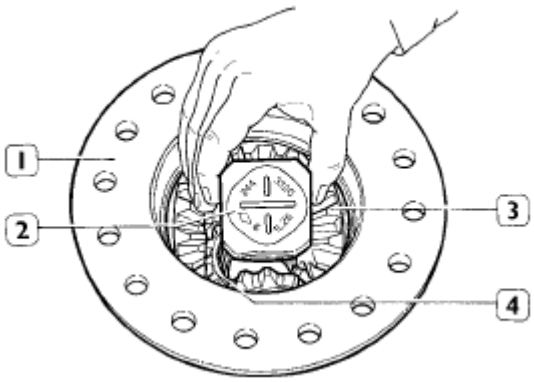



40090

Using a punch (1), first extract the long pin (2) and then the two short pins (3).

**NOTE** The exact position of the pins is marked on the spider body (2, Figure 30) by a long stripe for the long pin, and by two short stripes for the short pins.

Figure 30

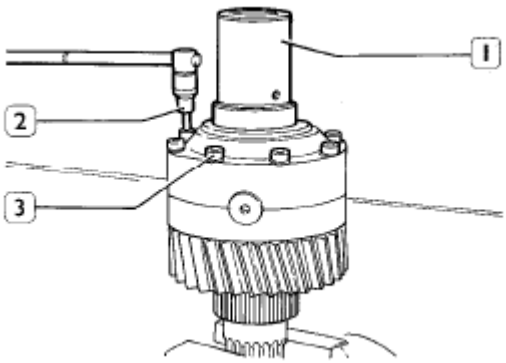



40091

Remove the spider (2) and the side pinions (3) with the relative shoulder washers and crown wheel (4) from the gear housing (1).

## Interaxle differential disassembly

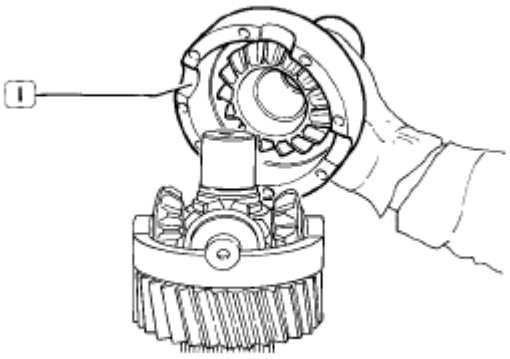
Figure 31




42553

Fit the differential-flow divider (1) in a vice. Using 8 mm Allen wrench (2) unscrew the screws (1).

Figure 32

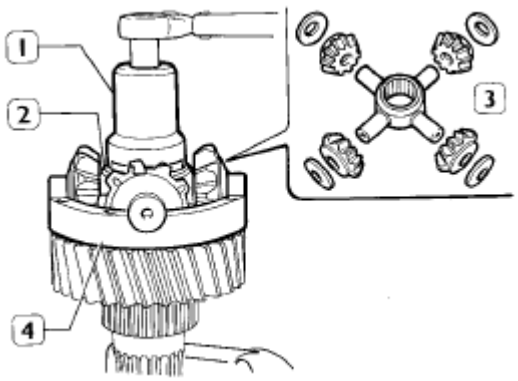



42554

Remove the half-housing (1) and crown wheel (2).

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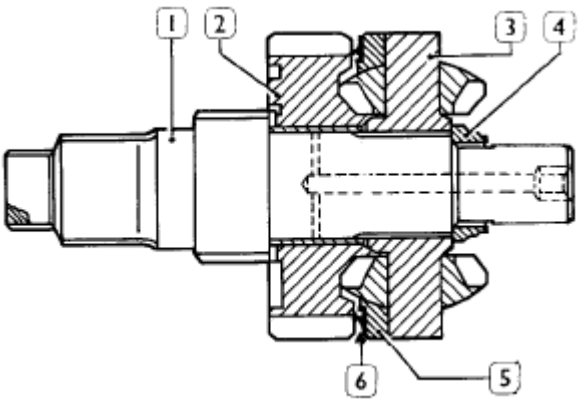
Figure 33




42555

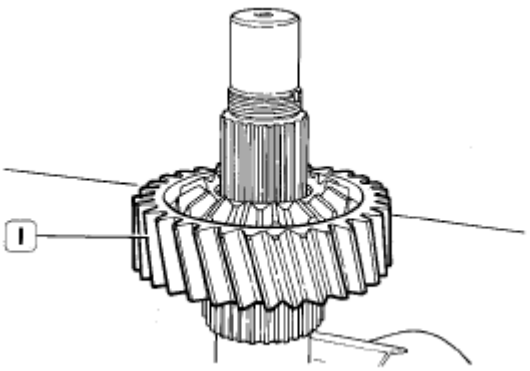
Using a punch, remove the notch on the ring nut (2). With wrench 99355086 (1) unscrew the ring nut (2), remove the spider (3) and the side pinion and shoulder washers. Remove the half-housing (4).

Figure 34




1. Input shaft - 2. Driving gear - 3. Spider - 4. Ring nut - 5. Differential half-housing - 6. Seal ring

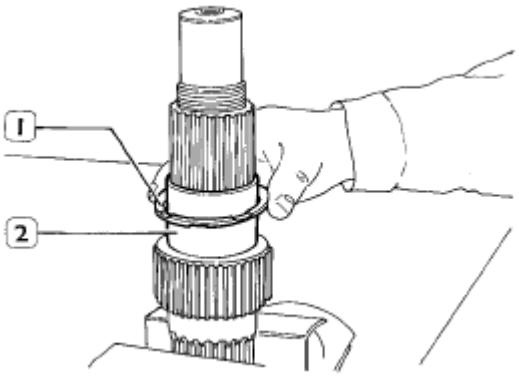
Figure 35




42556

Extract the driving gear (1).

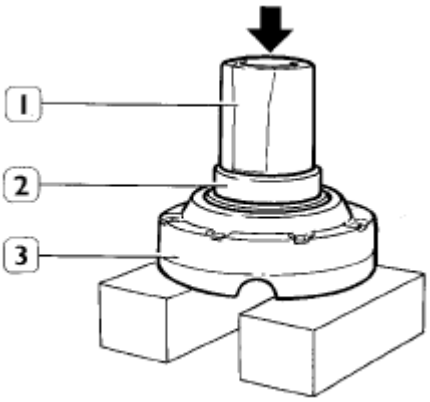
Figure 36




42557

Extract the shoulder washer (1) and the bushing (2). This is a destructive operation.

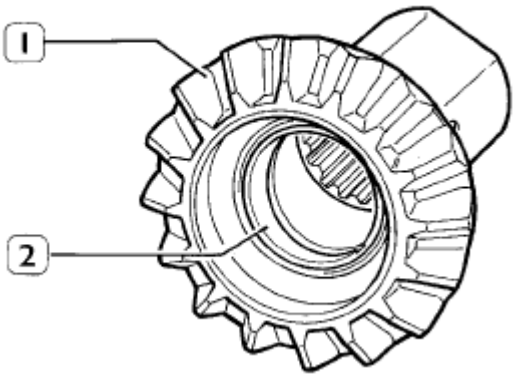
Figure 37




42558

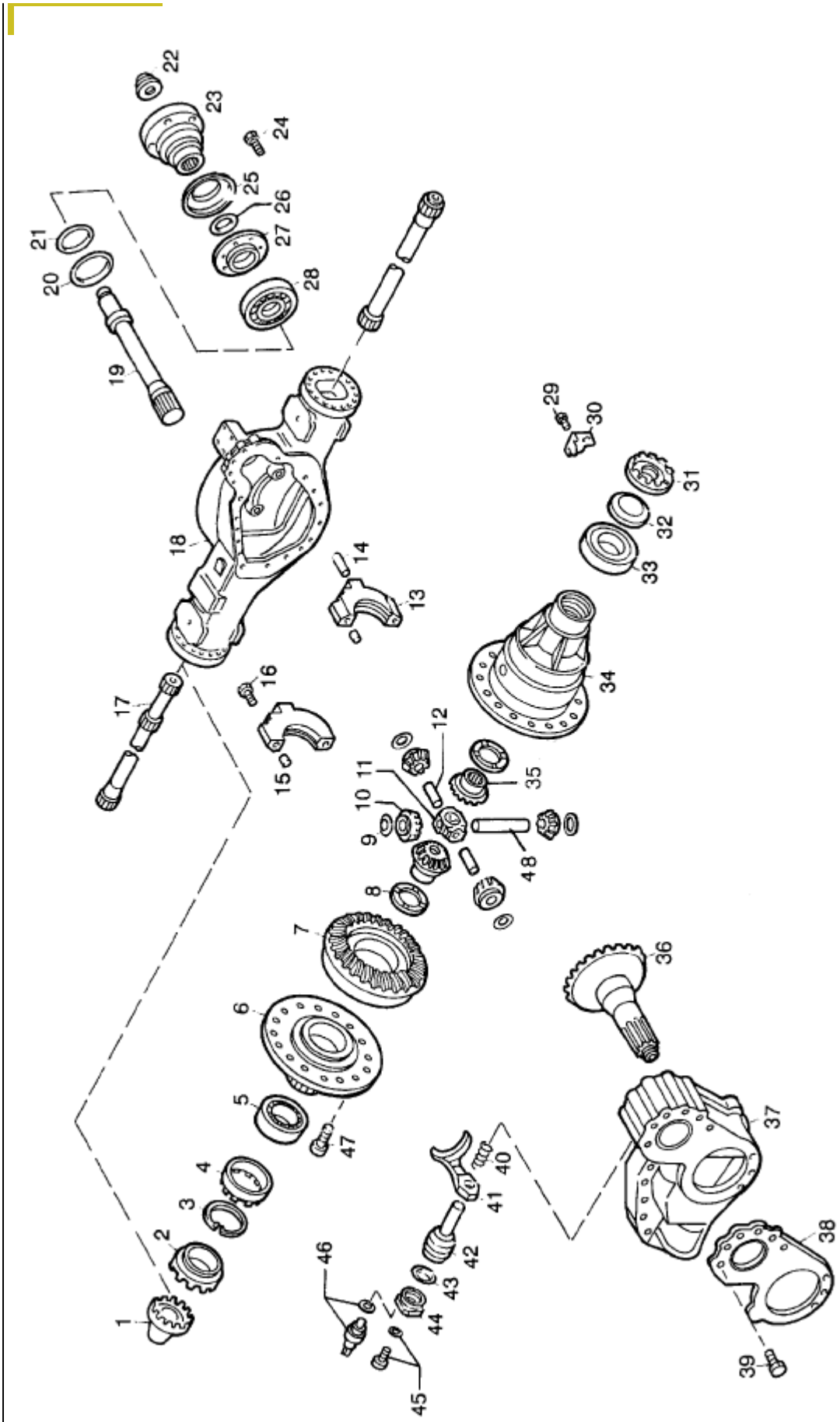
Acting on the crown wheel gear unit (1) in the direction indicated by the arrows, extract the roller bearing internal ring (2) and the crown wheel gear unit from the half-housing (3).

Figure 38




Using a punch, extract the bushing (2) from the crown wheel gear unit (1).

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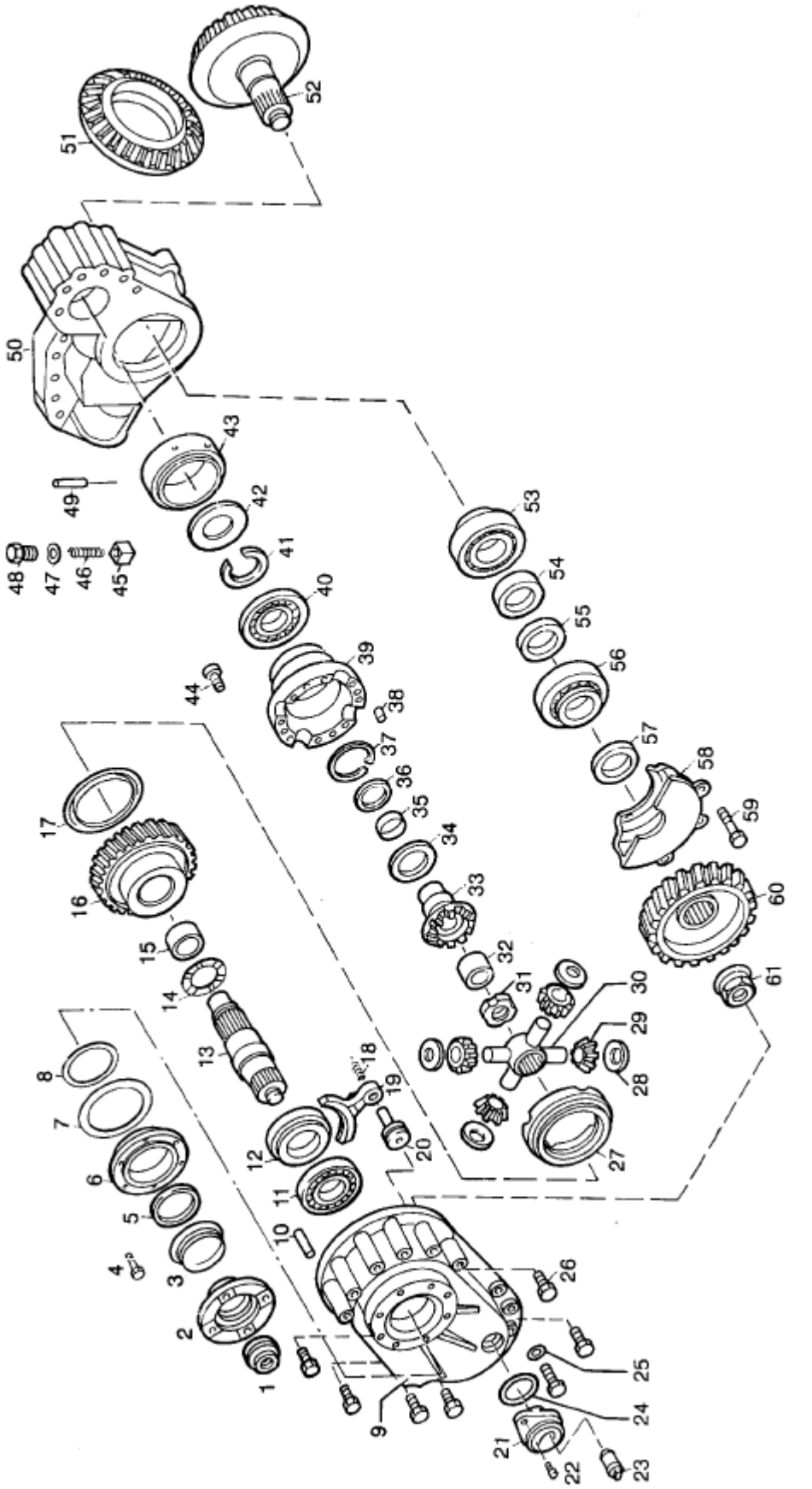


DIFFERENTIAL COMPONENTS

1. Sliding sleeve - 2. Fixed sleeve - 3. Circlip - 4. Ring nut - 5. Bearing - 6. Cover - 7. Crown - 8. Shoulder washer - 9. Fifth wheel - 10. Side pinion - 11. Spider - 12. Short pin - 13. Cap - 14. Pin - 15. Pin - 16. Screw - 17. Drive shaft - 18. Axle housing - 19. Shaft - 20. Seal ring - 21. Seal ring - 22. Nut - 23. Flange - 24. Screw - 25. Dust seal cover - 26. Seal ring - 27. Cover - 28. Bearing - 29. Screw - 30. Plate - 31. Ring nut - 32. Oil baffle - 33. Bearing - 34. Gear housing - 35. Crown wheel - 36. Pinion - 37. Support - 38. Adjusting shim - 39. Screw - 40. Spring - 41. Fork - 42. Piston - 43. Ring - 44. Cover - 45. Screw - 46. Switch - 47. Screw - 48. Long pin

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Figure 40



FLOW DIVIDER-DIFFERENTIAL COMPONENTS

1. Nut - 2. Flange - 3. Dust seal cover - 4. Screw - 5. Seal ring - 6. Cover - 7. Seal ring - 8. Seal ring - 9. Housing - 10. Pin - 11. Bearing - 12. Sliding sleeve - 13. Shaft - 14. Washer - 15. Bushing - 16. Gears - 17. Oil guard ring - 18. Spring - 19. Fork - 20. Piston - 21. Cover - 22. Screw - 23. Switch - 24. Seal ring - 25. Washer - 26. Screw - 27. Half housing - 28. Fifth wheel - 29. Side pinion - 30. Spider - 31. Ring nut - 32. Bushing - 33. Crown wheel - 34. Washer - 35. Oil guard - 36. Seal ring - 37. Circlip - 38. Pin - 39. Housing - 40. Bearing - 41. Ring - 42. Washer - 43. Eccentric ring - 44. Screw - 45. Piston - 46. Spring - 47. Circlip - 48. Plug - 49. Pin - 50. Housing - 51. Crown - 52. Pinion - 53. Bearing - 54. Spacer - 55. Adjusting ring - 56. Bearing - 57. Ring - 58. Oil feed - 59. Screw - 60. Gears - 61. Nut

Aquila Trucks Centres

## CHECKING THE INTERAXLE DIFFERENTIAL PARTS

Carefully clean all of the individual differential-flow divider components, replacing worn parts and all sealing elements

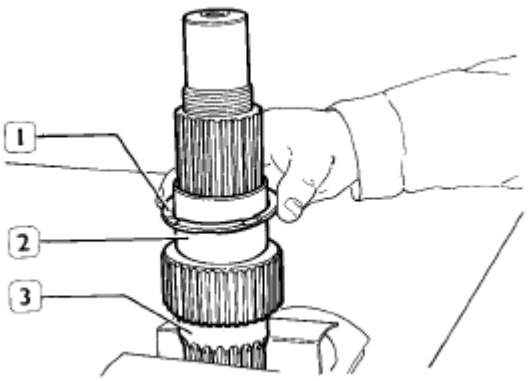
**NOTE** Carefully clean all the threads to ensure exact adjustments and precise tightening torque values.

**NOTE** If either the bevel gear or pinion need to be changed, both parts must be replaced as they are provided as coupled spare parts.

**NOTE** Replace all seal rings and bushings if damaged.

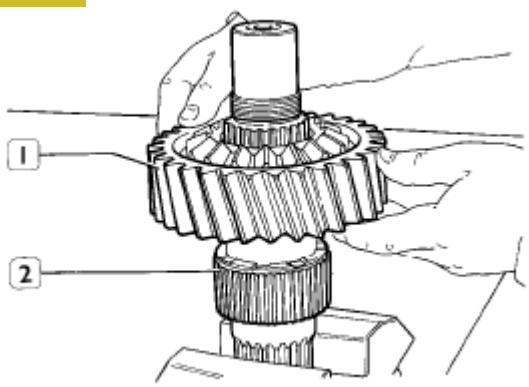
### Interaxle differential unit assembly

Figure 41




Position the input shaft (3) in a vice, heat the bushing (2) to 105°C and fit on the shaft. Fit the shoulder ring (1).

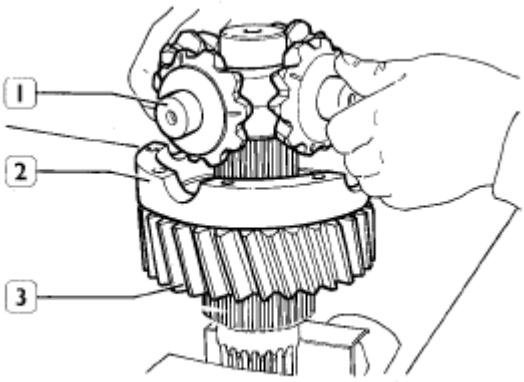
Figure 42




42561

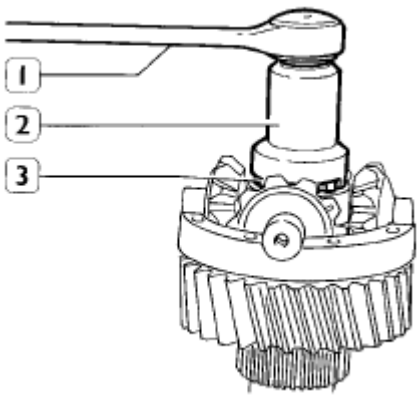
Fit the gear (1) on the input shaft (2). Check that the gear (1) rotates freely on the bushing (2, Figure 41).

Figure 43




Assemble the half-housing (2) and seal ring on the driven gear (3).
Fit the spider (1) and side pinions and fifth wheel.

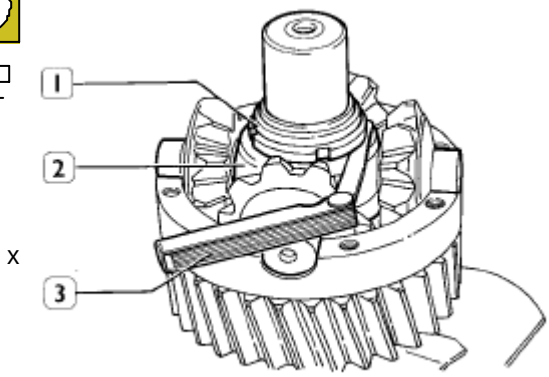
Figure 44




42563

Using the torque wrench (1) and wrench 99355086 (2), tighten the ring nut (3) to the correct torque value.

Figure 45

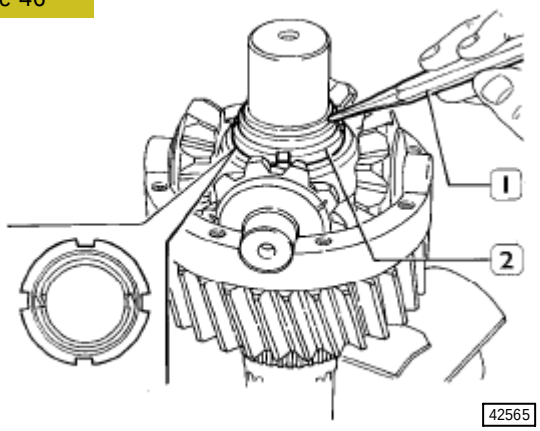



x

After tightening the ring nut (1) check (with a feeler gauge (3)) that there is a clearance of 0.05 to 0.1 mm between the ring nut (1) and the spider (2). If not, replace the necessary parts.

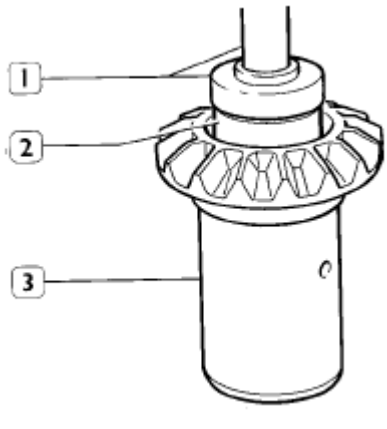
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Figure 46




Using a punch (1) secure the ring nut (2) as shown in the drawing.

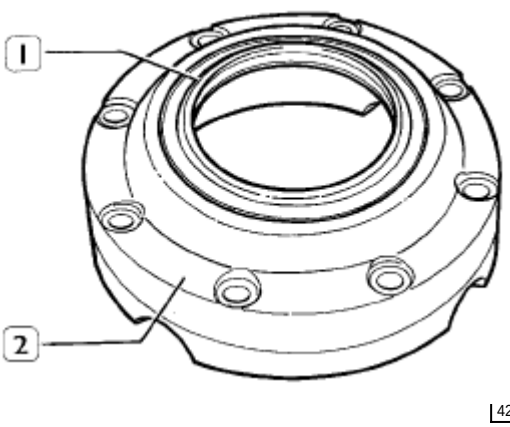
Figure 47




Using punch 99370121 (1) and grip 99370006, fit the bushing (2) in the crown wheel gear unit (3).

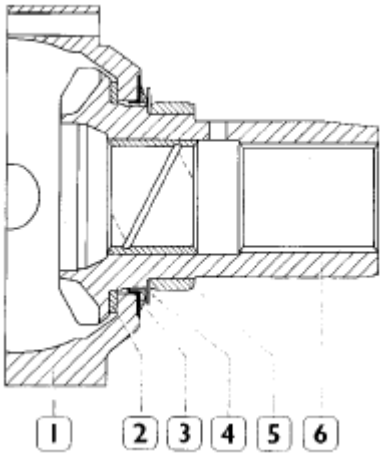
**NOTE** After assembling the bushing, make sure that it is keyed correctly on the input shaft.

Figure 48



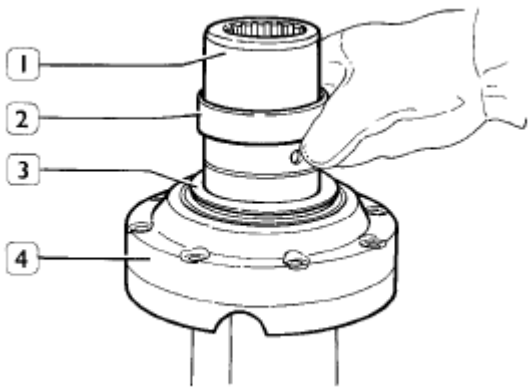

Fit the seal ring (1) in the half-housing (2).

Figure 49



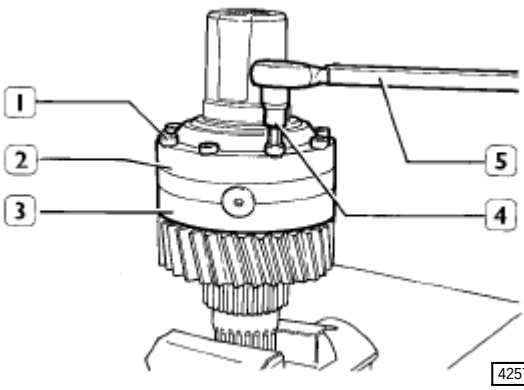

1. Half-housing - 2. Shoulder ring - 3. Seal ring - 4. Washer - 5. Roller bearing ring - 6. Crown wheel gear

Figure 50




Position the crown wheel gear unit (1) on a support. Fit the shoulder ring (2, Figure 48) the half-housing (4), the washer (3). Heat the internal ring (2) for the roller bearings and fit on the crown wheel gear unit.

Figure 51

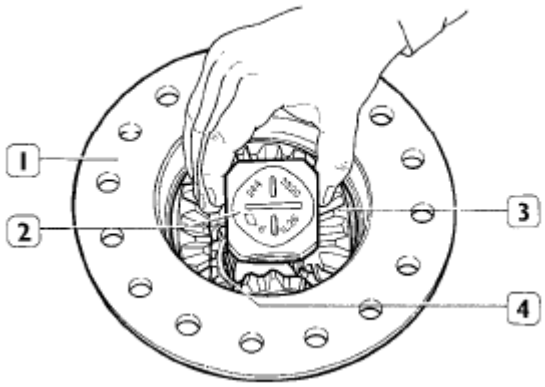



Fill the inner chamber of the half-housing (3) with 100g of lubricating oil. Fit the previously assembled half-housing assembly (2) on the half-housing (3) and, using a torque wrench (5) and an Allen wrench (4), tighten the screws (1) to the correct torque, after having smeared the screws with LOCTITE AVX.

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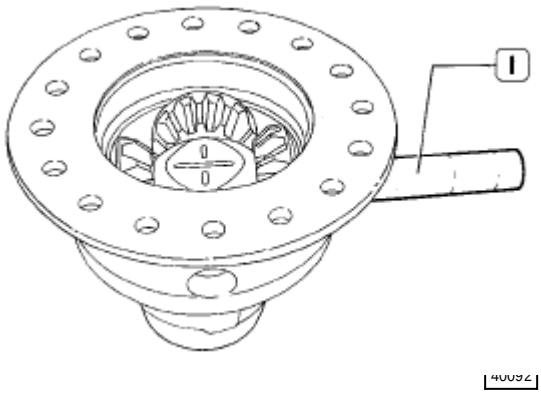
## Differential housing assembly

Figure 52




Place the gear housing (1) on a support. Position the crown wheel (4) and shoulder washer in the seat. Fit the 4 side pinions (3), complete with shoulder washer, and insert in the spider (2).

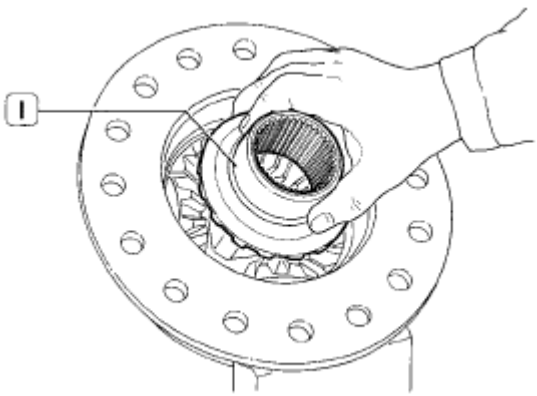
Figure 53




Insert the long pin (1) and the two short pins.

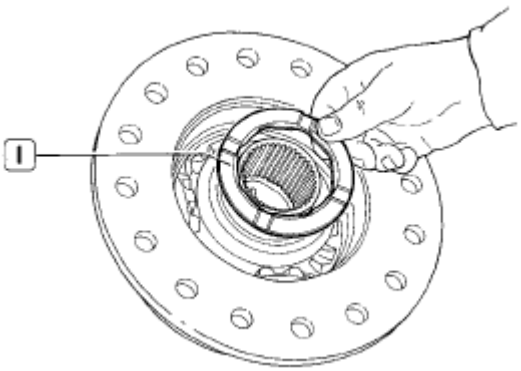
First insert the long (through) pin. The exact position of the pins is marked on the spider body by a long stripe for the long pin, and by two short stripes for the short pins

Figure 54



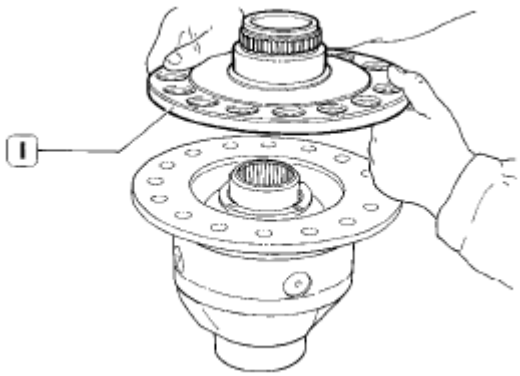

Assemble the crown wheel (1).

Figure 55



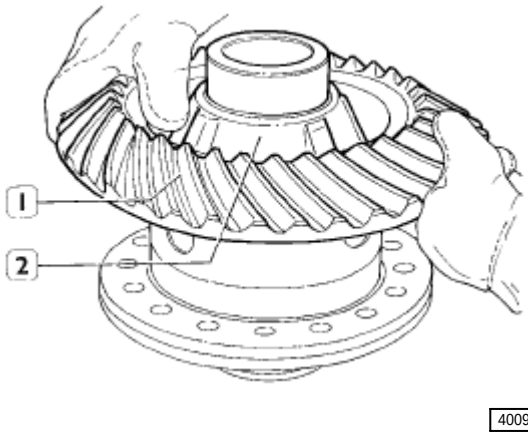

Fit the shoulder washer (1).

Figure 56




Fit the gear housing cover (1).

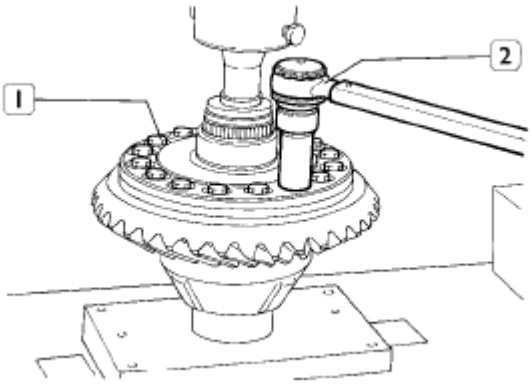
Figure 57




Heat the ring bevel gear (1) to approx. 80°C, fit in position in the gear housing (2) and secure with two screws.

Aquila Trucks Centres

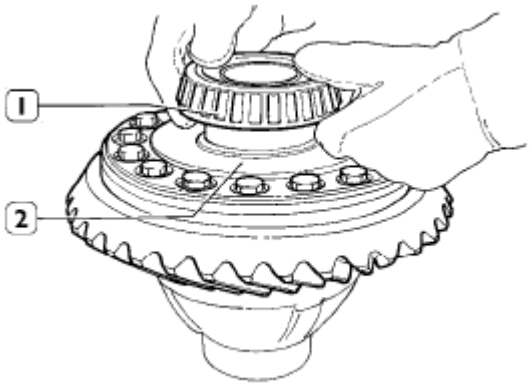
Figure 58




40097

Introduce the remaining screws (1); lock gear unit rotation using a press and tighten the screws (1) to the correct torque with a torque wrench (2).

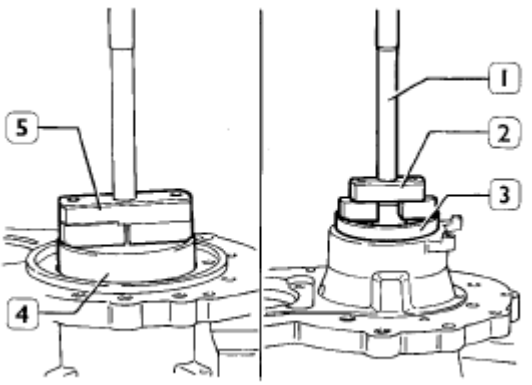
Figure 59




Using an electric heater, heat the support bearing (1) for 15' at a temperature of 100°C and fit on the gear housing (2). Repeat the same operation on the opposite side.

## Assembling the bevel pinion support

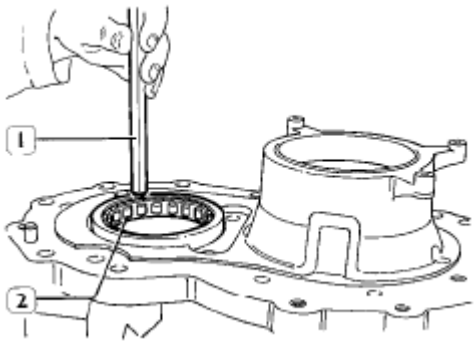
Figure 60




42571

Using punch 99374093 (2) and grip 99370007 (1), fit the bearing external ring (3) in the support. Repeat the same operation on the external ring (4) on the opposite side, using punch 99374094 (5).

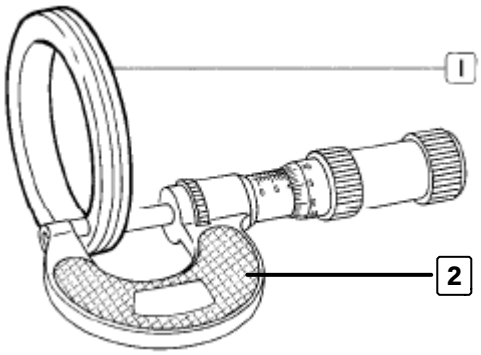
Figure 61




Using a punch (1) fit the roller bearing (2).

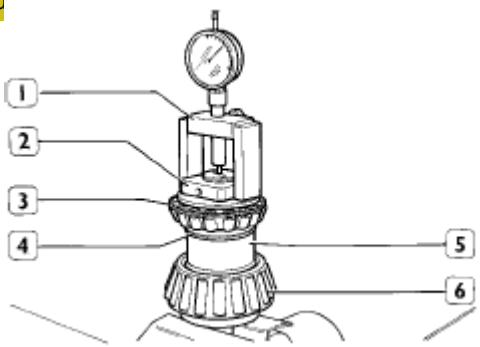
## Procedure to follow to determine the thickness of the bevel pinion rolling torque adjusting ring

Figure 62




Using a feeler gauge (2) measure and note the thickness of the adjusting ring (1) on disassembly (value A).

Figure 63




42573

Secure tool 99395027 in a vice and fit the following parts:

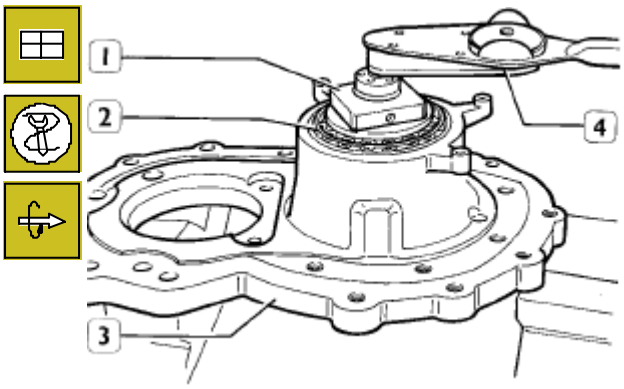
- the bearing (6) on the pinion-side;
- the previously measured adjusting ring (4), the spacer (5) and the bearing.

Fully tighten the ring nut (2).
Position part (1) of tool 99395027 on the bearing (3), fitted with a zero-set dial gauge on the end of the tool. Then remove:

- the part (1), the ring nut (2), the bearing (3), the adjusting ring (4) and the spacer (5).

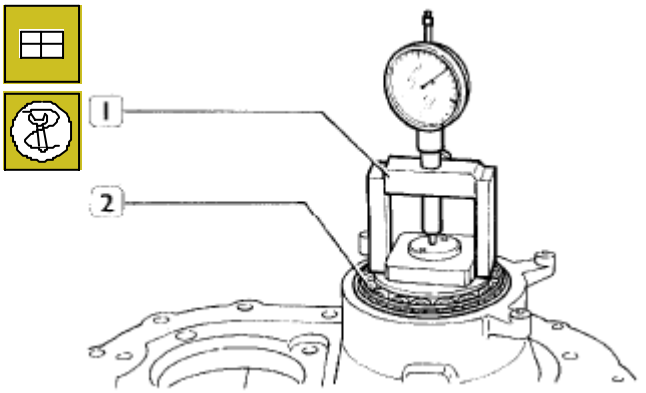
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Figure 64




Position tool 989395027 and bearing (6, Figure 63) in the support (3) and position the bearing (2, Figure 64). Tighten the ring nut (1) by hand and check (using a torque wrench (4)) the rolling torque, which should be 6 - 8 Nm; if necessary, adjust by means of the ring nut (1).

Figure 65




42575

Position the part (1), with the dial gauge zero-set, on the bearing (2) and read the eventual deviation (value B). Disassemble the parts on tool 99395027.

Thickness **S** on the adjusting ring is provided by the following formula:

$$S = A - (\pm B) + C$$

Where:

**A** = thickness of the adjusting ring assembled for dial gauge zero-setting;

**B** = deviation value read;

**C** = 0.05 mm coefficient which takes into account the expansion of the bearings as a result of the assembly negative allowance on the bevel pinion.

First example:

**A** = 10.12 mm

**B** = + 0.13 mm

**C** = 0.05 mm

$S = 10.12 - (+ 0.13) + 0.05 =$

$S = 10.12 - 0.13 + 0.05 = 10.04$ mm

Second example:

**A** = 10.12 mm

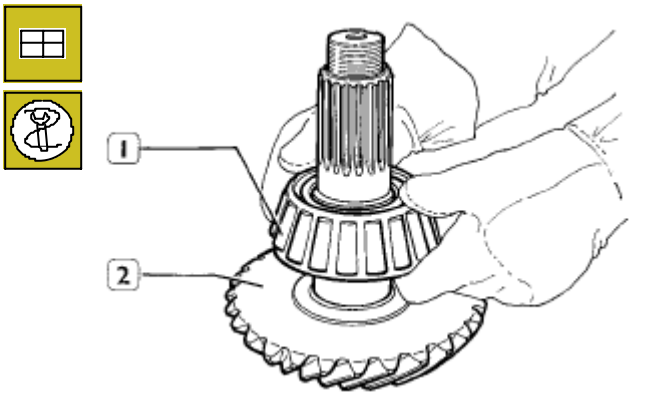
**B** = - 0.13 mm

**C** = 0.05 mm

$S = 10.12 - (- 0.13) + 0.05 =$

$S = 10.12 + 0.13 + 0.05 = 10.30$ mm

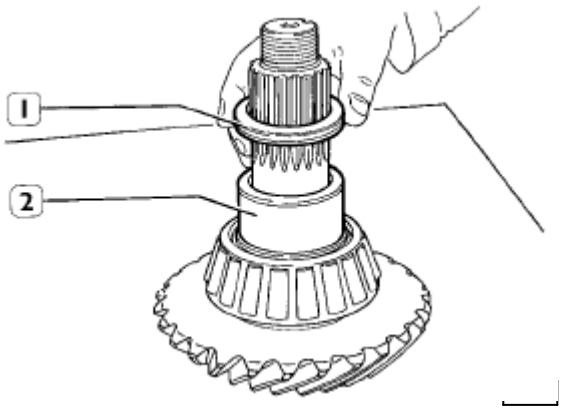
Figure 66




42576

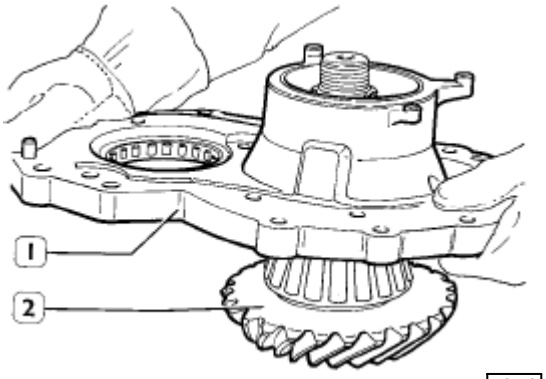
Heat the bearing (1) to 100°C and fit on the bevel pinion (2).

Figure 67




Fit the spacer ring (2) and the adjusting ring (1) with the thickness previously measured.

Figure 68

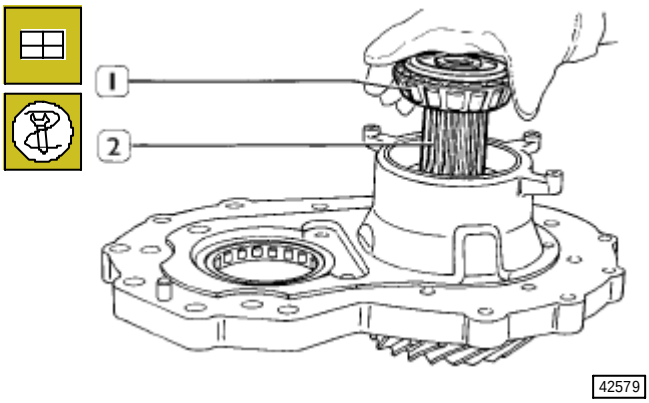



42578

Position the support (1) on the bevel pinion (2).

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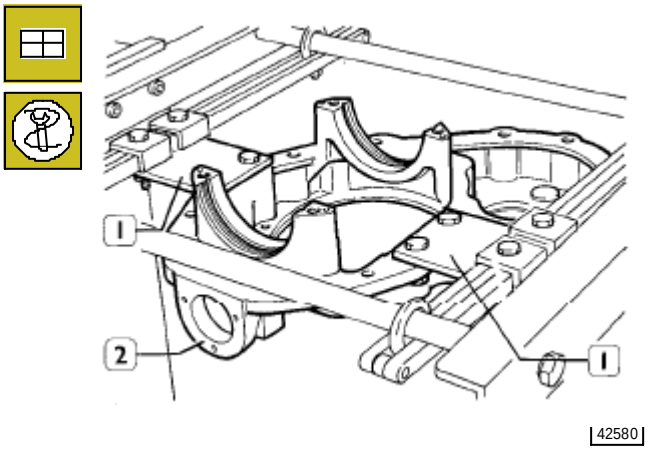
Figure 69




Heat the bearing (1) to 100°C and fit on the bevel pinion (2).

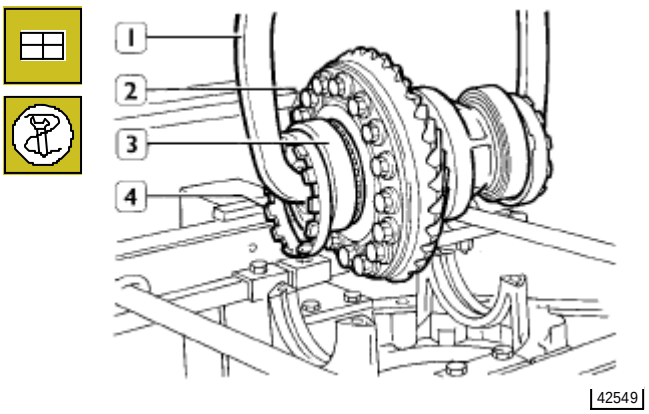
## Differential housing assembly

Figure 70



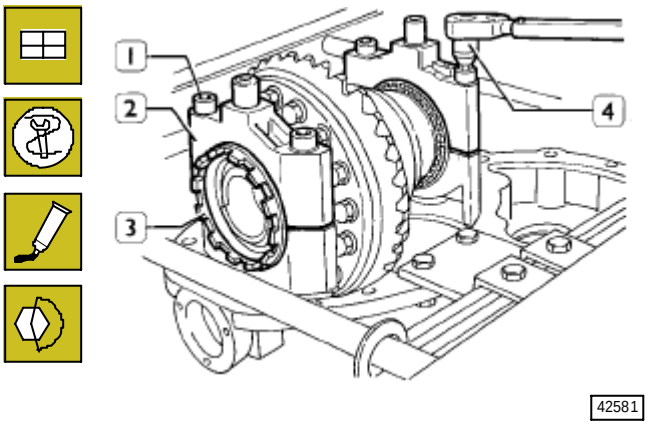

Position the housing (2) on a stand with brackets 99371022 (1).

Figure 71



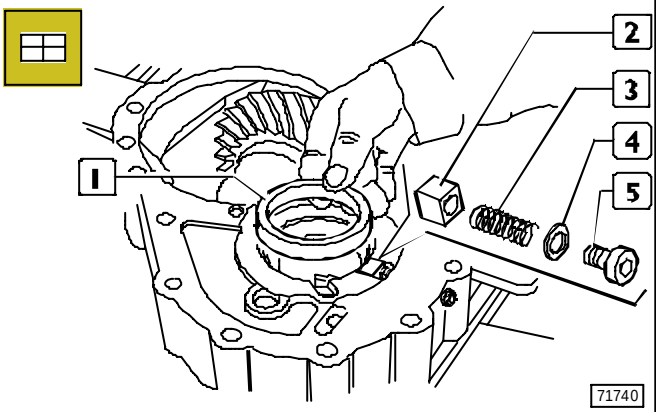

Using hook 99370509 (1), raise the gear housing (2), bearings (3) and adjusting ring nut (4). Position on the differential housing. Carefully position the adjusting ring nuts on the threads of the differential housing.

Figure 72



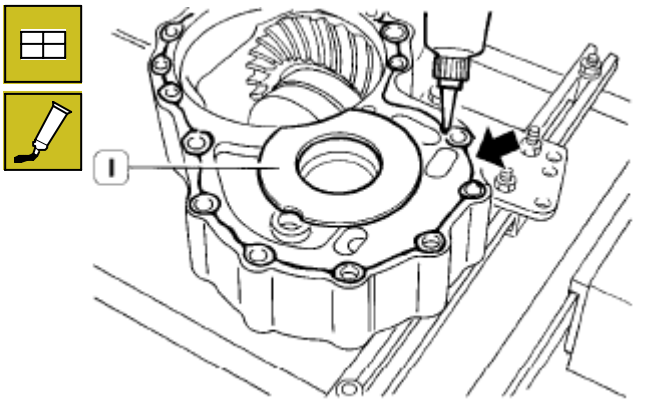

Fit the caps (2) and provisionally tighten the screws (1). Check that the adjusting ring nuts (3) screw on easily. Remove the screws, one at a time, apply LOCTITE AVX and tighten with a torque wrench (4) to the correct torque value.

Figure 73




Rotate the unit and fit: the eccentric ring (1), piston (2), spring (3) and plug (5) with a new washer (4), and tighten to the correct torque.

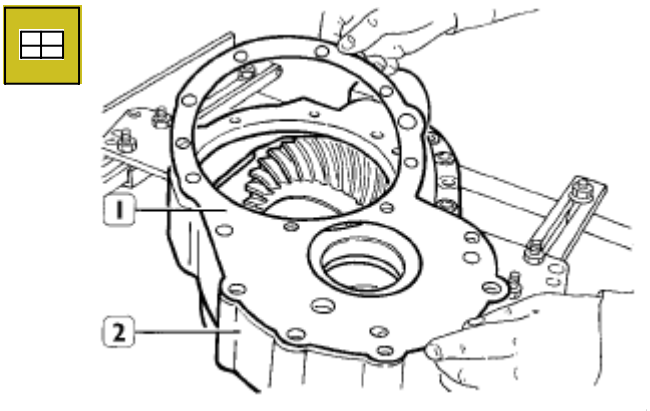
Figure 74




Fit the guard disk (1) and apply a bead (⇒) of LOCTITE 573 on the contact surface.

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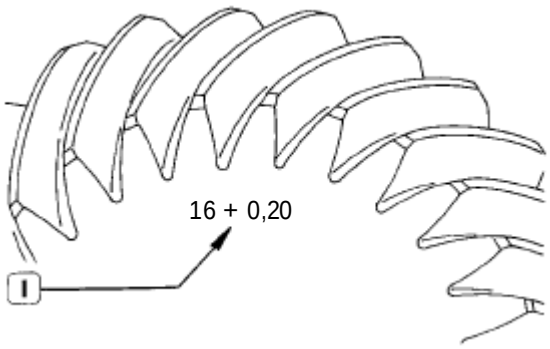
Figure 75




42584

Fit the adjusting ring (1), in order to position the pinion in relation to the bevel gear, on the housing (2). The thickness of the adjusting ring is determined by the reference value (1, Figure 76) marked on the bevel pinion.

Figure 76



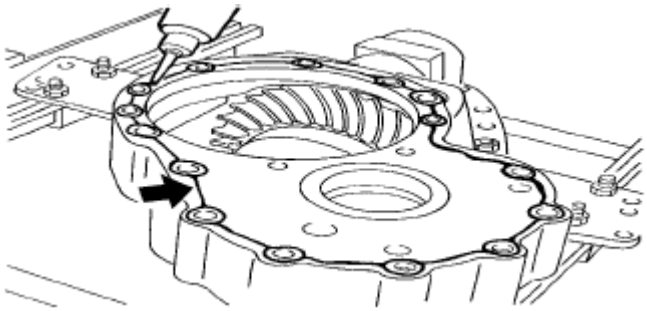

42585

Figure 77

| Value marked on the bevel pinion (1, Figure 76) | Adjusting shim |
|---|---|
| 0 | 0.5 |
| 0.1 | 0.6 |
| 0.2 | 0.7 |
| 0.3 | 0.8 |
| 0.4 | 0.9 |
| 0.5 | 1 |
| 0.6 | 1.1 |
| 0.7 | 1.2 |
| 0.8 | 1.3 |
| 0.9 | 1.4 |
| 1.0 | 1.5 |

Summary table to determine the thickness of the bevel pinion position adjusting ring.

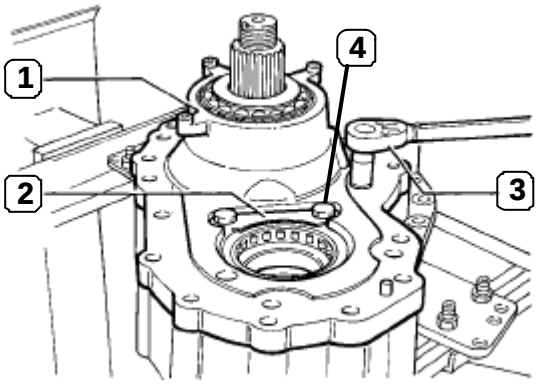
Figure 78



42586

Apply another bead (⇛) of LOCTITE 573 on the adjustment shim.

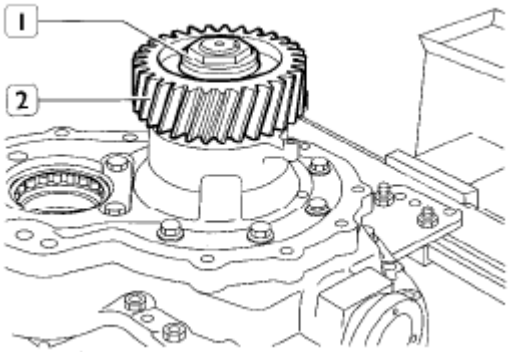
Figure 79




42587

Assemble the complete bevel pinion support (1), apply the bearing retainer plate (2). Use torque wrench (3) to tighten screws (4) to the set torque.

Figure 80

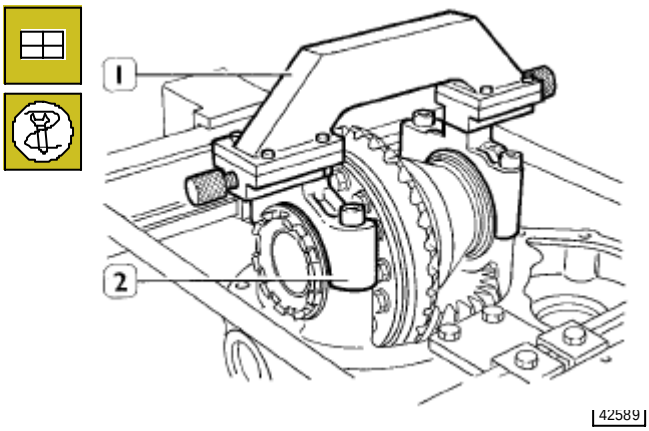



42588

Fit the gear (2) and tighten the fixing nut (1) to the correct torque.

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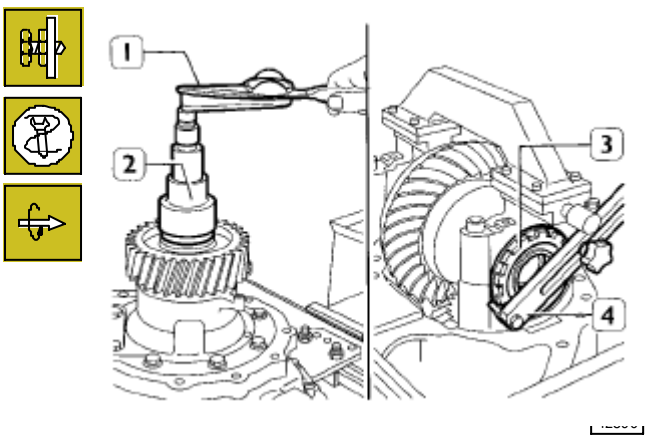
Figure 81




Position tool 99370133 (1) on the caps (2) to avoid excessive spread on the caps during adjustment operations.

## Differential housing bearings rolling torque adjustment

Figure 82




The rolling torque reading is carried out when there is a clearance between the teeth on the bevel gear pair. However, the total rolling torque value varies according to the reduction bevel gear pair ratio (see table in Figure 83).

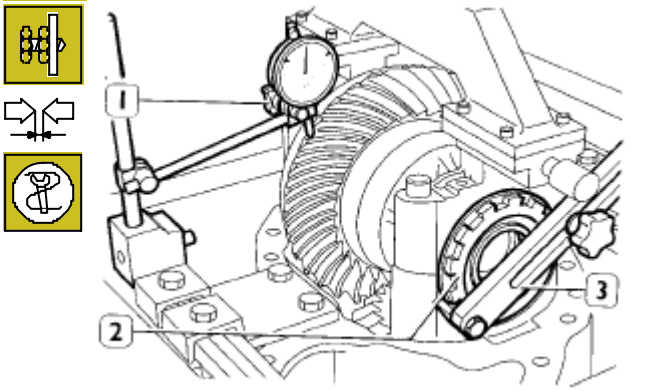
Using torque wrench 99389819 (1) and the appropriate Allen wrench (2), read the pre-stabilised torque value. If the torque value is different from that indicated in Figure 83, adjusting the bearing adjustment ring nuts (3) with the wrench (4).

Figure 83

| No. of teeth | Ratio | Total rolling torque (Nm) |
|---|---|---|
| 15/34 | 2.267 | a + (1.3 ÷ 1.8) |
| 17/35 | 2.059 | a + (1.5 ÷ 1.9) |
| 17/36 | 2.118 | a + (1.4 ÷ 1.9) |
| 19/33 | 1.737 | a + (1.7 ÷ 2.3) |
| 21/40 | 1.905 | a + (1.6 ÷ 2.1) |
| 21/34 | 1.619 | a + (1.9 ÷ 2.5) |
| 23/36 | 1.565 | a + (1.9 ÷ 2.6) |
| 24/35 | 1.458 | a + (2.1 ÷ 2.7) |
| 28/37 | 1.321 | a + (2.3 ÷ 3 ) |
| 27/32 | 1.185 | a + (2.5 ÷ 3.4) |
| 27/37 | 1.370 | a + (2.21 ÷ 2.9) |
| 29/37 | 1.276 | a + (2.4 ÷ 3.1) |
| 34/37 | 1.088 | a + (2.7 ÷ 3.7) |

a = 7.5 ÷ 9.5 Nm

Figure 84




If a different value is read, adjust the end float between the teeth on the bevel pinion/gear pair, as follows:

- Position a magnetic dial gauge (1) as shown in Figure 84.
- Prevent the bevel pinion from rotating whilst alternately rotating the bevel gear and, using a gauge (1), read the clearance between the teeth on the two gear units. This clearance should be 0.15 - 0.35 mm.

If not, using the wrench (3), adjust the adjusting ring nut (2).

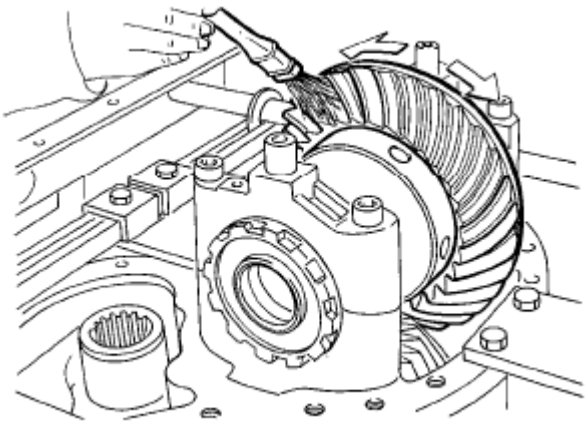
In order to prevent the previously measured rolling torque from varying, during adjustments of the coupling clearance between the pinion and the bevel gear teething, tighten the ring nut with the wrench (3) by the same amount as the ring nut on the opposite is loosened.

On completion of operations, check that the two adjusting ring nuts are suitably positioned to allow the safety plate to be fitted.

Remove tool 99370133.

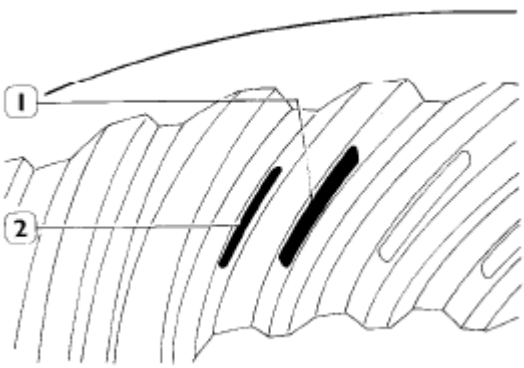
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Figure 85



Using a brush, apply a light covering of Prussian blue on the teeth of the bevel gear.
Rotate the bevel gear in both directions.

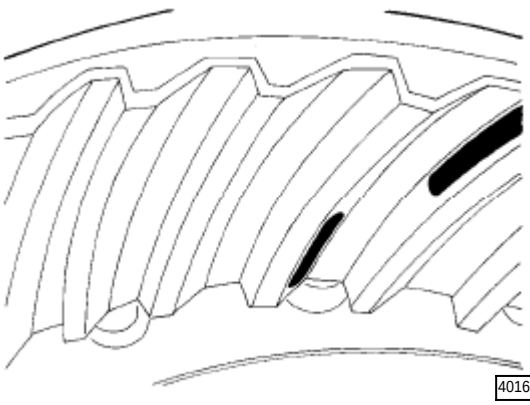
Figure 86




40160

The contact marks should be on both the leading face (1) and the pushing face (2), more or less in the centre between the teeth. When working without a load, both contact zones should be slightly out of position in relation to the external diameter of the bevel gear.

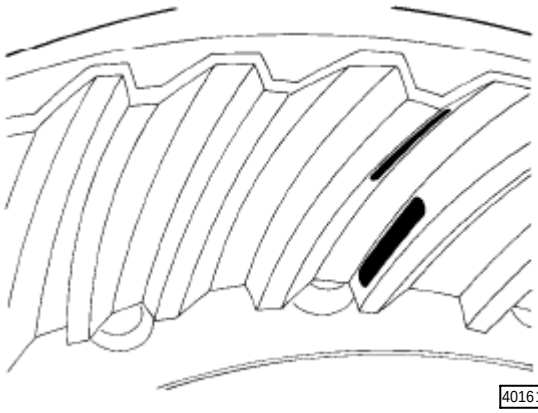
Figure 87



40161A

If the mark on the leading face (towards the external diameter) and on the pushing face (towards the internal diameter) is out of position, the pinion is located too close to the bevel gear.
- Solution: increase the thickness of the adjusting ring (1, Figure 75).

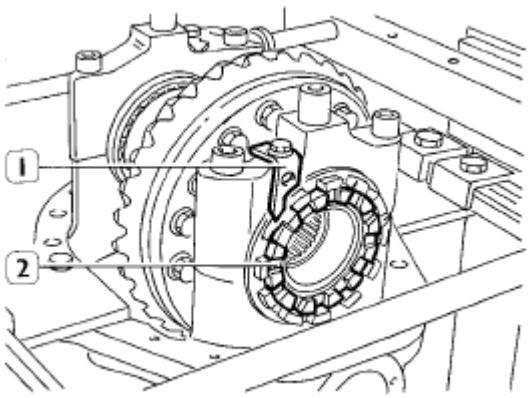
Figure 88



40161B

If the mark on the leading face is positioned towards the internal diameter, and on the pushing face it is located towards the external diameter of the bevel gear, the pinion is located too far away from the bevel gear axis.
- Solution: decrease the thickness of the adjusting ring (1, Figure 75).

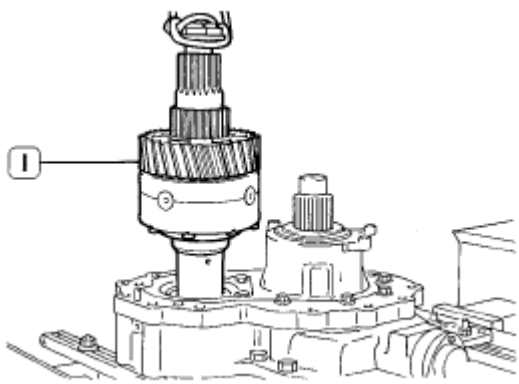
Figure 89




42593

Assemble the safety plate (1); tighten the screws to the correct torque.
Fit the circlip and key the sleeve (2) for the differential lock.

Figure 90

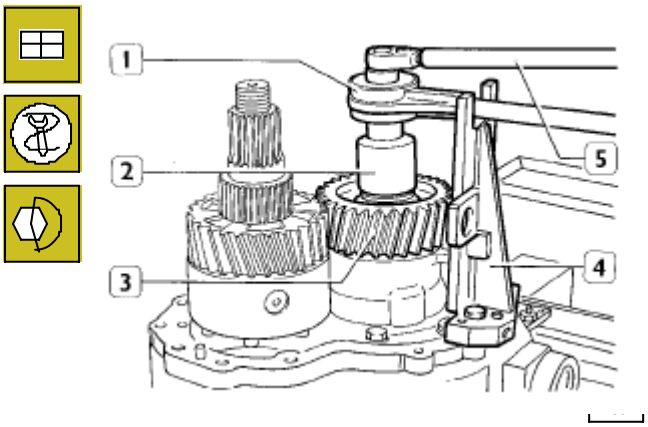



42542

Disassemble the gear unit (2, Figure 80) and assemble the differential - flow divider unit (1).

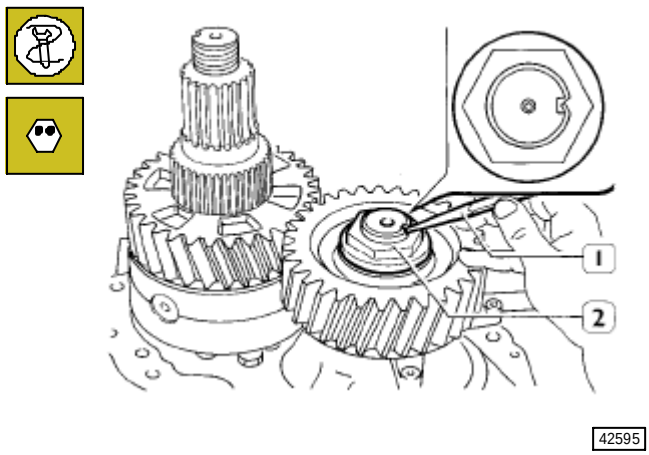
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Figure 91



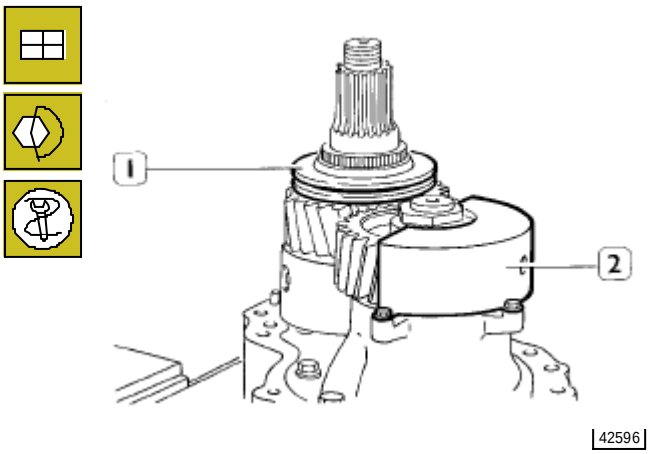

Remove the gear unit (3) and fit tool 99363310 (4), blocking gear unit (3) rotation.
Using Allen wrench 99355131 (2), multiplier 99389816 (1) and a torque wrench (5) tighten the gear nut to the correct torque value.

Figure 92




Using a punch (1) secure the ring nut (2) as shown in the drawing.

Figure 93



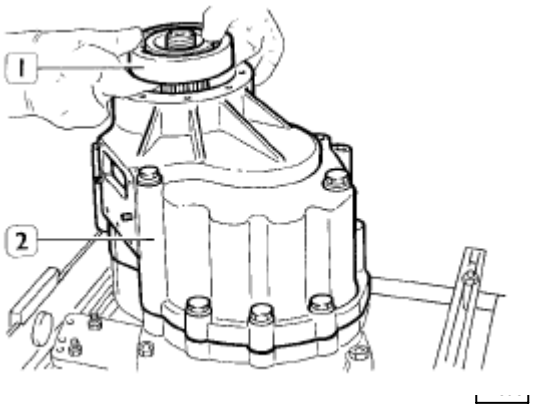

Assemble the oil feed (2) and tighten the screws to the correct torque; key the sliding sleeve (1).

Figure 94



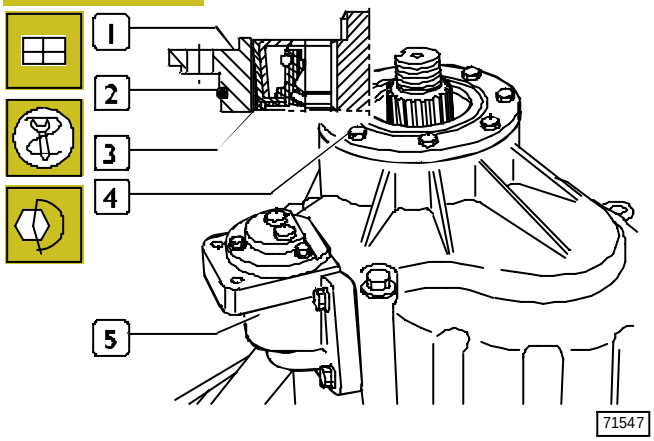

Assemble the control (1) with the differential lock fork.
Apply a bead of LOCTITE 573 on the contact surface.

Figure 95




Fit the cover (2) and tighten the screws to the correct torque.
Heat the bearing internal ring (1) and key on the input shaft.

Figure 96

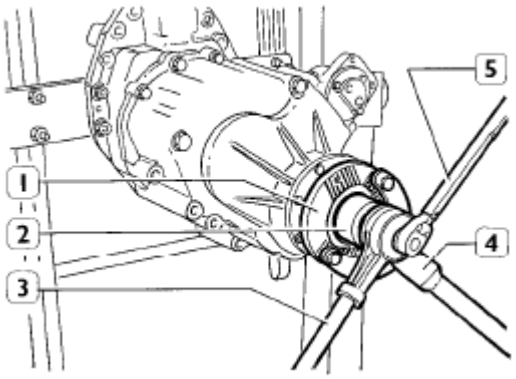



Assemble the cover (1), complete with internal (3) and external (2) seal rings, and tighten the screws to the correct torque. Fit the flow divider locking cover (5).

**NOTE** To fit the internal seal ring (3), use keying device 99374013 and grip 99370006.

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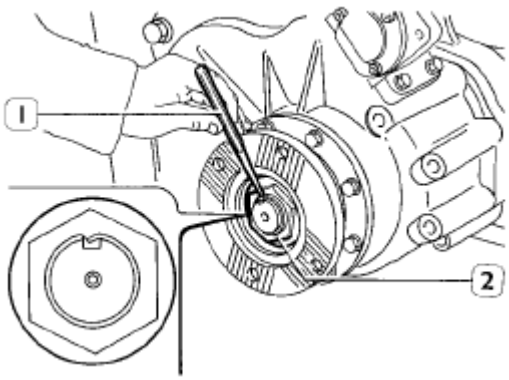
Figure 97




42600

Rotate the unit. Fit the flange (1) on the input shaft. Tighten the nut to the correct torque value using Allen wrench 99355131 (2).

Figure 98




42601

Using a punch (1) secure the ring nut (2) as shown in the drawing.

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# 5250 Rear axles 451391/2D (R 8284) 452191/2D (R 8274) 453291/2D (R 8298)

Page

DESCRIPTION . . . . . 135
MAIN DATA . . . . . 136
TIGHTENING TORQUES . . . . . 137
TOOLS . . . . . 139
REAR AXLES ASSEMBLY OVERHAUL . . . . . 144
- Removal . . . . . 144
- Epicyclic reduction gear disassembly . . . . . 144
- Wheel hub disassembly . . . . . 145
CHECKING THE WHEEL HUB AND EPICYCLIC REDUCTION GEAR UNIT PARTS . . . . . 147
WHEEL HUB ASSEMBLY . . . . . 148
- Assembling the epicyclic reduction gear . . . . . 150
REMOVING-REFITTING THE DIFFERENTIAL . . 153
REFITTING . . . . . 154
REPAIRING THE DIFFERENTIAL . . . . . 155
- Disassembly . . . . . 155
- Differential housing disassembly . . . . . 156
- Removing the bevel pinion support . . . . . 157
CHECKING THE DIFFERENTIAL COMPONENTS . . . . . 159
- Differential housing assembly . . . . . 160
- Assembling the bevel pinion support . . . . . 161
- Procedure to follow to determine the thickness of the bevel pinion rolling torque adjusting ring 161
- Differential carrier assembly . . . . . 163
- Differential housing bearings rolling torque adjustment . . . . . 164

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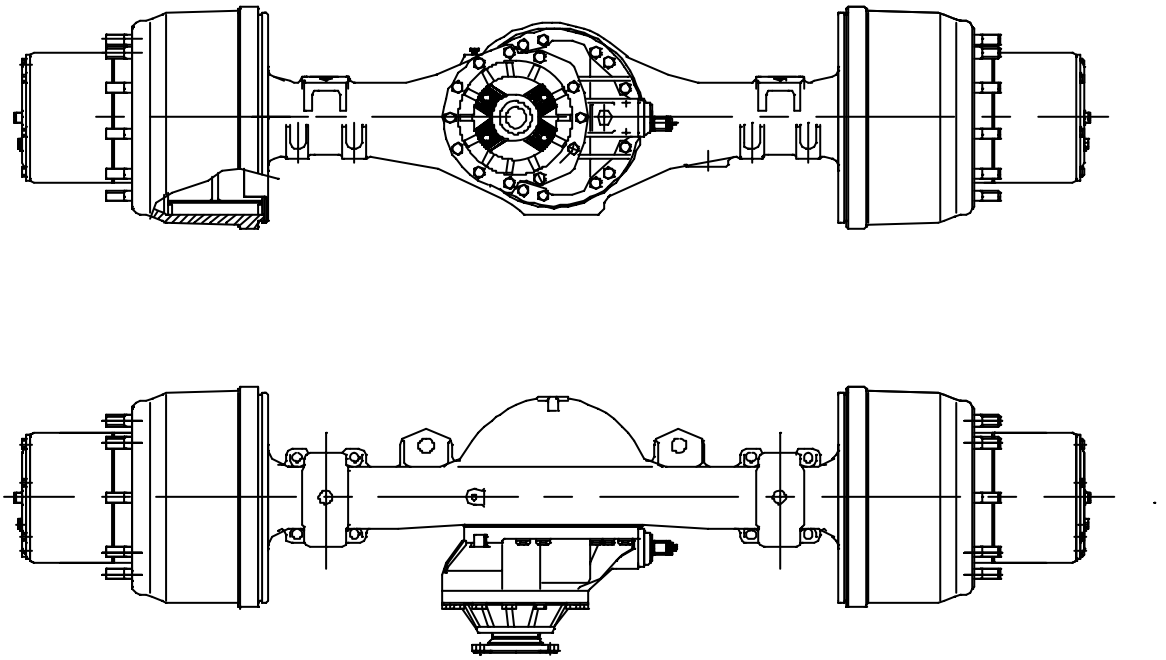

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## DESCRIPTION

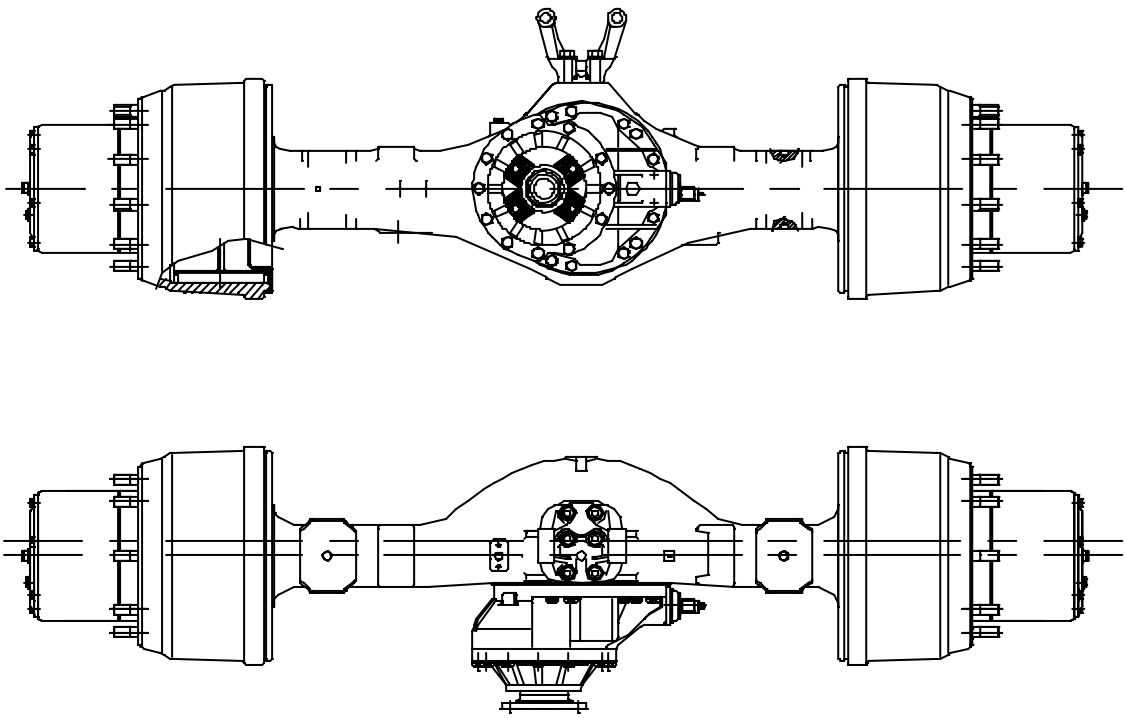
The rear axle is of the double reduction type; the first reduction is provided by the bevel pinion/ring bevel gear, whereas the second reduction is by means of an epicyclic unit on the wheel hubs.
The differential housing (with ring bevel gear) is supported by taper roller bearings, which can be adjusted by means of two threaded ring nuts.
The bevel pinion is supported by two taper roller bearings and a third straight roller bearing.
The bevel pinion can be adjusted by means of adjustment rings located between the two taper roller bearings.
The axle is provided with a pneumatic device for differential locking.
The axle shafts start from the differential and transmit drive to the epicycloid reduction units.
The drum brake is of the Duo/Duplex type.

Figure 1




REAR AXLE 451391/2D

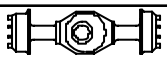
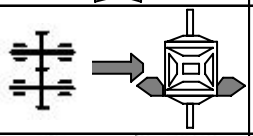
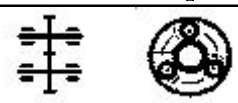
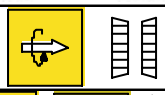
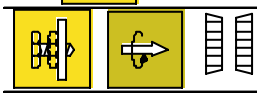
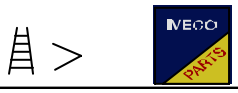
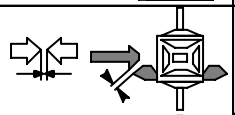
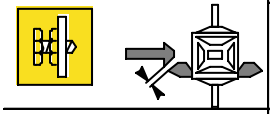
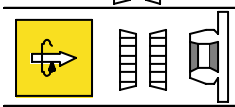
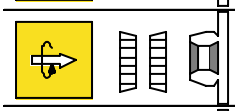
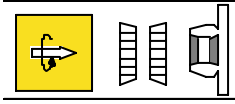
Figure 2




REAR AXLES 452191/2D - 453291/2D

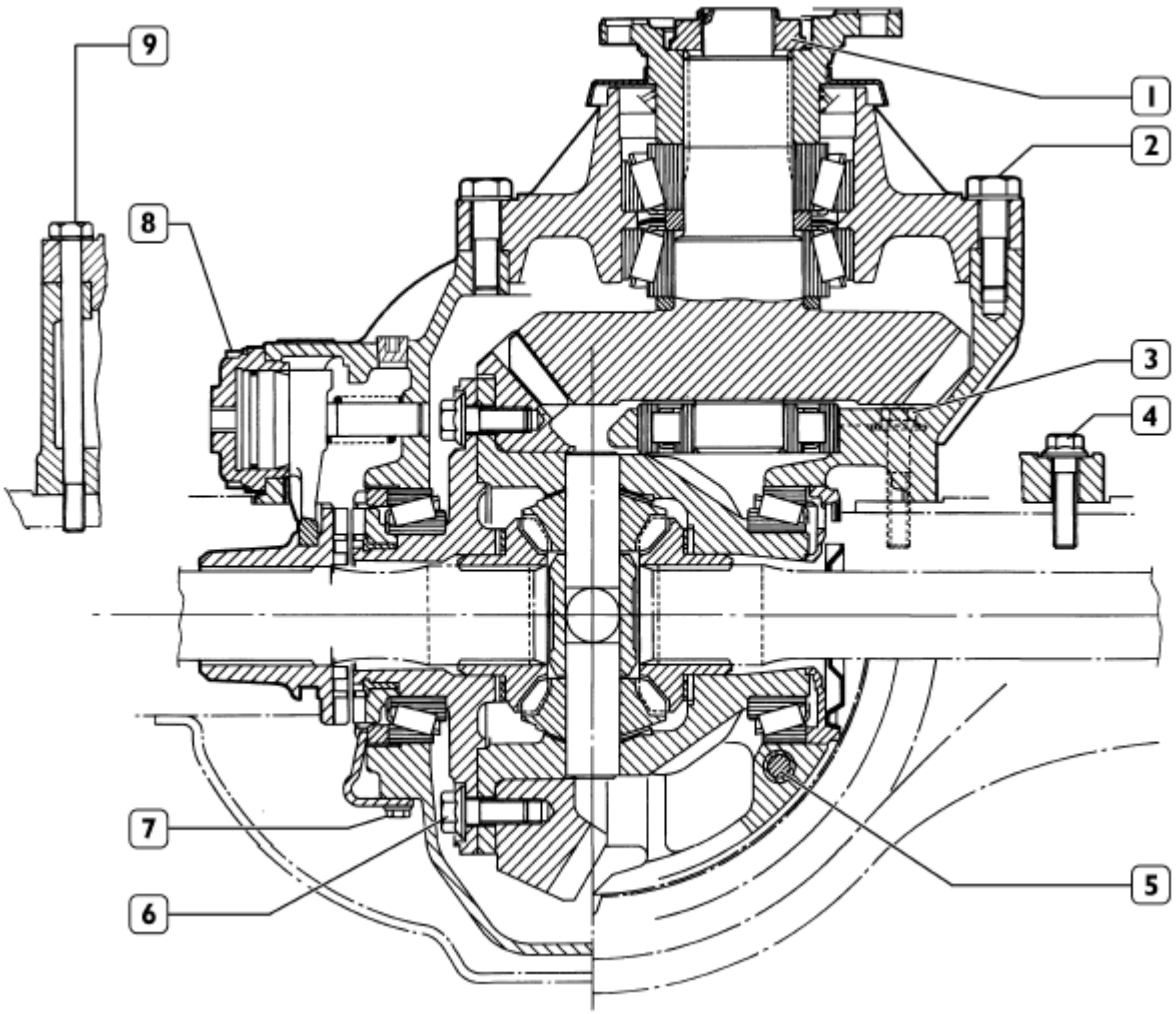
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## MAIN DATA

| | | | | |
|---|---|---|---|---|
|  | Type of axle:<br>Load-bearing, double reduction with pneumatically controlled differential locking | 452191/2D (R8274) | 451391/2D (R8284) | 453291/2D (R8298) |
|  | Bevel pinion bearings | 2 taper rollers and 1 straight roller | | |
|  | Bevel gear reduction unit ratio | 27/32 (1.185) - 29/37 (1.276) - 27/37 (1.370) - 28/37 (1.321) - 24/35 (1.458) - 23/36 (1.565) - 21/34 (1.619) - 19/33 (1.737) - 21/40 (1.905) - 17/35 (2.059) | | |
|  | Epicycloid reduction unit/wheels ratio | 3.2 | | |
|  | Bevel pinion bearing rolling torque without seal Nm | 1.5 ÷ 3.5 | | |
|  | Bevel pinion bearing rolling torque adjustment | with adjustment rings | | |
|  | Thickness of bevel pinion bearing rolling torque adjustment rings mm | 9.80 ÷ 10.80 (series of increased thicknesses = 0,02 mm) | | |
|  | Thickness of bevel pinion/ring bevel gear position adjustment rings mm | 3.6 - 3.7 - 3.8 - 3.9 - 4.0 - 4.1 - 4.2 - 4.3 - 4.4 - 4.5 - 4.6 | | |
|  | Clearance between pinion and ring bevel gear mm | 0.20 ÷ 0.33 | | |
|  | Adjustment of clearance between pinion and ring bevel gear | with ring nuts | | |
|  | **WHEEL HUBS** | | | |
|  | Wheel hub bearings | 2 taper rollers | | |
|  | Wheel hub bearings rolling torque: new bearings with surface protection Nm | 6 ÷ 7 + (12 ÷ 16) | | |
|  | Wheel hub bearings rolling torque: run in bearings and new, lubricated seals Nm | 6 ÷ 7 + (5 ÷ 7) | | |
|  | Wheel hub bearings rolling torque: run in bearings and seals Nm | 6 ÷ 7 Nm + (2.5 ÷ 4.5 Nm) | | |
|  | Drive shaft end float mm | 0.5 ÷ 1 | | |
|  | Axle oil | **TUTELA W140/MDA**<br>16<br>14.5 | | |
| | G.R.W. maximum load kg | 11.000 | 13.000 | 16.000 |

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Figure 3



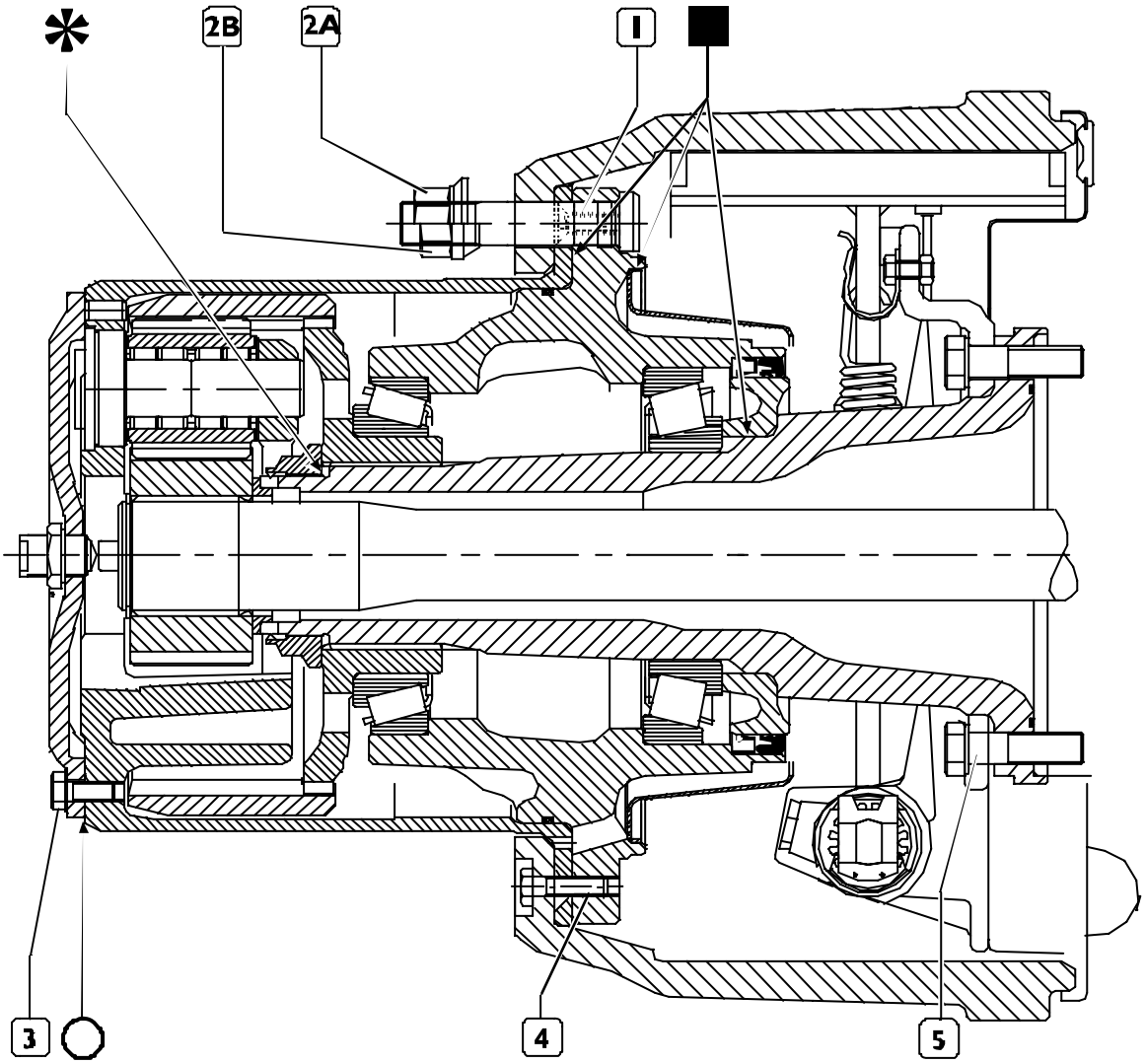

## TIGHTENING TORQUES

| | DESCRIPTION | TORQUE Nm | TORQUE kgm |
|---|---|---|---|
| 1 | Nut fixing bevel pinion | 700 ± 50 | 70 ± 5 |
| 2 | Screw fixing bevel pinion support to differential carrier | 165 ± 15 | 16.5 ± 1.5 |
| 3 | Screw fixing differential carrier to axle | 160 ± 10 | 16 ± 1 |
| 4 | Screw fixing differential carrier to axle • | 160 ± 10 | 16 ± 1 |
| 5 | Screw fixing bevel pinion support to differential carrier • | 280 ± 15 | 28 ± 1.5 |
| 6 | Screw fixing ring bevel gear to differential housing 1st stage<br>2nd stage | 100<br>300 ± 10 | 10<br>30 ± 1 |
| 7 | Screw fixing safety plate to gear housing cover | 60 ± 6 | 6 ± 0.6 |
| 8 | Cheese headed screw fixing control cylinder | 25 ± 2 | 2.5 ± 0.2 |
| 9 | Self-locking screw | 120 ± 10 | 12 ± 1 |

D apply LOCTITE AVX
♦ apply LOCTITE 573

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Figure 4



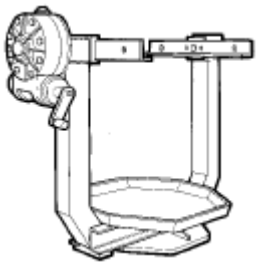
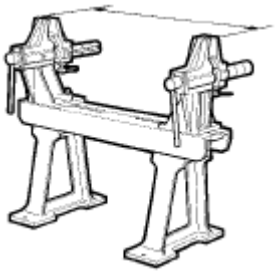
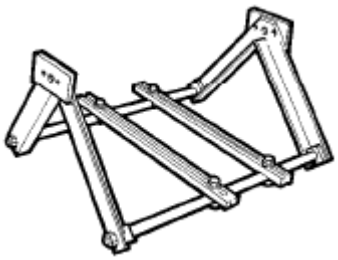
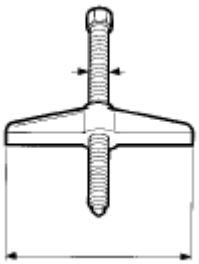
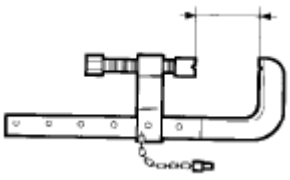

## TIGHTENING TORQUES

| | DESCRIPTION | TORQUE Nm | TORQUE kgm |
|---|---|---|---|
| 1 | Countersunk screw fixing drum | 25 ± 3 | 2.5 ± 0.3 |
| 2A | Nut fixing wheel | 615 ± 35 | 61.5 ÷ 3.5 |
| 2B | Nut fixing wheel | 415 ± 35 | 41.5 ÷ 3.5 |
| 3 | Screw fixing cover to side pinion support h | 50 ± 5 | 5 ± 0.5 |
| 4 | Countersunk screw | 50 ± 5 | 5 ± 0.5 |
| 5 | Screw fixing load bearing sleeve | 295 ± 30 | 29.5 ± 3 |

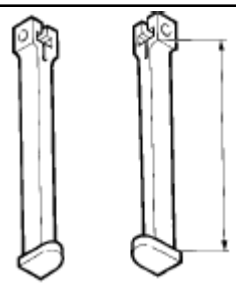
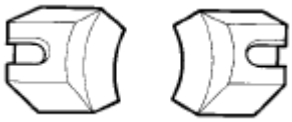
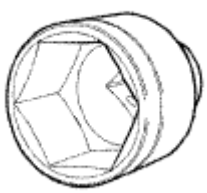
d applyLOCTITE 5970 on connection surface
h apply LOCTITE 573 on thread
H apply LOCTITE 573 on mating surface
: apply MOLYKOTE on the nut contact surface

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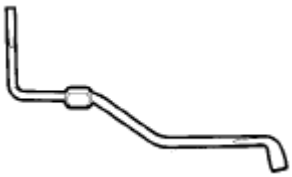
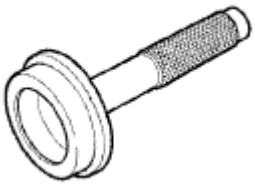
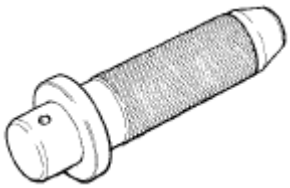
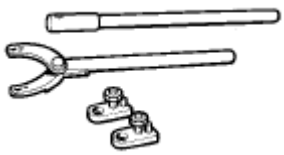
## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99305121** |  | Hot air device |
| **99322205** |  | Rotating stand for assembly overhaul |
| **99322215** |  | Stand for axles overhaul |
| **99322225** |  | Support for assemblies (to be fitted onto stand 99322205) |
| **99341003** |  | Single-acting bridge |
| **99341015** |  | Press |

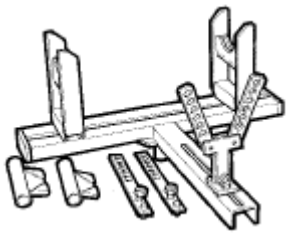
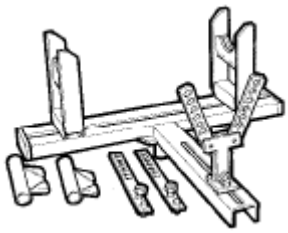
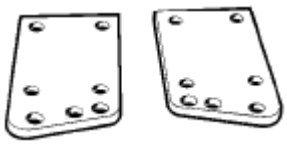
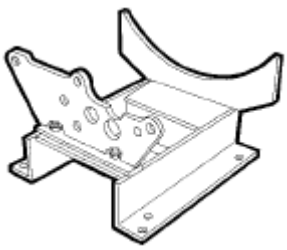
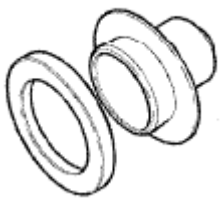
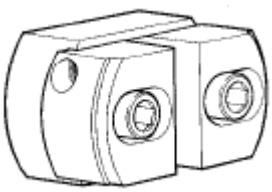
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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99341020** |  | Pair of tie rods for grips |
| **99341023** |  | Grips |
| **99345055** |  | Reaction block for extractors |
| **99354001** |  | Wrench for differential gear housing bearing adjustment ring nuts |
| **99354207** |  | Wrench (94.5 mm) for wheel hub bearings adjusting nut |
| **99355081** |  | Wrench (60 mm) for differential bevel pinion nut (use with 99370317) |

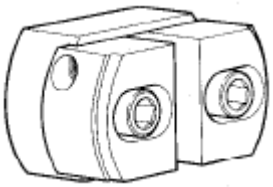
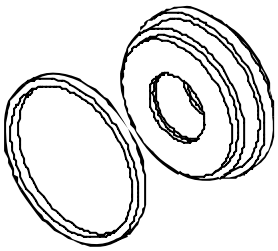
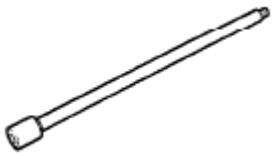
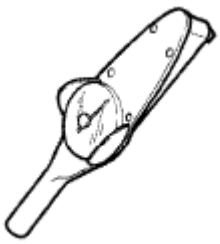
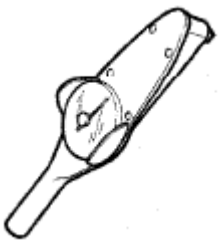
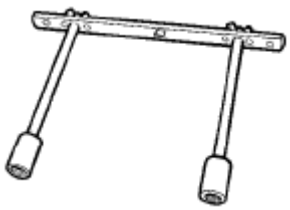
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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99356001** |  | Wrench for adjusting wheel brake jaws |
| **99370005** |  | Grip for interchangeable punches |
| **99370006** |  | Interchangeable grip for punches |
| **99370007** |  | Interchangeable grip for punches |
| **99370317** |  | Reaction lever with extension for flange retaining |
| **99370509** |  | Hook to extract differential gear half-housing |

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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99370616** |  | Mounting for removal and refitting of differential |
| **99370617** |  | Universal mounting to support axles during removal and refitting |
| **99371022** |  | Pair of differential support brackets for use during overhaul (use with 99322205-99322225) |
| **99372211** |  | Tool for removal and refitting of brake jaws retaining springs |
| **99374013** |  | Key to fit flow divider drive infeed shaft seal (use with 99370006) |
| **99374093** |  | Punch to fit external races of bearings (use with 99370007) |

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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99374094** |  | Punch to fit external races of bearings (diameter 134 - 215 mm use with 99370007) |
| **99374161** |  | Key for assembly of wheel hub internal seals |
| **99374451** |  | Tool for axle shaft disassembly-assembly |
| **99389819** |  | Torque wrench from 0 to 10 Nm with 1/4" square connection |
| **99389821** |  | Torque wrench from 0 to 70 Nm with 3/8" square connection |
| **99395026** |  | Tool to check rolling torque of hubs (use with torque wrench) |

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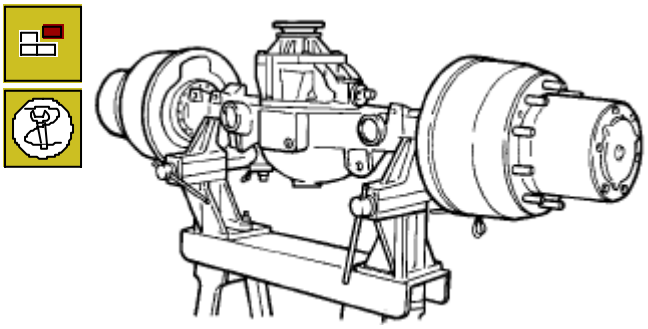
# 525010 REAR AXLES ASSEMBLY OVERHAUL

## Disassembly

**NOTE** The drive shafts - brake drums and jaws - air breather - wheel hubs differential and epicycloid reduction units removal-refitting operations, can all be carried out with the units fitted on the vehicle.

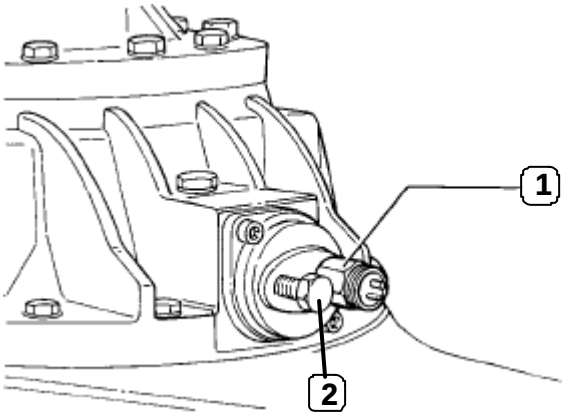
Before positioning the axle assembly on the overhaul stand, drain off the oil by unscrewing the lower plug on the axle housing.

Figure 5



Position the axle assembly on stand 99322215.

Figure 6




39628

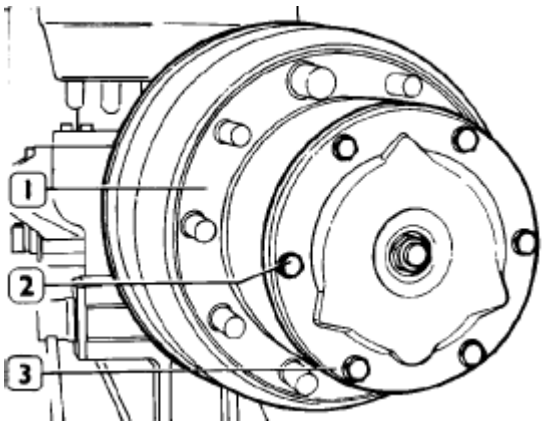
Block the differential locking device sliding sleeve with a screw.
Remove the control cylinder threaded coupling (2) and replace with a screw (1) (M 14 x 1.5).
Rotate the axle mechanism to facilitate engagement between the sliding sleeve and the engagement sleeve; this will avoid involuntary sleeve movement whilst the drive shaft is being extracted.

**NOTE** Position a container under the wheel hub to recover the oil.

Before extracting the axle shaft make sure that the screw has been tightened (2, Figure 6).

## Epicyclic reduction gear disassembly

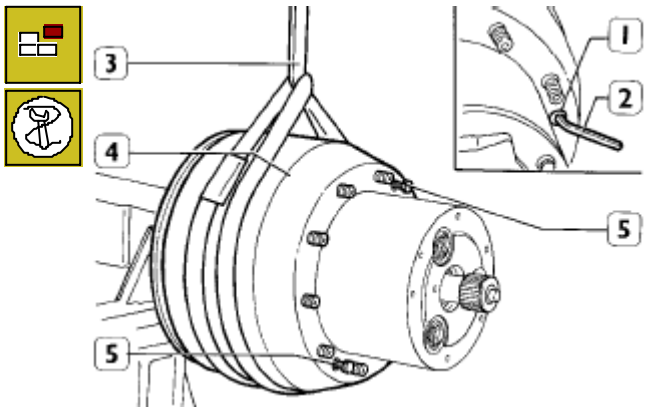
Figure 7




71534

Unscrew the screws (1), remove the cover (3) and drain off the oil into the container.

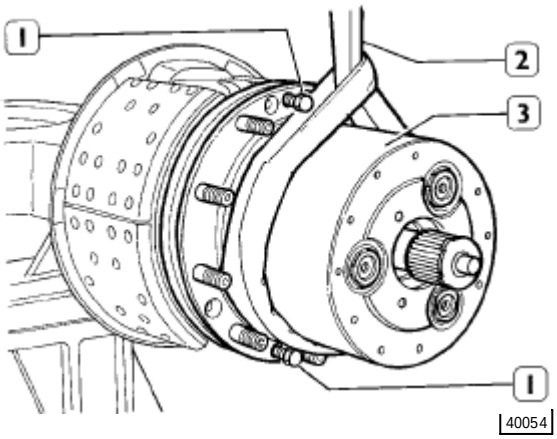
Figure 8




40338

Using an Allen wrench (2) unscrew the two screws (1) fixing the drum; replace with the reaction screws (5). Tighten the reaction screws and remove the drum (4) from the hub and, using a sling (3), raise and remove.

Figure 9

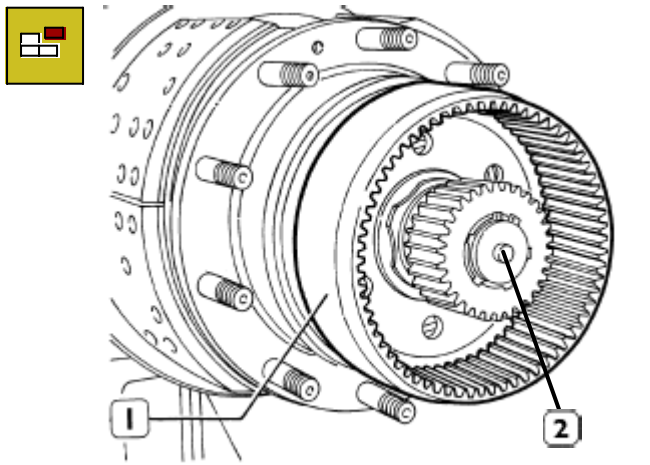



40054

Unscrew the 3 side pinion (3) fixing screws; tighten the reaction screws (1) and, using a sling (2), remove the support (3).

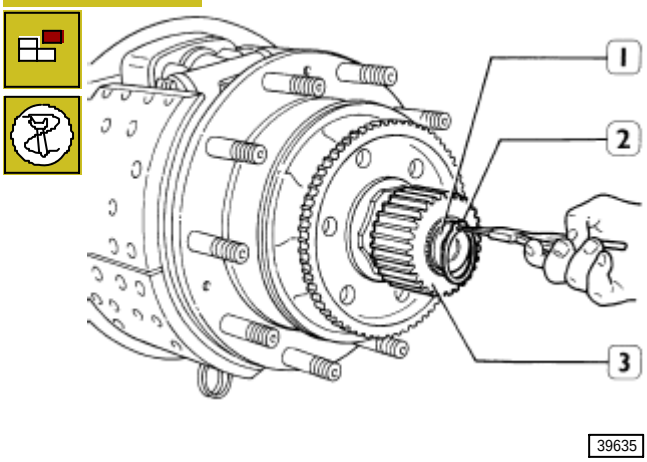
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Figure 10



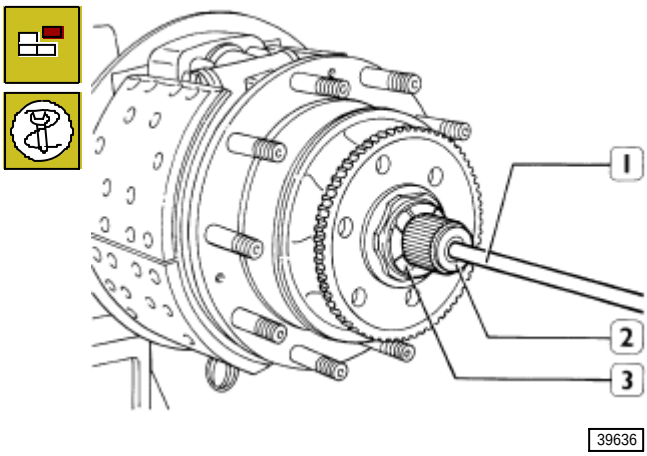

Remove the bevel gear (1) from the mounting.
Remove the shoulder pin (2).

Figure 11



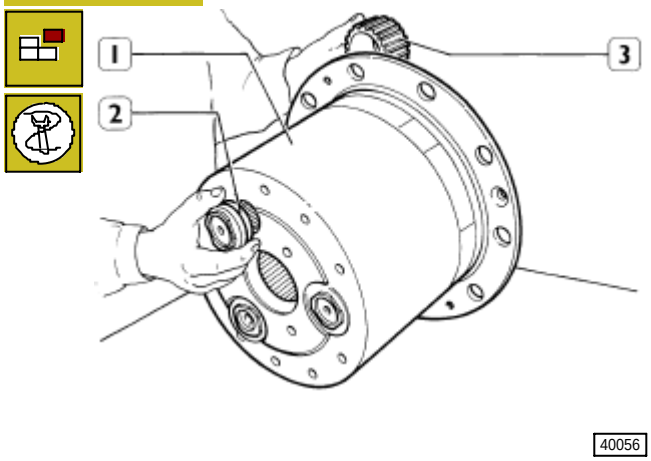

Using suitable pliers, remove the safety ring (2), extract the gear unit (3) from the drive shaft.

Figure 12




Fit tool 99374451 (1) in the shoulder pin seat and extract the drive shaft (2) from the load bearing sleeve.
Remove the spacer ring (3).

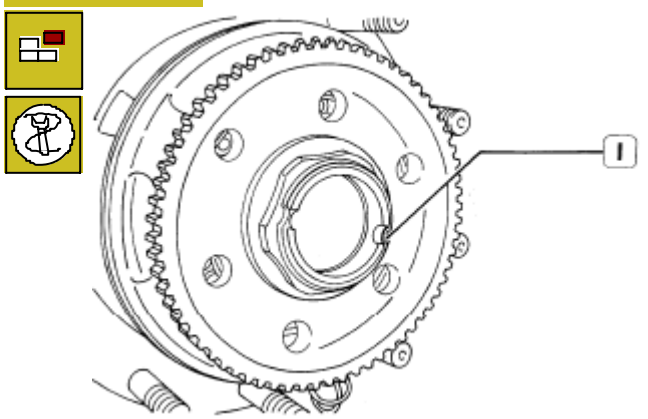
Figure 13




Extract the support pins (2) from the side pinion support (1).
Remove the side pinions (3) from the support (1) and recover the rollers and the spacer rings.

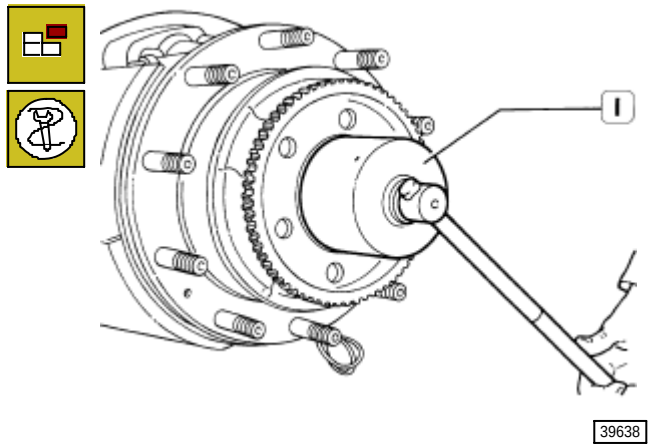
## 525130 Wheel hub disassembly

Figure 14




Using a punch, remove the notch (1) on the adjusting nut.

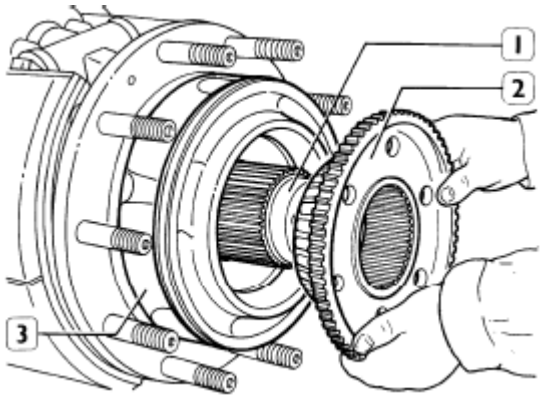
Figure 15




Using Allen wrench 99354207 (1), unscrew the adjusting nut.

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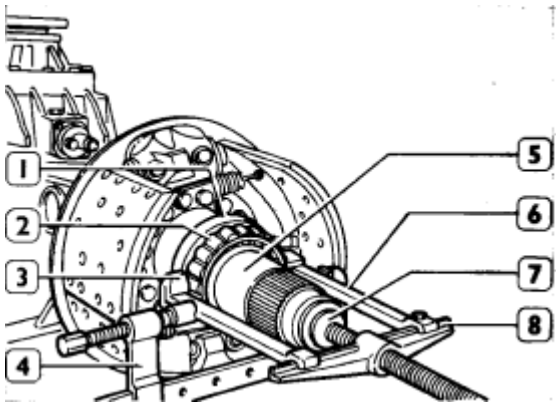
Figure 16




39639

Extract the bevel gear mounting (2), together with the bearing and wheel hub (3), from the load bearing sleeve (1).

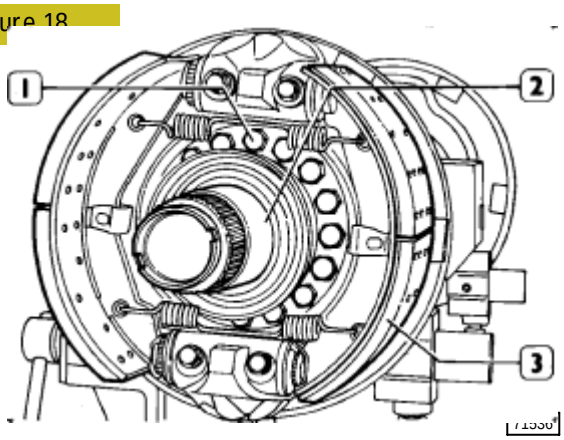
Figure 17




71535

Check the surface of the ring (1), on which the hub seal ring rotates, is not damaged or worn, if necessary, replace the ring (1).
Using the extractor [comprising bridge 99341003 (8), grips 99341023 (3), tie rods 99341020 (6), press 99341015 (4) and reaction block 99345053 (7)], extract the ring (replacing if necessary) and/or the internal ring (2) of the sleeve (5) taper bearing.

Figure 18

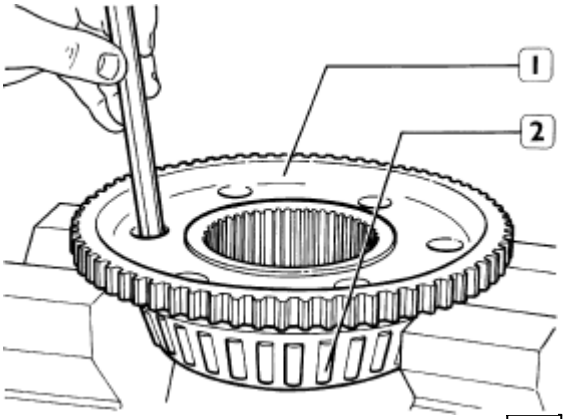



71536

Check the load bearing sleeve (2). If damaged, replace as follows.
Unscrew the screws (1), remove the brake support plate (3) and the axle casing sleeve (2).

**NOTE** Screws (1) are secured with LOCTITE AVX.

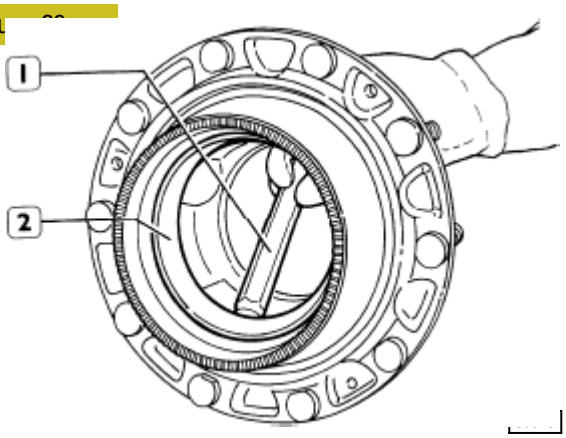
Figure 19




39642

Using a punch inserted through the holes on the bevel gear support, extract the external taper roller bearing (2) from the bevel gear support (1).

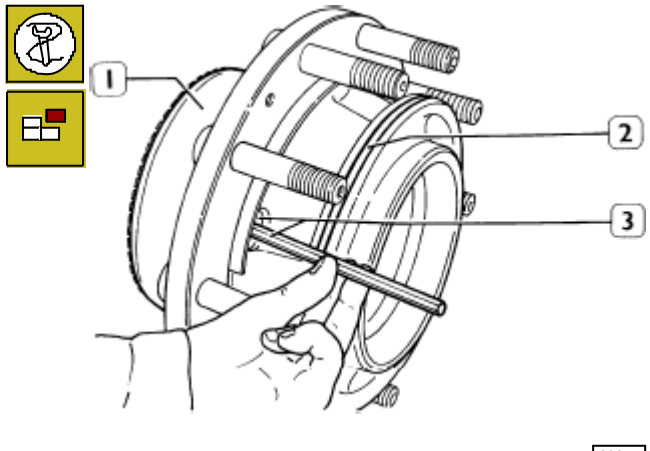
Figure




Using a universal bronze punch (1), extract the external ring (2) for the internal bearing. The seal ring will also be extracted. Proceed in the same way to extract the external bearing external ring. If necessary, disassemble the phonic wheel.

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Figure 21

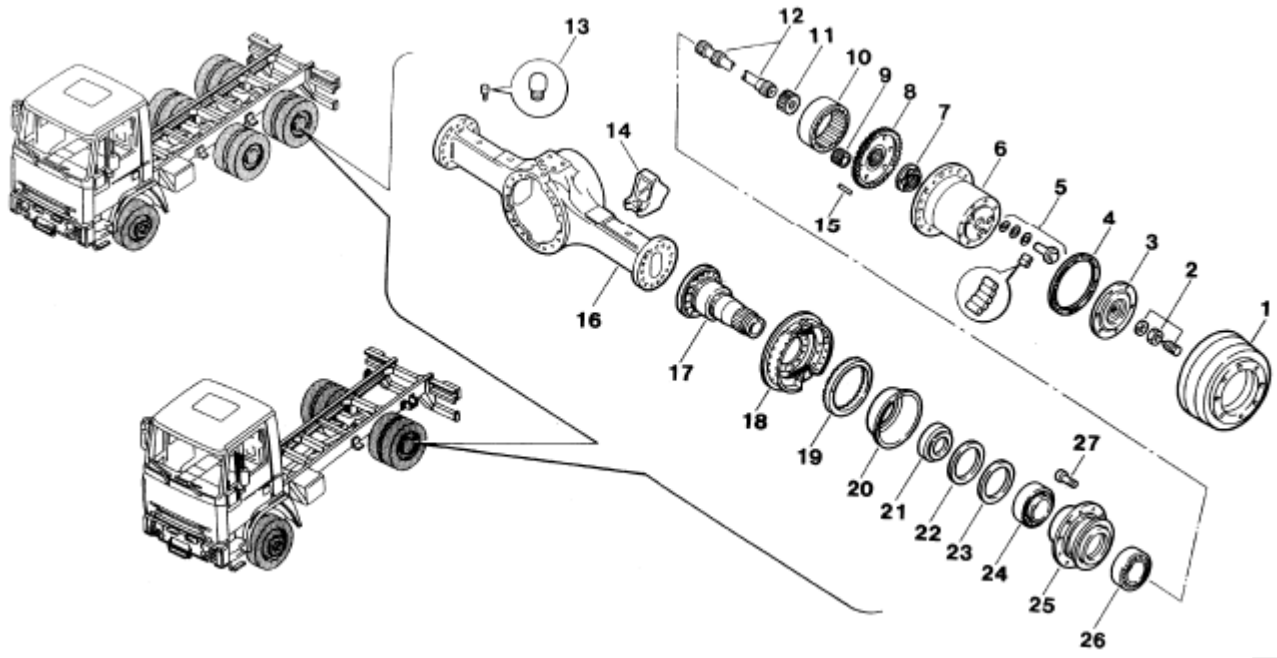



Check the oil manifold (1) and replace if damaged. Extract with a punch inserted in the slots on the hub (3). Remove the seal ring (2).

## CLEANING AND CHECKING WHEEL HUB AND EPICYCLIC GEAR PARTS

Carefully clean the wheel hub parts. Check the drive shafts for deformation. If necessary, straighten the drive shafts using a hydraulic press; if this does not provide satisfactory results, replace the drive shafts.
Check the studs fixing the wheel: if the threads are damaged or deformed they must be replaced. Work under a press to extract and re-assemble the studs.
On completion of assembly operations, check that the orthogonal deviation is no greater than 0.3 mm.
Lubricate the bearings and make sure that the roller support cage rotates freely, rotation should be smooth, without hardening.
Check the threads on the hub bearings adjustment nuts and on the load bearing sleeves; replace the nuts if necessary. Check the oil manifold and replace if damaged.
Replace all seals with new parts.
Carefully clean all the epicycloid gear unit parts. Visually check the toothing on the bevel gear support, the bevel gear, the crown wheel gears and the open gear unit.
Check the spacer rings, distance ring, bearing rollers and support pins.
Replace any damaged or worn parts.

Figure 22



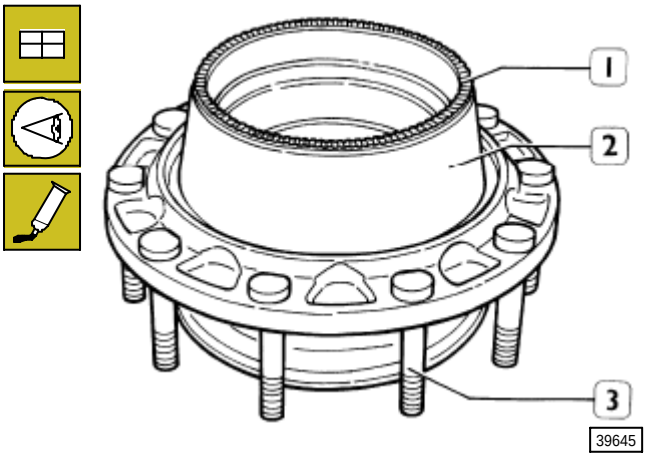

WHEEL HUB PARTS

1. Brake drum - 2. Adjusting nut and screw - 3. Cover - 4. Seal - 5. Pin and roller for side pinions - 6. Side pinion support - 7. Adjusting nut - 8. Ring bevel gear support - 9. Side pinion - 10. Shoulder pin - 11. Ring bevel gear - 12. Drive shaft - 13. Breather - 14. Bracket - 15. Shoulder pin - 16. Axle housing - 17. Load bearing sleeve - 18. Brake unit - 19. Phonic wheel - 20. Oil sump - 21. Support ring - 22. Seal ring - 23. Seal ring - 24. Bearing - 25. Wheel hub - 26. Bearing - 27. Stud

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## 525030 WHEEL HUB ASSEMBLY

Figure 23



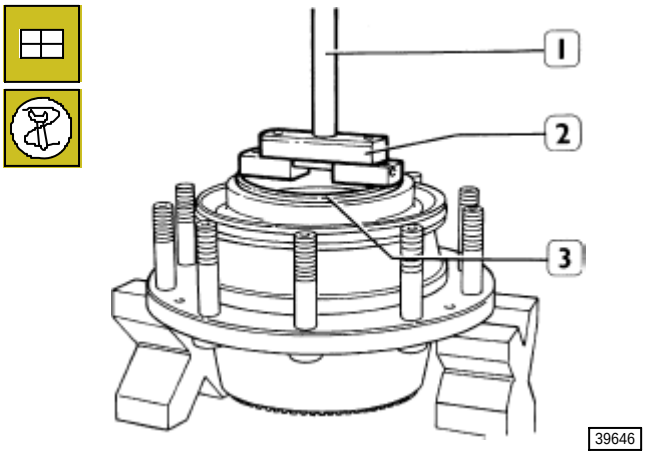

If the studs (3) need to be replaced, before fitting new studs, make sure that the contact surface on the head is free of slag, burr, blisters.

After fitting, check that the studs are fully inserted on the hub and that the right angle error does not exceed 0.3 mm.

If the oil collecting sump (2) needs to be replaced, before assembly, smear the contact surface on the hub/sump and hub/hub seat with LOCTITE 573 sealing compound.

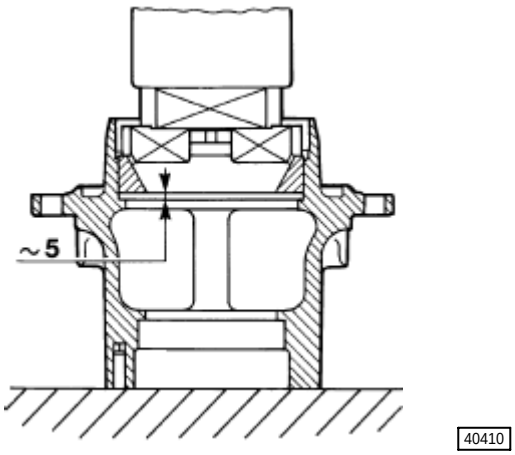
Refit the phonic wheel (1) and, on completion, make sure that phonic wheel is positioned perfectly in the hub seat.
Using a 1/100ths feeler gauge, check that the right angle error does not exceed 0.2 mm.

Figure 24



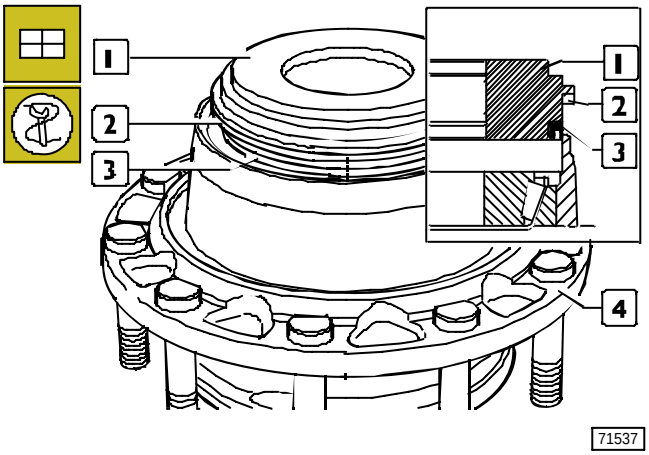

Using punch 99374093 (2) and a press, fit the external ring on the external bearing (3), stopping approx. 5 mm from the fully fitted position; complete fitting operations manually, using grip 99370007 (1).

Figure 25



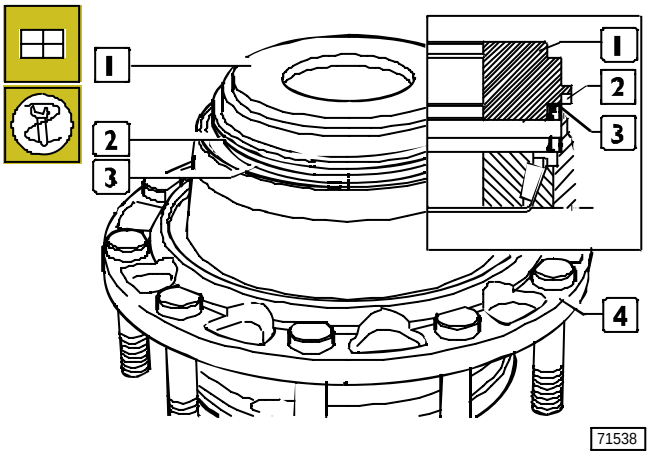

Complete fitting operations manually, using grip 99370007, then turn the hub over and carry out the same operation with the external ring of the internal bearing.

Figure 26




Using a hydraulic press and key 99374161 (1), with the ring (2) positioned as shown in the drawing, fit the brown internal seal ring (3) on the wheel hub (4).

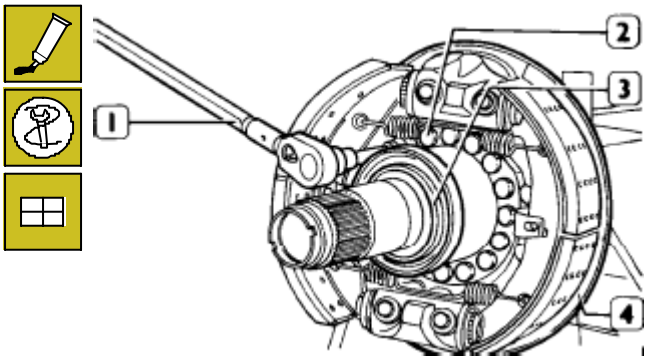
Figure 27




Using a hydraulic press and key 99374161 (1), with the ring (2) positioned as shown in the drawing, fit the blue seal ring (3) on the wheel hub (4).

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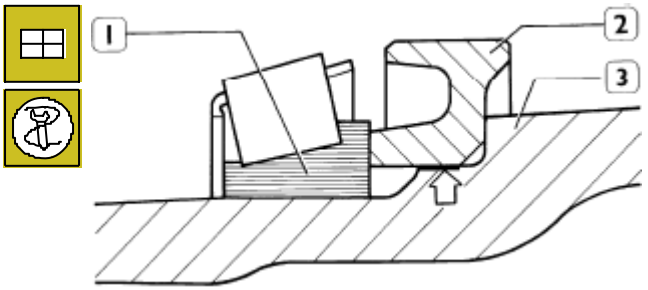
Figure 28




71539

Position the seal ring on the load bearing sleeve. Fit the load bearing sleeve (3), the brake support plate (4) and dust seal disk. Smear the screws (2) and tighten to the correct value with a torque wrench (1).

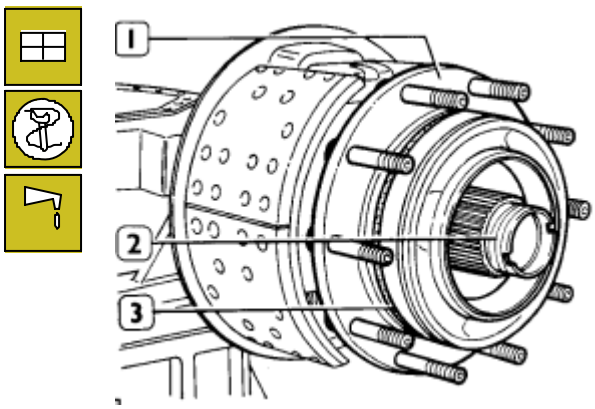
Figure 29




40375

Smear LOCTITE 573 on the seat (⇒) of the load bearing sleeve (3) on the seal rings support ring (2). Heat the ring (2) with an electric drier and key on the load bearing sleeve (3). Heat the taper bearing internal ring (1) to 100°C and fit on the load bearing sleeve.

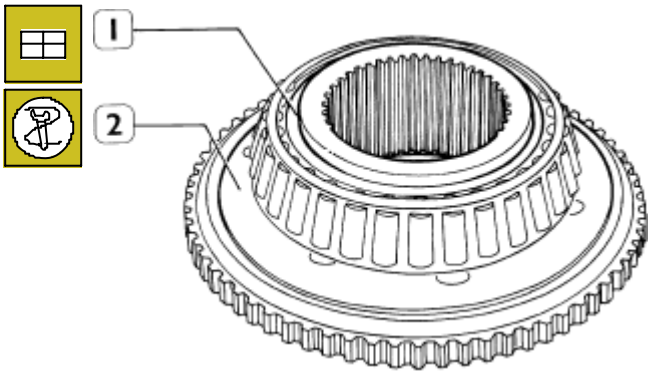
Figure 30




71540

Lubricate the lip of the seal rings and sleeve.
Fit the hub (1) on the load bearing sleeve (2).
Lubricate the seal ring (3) and fit on the wheel hub.

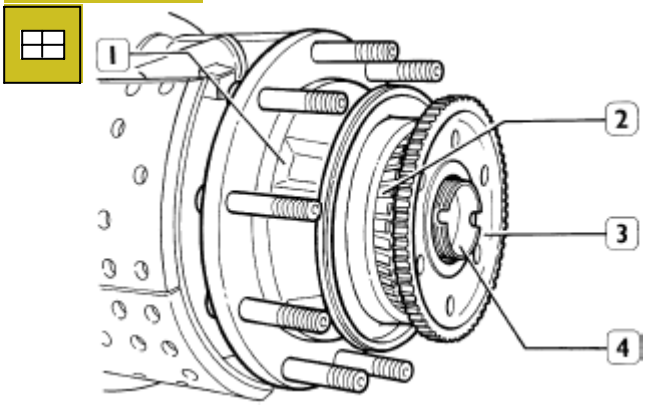
Figure 31




40377

Using an electric drier, heat the taper roller bearing (1) to 100°C and fit on the bevel gear support (2) with a punch.

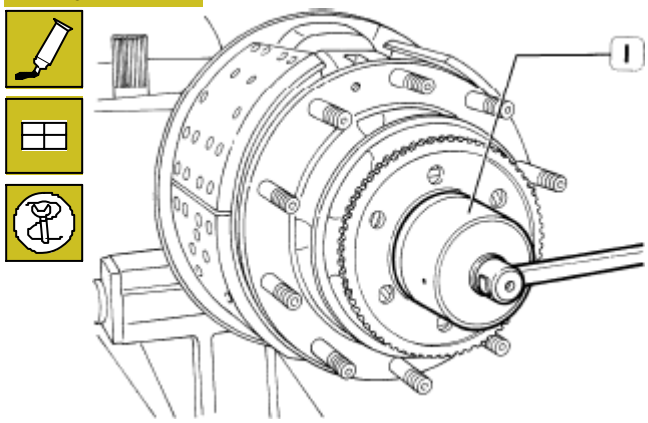
Figure 32




39650

Fit the bevel gear support (3) and the taper roller bearing (2) on the load bearing sleeve (4).

Figure 33

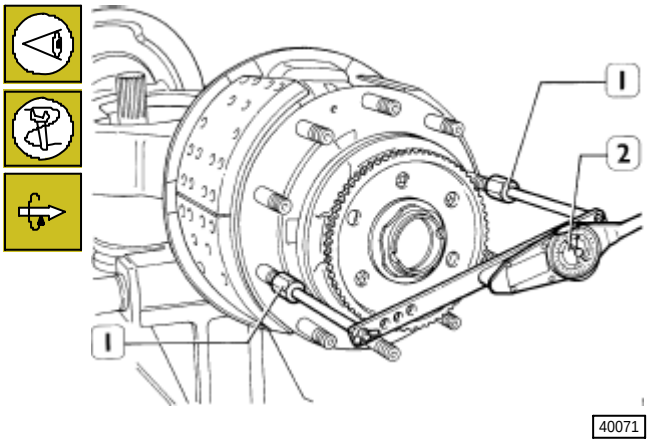



40070

Apply a thin layer of MOLYKOTE on the contact surface of the adjusting nut and tighten with wrench 99354207 (1) until the hub rotates with difficulty. Release the hub with a few blows from a hammer in the direction of the axis and in both directions.

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Figure 34



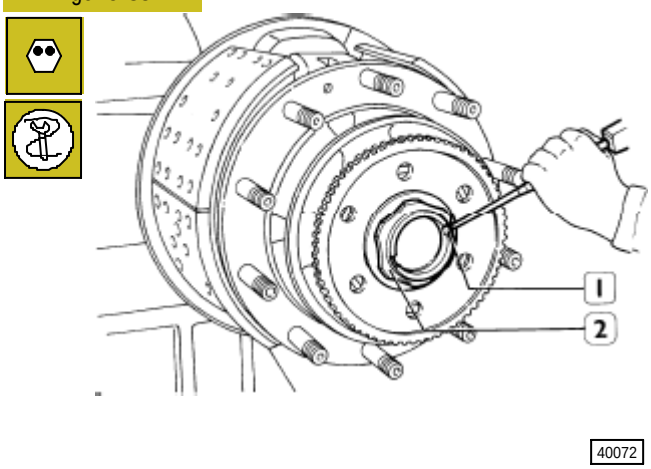

Position tool 99395026 (1) and, using a torque wrench (2), read the wheel hub rolling torque.

Whilst reading the wheel hub rolling torque, hub rotation must not exceed 40 rpm.

Wheel hub rolling torque values vary according to the following conditions:

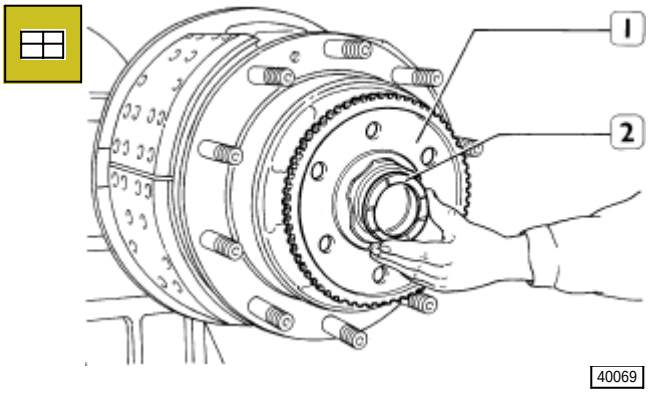
- new bearings with surface protection 6 ÷ 7 + (12 ÷ 16) Nm
- run in bearings and new, lubricated seals 6 ÷ 7 + (5 ÷ 7) Nm
- run in bearings and seals 6 ÷ 7 + (2.5 ÷ 4.5) Nm

Figure 35




Once the required rolling torque has been achieved, secure the adjusting nut (2) with a punch in the two grooves on the load bearing sleeve (1).

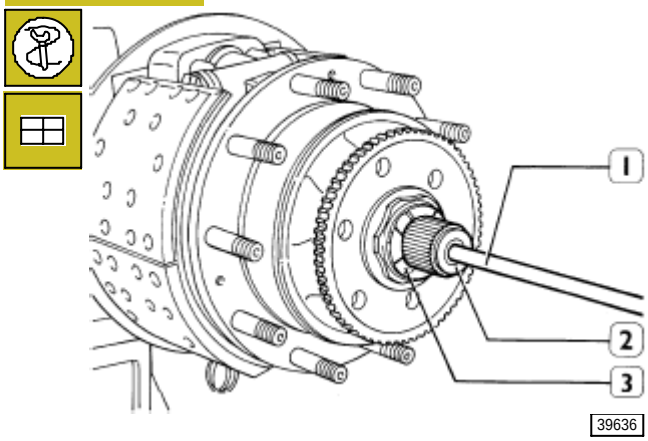
Figure 36




Position the spacer ring (2) on the load bearing sleeve.

## 525140 Assembling the epicyclic reduction gear

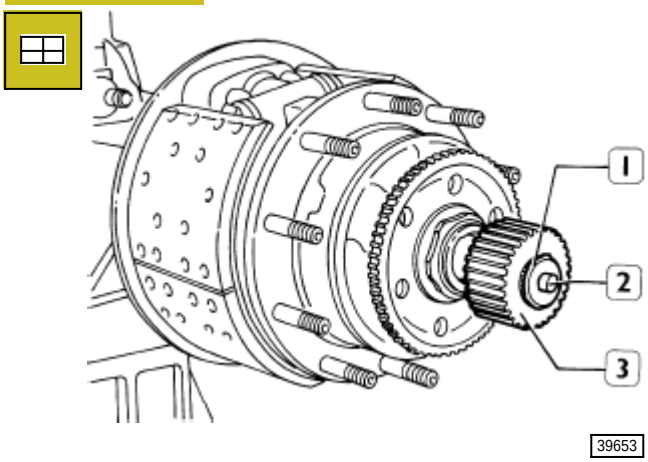
Figure 37




Using tool 99374451 (1) introduce the drive shaft (2) on the load bearing sleeve (3).

The double toothed short half shaft is to be fitted in the bearing shaft on the differential locking side.

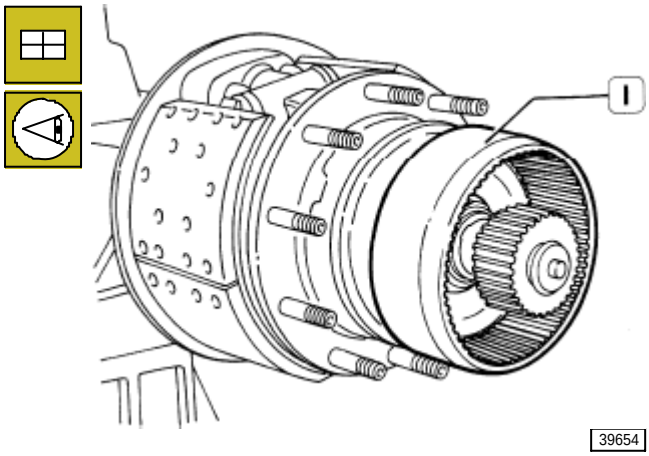
Figure 38




Position the gear unit (3) on the grooved section of the drive shaft and the safety ring (1) in the seat. Drive the shoulder pin (2) into the seat on the drive shaft.

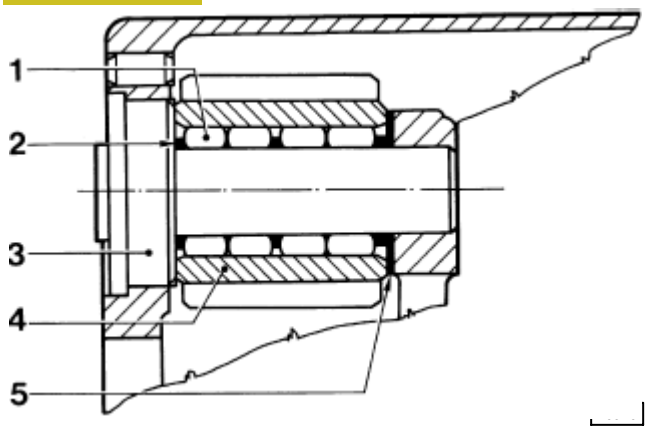
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Figure 39



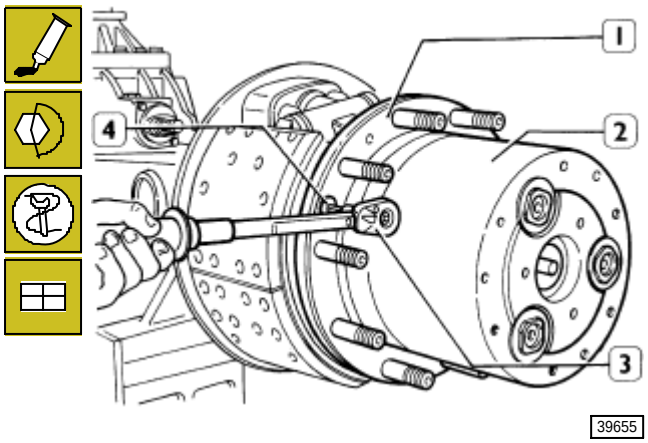

Position the bevel gear (1) with the external bevel facing outwards and then fit on the bevel gear support.

Figure 40




Smear the rollers (1) with grease and position, together with the three spacer rings (2) on the side pinion (4), as shown in the drawing.
Position the side pinion (4) and the spacer washer (5) in the side pinion support.
Introduce the support pin (3) from the cover side, pushing it fully into position.
Repeat the same operation for the remaining two side pinion units.

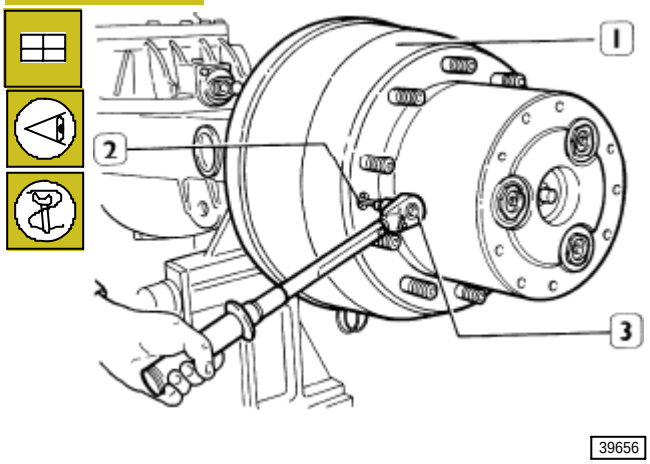
Figure 41




Smear a thin layer of LOCTITE 573, or Reinzoplast, on the contact surfaces of the side pinion support (2) and the wheel hub (1).

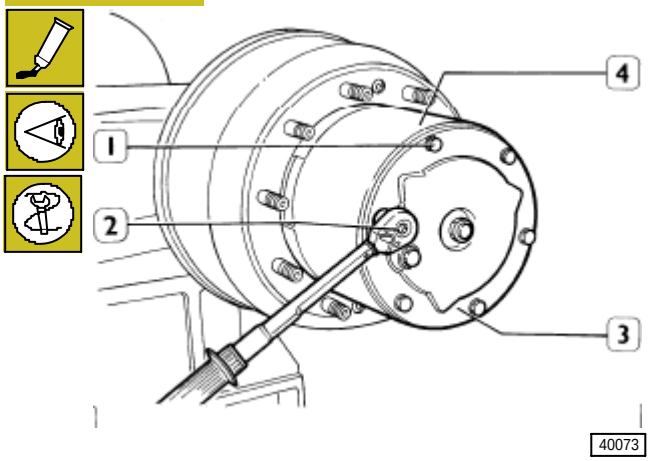
Push the side pinion support (2) onto the hub by moving the drive coupling flange in both directions to facilitate toothing engagement. Make sure that the fixing holes on the side pinion support and the hub coincide.
Position the three cheese-headed screws (4) and tighten to a torque of 50 ± 5 Nm with a torque wrench (3).

Figure 42




Fit the brake drum (1) on the side pinion support. Secure the brake drum with the two cheese-headed screws (2) and tighten to a torque of 50 ± 5 Nm with a torque wrench (3).

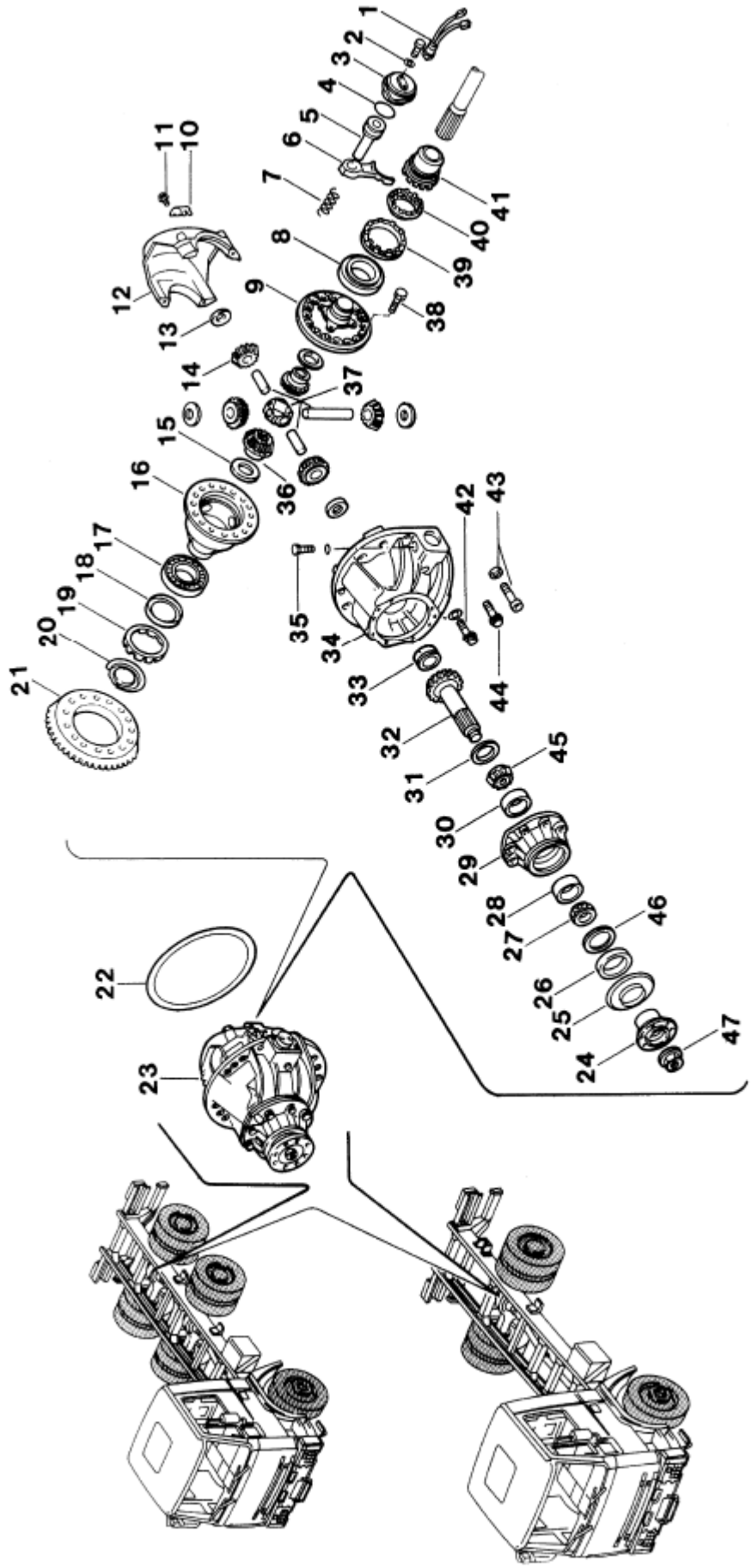
Figure 43




Smear a thin layer of LOCTITE 510 on the cover (3) and side pinion support (4) contact surfaces.
Position the cover so that the bevels of the support pins coincide with the holes on the cover.
Smear LOCTITE 573 sealing compound on the screw (1) thread and tighten to a torque of 50 ± 5 Nm with a torque wrench (2).

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Figure 44

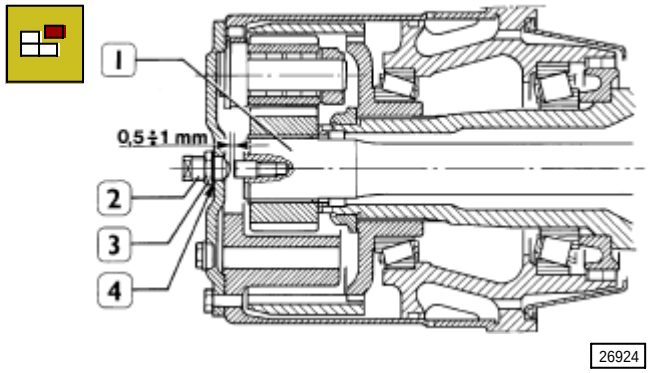


DIFFERENTIAL UNIT PARTS

1. Electric transmitter - 2. Seal and coupling ring - 3. Cover - 4. Seal ring - 5. Piston - 6. Fork - 7. Springs - 8. Bearing - 9. Cover - 10. Plate - 11. Screw - 12. Cover - 13. Washer - 14. Side pinion - 15. Shoulder washer - 16. Half-housing - 17. Bearing - 18. Ring - 19. Ring nut - 20. Oil baffle - 21. Ring bevel gear - 22. Seal ring - 23. Differential unit - 24. Flange - 25. Dust seal - 26. Seal ring - 27. Bearing - 28. Bearing - 29. Pinion support - 30. Bearing - 31. Adjusting ring - 32. Pinion - 33. Bearing - 34. Housing - 35. Screw - 36. Crown wheel - 37. Cross pins - 38. Screw - 39. Ring nut - 40. Sleeve - 41. Sliding sleeve - 42. Screw - 43. Screw - 44. Screw - 45. Bearing - 46. Ring - 47. Nut

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Figure 45



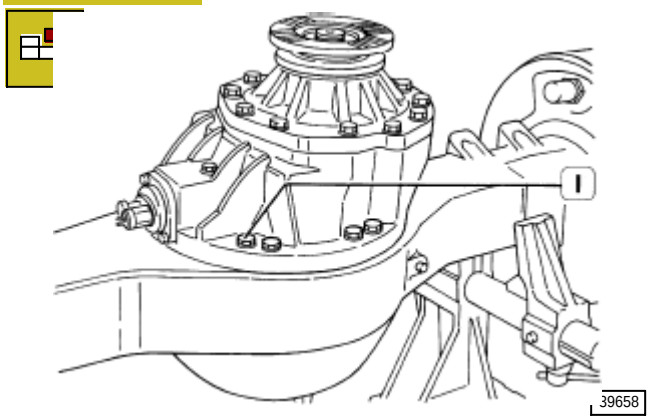

26924

The end float on the drive shaft (1) must be between 0.5 and 1 mm. To carry out this adjustment fully tighten the adjusting screw (2), then unscrew by half a turn and secure with the hex nut (3).

**NOTE** The flat face of the hex nut must be positioned towards the seal ring (4).

## 526210 REMOVING-REFITTING THE DIFFERENTIAL

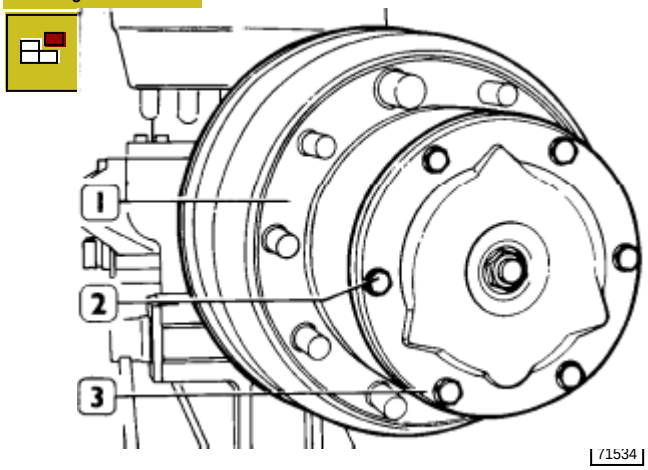
Figure 46




39658

Remove the screws (1) fixing the differential carrier to the axle housing.

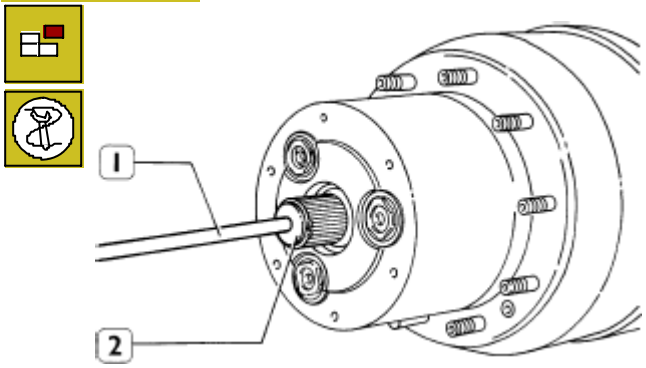
Figure 47




71534

Position a container under the wheel hub (1); unscrew the screws (2), remove the cover (3) and drain off the oil.

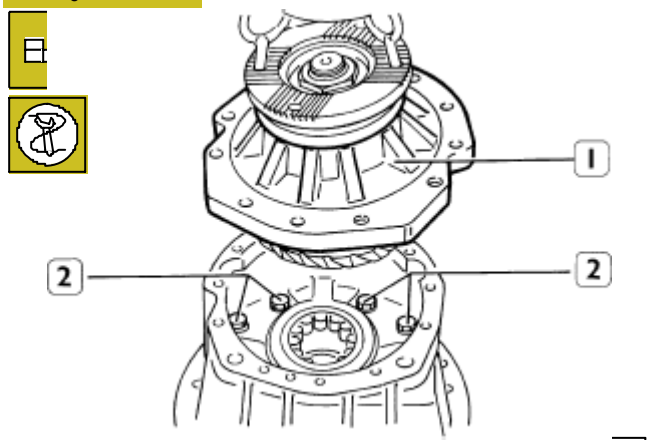
Figure 48




39659

Fit tool 99374451 (1) in the shoulder pin seat thread, then extract the drive shaft (2) from the load bearing sleeve.

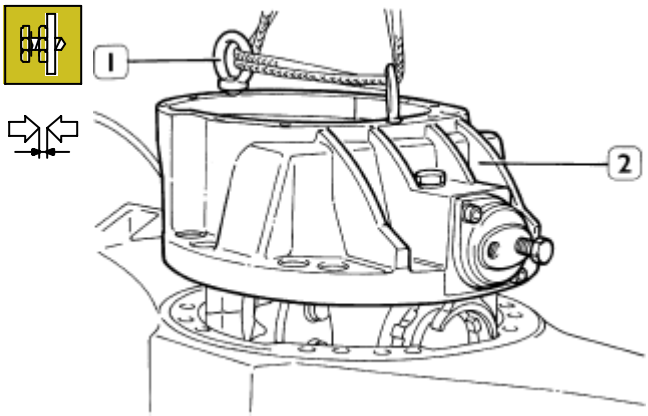
Figure 49




39660

Using eyebolts, raise the pinion support (1) with a sling and unscrew the four screws (2) fixing the differential carrier.

Figure 50



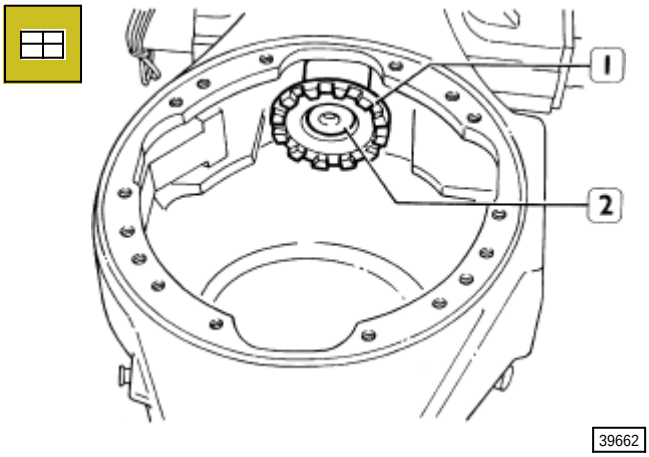

39661

Using eyebolts (1) and a sling, raise the differential carrier (2).

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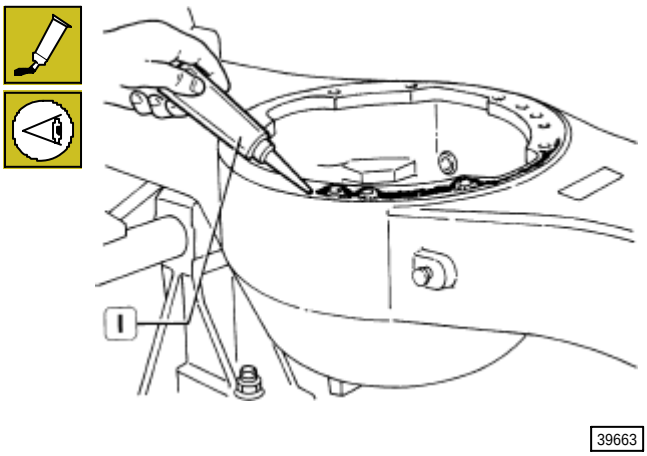
## REFITTING

Figure 51



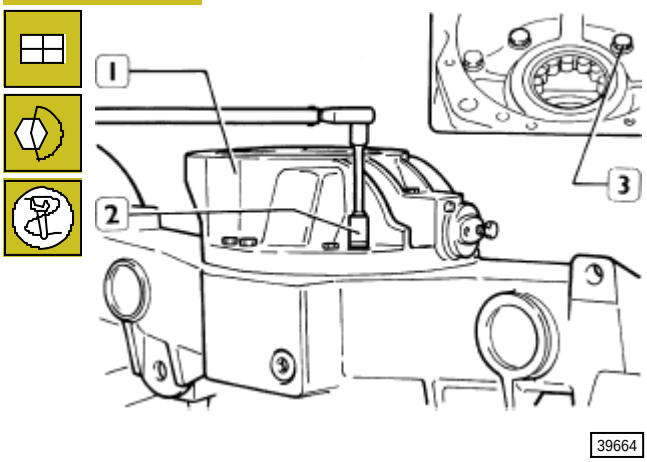

Fit the sliding sleeve (1) on the drive shaft (2) with double toothing.

Figure 52



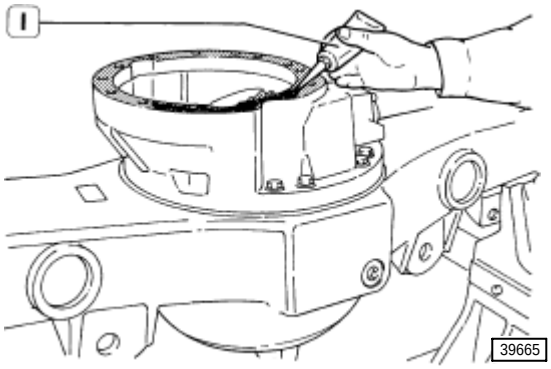

Smear LOCTITE 573 (1) sealing compound on the contact surface. When assembling the differential housing, make sure that the differential lock engagement fork is correctly introduced on the sliding sleeve.

Figure 53




Position the seal ring and assemble the differential carrier (1). Apply LOCTITE 573 on the threads of the external screws (2). Using a torque wrench, tighten the external (2) and internal (3) screws to the correct torque.

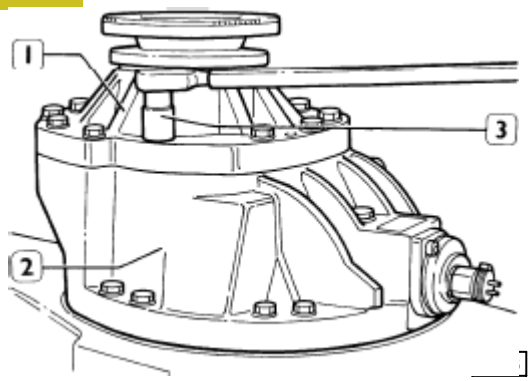
Figure 54




Smear LOCTITE 573 (1) sealing compound on the contact surface.

Apply a bead of LOCTITE 510 around the oil passage holes.

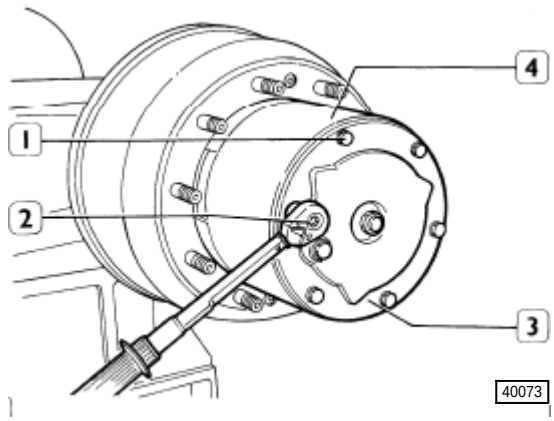
Figure 55




Position the bevel pinion support (1) on the differential carrier (2). Using a torque wrench, tighten the screws (3) to the correct torque.

Apply LOCTITE 573 on the threads of the screws (3) that pass through the holes.

Figure 56



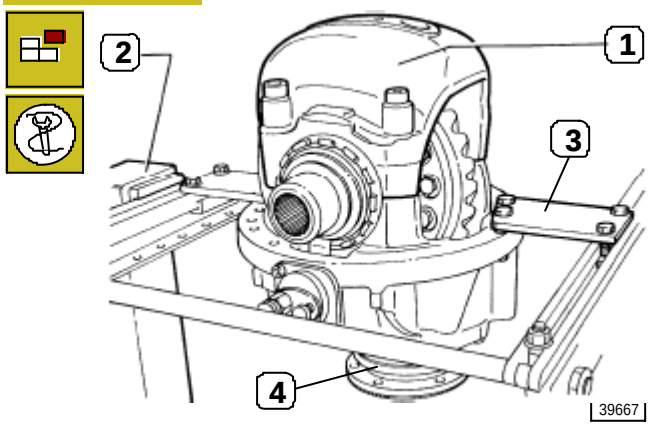

Smear a thin layer of LOCTITE 510 on the cover (3) and crown wheel support (4) contact surfaces. Position the cover so that the bevels of the support pins coincide with the holes on the cover. Smear LOCTITE 573 sealing compound on the screw (1) thread and tighten to the correct torque with a torque wrench (2).

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## 526210 REPAIRING THE DIFFERENTIAL

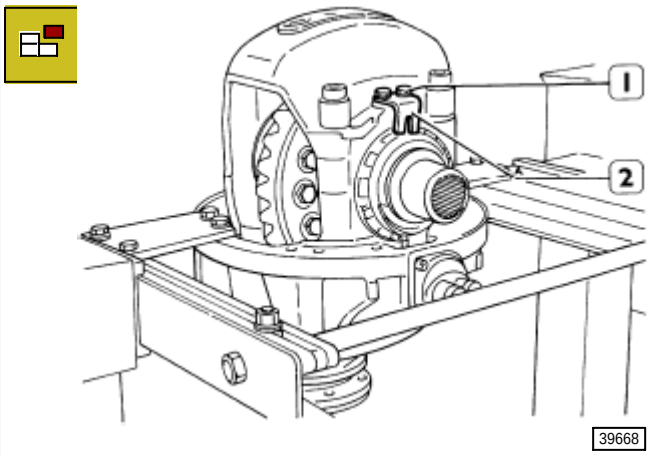
### Removal

Figure 57



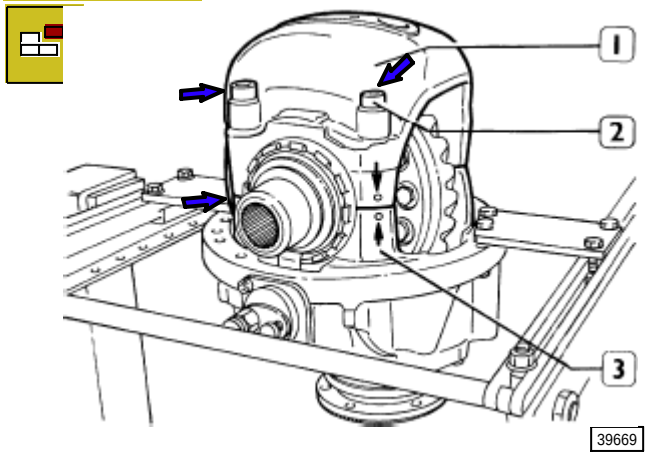

Position the differential unit with the gear housing cover (1) facing upwards, on rotating stand 99322205 (2), together with support 99322225 and pair of brackets 99371022 (3). Provisionally fit the bevel pinion support (4).

Figure 58



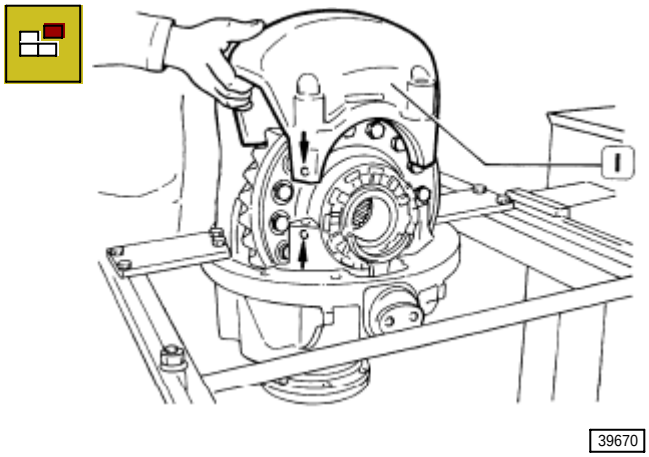

Unscrew the screws (1) and remove the safety plate (2). Repeat the same operation on the opposite side.

Figure 59



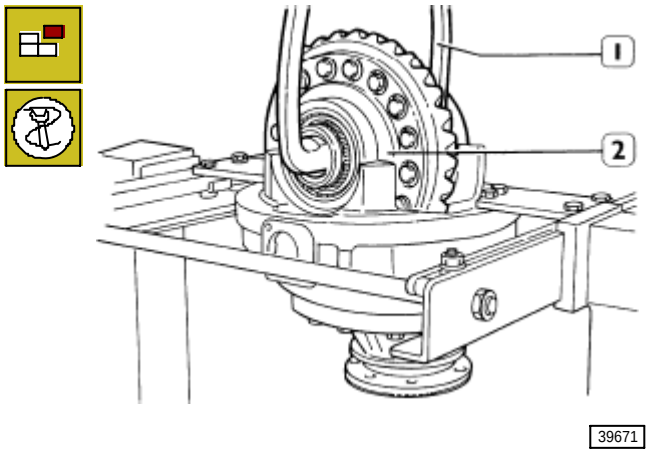

Heat the points indicated by the arrows with drier 99305121 and unscrew the screws (2) fixing the cover (secured with LOCTITE).

Figure 60



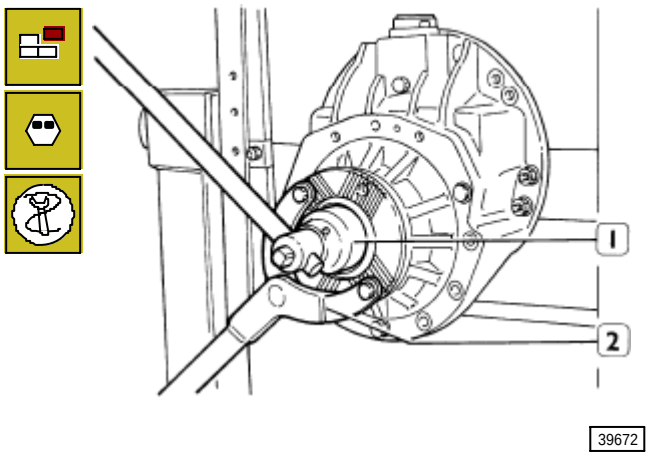

Raise the gear housing cover (1).

Figure 61




Using hook 99370509 (1), raise the gear housing (2), together with the taper roller bearings and bearing external rings.

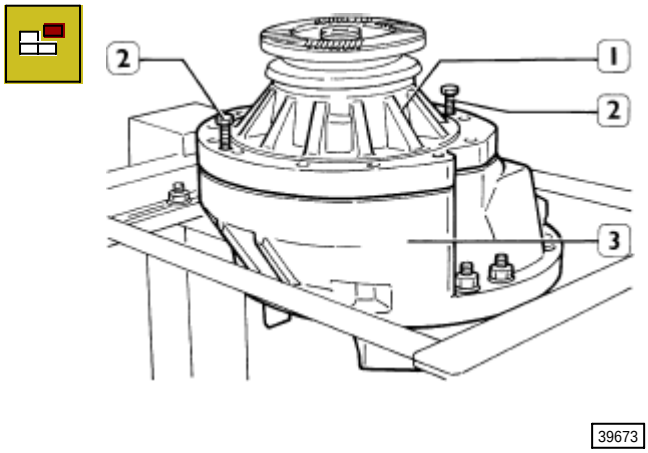
Figure 62




Rotate the differential carrier through 90º.
Remove the safety notch on the fixing nut.
Apply reaction lever 993701317 (2) to the drive coupling flange and, using Allen wrench 99355081 (1), loosen the fixing nut.

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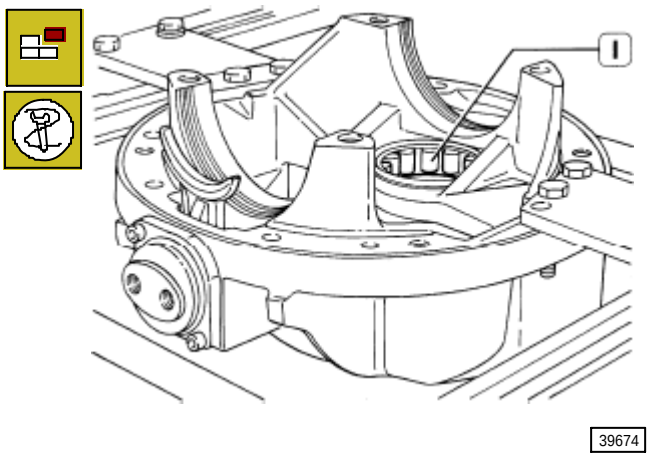
Figure 63




39673

Unscrew the screws and washers of the differential carrier (3) bevel pinion support (1). Fit the reaction screws (2) and extract the differential housing support.

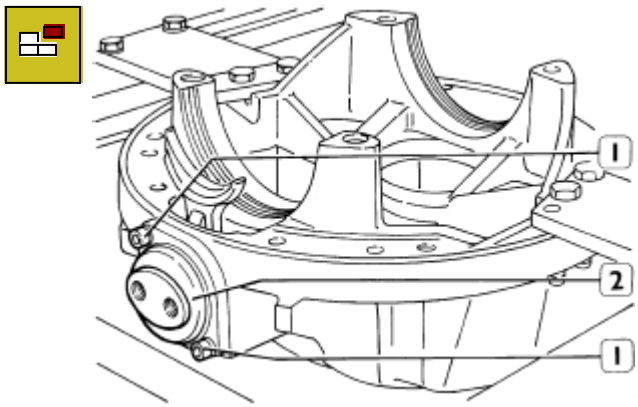
Figure 64




39674

Using a universal punch, extract the bevel pinion taper roller bearing (1) from the seat on the differential carrier.

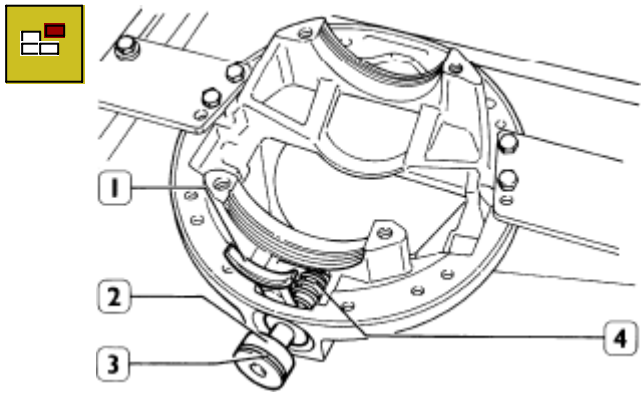
Figure 65




39675

Unscrew the 2 sunken hex screws (1) and remove the differential locking device control cylinder (2).

Figure 66

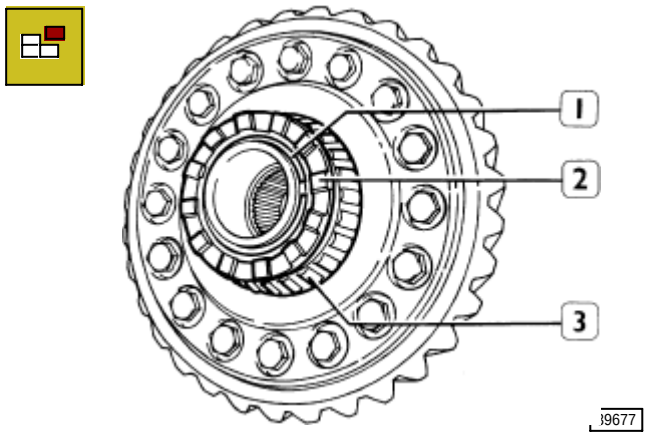



39676

Extract the piston (2), together with the seal ring (3), the engaging fork (1) and the compression spring (4).

## Differential housing disassembly

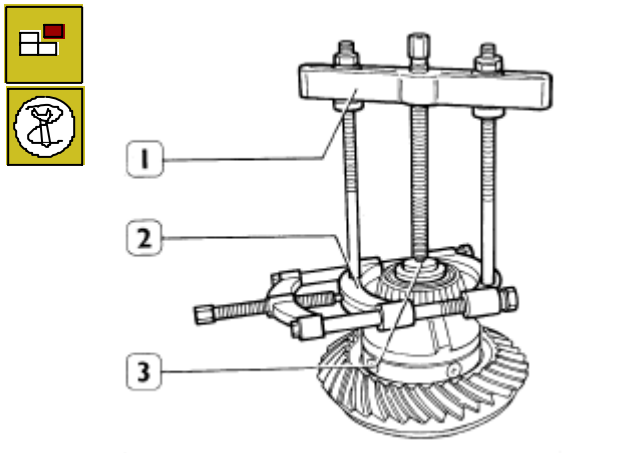
Figure 67




39677

Remove the circlip (1) and extract the differential lock engaging sleeve (3) from the gear housing cover (2).

Figure 68

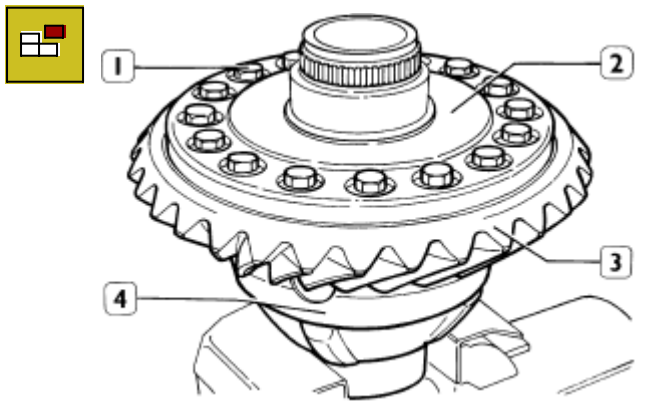



40086

Using extractor 99348001 (1-2) and reaction block 99345053 (3), extract the taper roller bearing from the differential housing. Repeat the same operation on the opposite side.

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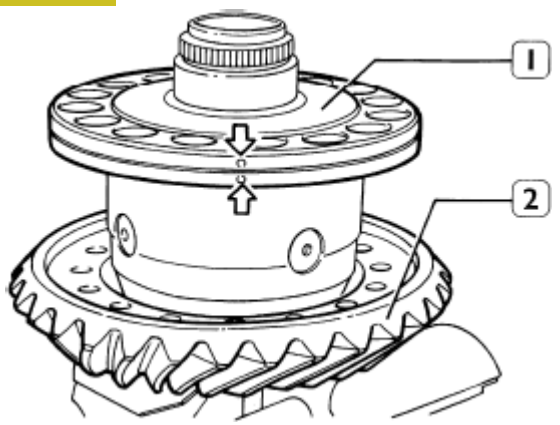
Figure 69




39679

Loosen and extract the screws (1) fixing the ring bevel gear (3) and cover (2) to the half-housing (4).

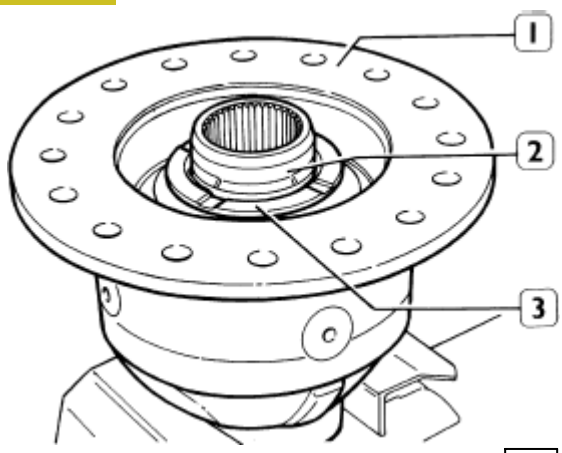
Figure 70




39680

Counter-mark the cover and gear housing (⇒ ⇐).
Remove the differential housing cover (1) and release the ring bevel gear (2).

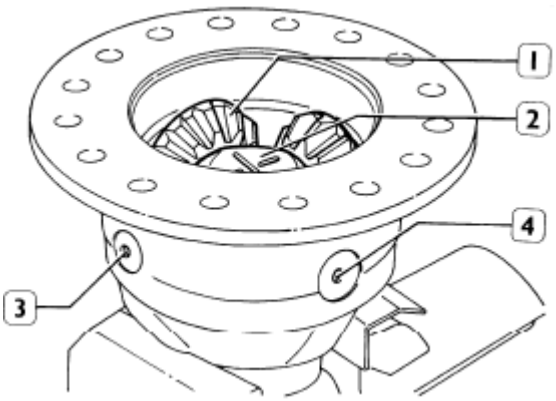
Figure 71




39681

Remove the crown wheel (2), together with the shoulder washer (3), from the differential housing (1).

Figure 72




39682

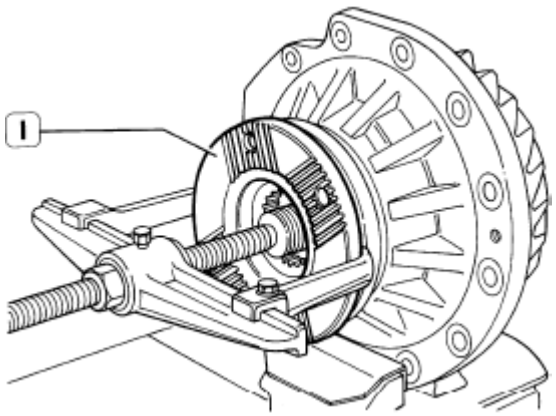
Using a punch, first extract the long pin (4) and then the two short pins (3).

**NOTE** The exact position of the pins is marked on the spider body (2) by a long stripe for the long pin, and by two short stripes for the short pins.

Remove the spider (2) and the four side pinions (1) with the relative shoulder washers.
Remove the crown wheel and the shoulder washer.

## Removing the bevel pinion from the support

Figure 73

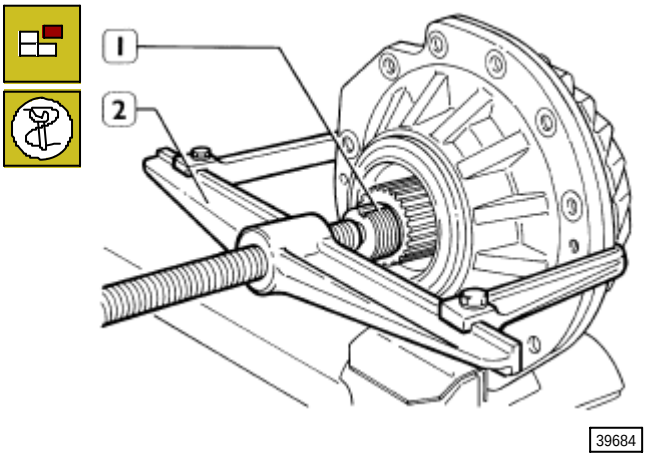



39683

Remove the fixing nut and the drive coupling flange (1).
If flange extraction proves difficult, use a universal extractor.

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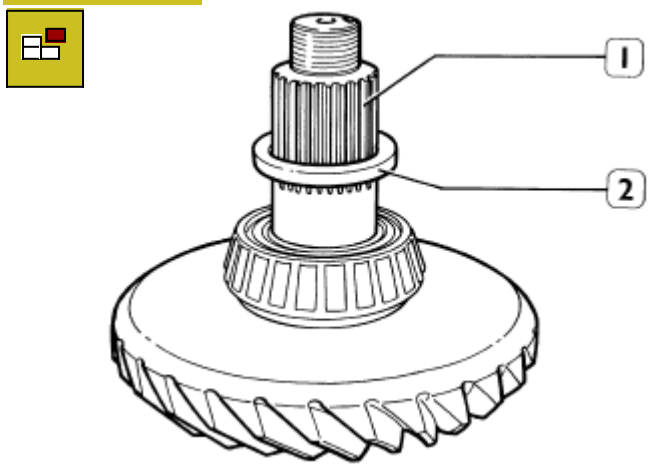
Figure 74




39684

Remove the bevel pinion (1), intermediate bearing and adjusting rings from the support. This operation should be carried out under a press; if not, use an extractor (2).

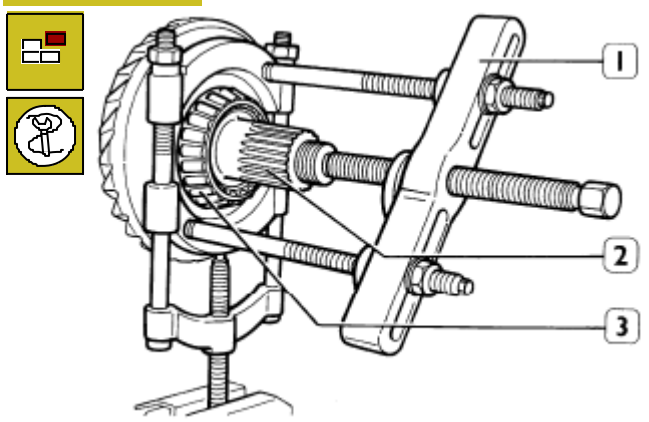
Figure 75




39685

Remove the bearing adjustment ring (2) from the bevel pinion (1).

Figure 76




39686

Using universal extractor 99348001 (1), extract the intermediate taper roller bearing (3) from the bevel pinion (2).

Figure 77




9687

Extract the pinion position adjusting ring (2) from the bevel pinion (1).

Figure 78




39688

Extract the rear straight roller bearing internal ring (2) from the bevel pinion (1). This is a destructive operation.

Figure 79




39689

Using a punch, extract the external rings (3 and 2) for the front and intermediate bearings from the support (1).

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## CHECKING THE DIFFERENTIAL COMPONENTS

Carefully clean all of the individual differential components. Lubricate the bearings and make sure that the roller support cage rotates freely, rotation should be smooth, without hardening.

**NOTE** Carefully clean all the threads to ensure exact adjustments and precise tightening torque values.

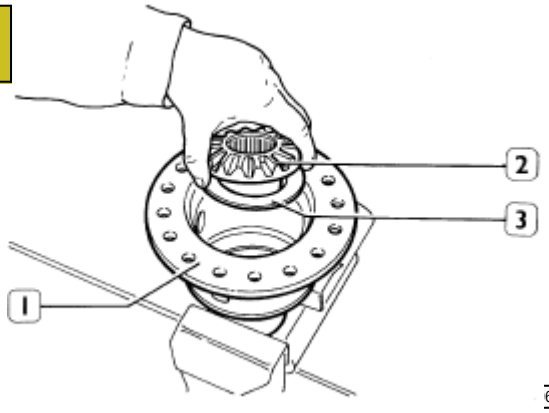
Check that the grooved section on the pinion flange is not excessively worn. Replace the pinion if necessary.

**NOTE** If either the bevel gear or pinion need to be changed, both parts must be replaced as they are provided as coupled spare parts.

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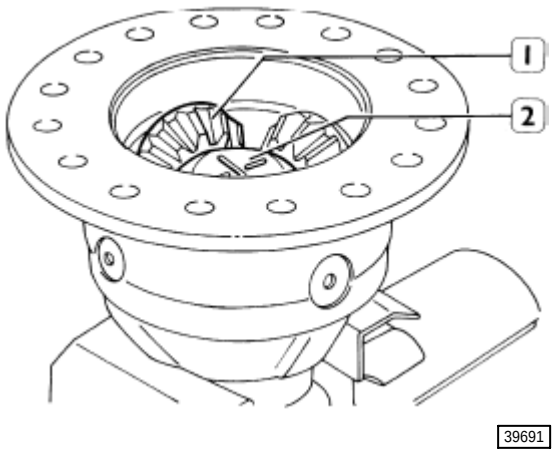
## Differential housing assembly

Figure 80



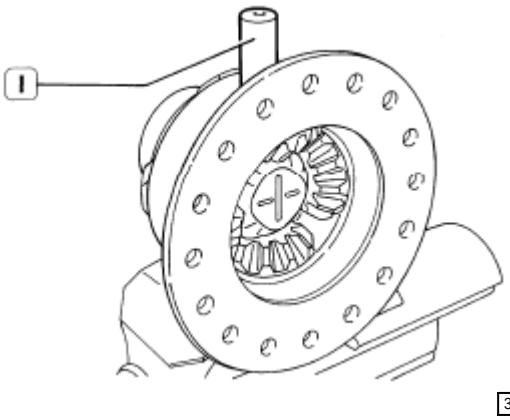

Secure the gear housing (1) in a vice and position the crown wheel (2) in its seat, together with the shoulder washer (3).

Figure 81




Assemble the four side pinions (1) with the shoulder washers and insert the spider (2).

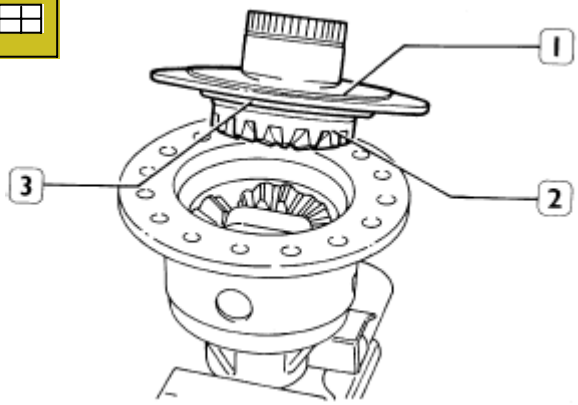
Figure 82




Insert the long pin (1) and the two short pins.

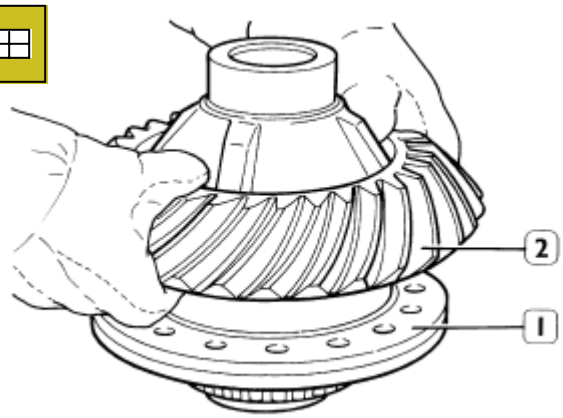
**NOTE** First insert the long (through) pin. The exact position of the pins is marked on the spider body by a long stripe for the long pin, and by two short stripes for the short pins.

Figure 83



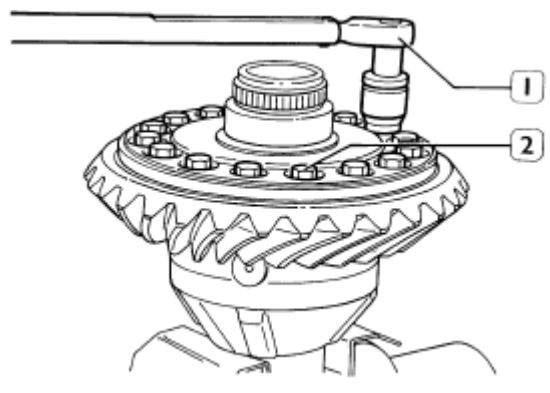

Position the crown wheel (2) and shoulder washer (3) on the side pinion gear unit.
Fit the cover (1) on the differential housing by making the marks (made during disassembly operations) coincide.

Figure 84




Heat the ring bevel gear (2) to approx. 80°C, fit in position in the gear housing (1) and secure with two fixing screws.

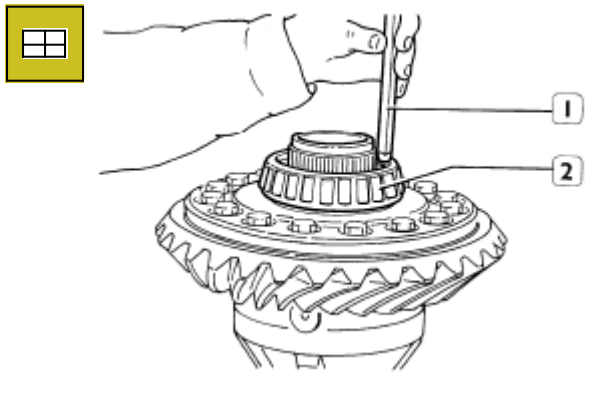
Figure 85




Fit the remaining screws (2) and tighten with a torque wrench (1) to 300 ± 10 Nm (30 ± 1).

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Figure 86

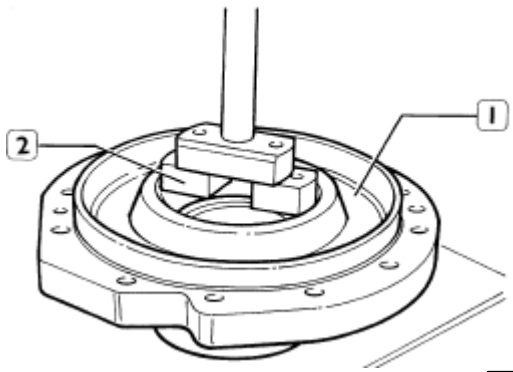



39696

Using an electric heater, heat the support bearing (2) for 15' at a temperature of 100°C and fit on the differential housing cover using a punch (1). Repeat the same operation on the other bearing.

## Assembling the bevel pinion support

Figure 87

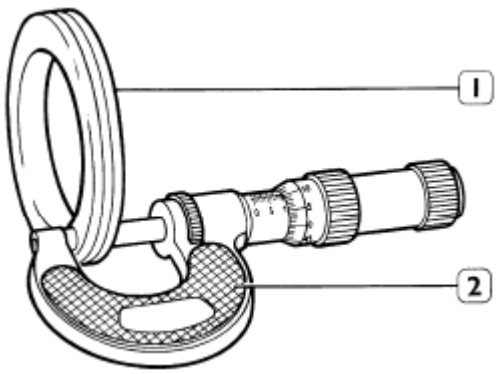



39697

Fit a new oil baffle on the pinion support (1) Using punch 99374093 (2), fit the intermediate bearing external ring and the front bearing external ring in the support in their respective seats.

## Procedure to follow to determine the thickness of the bevel pinion rolling torque adjusting ring

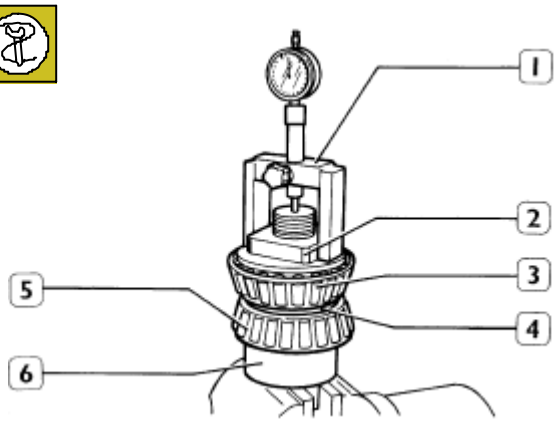
Figure 88




39572

Using a feeler gauge (1) measure and note the thickness of the adjusting ring on disassembly (value A).

Figure 89




39698

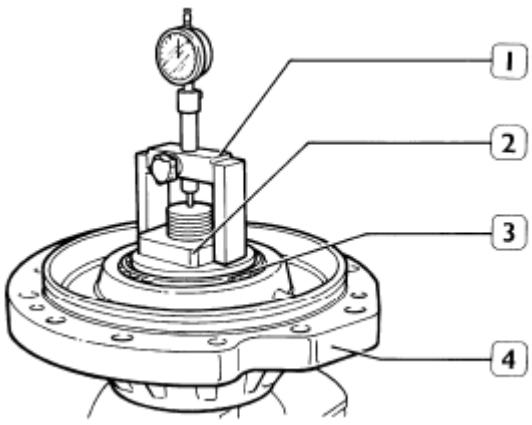
Secure tool 99395027 (6) in a vice and fit the following parts:

- the bearing (5) on the pinion-side;
- the previously measured adjusting ring (4) and the bearing (3).

Fully tighten the ring nut (2).
Position part (1) of tool 99395027 (6) on the bearing (3), fitted with a zero-set dial gauge on the end of the tool (6).
Then remove:

- the part (1),
- the ring nut (2),
- the bearing (3),
- the adjusting ring (4) on the tool (6).

Figure 90

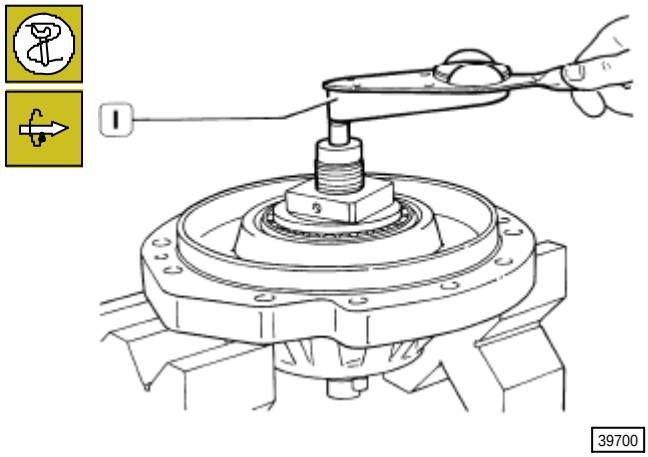



39699

Position the support (4) on the bearing (5, Figure 89) and the bearing (3) on the support. Tighten the ring nut (2) by hand and check the rolling torque, as indicated in Figure 91.

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Figure 91




39700

Position the complete support on two parallel blocks; using the torque wrench (1) applied on tool 99395027 and read the rolling torque. This value should be 1.5 to 3.5 Nm; if not, adjust by means of the ring nut (2, Figure 89).
Position the part (1, Figure 89), with the dial gauge zero-set, on the bearing (3) and read the eventual deviation (value B).

Thickness S on the adjusting ring is provided by the following formula:

Where:

A = thickness of the adjusting ring assembled for dial gauge zero-setting;

B = deviation value read;

C = 0.05 mm coefficient which takes into account the expansion of the bearings as a result of the assembly negative allowance on the bevel pinion.

First example:

A = 10.12 mm
B = + 0.13 mm
C = 0.05 mm

S = 10.12 - (+ 0.13) + 0.05 =
S = 10.12 - 0.13 + 0.05 = 10.04 mm.

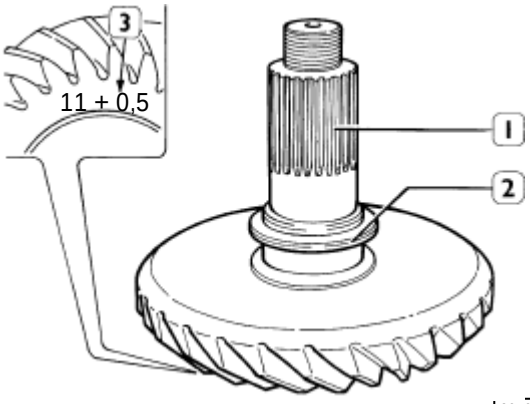
Second example:

A = 10.12 mm
B = - 0.13 mm
C = 0.05 mm

S = 10.12 - (- 0.13) + 0.05 =
S = 10.12 + 0.13 + 0.05 = 10.35 mm.

On completion of the operation, remove the parts of tool 99395027.

Figure 92




39701

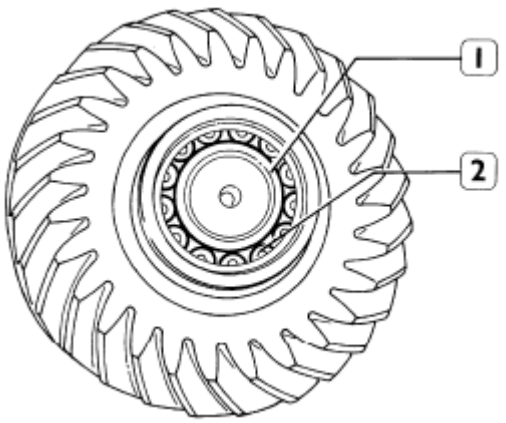
Fit the adjusting ring (2), in order to position the pinion in relation to the bevel gear, on the bevel pinion (1). The thickness of the adjusting ring is determined by the reference value (3) marked on the bevel pinion.
See the table in Figure 93.

Figure 93

| Value marked on the bevel pinion | Total thickness of adjusting ring |
|---|---|
| -0.5 | 4.6 |
| -0.4 | 4.5 |
| -0.3 | 4.4 |
| -0.2 | 4.3 |
| -0.1 | 4.2 |
| 0 | 4.1 |
| +0.1 | 4.0 |
| +0.2 | 3.9 |
| +0.3 | 3.8 |
| +0.4 | 3.7 |
| +0.5 | 3.6 |

Summary table to determine the thickness of the bevel pinion position adjusting ring.

Figure 94



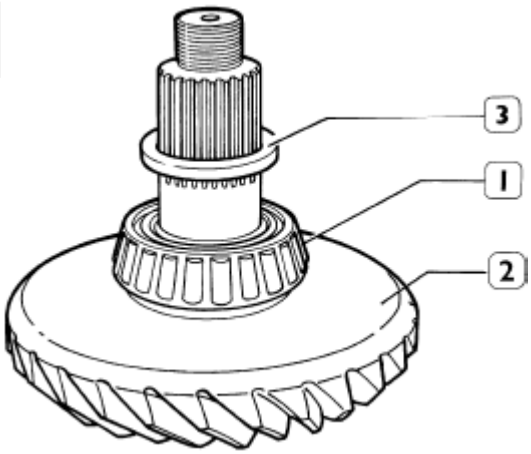

39702

Heat with an electric drier to 100°C and insert the rear straight rollers bearing internal ring (1) on the bevel pinion (2).

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## Differential carrier assembly

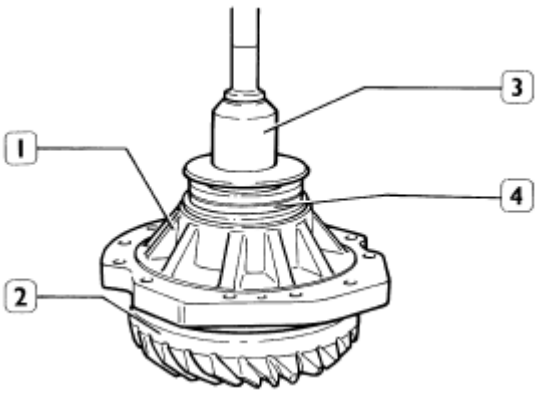
Figure 95




39703

Heat the intermediate bearing (1) for approx. 15' at a temperature of 100°C and fit on the bevel pinion (2); fit the adjusting ring (3) with the same thickness as previously noted (page 164).

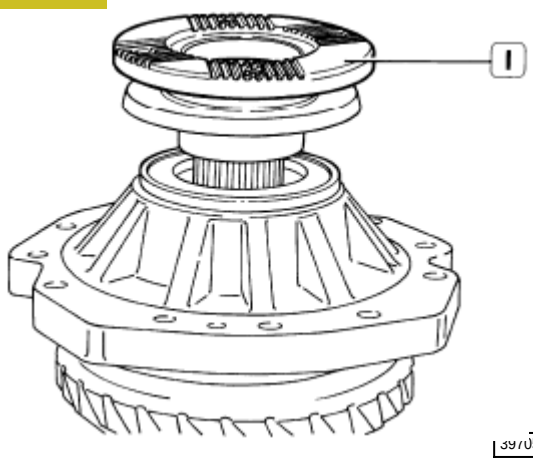
Figure 96




39704

Fit the previously assembled support (1) on the bevel pinion (2), fitting the front bearing. Using key 99374013 (3) and grip 99370006, insert the oil seal ring (4).

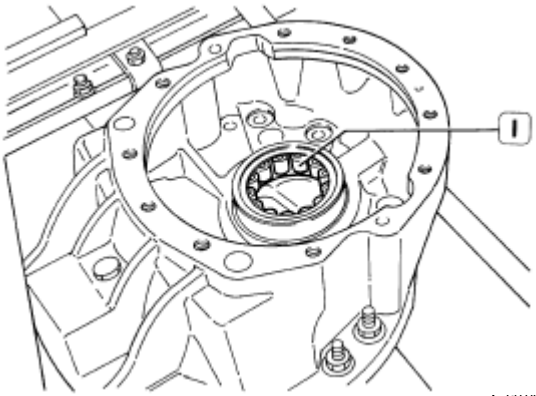
Figure 97




39705

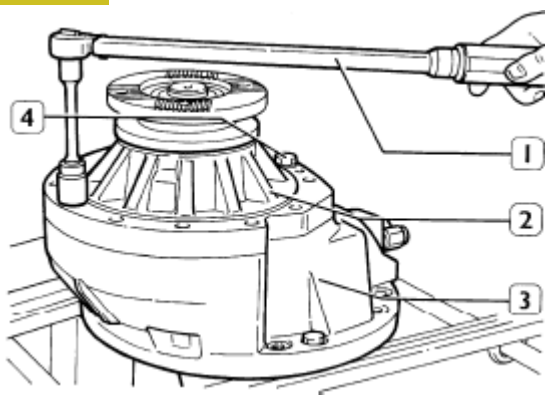
Assemble the drive coupling flange (1) with a punch and tighten the fixing nut by hand.

Figure 98




Using a punch, fit the rear straight rollers bearing (1) in position on the differential carrier.

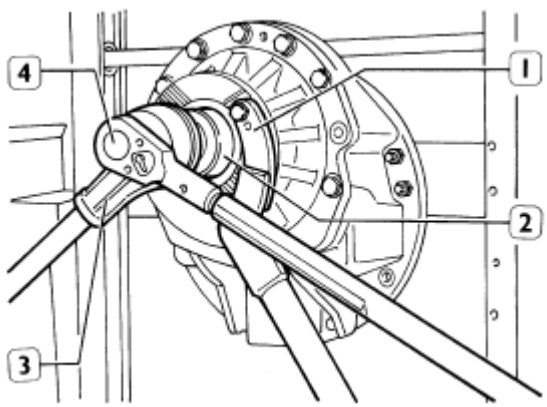
Figure 99




39707

Provisionally assemble the bevel pinion support (2) on the differential carrier (3), insert 2 screws (4) and washers in diametrically opposing positions. Using a torque wrench (1), tighten to a torque of 160 ± 10 Nm (16 ± 1 kgm).

Figure 100

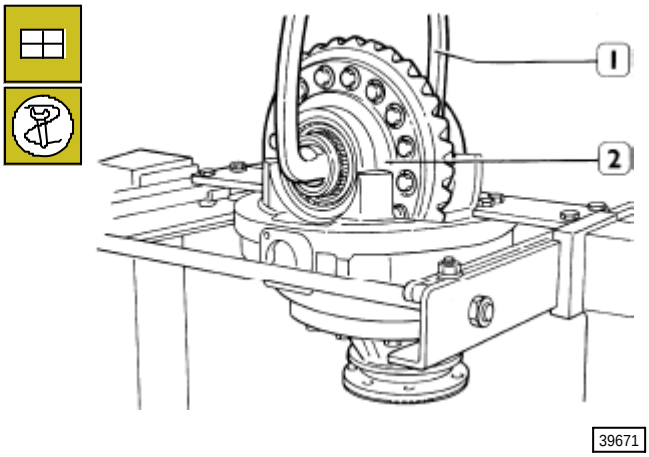



39708

Block the drive coupling flange rotation using reaction lever 99370317 (1) and, using Allen wrench 99355081 (2), the multiplier (3) and a torque wrench (4) tighten the fixing nut to a torque value of 700 ± 50 Nm (70 ± 5 kgm).

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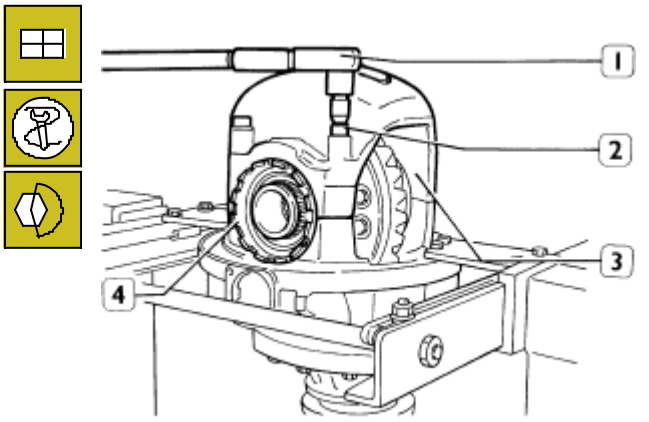
Figure 101




39671

Using hook 99370509 (1), position the gear housing (2) together with the roller bearings on the differential carrier.

Figure 102



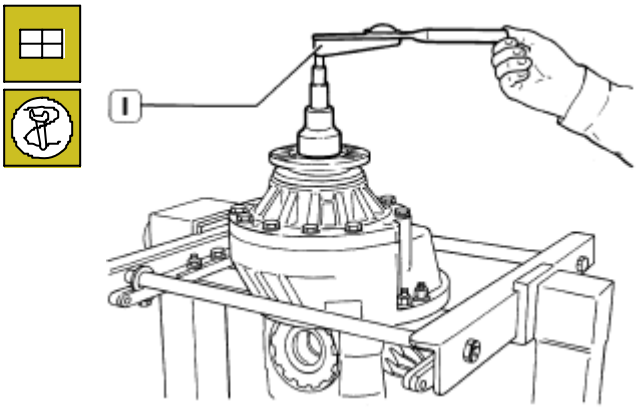

39709

Correctly fit the cover (3) making the marks (made during disassembly operations) coincide. Provisionally tighten the screws (2) and check that the adjusting ring nuts (4) screw-in easily.
Remove the screws (2), smear the threads with LOCTITE AVX and then re-tighten with a torque wrench (1) to a torque of 280 ± 15 Nm.

## Differential housing bearings rolling torque adjustment

The rolling torque reading is carried out when there is a clearance between the teeth on the bevel gear pair. However, the total rolling torque value varies according to the reduction bevel gear pair ratio (see table in Figure 104).

Figure 103




39712

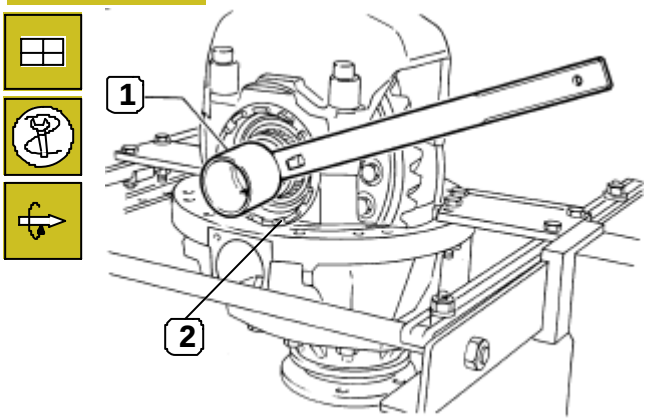
Using torque wrench 99389819 (1) and the appropriate Allen wrench, check that the total rolling torque value corresponds with the value indicated in Figure 104.

Figure 104

| No. of teeth | Ratio | Total rolling torque (Nm) |
|---|---|---|
| 17/35 | 2.059 | a + (1.5 - 2.4) |
| 19/33 | 1.737 | a + (1.6 - 2.6) |
| 21/34 | 1.619 | a + (1.9 - 3.1) |
| 23/36 | 1.565 | a + (1.9 - 3.2) |
| 24/35 | 1.458 | a + (2.1 - 3.4) |
| 28/37 | 1.321 | a + (2.3 - 3.8) |
| 27/32 | 1.185 | a + (2.5 - 4.2) |
| 21/40 | 1.905 | a + (1.6 - 2.6) |
| 27/37 | 1.370 | a + (2.2 - 3.6) |
| 29/37 | 1.276 | a + (2.4 - 3.9) |

a = 7.5 ÷ 9.5 Nm

Figure 105




39711

If the torque value is different from that indicated in Figure 104, adjust the adjustment ring nuts (2) with wrench 99354001 (1) until the required torque is obtained.

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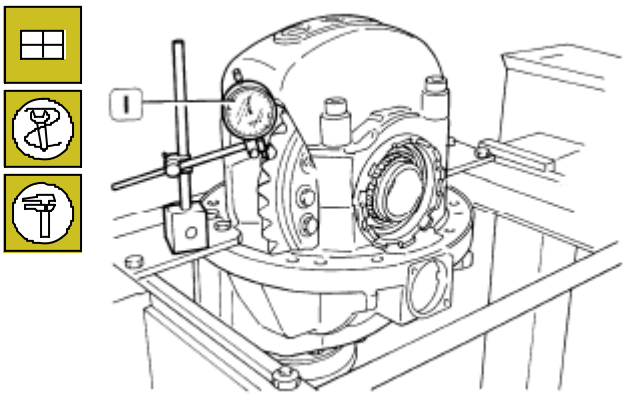
Adjust the end float between the teeth on the bevel gear pair as follows:

- Read the clearance value between the teeth in Figure 106.

Figure 106

| No. of teeth | Ratio | Clearance between teeth |
|---|---|---|
| 17/35 | 2.059 | 0.2 ÷ 0.33 |
| 19/33 | 1.737 | 0.2 ÷ 0.33 |
| 21/34 | 1.619 | 0.2 ÷ 0.33 |
| 23/36 | 1.565 | 0.2 ÷ 0.33 |
| 24/35 | 1.458 | 0.25 ÷ 0.33 |
| 28/37 | 1.321 | 0.2 ÷ 0.33 |
| 27/32 | 1.185 | 0.2 ÷ 0.33 |
| 21/40 | 1.905 | 0.2 ÷ 0.33 |
| 27/37 | 1.370 | 0.2 ÷ 0.33 |
| 29/37 | 1.276 | 0.2 ÷ 0.33 |

Figure 107

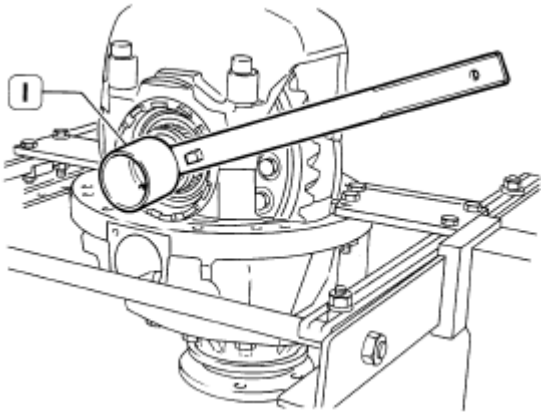


39710

- Position a magnetic stand dial gauge (1) as shown in the drawing.
- Prevent the bevel pinion from rotating with reaction lever 99370317, reverse the direction of rotation of the bevel gear and, using a gauge (1), read the clearance between the teeth on the two gear units.

If not, using the wrench 99354001 (1, Figure 108), adjust the adjusting ring nut.

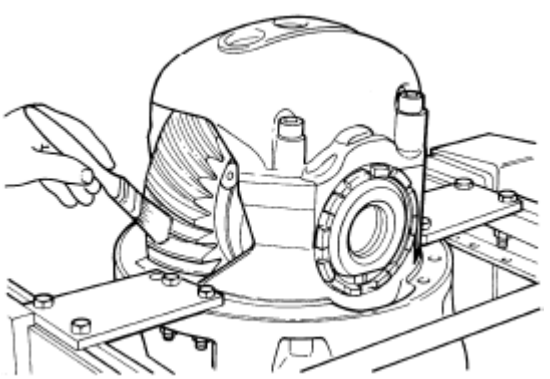
Figure 108



39711

In order to prevent the previously measured rolling torque from varying, during adjustments of the coupling clearance between the pinion and the bevel gear teething, tighten the ring nut with the wrench 99354001 (1) by the same amount as the ring nut on the opposite is loosened.
On completion of operations, check that the two adjusting ring nuts are suitably positioned to allow the safety plate to be fitted.

Figure 109

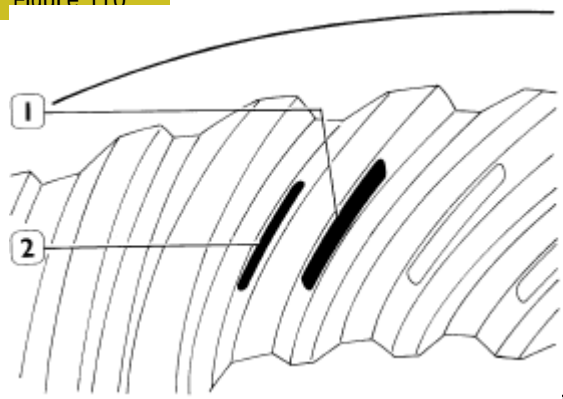


39704

Using a brush, apply a light covering of Prussian blue on the teeth of the bevel gear.
Rotate the pinion and check the coloured contact marks that the pinion teeth have made on the bevel gear teeth.
The following drawings illustrate possible contact marks and the operations required in order to correct the faults.

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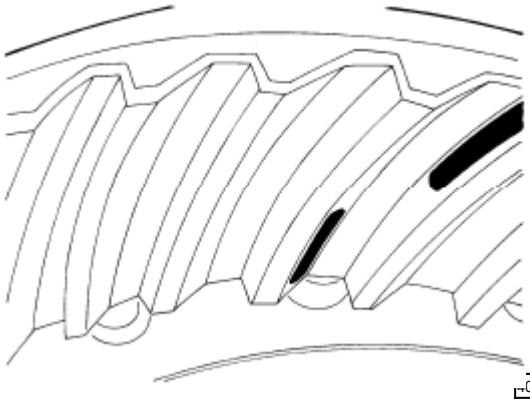
Figure 110




40160

The contact marks should be on both the leading face (1) and the pushing face (2), more or less in the centre between the teeth. When working without a load, both contact zones should be slightly out of position in relation to the external diameter of the bevel gear.

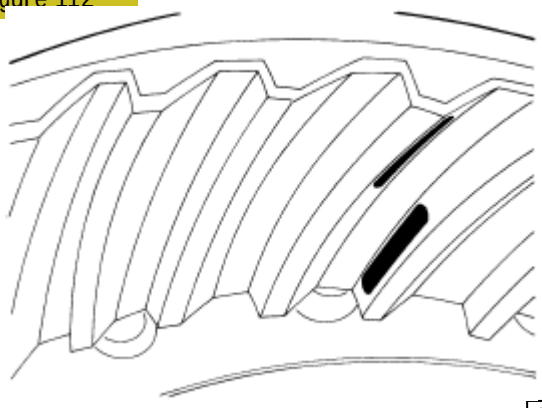
Figure 111



0161A

If the mark on the leading face (towards the external diameter) and on the pushing face (towards the internal diameter) is out of position, the pinion is located too close to the bevel gear.
- Solution: decrease the thickness of the adjusting ring (2, Figure 92) between the intermediate bearing and the bevel pinion.

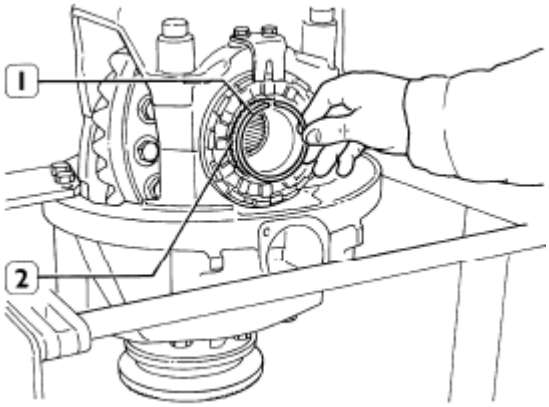
Figure 112



40161B

If the mark on the leading face is positioned towards the internal diameter, and on the pushing face it is located towards the external diameter of the bevel gear, the pinion is located too far away from the bevel gear axis.
- Solution: increase the thickness of the adjusting ring (2, Figure 92) between the intermediate bearing and the bevel pinion.

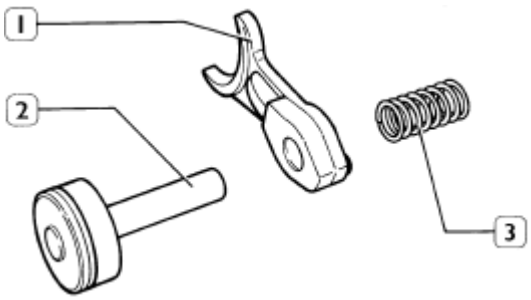
Figure 113




39713

Assemble the engaging sleeve (1) on the gear housing toothing and, with a screwdriver, position the circlip (2) in the groove.

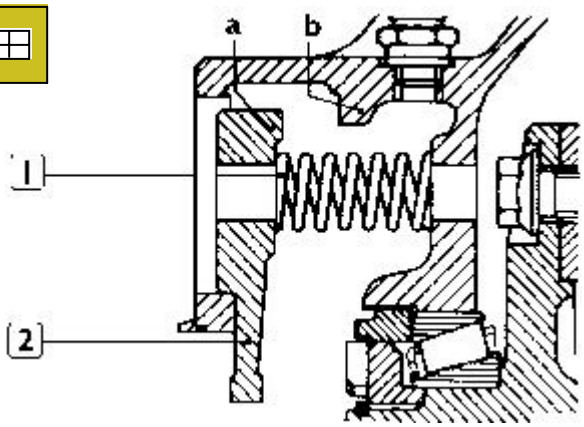
Figure 114




39714

Fit the differential lock engagement assembly comprising: the control cylinder, the piston (2), the engaging fork (1) and the compression spring (3).

Figure 115

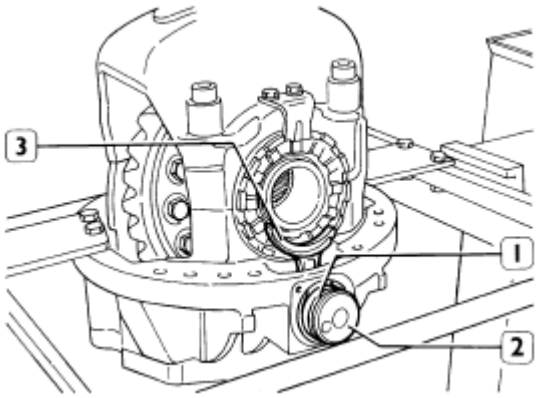



26609

Introduce the compression spring (1) in the differential housing. Fit the engaging fork (2) so that fork (a) travel limit corresponds with travel limit (b) on the differential housing.

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Figure 116




Fit a new seal ring (1) on the control piston (2) and smear with grease.
Introduce the control piston (2) on the engaging fork (3) in the compression spring, then fit the assembly in the gap on the differential housing.
Disassemble the bevel pinion support.
Fitting the differential on the axle housing.

1. Fit the sliding sleeve on the drive shaft.
2. Fit the gear housing assembly, taking care that the fork engages in the groove on the sliding sleeve.
3. Tighten the screw whilst pushing the drive shaft so that the sliding sleeve engages on the differential engaging sleeve.
4. Apply LOCTITE 573 on the threads and under the heads of the screws and tighten to the correct torque with a torque wrench.
5. Apply LOCTITE 573 on the contact surface, refit the pinion support and tighten the screws to the correct torque.

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# Rear axle 452146/2D (R 8174)

Page

DESCRIPTION . . . . . 171

MAIN DATA . . . . . 172

TIGHTENING TORQUES . . . . . 173

TOOLS . . . . . 175

REAR AXLE ASSEMBLY OVERHAUL . . . . . 180

REPAIRING THE DIFFERENTIAL . . . . . 180

- Disassembly . . . . . 180
- Disassembling the differential housing . . . . . 181
- Disassembling the bevel pinion support . . . . . 182

CHECKING THE DIFFERENTIAL COMPONENTS . . . . . 182

- Assembly the differential housing . . . . . 183
- Assembling the bevel pinion support . . . . . 184
- Differential carrier assembly . . . . . 186
- Adjusting the rolling torque on the differential housing bearings . . . . . 187

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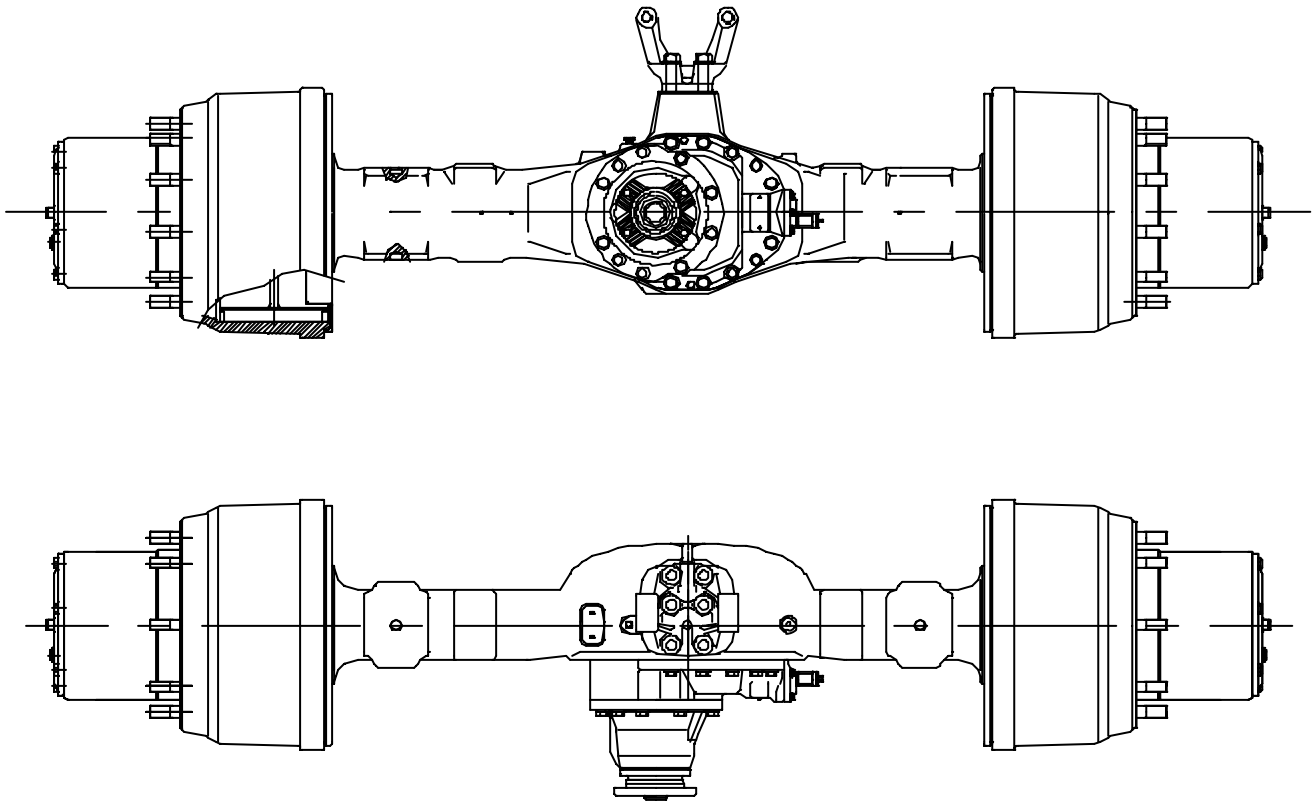
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## DESCRIPTION

The rear axle is of the double reduction type; the first reduction is provided by the bevel pinion/ring bevel gear, whereas the second reduction is by means of an epicyclic unit on the wheel hubs.
The differential housing (with ring bevel gear) is supported by taper roller bearings, which can be adjusted by means of two threaded ring nuts.
The bevel pinion is supported by two taper roller bearings.
The bevel pinion can be adjusted by means of adjustment shims located between the two taper roller bearings.
The axle is provided with a pneumatic device for differential locking.
The axle shafts start from the differential and transmit drive to the epicycloid reduction units.
The drum brake is of the Duo/Duplex type.

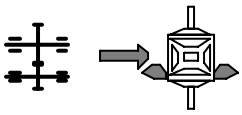
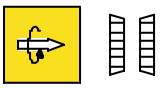
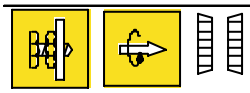
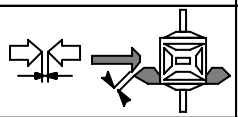
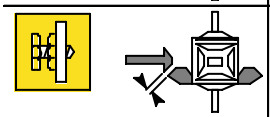
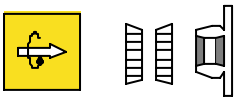
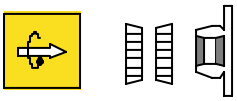
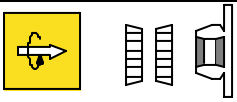
Figure 1




LONGITUDINAL PICTORIAL SECTION OF THE DIFFERENTIAL

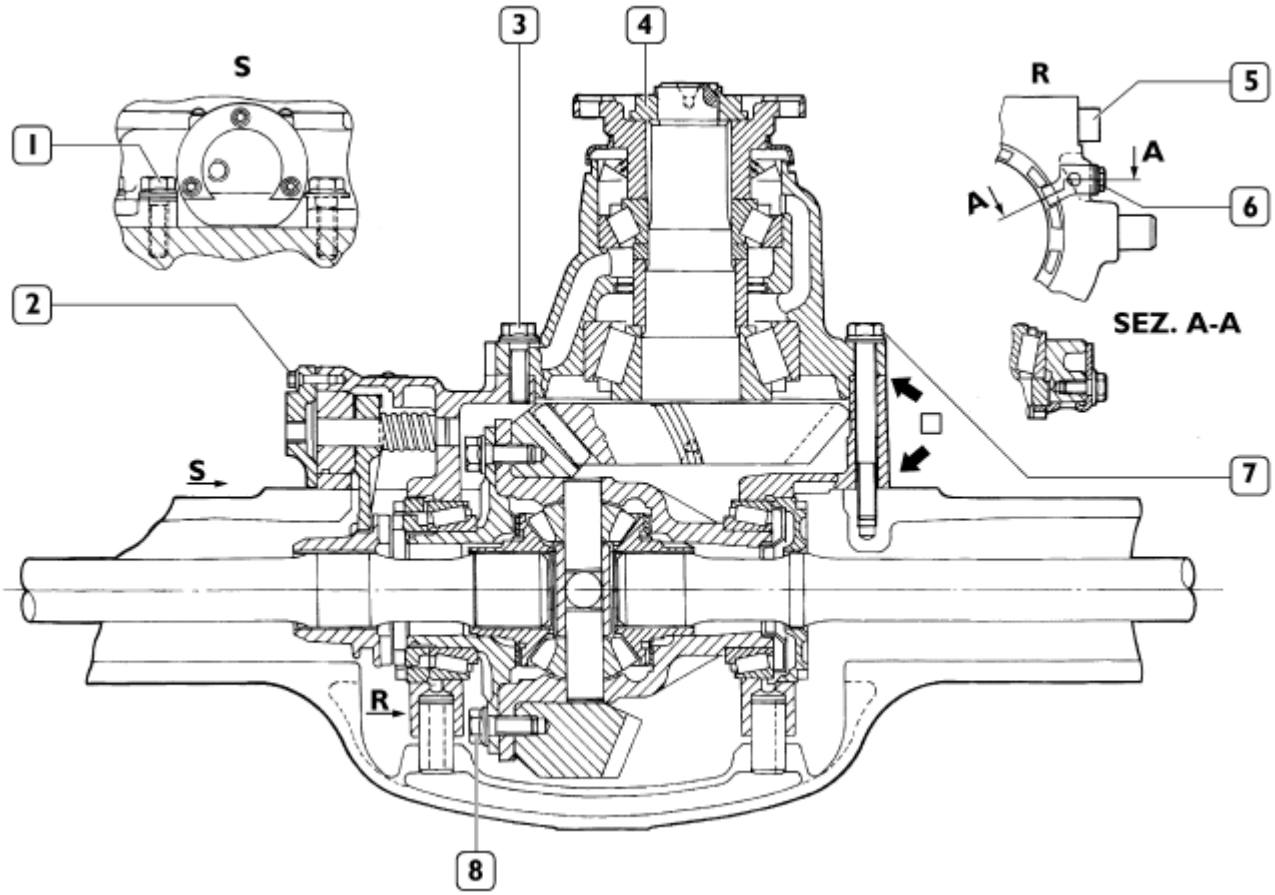
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## MAIN DATA

| | | |
|---|---|---|
|  | Type of axle:<br>Load-bearing, double reduction with pneumatically controlled differential locking | 452146/2D (R 8174) |
|  | Bevel pinion bearings | 2 taper rollers |
|  | Bevel gear reduction unit ratio | 27/32 (1.185) - 28/37 (1.321) - 24/35 (1.458) - 23/36 (1.565) - 21/34 (1.619) - 19/33 (1.737) - 17/35 (2.059) -13/35 (2.692) - 15/34 (2.267) - 17/36 (2.118) - 21/40 (1.905) - 27/37 (1.370) - 34/37 (1.088) |
|  | Epicycloid reduction unit/wheels ratio | 3.2 |
|  | Bevel pinion bearing rolling torque without seal Nm | 6 ÷ 8 |
|  | Bevel pinion bearing rolling torque adjustment | with adjustment rings |
|  | Thickness of bevel pinion bearing rolling torque adjustment rings mm | 10 - 10.02 - 10.04 - 10.06 - 10.08 - 10.10 - 10.12 - 10.14 - 10.16 - 10.18 - 10.20 - 10.22 - 10.24 - 10.26 - 10.28 - 10.30 - 10.32 - 10.34 - 10.36 - 10.38 - 10.40 - 10.42 - 10.44 - 10.46 - 10.48 - 10.50 - 10.52 - 10.54 - 10.56 - 10.58 - 10.60 |
|  | Thickness of bevel pinion/ring bevel gear position adjustment rings mm | 0.2 - 0.3 - 0.5 - 1 |
|  | Clearance between pinion and ring bevel gear mm | 0.15 ÷ 0.35 |
|  | Adjustment of clearance between pinion and ring bevel gear | with ring nuts |
|  | WHEEL HUBS | |
|  | Wheel hub bearings | 2 taper rollers |
|  | Wheel hub bearings rolling torque: new bearings with surface protection Nm | 6 ÷ 7 + (12 ÷ 16) |
|  | Wheel hub bearings rolling torque: run in bearings and new, lubricated seals Nm | 6 ÷ 7 + (5 ÷ 7) |
|  | Wheel hub bearings rolling torque: run in bearings and seals Nm | 6 ÷ 7 + (2.5 ÷ 4.5) |
|  | Drive shaft end float mm | 0.5 ÷ 1 |
|  | Axle oil:<br>Quantity Litres<br>kg | **TUTELA W140/MDA**<br>11.5 |
| | G.R.W. maximum load kg | 11000 |

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Figure 2



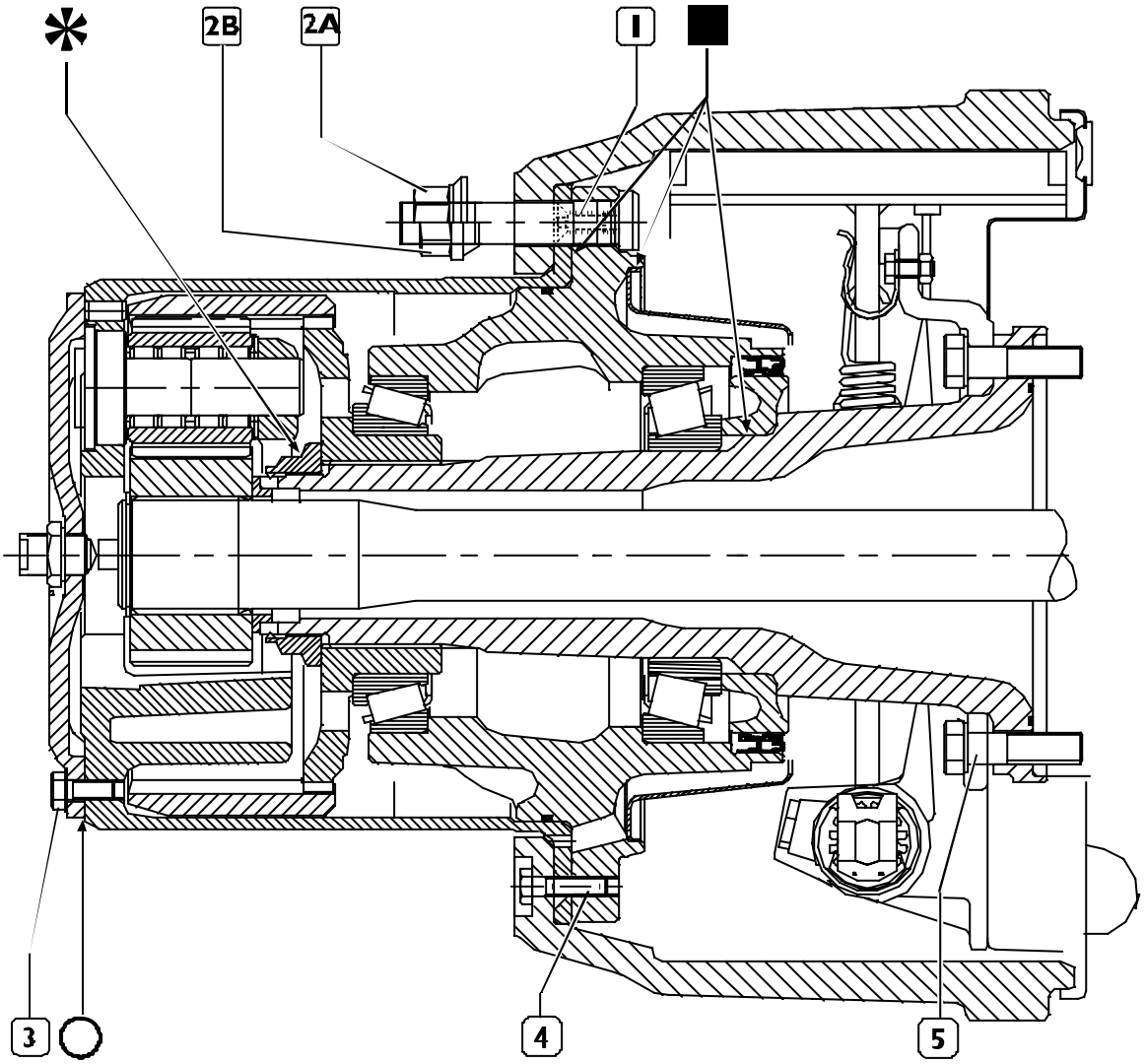

## TIGHTENING TORQUES

| DESCRIPTION | | TORQUE | |
|---|---|---|---|
| | | Nm | kgm |
| 1 | Toothed flange | 180 ± 10 | 18 ± 1 |
| 2 | Self-locking screw | 19 ± 2 | 1.9 ± 0.2 |
| 3 | Screw fixing bevel pinion support | 180 ± 10 | 18 ± 1 |
| 4 | Nut fixing bevel pinion flange | 700 ± 50 | 70 ± 5 |
| 5 | Screw fixing supports for bearings Z | 180 ± 10 | 18 ± 1 |
| 6 | Self-locking screw for safety plate | 51 ± 4 | 5.1 ± 0.4 |
| 7 | Screw fixing differential carrier to axle housing | 180 ± 10 | 18 ± 1 |
| 8 | Screw fixing ring bevel gear to gear housing Z | 180 ± 10 | 18 ± 1 |

Z apply LOCTITE AVX
h apply LOCTITE 573

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Figure 3



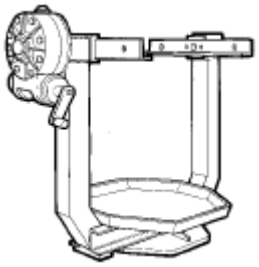
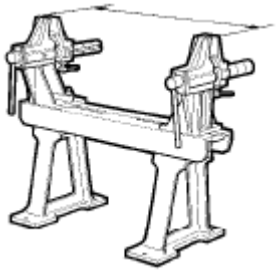
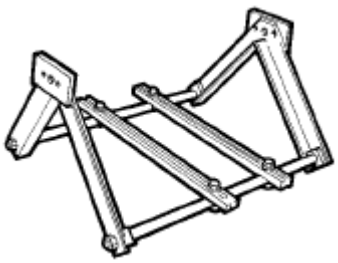
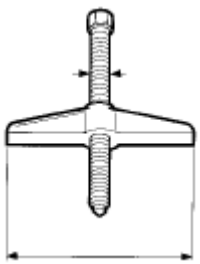
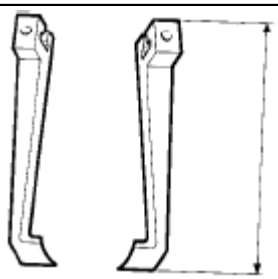

## TIGHTENING TORQUES

| DESCRIPTION | | TORQUE | |
|---|---|---|---|
| | | Nm | kgm |
| 1 | Countersunk screw fixing drum | 25 ± 3 | 2.5 ± 0.3 |
| 2A | Nut fixing wheel | 615 ± 35 | 61.5 ÷ 3.5 |
| 2B | Nut fixing wheel | 415 ± 35 | 41.5 ÷ 3.5 |
| 3 | Screw fixing cover to side pinion support h | 50 ± 5 | 5 ± 0.5 |
| 4 | Screw | 50 ± 5 | 5 ± 0.5 |
| 5 | Screw fixing load bearing sleeve | 295 ± 30 | 29.5 ± 3 |

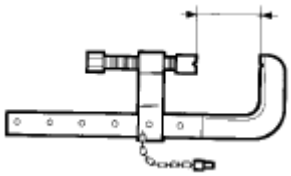
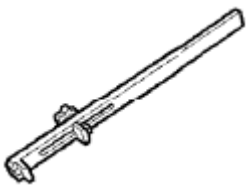
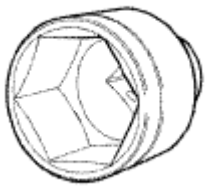
d smear LOCTITE 5970 on connection surface
h apply LOCTITE 573 on thread
H apply LOCTITE 573 on mating surface
: before mounting, slightly smear MOLYCOTE on nut rest surface

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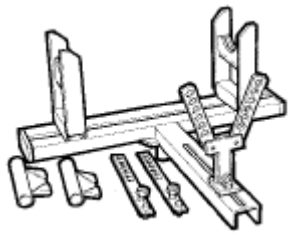
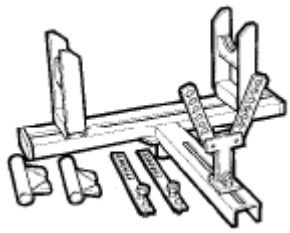
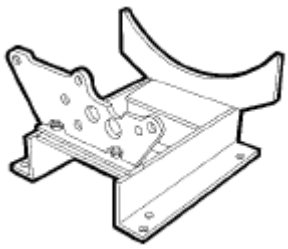
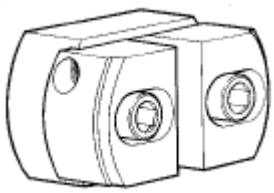
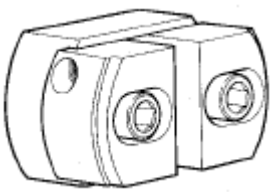
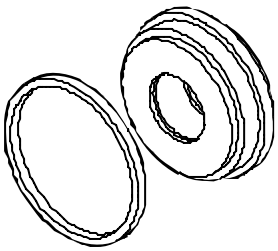
## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99305121** |  | Hot air device |
| **99322205** |  | Rotating stand for assembly overhaul |
| **99322215** |  | Stand for axles overhaul |
| **99322225** |  | Support for assemblies (to be fitted onto stand 99322205) |
| **99341003** |  | Single-acting bridge |
| **99341012** |  | Pair of brackets |

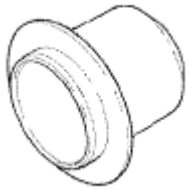
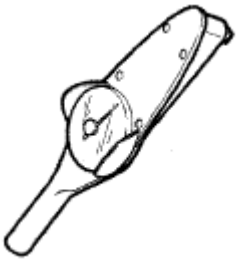
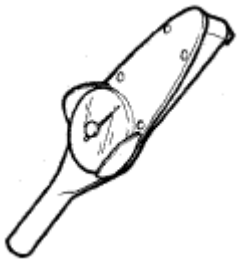
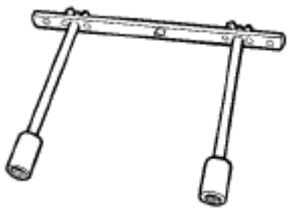
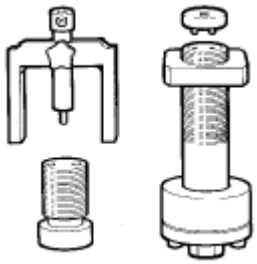
Aquila Trucks Centres

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99341015** |  | Press |
| **99345053** |  | Reaction block for extractors |
| **99348001** |  | Extractor with locking device |
| **99354207** |  | Wrench (94.5 mm) for wheel hub bearings adjusting nut |
| **99355025** |  | Wrench for differential gear housing bearing adjustment ring nuts |
| **99355081** |  | Wrench (60 mm) for differential bevel pinion nut (use with 99370317) |

Aquila Trucks Centres

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99370616** |  | Mounting for removal and refitting of differential |
| **99370617** |  | Universal mounting to support axles during removal and refitting |
| **99372211** |  | Tool for removal and refitting of brake jaws retaining springs |
| **99374093** |  | Punch to fit external races of bearings (use with 99370007) |
| **99374094** |  | Punch to fit external races of bearings (134 - 215) (use with 99370007) |
| **99374161** |  | Key for assembly of wheel hub internal seals |

Aquila Trucks Centres

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99374233** |  | Key to fit differential bevel pinion seal (use with 99370006) |
| **99374451** |  | Tool for axle shaft disassembly-assembly |
| **99389819** |  | Torque wrench from 0 to 10 Nm with 1/4" square connection |
| **99389821** |  | Torque wrench from 0 to 70 Nm with 3/8" square connection |
| **99395026** |  | Tool to check rolling torque of hubs (use with torque wrench) |
| **99395027** |  | Tool to determine differential bevel pinion adjusting shim (use with 99395603) |

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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99395603** |  | Dial gauge (0-5 mm) |

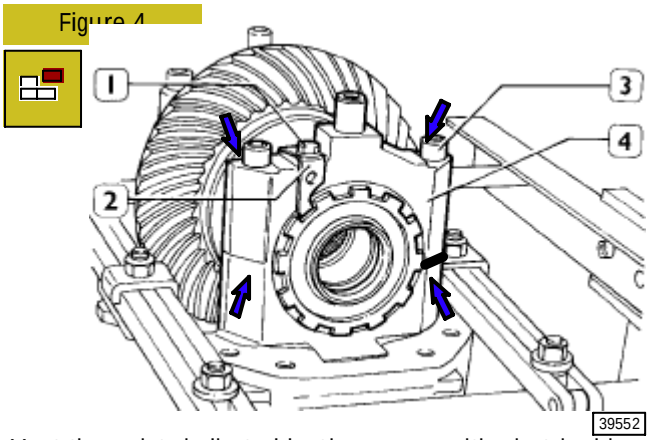
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## 525010 REAR AXLE ASSEMBLY OVERHAUL

**NOTE** For repairs on the wheel hubs, epicycloid reduction units, drive shaft and flow divider differential removal-refitting operations, follow the instructions for the 451391/2D - 452191/2D - 453291/2D axles.

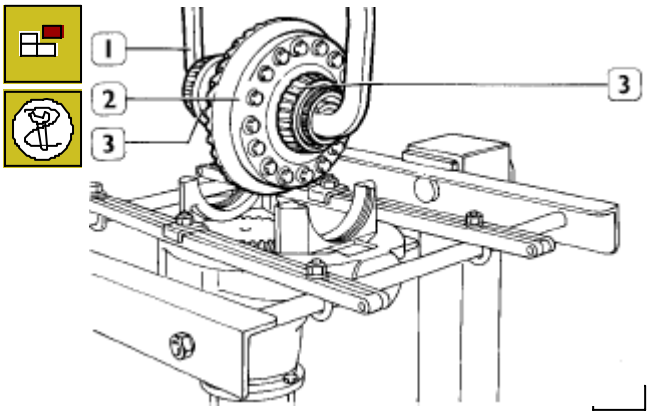
## 526210 REPAIRING THE DIFFERENTIAL
### Disassembly

Figure 4



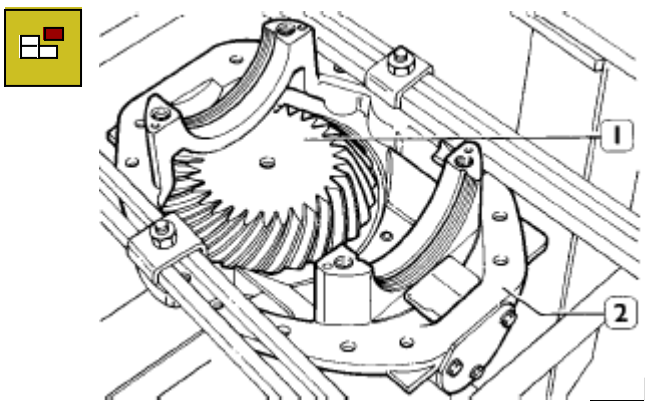

Heat the points indicated by the arrows with electric drier 99305121 and unscrew the screw (1) sealed with LOCTITE. Remove the safety plate (2). Unscrew the screws (3) sealed with LOCTITE. Remove the caps (4) and ring nuts.

Figure 5



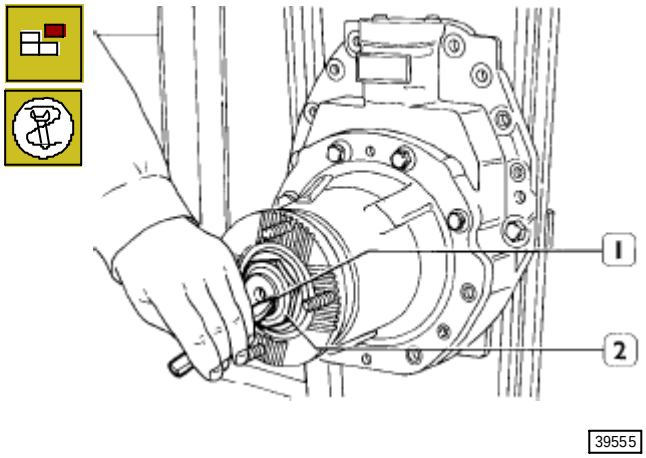

Raise the differential housing (2) and bearings (3) using a hook (1).

Figure 6



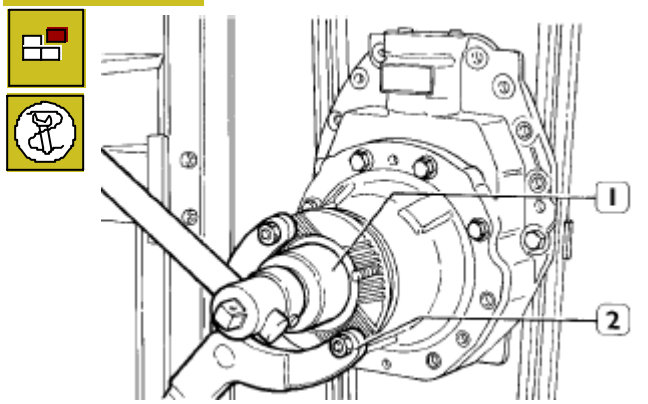

View of pinion (1) inside the differential carrier (2).

Figure 7



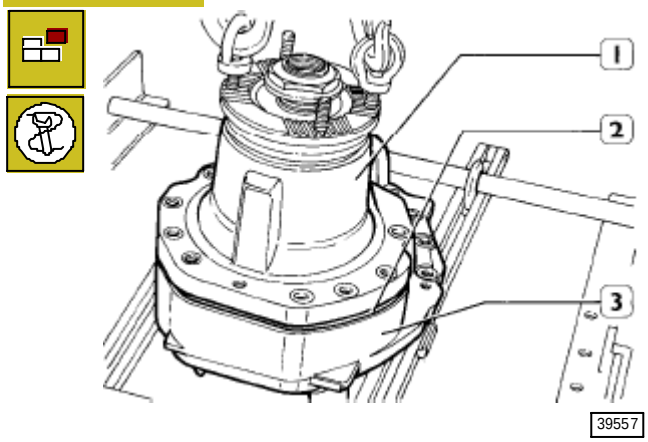

Use a punch to remove the securing (1) notch and unscrew the nut (2) as described below.

Figure 8




Block the rotation of the drive coupling flange with the reaction lever 99370317 (2), and loosen the drive coupling flange fixing nut using the Allen wrench 99355081 (1).

Figure 9

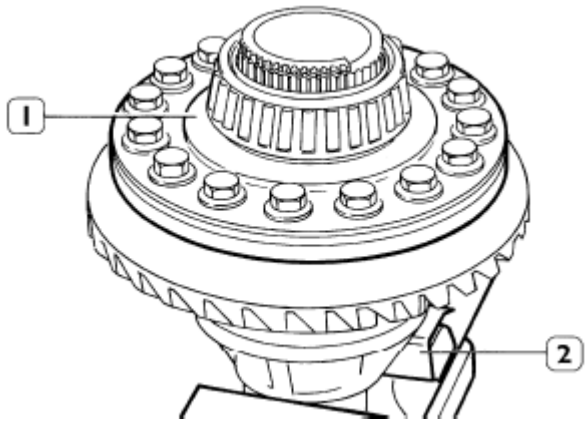



Unscrew the bolts that fix the bevel pinion support to the differential carrier.
Extract the support (1) and bevel pinion from the differential carrier (3); remove the pinion/bevel gear positioning shims (2).

Aquila Trucks Centres

## Disassembling the differential housing

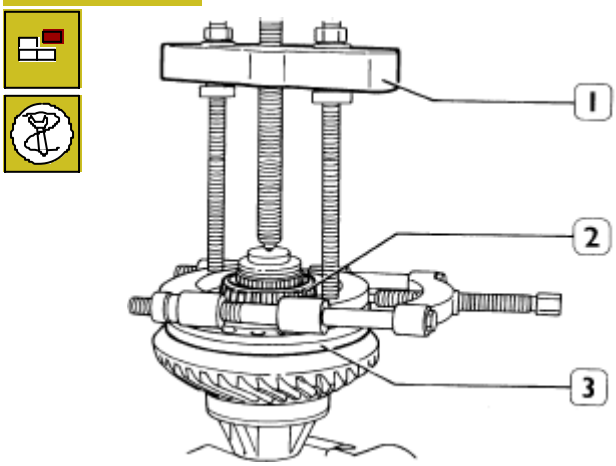
Figure 10




39558

Fit the gear housing (1) in a vice (2).

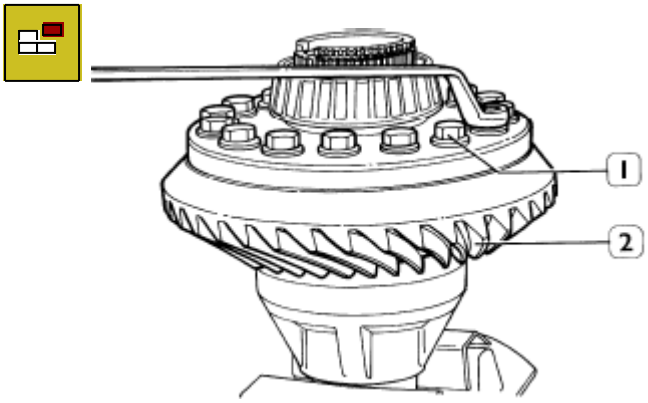
Figure 11




39559

Using extractor 99348001 (1), extract the support bearing (2) on the toothed side from the differential housing (3).

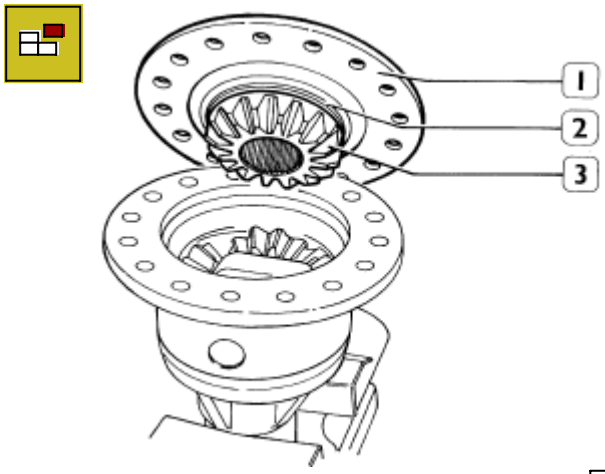
Figure 12




39560

Loosen and remove the screws (1).
Detach the ring bevel gear (2) using a punch.

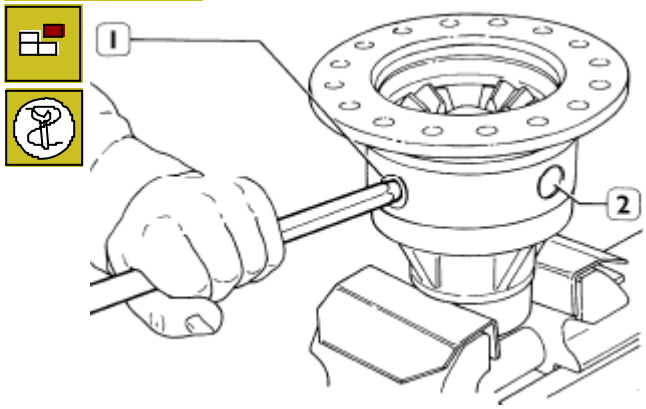
Figure 13




39561

Remove the differential housing cover (1).
Remove the crown wheel (3) from the differential housing, together with the shoulder washer (2).

Figure 14




39562

Using a punch, first extract the long pin (1) and then the two short pins (2).

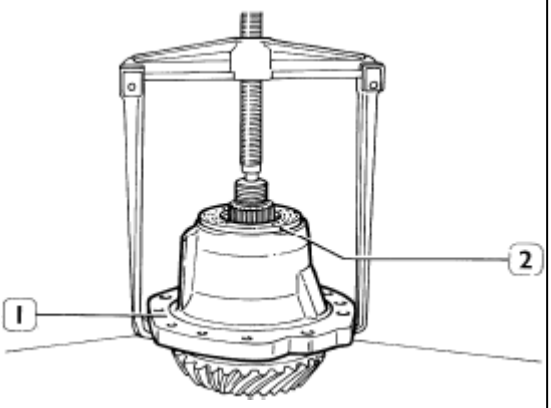
**NOTE** The exact position of the pins is marked on the spider body by a long stripe for the long pin, and by two short stripes for the short pins.

Remove the spider and the four planetary gears with the relevant shoulder washers.
Remove the crown wheel and shoulder washer.

Aquila Trucks Centres

## Disassembling the bevel pinion support

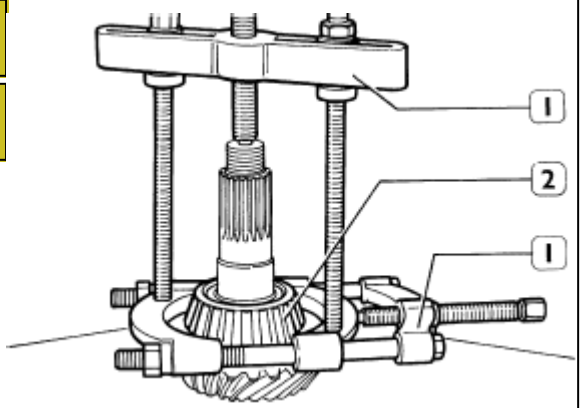
Figure 15




39563

Using an extractor, positioned as shown in the drawing, extract the bevel pinion with bearing and support adjusting ring (1).
Extract the seal ring (2).

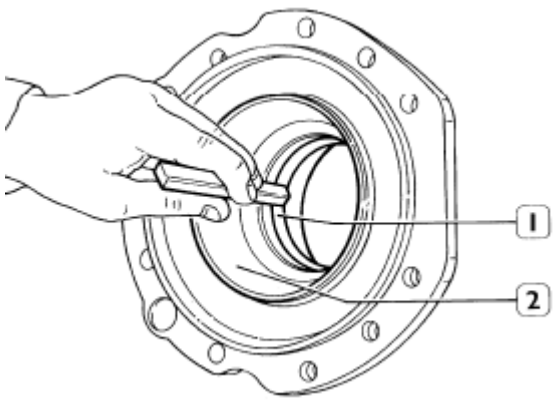
Figure 16




39564

Using extractor 99348001 (1), extract the bearing (2) from the bevel pinion.

Figure 17




39565

Using a punch, remove the front and intermediate bearing external rings (1 and 2) from the support.
Remove the oil baffle.

## CHECKING THE DIFFERENTIAL COMPONENTS

Carefully clean all of the individual differential components. Lubricate the bearings and make sure that the roller support cage rotates freely, without sticking. Check the ring bevel gear and half-casing contact surfaces, making sure that the bevel gear matches perfectly. Any eventual deformation on these surfaces would cause screw vibration on the bevel gear, leading to incorrect assembly operation.

**NOTE** Carefully clean all the threads to ensure exact adjustments and precise tightening torque values.

Check that the splined section used to key the flange on the pinion is not worn. Replace the pinion if necessary.

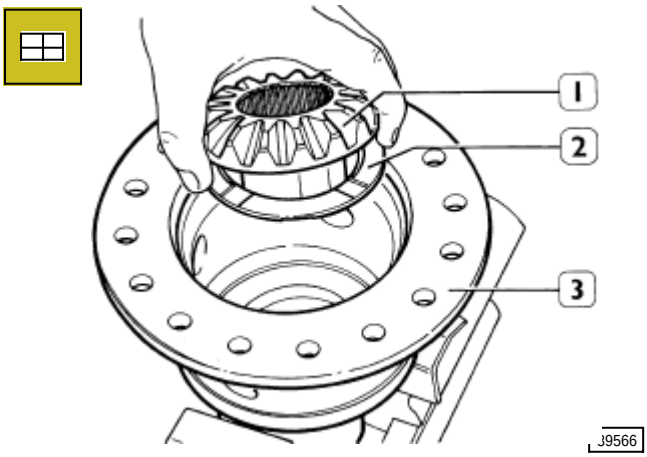
**NOTE** If either the bevel gear or pinion need to be changed, both parts must be replaced as they are provided as coupled spare parts.

Check the side pinions with relative shoulder washers, and the spider and crown wheels with relative shoulder washers.
Replace all sealing elements and safety washers with new parts.

Aquila Trucks Centres

## Assembling the differential housing

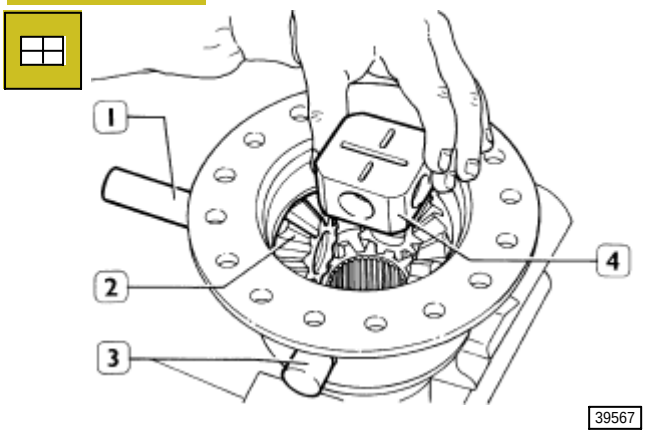
Figure 18




39566

Place the differential housing (3) on a suitable support, position the crown wheel (1) in its seat, together with the shoulder washer (2).

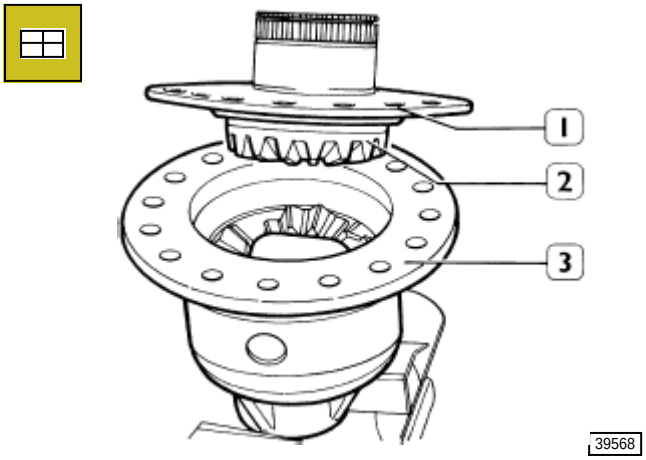
Figure 19




39567

Assemble the four side pinions (2) with the shoulder washers and insert the spider (4). Insert the long pin (1) and the two short pins (3).
The exact position of the pins is marked on the spider body (4) by a long stripe for the long pin, and by two short stripes for the short pins.

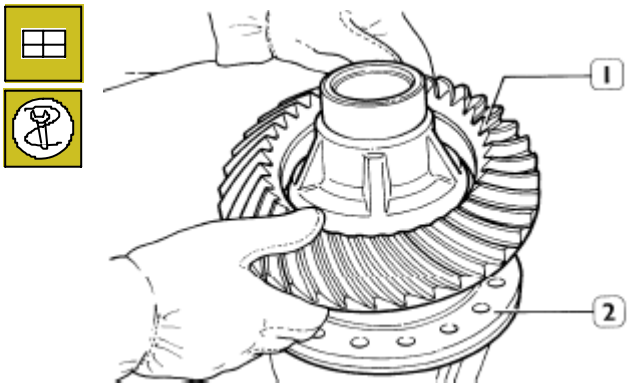
Figure 20




39568

Position the crown wheel (2) and shoulder washer on the side pinion gear unit.
Fit the cover (1) on the differential housing (3) by centering the fixing screw holes.

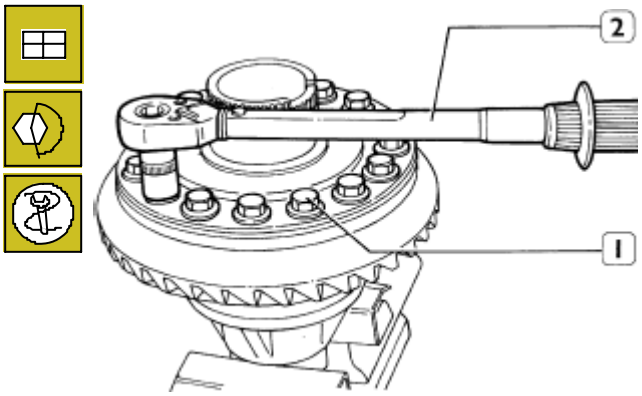
Figure 21




39569

Heat the ring bevel gear (1) to approx. 80°C, fit in position in the differential housing (2) and secure with the two fixing screws.

Figure 22



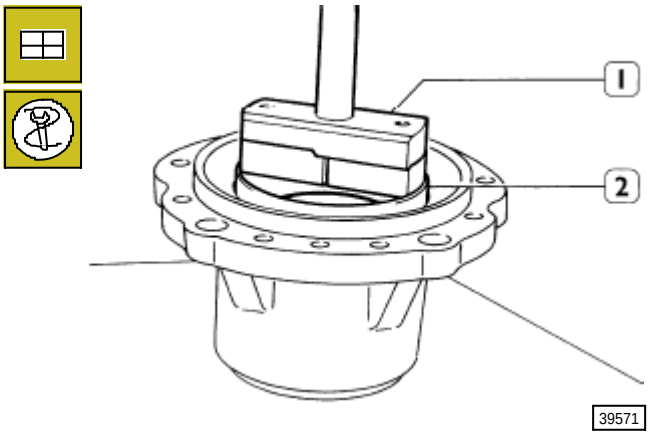

39570

Fit the other screws (1) and tighten with a torque wrench (2) to the specified torque.
Heat the support bearings with electric drier 99305121 and assemble in the differential housing.

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## Assembling the bevel pinion support

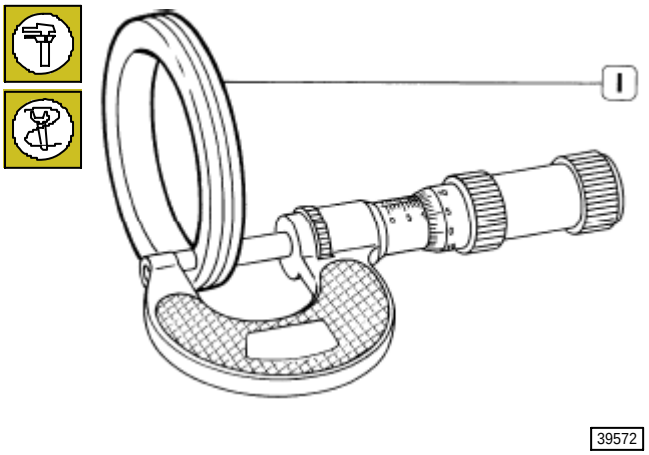
Figure 23




Fit a new oil baffle on the pinion support.
Fully fit the external ring (2) for the front bearing into the seat, using punch 99374093 (1), and the external ring for the rear bearing, using punch 99374094, into the seat.

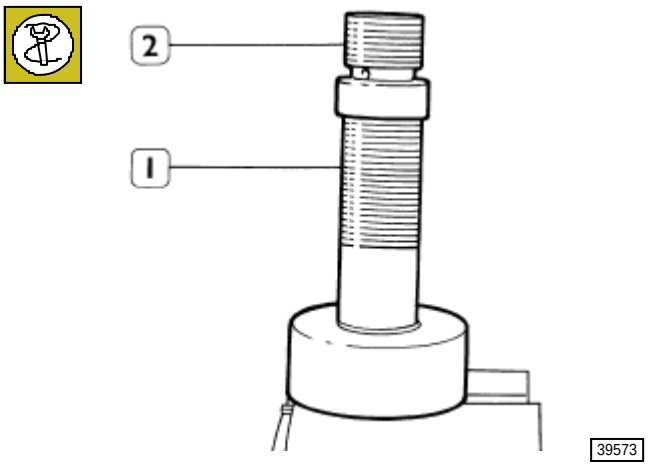
Procedure to follow to determine the thickness of the bevel pinion rolling torque adjusting ring.

Figure 24



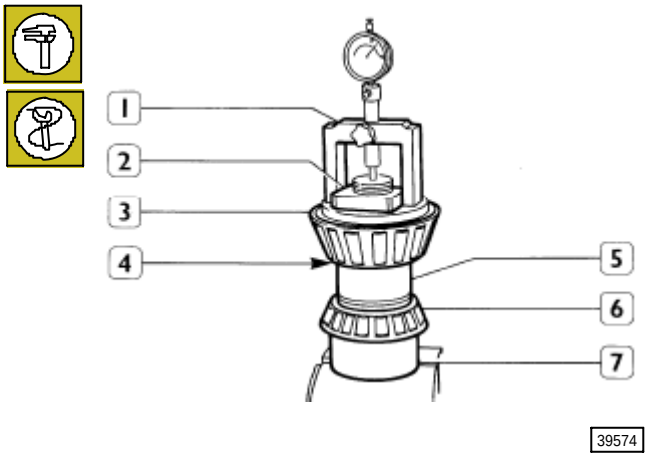

Measure and note the thickness of the adjusting ring (1) on disassembly (value A).

Figure 25




Secure tool 99395027 (1) and extension (2) in a vice.

Figure 26



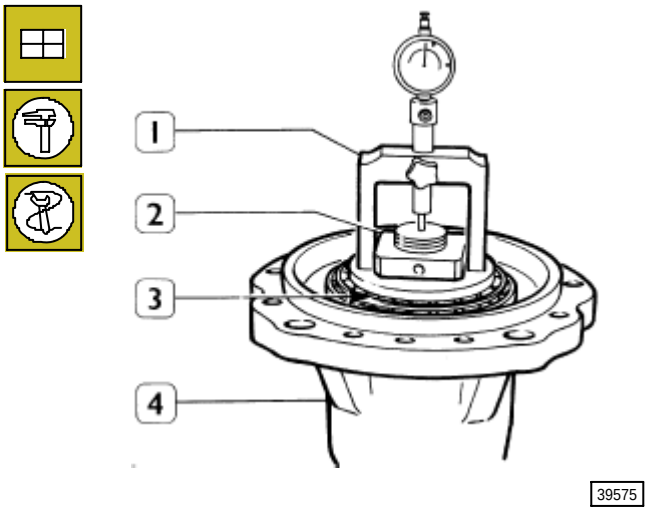

Fit the following parts on tool 99395027:

- the bearing (6) on the pinion-side;
- the spacer ring (5), the previously measured adjusting ring (4) and the bearing (3).

Fully tighten the ring nut (2).
Position part (1) of tool 99395027 (7) on the bearing (3), fitted with a zero-set dial gauge on the end of the tool (7).
Then remove:

- the part (1);
- the ring nut (2);
- the bearing (3);
- the adjusting ring (4) on the tool (7).

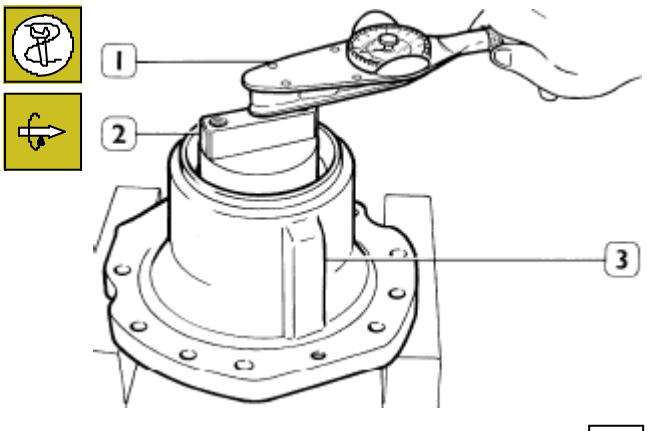
Figure 27




Position the support (4, Figure 27) on the bearing (6, Figure 26) and assemble the bearing (3) on the support.
Tighten the ring nut (2) by hand. Check the rolling torque as indicated in Figure 28.

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Figure 28




39576

Position the complete support (3) on two parallel blocks; using the torque wrench (1) applied on the tool (2) and read the rolling torque. This value should be:

- 6 to 8 Nm; if not, adjust by means of the ring nut (2, Figure 26).

Position the part (1, Figure 26), with the dial gauge zero-set, on the bearing (3) and read the eventual deviation (value B).

Thickness **S** on the adjusting ring is provided by the following formula:

Where:

**A** = thickness of the adjusting ring assembled for dial gauge zero-setting;

**B** = deviation value read;

**C** = 0.05 mm coefficient which takes into account the expansion of the bearings as a result of the assembly negative allowance on the bevel pinion.

**First example:**

**A** = 10.12 mm
**B** = + 0.13 mm
**C** = 0.05 mm

**S = 10.12 - (+ 0.13) + 0.05 =**
**S = 10.12 - 0.13 + 0.05 = 10.04 mm**

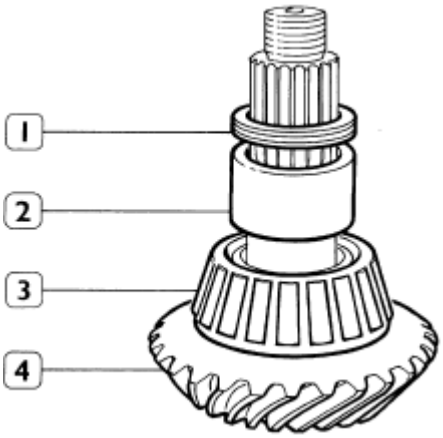
**Second example**

**A** = 10.12 mm
**B** = - 0.13 mm
**C** = 0.05 mm

**S = 10.12 - (- 0.13) + 0.05 =**
**S = 10.12 + 0.13 + 0.05 = 10.30 mm**

On completion of the operation, remove the parts of tool 99395027.

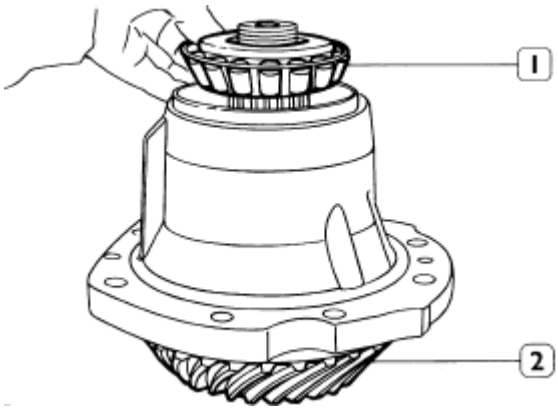
Figure 29




39577

Heat the bearing (3) with electric drier 99305121 and fit on the bevel pinion (4).
Fit the spacer (2).
Assemble the adjusting ring (1) with the same thickness as previously noted, and position on the bevel pinion.
Fit the bevel pinion on the support, complete with external rings for bearings.

Figure 30

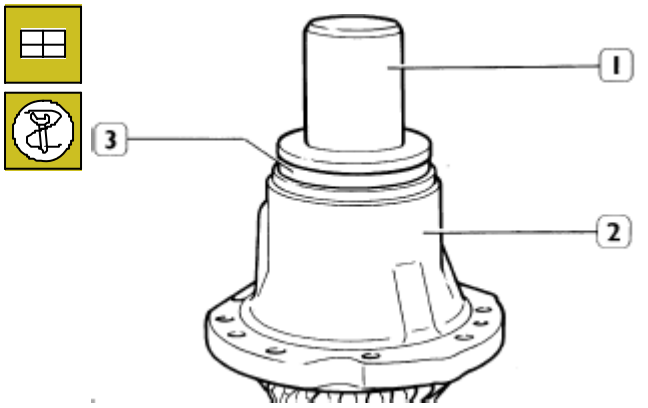



39578

Heat the bearing (1) with electric drier 99305121 and position in the bevel pinion (2) seat using a punch.

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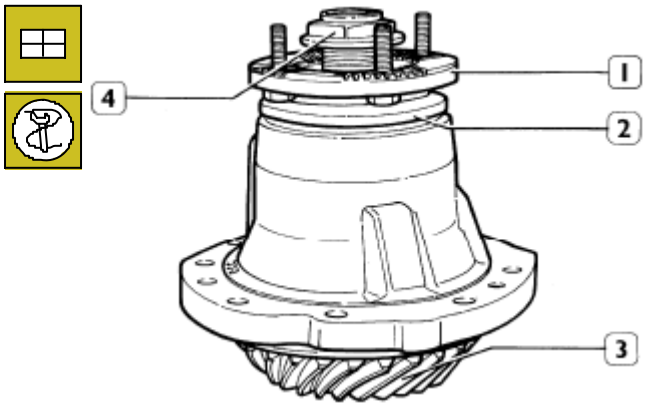
Figure 31




39579

Using key 99374233 (1) fit the new seal (3) on the support (2). Spare part seals are supplied pre-lubricated and with grease between the lips.

Figure 32

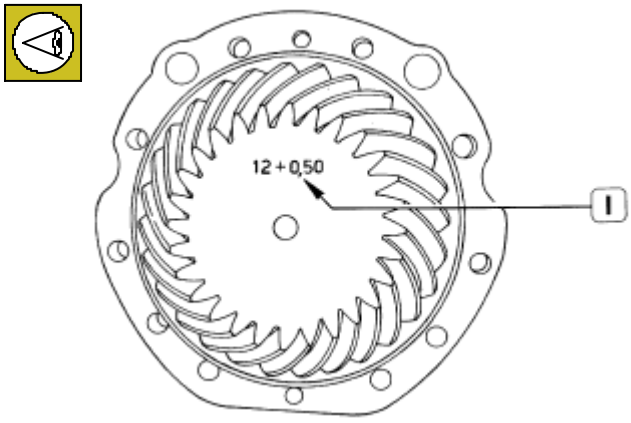



39580

Position the drive coupling flange (1), complete with baffle (2), on the splined section of the bevel pinion (3) and settle in the seat with a punch.
Provisionally tighten the fixing nut (4).

## Differential carrier assembly

Figure 33




39581

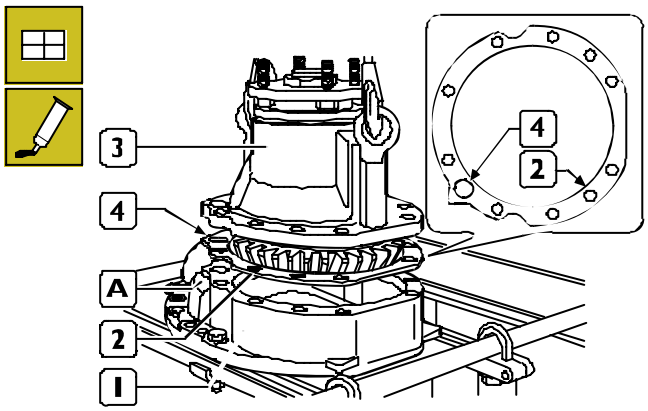
Before fitting the bevel pinion support assembly on the differential carrier, check the value (1) marked on the bevel pinion and, by consulting the table in Figure 34, the thickness of the adjusting shim to be positioned between the support and the carrier will be given.
Example:
If the reference value (1) marked on the bevel pinion is + 0.5, the thickness of the adjusting ring must be 1.5 mm.
The adjusting rings are available in the following dimensions: 0.2, 0.3, 0.5, 1 mm.

Figure 34

| Value marked on the bevel pinion | Total thickness of adjusting ring |
|---|---|
| 0 | 0.5 |
| 0.1 | 0.6 |
| 0.2 | 0.7 |
| 0.3 | 0.8 |
| 0.4 | 0.9 |
| 0.5 | 1.0 |
| 0.6 | 1.1 |
| 0.7 | 1.2 |
| 0.8 | 1.3 |
| 0.9 | 1.4 |
| 1.0 | 1.5 |

SUMMARY TABLE TO DETERMINE THE THICKNESS OF THE BEVEL PINION POSITION ADJUSTING RING

Figure 35



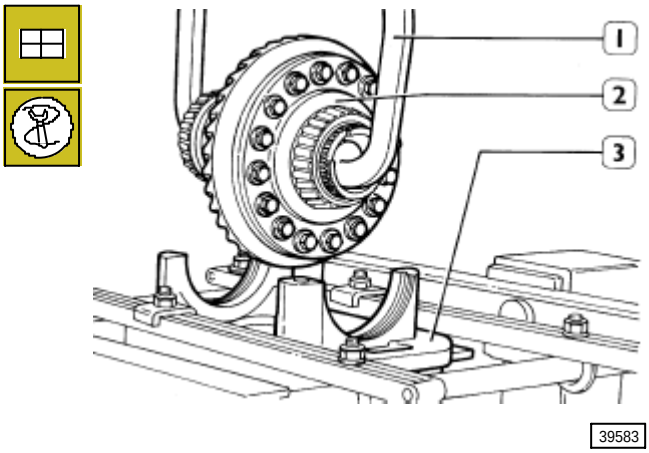

71850

Apply LOCTITE 573 on the differential housing (1) contact surface, adding LOCTITE 510 around the holes indicated by the arrows. Fit the adjusting ring (2) on the differential housing (1), so that the hole (4) faces towards upper part A of the differential housing. Using eyebolts and cables, fit the bevel pinion assembly support (3) on the differential housing (1). Tighten the fixing screws to the correct torque value.

Apply LOCTITE 573 on the threads of the screws that pass through the holes on the differential housing.

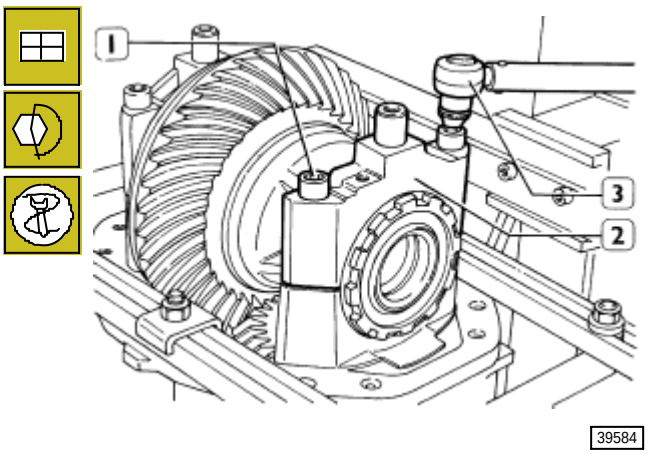
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Figure 36



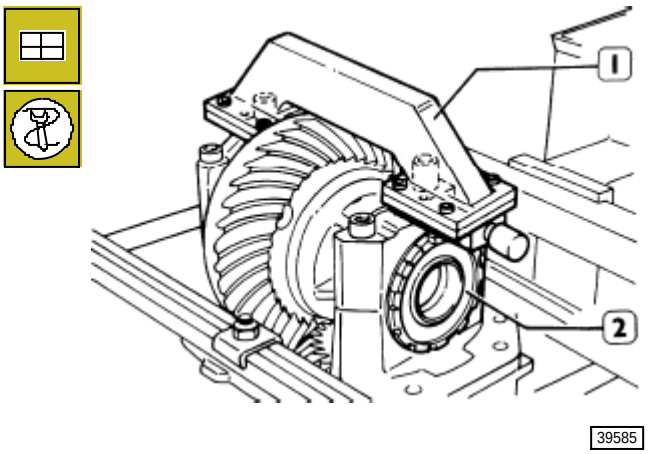

Using the hook (1), raise the previously assembled differential housing (2) and position on the differential housing (3).

Figure 37




Fit the external bearing rings and position the caps (2), and tighten the screws (1) without fully screwing down. Fit the adjusting ring nuts, making sure that they screw on easily. Using a torque wrench (3), tighten the screws (1) to the correct torque value.

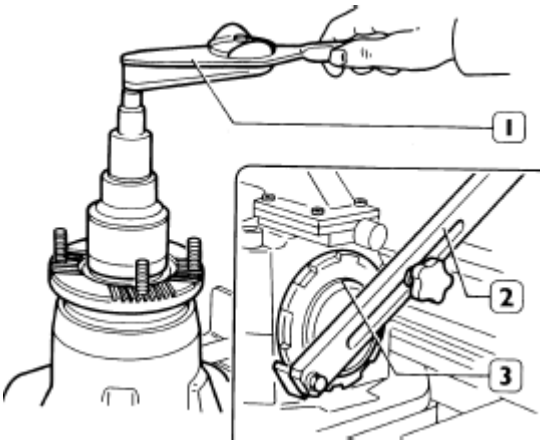
Figure 38




Position tool 99370133 (1) as shown in the drawing to avoid excessive spread on the caps during adjustment operations.

## Adjusting the rolling torque on the differential housing bearings

Figure 39




The total rolling torque reading is carried out when there is a clearance between the teeth on the bevel gear pair. However, the total rolling torque value varies according to the reduction bevel gear pair ratio (see following table).
Using torque wrench 99389819 (1) and the appropriate Allen wrench, check that the total torque value corresponds with that indicated on the following table, according to the reduction bevel gear pair ratio.

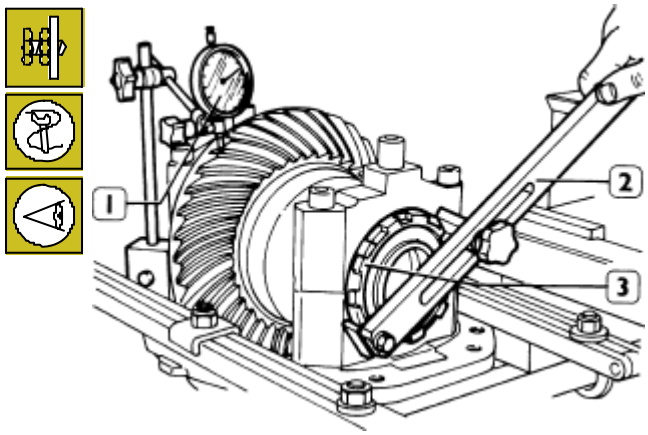
Figure 40

| No. of teeth | Ratio | Total rolling torque (Nm) |
|---|---|---|
| 13/35 | 2.692 | a + (1.1 - 1.5) |
| 15/34 | 2.267 | a + (1.3 - 1.8) |
| 17/35 | 2.059 | a + (1.5 - 1.9) |
| 17/36 | 2.118 | a + (1.4 - 1.9) |
| 19/33 | 1.737 | a + (1.7 - 2.3) |
| 21/34 | 1.619 | a + (1.9 - 2.5) |
| 21/40 | 1.905 | a + (1.6 - 2.1) |
| 23/36 | 1.565 | a + (1.9 - 2.6) |
| 24/35 | 1.458 | a + (2.1 - 2.7) |
| 28/37 | 1.321 | a + (2.3 - 3.0) |
| 27/32 | 1.185 | a + (2.5 - 3.4) |
| 27/37 | 1.370 | a + (2.2 - 2.9) |
| 34/37 | 1.088 | a + (2.7 - 3.7) |

a = 7.5 ÷ 9.5 Nm

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Figure 41

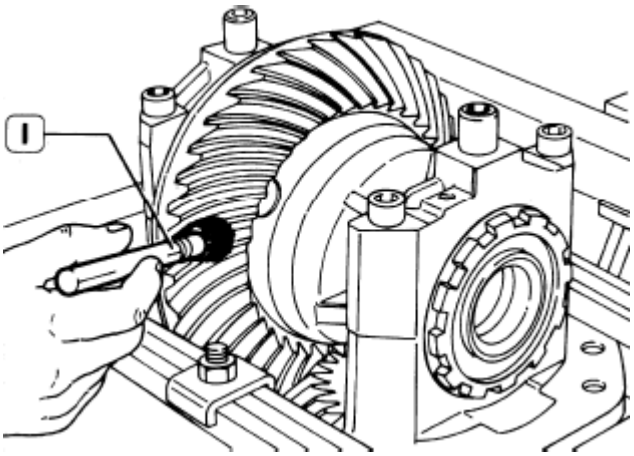



39586

Adjust the axial clearance between the teeth on the pinion/bevel gear, which should be 0.15 to 0.35 mm, proceeding as follows:

- Position a magnetic dial gauge (1) as shown in the drawing.
- Using wrench 99355205 (2), tighten the bearing adjustment ring nut (3) whilst loosening the ring nut on the opposite side by the same amount. This prevents the previously measured rolling torque from varying.

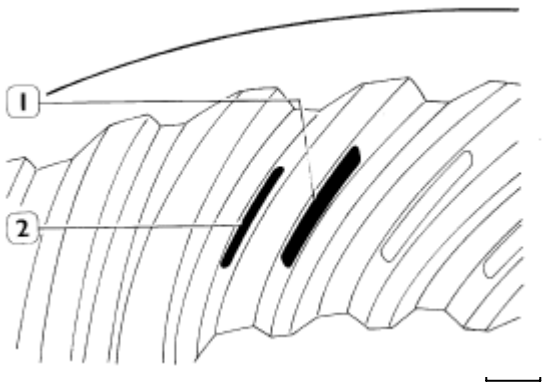
Figure 42




39588

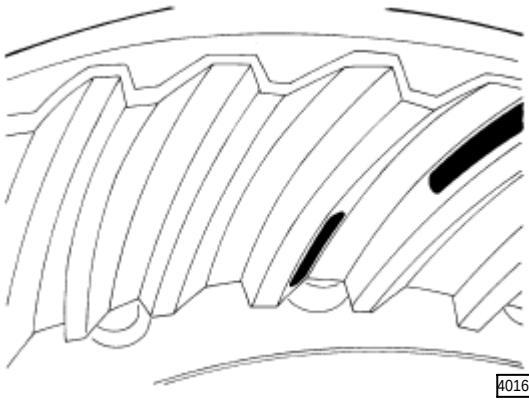
Using a brush (1) apply a light covering of Prussian blue on the teeth of the bevel gear.
Rotate the pinion and check the coloured contact marks that the pinion teeth have made on the bevel gear teeth.
The following drawings illustrate possible contact marks and the operations required in order to correct the faults.

Figure 43




The contact marks should be on both the leading face (1) and the pushing face (2), more or less in the centre between the teeth. When working without a load, both contact zones should be slightly out of position in relation to the external diameter of the bevel gear.

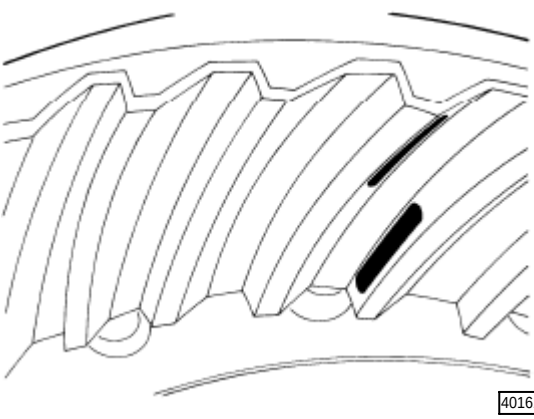
Figure 44



40161A

If the mark on the leading face (towards the external diameter) and on the pushing face (towards the internal diameter) is out of position, the pinion is located too close to the bevel gear.
- Solution: decrease the thickness of the adjusting ring between the intermediate bearing and the bevel pinion (2, Figure 35).

Figure 45

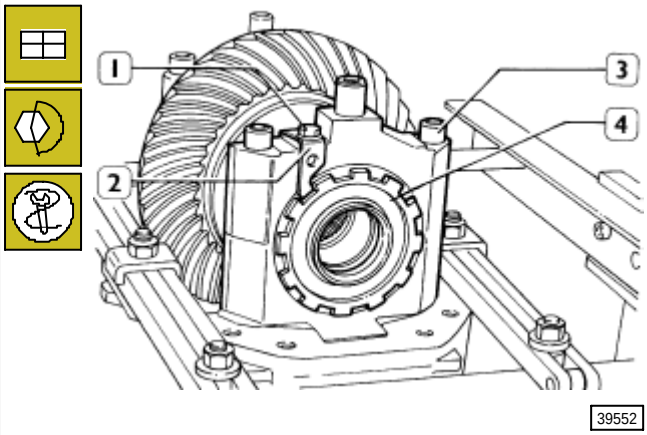


40161B

If the mark on the leading face is positioned towards the internal diameter, and on the pushing face it is located towards the external diameter of the bevel gear, the pinion is located too far away from the bevel gear axis.
- Solution: increase the thickness of the adjusting ring between the intermediate bearing and the bevel pinion (2, Figure 35).

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Figure 46




Position the plate (2) and tighten the fixing screws (1) to the correct torque value.
If the plate (2) does not coincide with the notch on the ring nut (3), slightly rotate the ring nut until the plate and ring nut notch coincide. Repeat this operation on the opposite side.

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# Axles in tandem ARVINMERITOR MT23-155/2D

Page

AXLES IN TANDEM MT 23-155/2D

INTERMEDIATE AXLE MD11-155/2D . . . . . 193÷234

REAR AXLE MR11-155/2D . . . . . 235÷264

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## Intermediate Axles
## ARVINMERITOR MD11-155/2D


| | Page |
|---|---|
| DESCRIPTION | 195 |
| LOCATION OF DIFFERENTIAL UNIT PLATES - REAR AXLE | 196 |
| MAIN DATA | 197 |
| TIGHTENING TORQUES | 199 |
| TOOLS | 201 |
| EXPERIMENTAL TOOLS | 207 |
| INTERMEDIATE REAR AXLE ASSEMBLY OVERHAUL | 208 |
| OVERHAULING THE WHEEL HUBS | 208 |
| - Removal | 208 |
| - Wheel hub component check | 209 |
| REPLACING THE WHEEL HUB BOLTS | 210 |
| - Wheel hub reassembly | 210 |
| DIFFERENTIAL CARRIER REMOVAL | 212 |
| - Case removal | 212 |
| - Differential housing removal | 218 |
| - Checking the differential components | 219 |
| - Refitting the differential housing | 219 |
| ASSEMBLING DIFFERENTIAL CARRIER | 221 |
| - Calculating bevel pinion position in differential carrier | 221 |
| EXAMPLES | 221 |
| - Adjust the limit switch of the differential interaxle lock control pin | 225 |
| - Adjusting drive input shaft bearing end float | 226 |
| ADJUSTING THE CAP SPREAD | 227 |
| CORRECTING THE BEVEL GEAR PAIR CONTACTS (AFTER FITTING IN PLACE) | 230 |

https://truckmanualshub.com/
Aquila Trucks Centres

Page

REMOVAL-OVERHAUL-REFITTING OF INTERAXLE SHAFT . . . . . 233

- Adjustment of interaxle shaft bearing end play . . . . . 234

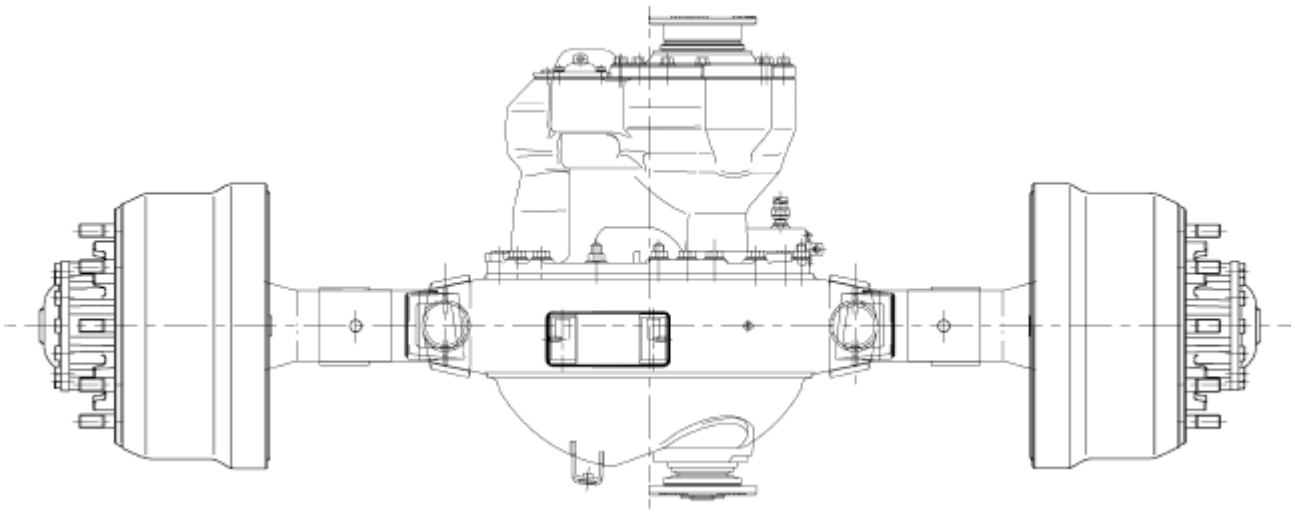
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## DESCRIPTION

The intermediate axle is of the full-floating, single-reduction type and consists of a steel case housing the inter-axle differential and the main differential.
Drive is transmitted from the inter-axle differential to the main differential by means of two helical gears.

The rear axle is fitted with an air-controlled differential lock device.
Wheel hubs are mounted on two taper roller bearings floating on the sleeve and adjusted by means of a threaded nut.
Brakes are of the drum DUO-DUPLEX type.

Figure 1



107467

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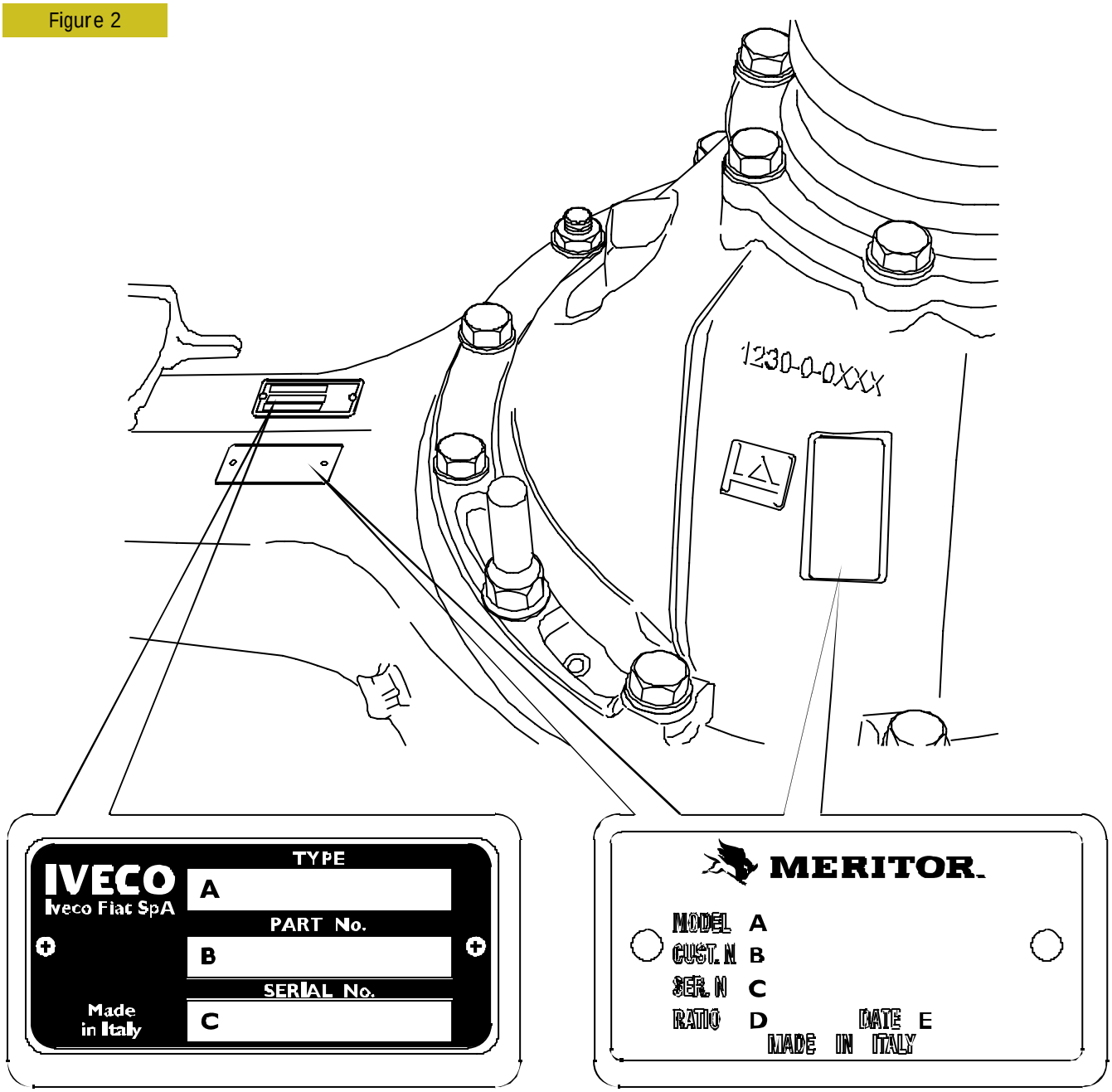
## LOCATION OF DIFFERENTIAL UNIT PLATES - REAR AXLE

The plates contain all information and details relating to either DIFFERENTIAL UNIT and REAR AXLE.

On real axle, two plates are present: one on the differential unit and one in same position on rear axle box. On the notifications of interventions under guarantee, rear axle box and differential unit plate data must always be shown. It is suggested always to read and copy out shown data before any repair so as to order correct spare parts and transmit correct information to either IVECO Service Network.

Plate is never to be removed from the unit.

Figure 2




IVECO identification plate
- A = identifies rear axle type
- B = drawing number
- C = production progressive number

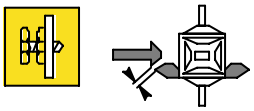
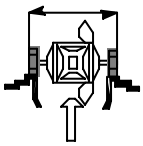
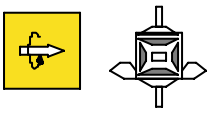
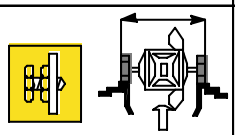
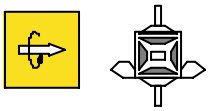
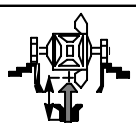
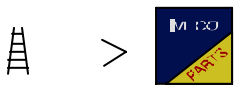
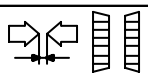
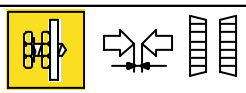
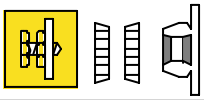
ARVINMERITOR identification plate
- A = identifies the family the item is belonging to / the model
- B = drawing number
- C = ArvinMeritor series number
- D = rear axle ratio
- E = production date

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## MAIN DATA

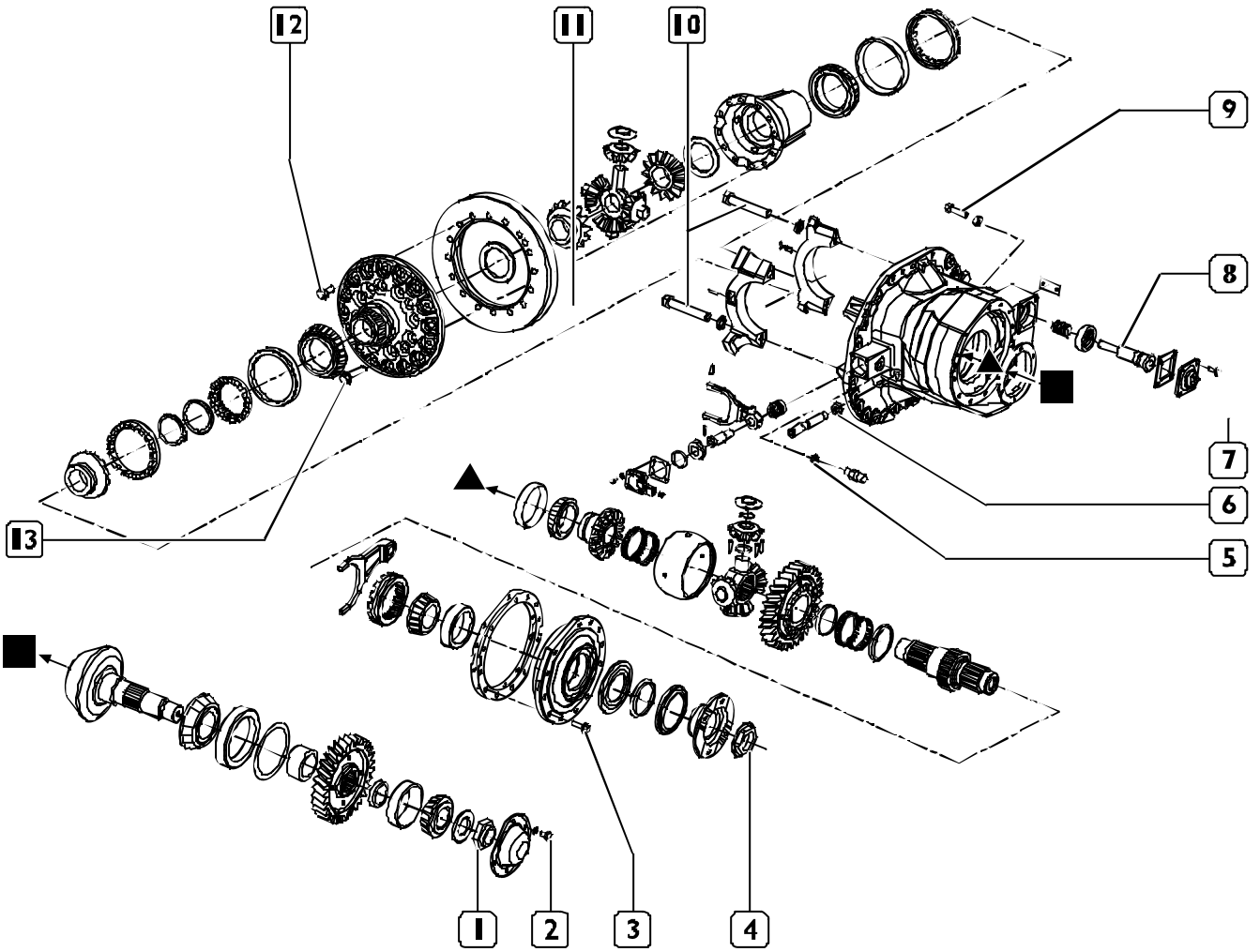
| | |
|---|---|
| Axle type:<br>Full-floating, single reduction with air-controlled differential lock device | MT23-155/2D |
| **DIFFERENTIAL** | |
| Final bevel gear ratio (number of teeth: pinion/crown wheel) Standard on models: | 4.50 (8/36) - 4.13 (8/33) - 3.78 (9/34) - 3.40 (10/34) |
| Bevel drive pinion bearings | 2 taper roller |
| Bevel drive pinion bearing rolling torque<br>New bearings Nm<br>kgm<br>Used bearings Nm<br>kgm | <br><br>2.30 ÷ 7.40<br>0.23 ÷ 0.74<br>3.00 ÷ 5.30<br>0.30 ÷ 0.53 |
| Bearing drive pinion preloading adjustment | by shims |
| Shim thickness range or bevel pinion bearing preloading adjustment | - |
| Bevel drive pinion bearing rolling torque<br>New bearings mm<br>Used bearings mm | <br>0.20 ÷ 0.46<br>0.30 |

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| | | |
|---|---|---|
|  | Bevel pinion to crown wheel end play adjustment | By ring nuts |
|  | Cap divergency | 0.05 ÷ 0.23 |
|  | Differential carrier bearing rolling torque Nm<br>kgm | 1.7 ÷ 3.9<br>0.17 ÷ 0.39 |
|  | Cap divergency adjustment | By ring nuts |
|  | Rolling torque between planetary gear and differential gears Nm<br>kgm | - |
|  | Bevel drive pinion setting as to differential carrier | By shims |
|  | Thickness range for shims located between intermediate bearing ring and differential carrier | - |
| **INTER-AXLE DIFFERENTIAL UNIT** | | |
|  | Inter-axle differential bearings | 2, taper roller |
|  | Inter-axle differential bearing end play mm | 0.05 ÷ 0.20 |
|  | End play adjustment | By shims |
|  | Inter-axle differential bearing shim thickness range mm | - |
|  | **WHEEL HUBS** | |
|  | Wheel hub bearings | Two of type UNIT - BEARING |
|  | Wheel hub bearing end play adjustment | Not adjustable<br>Torque tightening by threaded nut |
|  | Rear axle oil<br>Quantity:<br>air suspension litres (kg) | TUTELA W140/M-DA<br><br>20 (18) |

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Figure 3

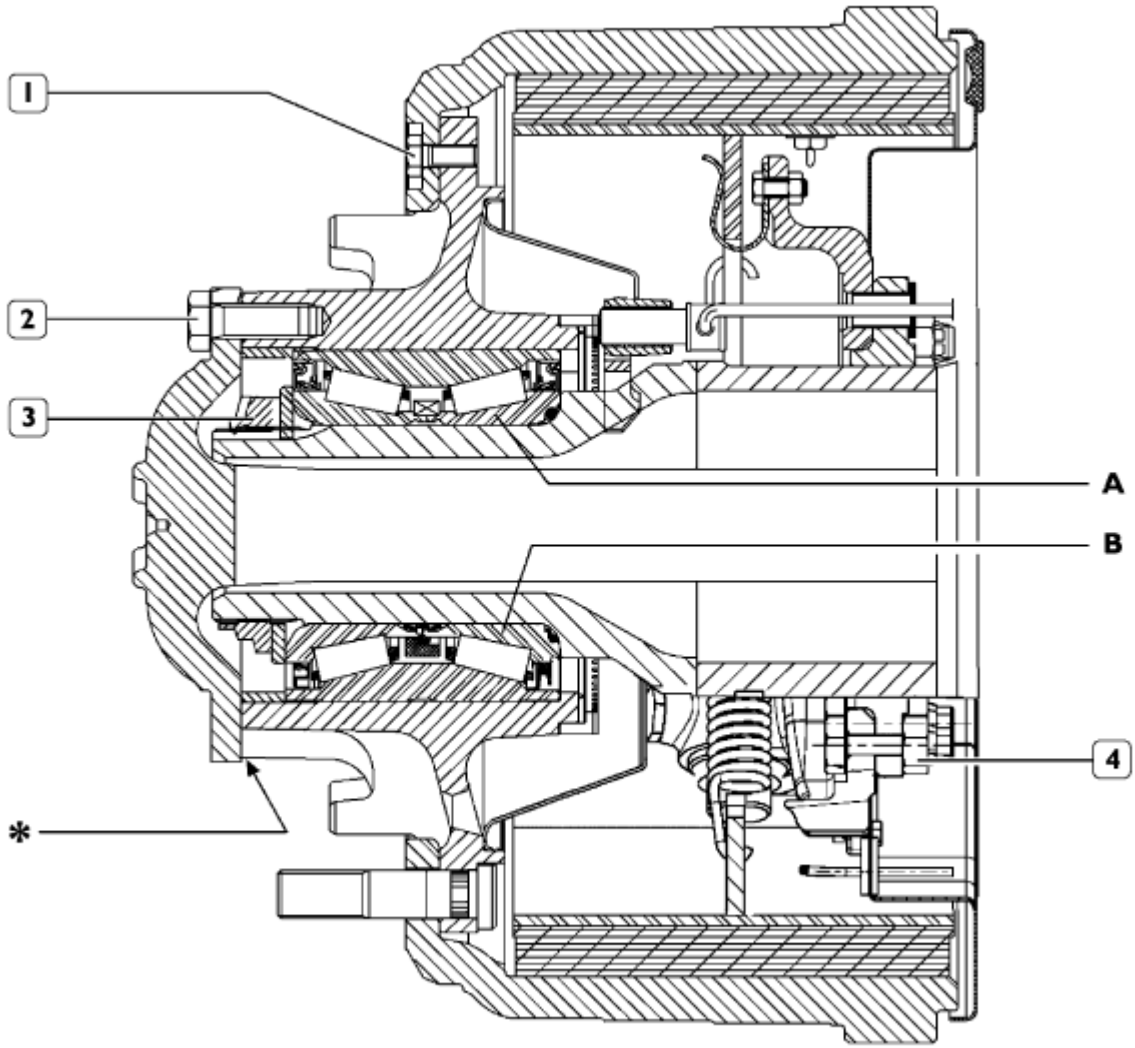



## TIGHTENING TORQUES

| PART | | TORQUE | |
|---|---|---|---|
| | | Nm | kgm |
| 1 | Pinion nut | 1220 ÷ 2035 | 122 ÷ 203 |
| 2 | Pinion cover cheese-headed screw | 40 ÷ 70 | 4 ÷ 7 |
| 3 | Drive input shaft cover cylindrical-headed bolt | 75 ÷ 95 | 7.5 ÷ 9.5 |
| 4 | Motion input shaft nut | 1200 ÷ 1400 | 120 ÷ 140 |
| 5 | Sensor switch lock nut | 35 ÷ 45 | 3.5 ÷ 4.5 |
| 6 | Pressure screw nut | 270 ÷ 335 | 27 ÷ 33.5 |
| 7 | Longitudinal clamp cover cheese-headed screw | 15 ÷ 25 | 1.5 ÷ 2.5 |
| 8 | Differential longitudinal clamp piston | 180 ÷ 220 | 18 ÷ 22 |
| 9 | Adjusting screw | 55 ÷ 75 | 5.5 ÷ 7.5 |
| 10 | Half-cap fastening cheese-headed screw | 650 ÷ 810 | 65 ÷ 81 |
| 11 | Differential cover cheese-headed screw | 15 ÷ 25 | 1.5 ÷ 2.5 |
| 12 | Cover cheese-headed screw | 520 ÷ 540 | 52 ÷ 54 |
| 13 | Differential casing cheese-headed screw | 460 ÷ 480 | 46 ÷ 48 |
| - | Differential lock switch | 30 ÷ 50 | 3 ÷ 5 |

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Figure 4




115272

## TIGHTENING TORQUES

| | PART | TORQUE | |
|---|---|---|---|
| | | Nm | kgm |
| 1 | Screw fixing drum | 42 to 67 | 4.2 to 6.7 |
| 2 | Screw fixing drive shaft flange | 235 to 289 | 23.5 to 28.9 |
| 3 | Ring nut for wheel hub bearings | 834 to 1030 | 83.4 to 103 |
| 4 | Nut for screw fixing brake mount | 275 to 304 | 27.5 to 30.4 |
| D | Screw fixing speed sensor mount | 5 to 7 | 0.5 to 0.7 |

: Spread with sealant type IVECO 1905685 (LOCTITE 14780)

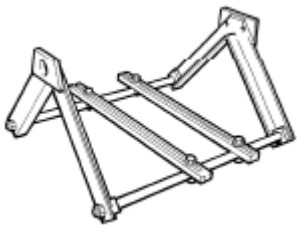
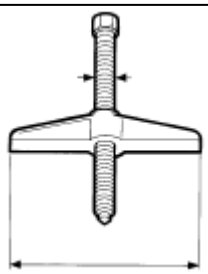
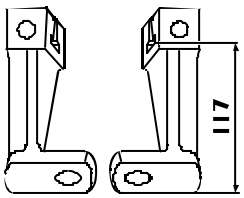
D Spread LOCTITE 245 on the thread

A = TIMKEN bearing

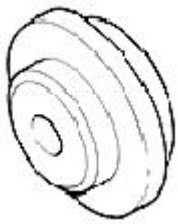
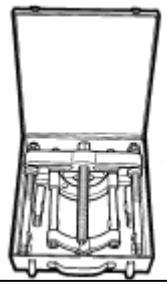
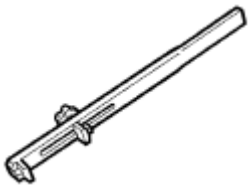
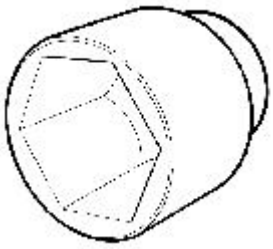
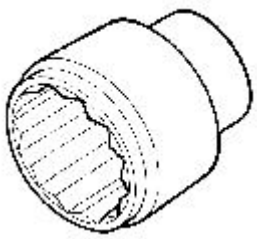
B = SKF bearing

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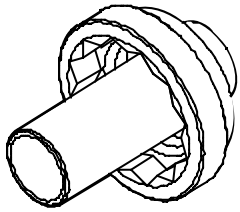
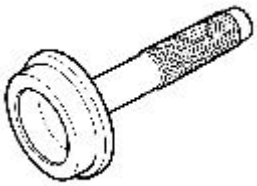
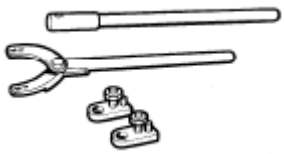
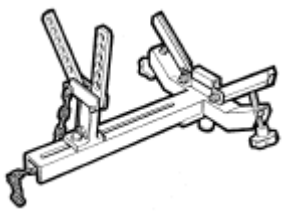
## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99305121** |  | Heater |
| **99322205** |  | Rotary stand for overhauling assemblies (capacity 1000 daN, torque 120 daNm) |
| **99322215** |  | Stand for axle overhauling |
| **99322225** |  | Unit holder (to be mounted on stand 99322205) |
| **99341003** |  | Single-acting lift |
| **99341017** |  | Pair of brackets with holes |

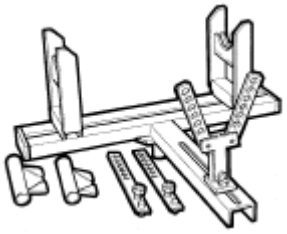
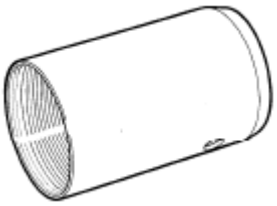
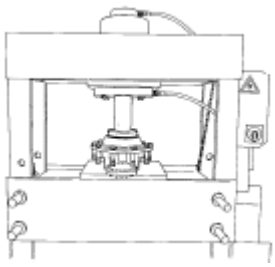
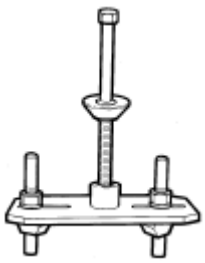
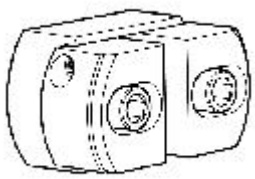
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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99345053** |  | Reaction block for puller tools |
| **99345055** |  | Reaction block for puller tools |
| **99348001** |  | Puller tool with clamping device |
| **99355025** |  | Wrench for differential gearcase bearing adjustment ring nuts |
| **99355069** |  | Wrench (75 mm) for differential bevel pinion nut<br>(to be used with 99370317) |
| **99355131** |  | Wrench (55 mm) for the nut of the drive input flange of the transfer box (use with 99370317) |

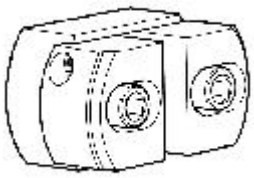
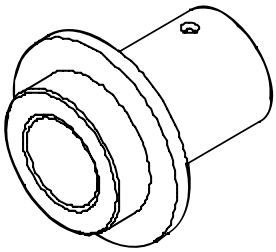
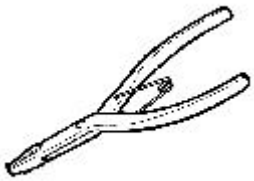
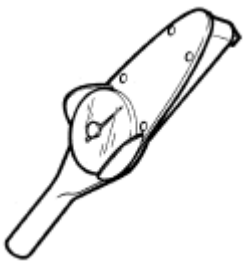
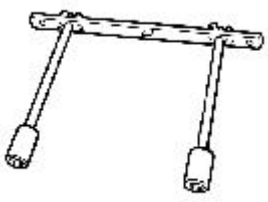
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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99355180** |  | Wrench (105 mm) for wheel hub bearing adjustment nut |
| **99370005** |  | Hand-grip for interchangeable drift punches |
| **99370007** |  | Hand-grip for interchangeable drift punches |
| **99370317** |  | Reaction lever and extension for flange lock |
| **99370509** |  | Hook to remove differential gearcase half-housing |
| **99370616** |  | Support to remove-fit back differential |

Aquila Trucks Centres

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99370617** |  | Universal support to remove-fit back rear axles |
| **99370700** |  | Guide to assemble wheel hub |
| **99370706** |  | Tool to fit wheel hub bearing |
| **99370708** |  | Tool for removing wheel hub bearing |
| **99371047** |  | Stand to hold differential half-housing when tightening crown wheel screws (to be used with 99322205 - 993222225) |
| **99374093** |  | Drift punch for installation of bea ring outer races (91 ÷ 134) (use with 99370007) |

Aquila Trucks Centres

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99374094** |  | Drift punch for installation of bearing outer races (134 ÷ 215) (use with 99370007) |
| **99374163** |  | Installer, transfer case output shaft seal |
| **99381125** |  | Pliers for removal of circlips on transfer box shaft |
| **99389816** |  | 4 x torque multiplier, with square connection, 3/4" in, 1" out (maximum torque 2745 Nm). |
| **99389819** |  | Torque wrench (0 - 10 Nm) with 1/4" square fitting |
| **99395026** |  | Tool for measuring hub rolling drag torque (use with torque wrench) |

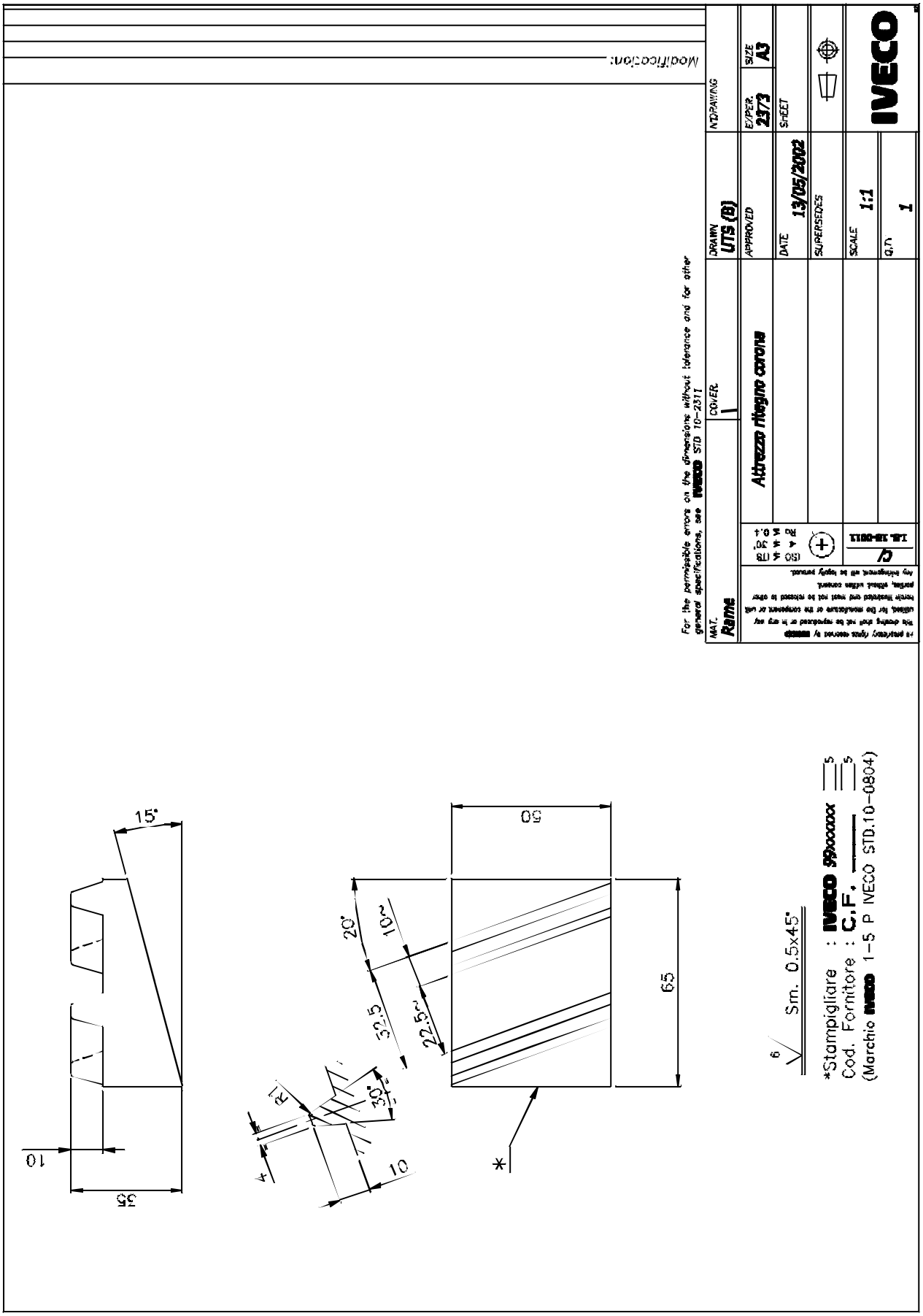
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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99395603** |  | Dial gauge (0÷5 mm) |

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## EXPERIMENTAL TOOLS

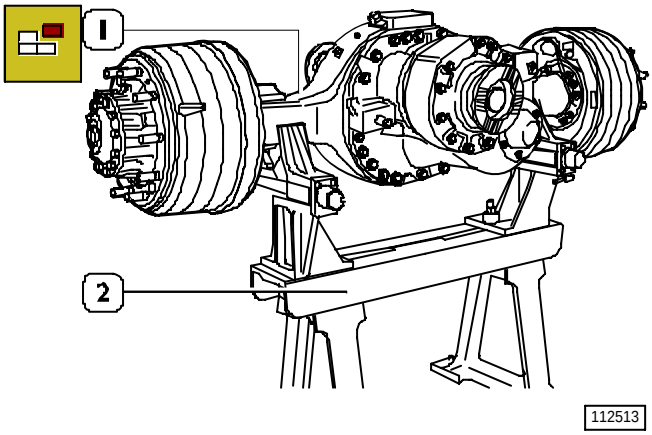
This chapter shows technical construction drawings of the special purpose tools (S.P. 2373) used to service the axle described in this section. These may be built by the repair workshops.



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## 525010 INTERMEDIATE REAR AXLE ASSEMBLY OVERHAUL

Figure 5

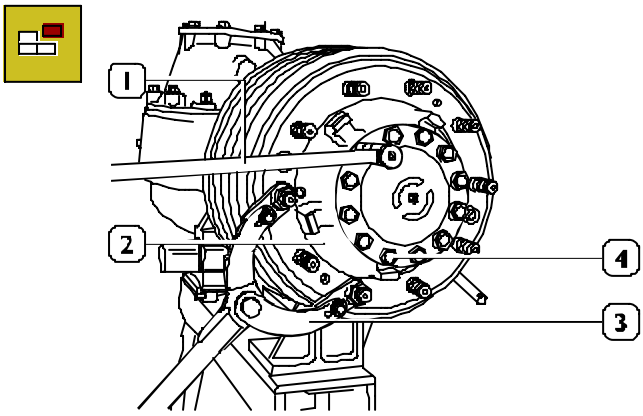



Put the rear axle (1) on the overhaul stand 99322215 (2).

## 525030 OVERHAULING THE WHEEL HUBS

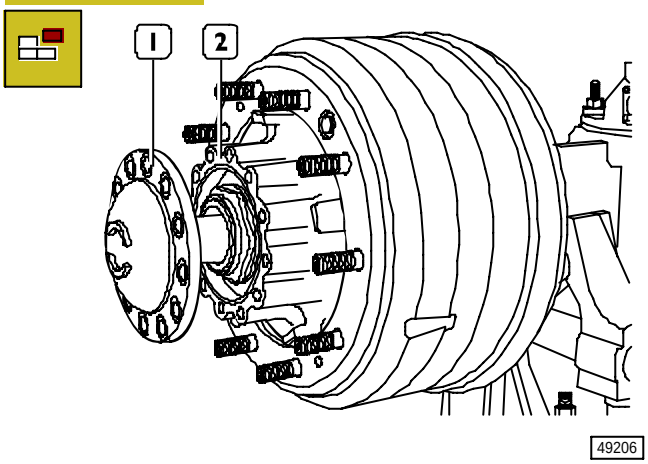
### Removal

Figure 6



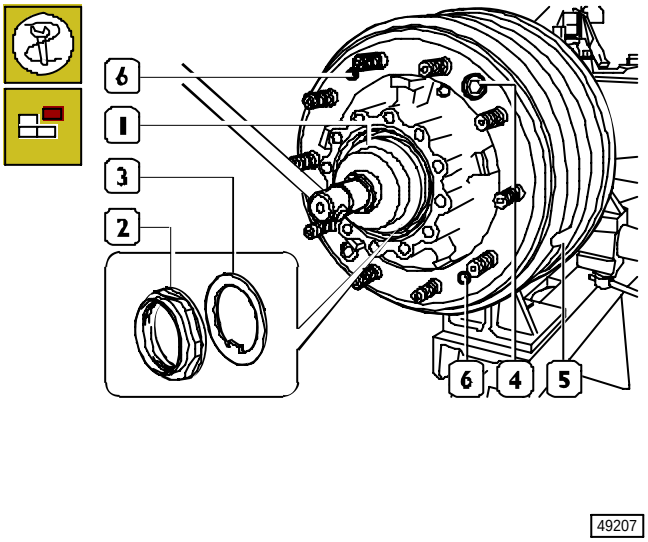

Put a container under the wheel hub to collect the oil.
Lock rotation of the wheel hub (2) with the retaining tool 99370317 (3).
Undo the screws fixing the drive shaft (4) with the wrench (1).

Figure 7




Take the drive shaft (1) out of the wheel hub (2).

Figure 8

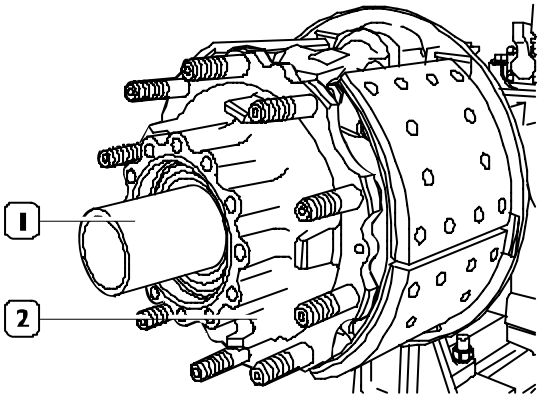



Using an appropriate tool, straighten the bending on the ring nut (2) preventing it from unscrewing.

Using the wrench 99355180 (1), unscrew the ring nut (2) locking the wheel hub bearing. Take out the retaining ring (3).
Undo the screws (4), screw reaction screws into the threaded holes (6) in order to extract the brake drum (5).

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Figure 9

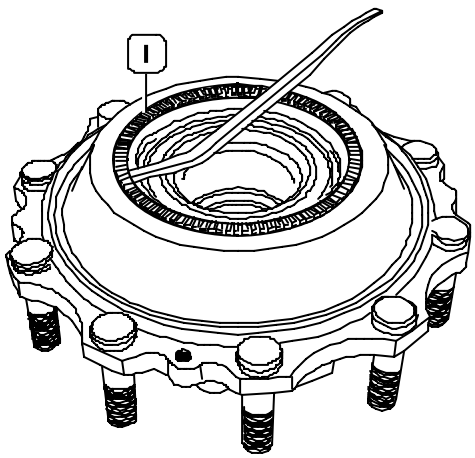



49208

Screw tool 99370700 (1) onto the sleeve and extract the wheel hub (2). This operation is carried out by hand, since bearings float on the sleeve.

**NOTE** Tool 99370700 (1) is used to safeguard the sleeve thread.

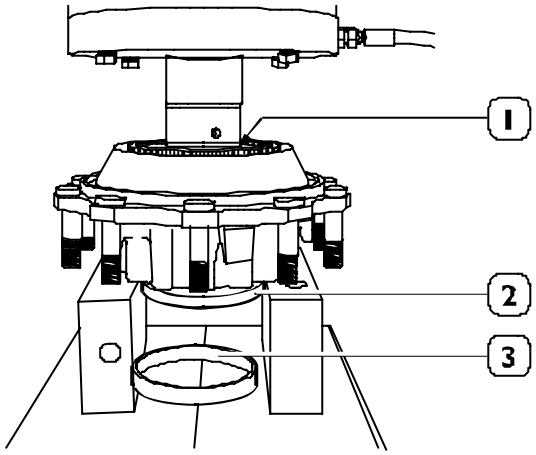
Figure 10




49209

The phonic wheel (1) is only removed if it has to be replaced. To remove it, use a suitable lever.

Figure 11




49210

Using the suitable tool 99370708 (1) and a vice, extract the bearing (2), along with the related adjustment ring (3).

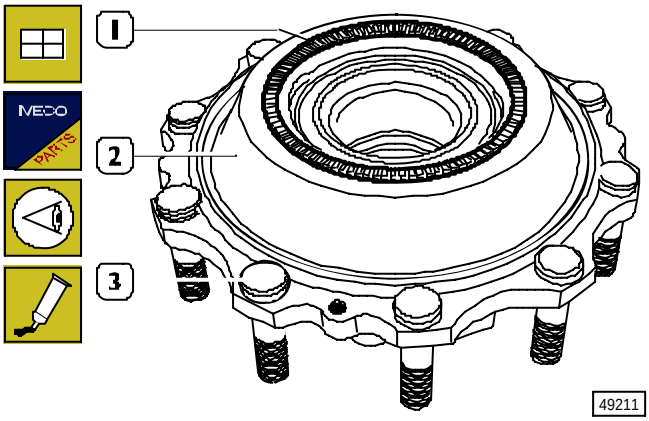
## Wheel hub component check

Carefully clean all wheel hub components. Inspect half-shafts, making sure they are not warped.
Inspect wheel clamping bolts: if the thread is damaged, replace them. To extract the bolts, use a vice.
The bearing rotation must be free and smooth.
Inspect the threads of wheel hub bearing adjustment nuts and axle casing ends; if needed, replace the nuts.
Replace all sealing elements with new ones.

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## 525035 REPLACING THE WHEEL HUB BOLTS

Figure 12

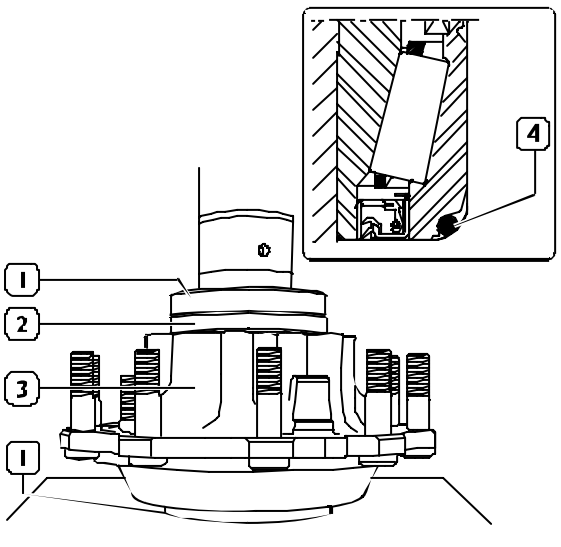



Before replacing wheel hub bolts (3) with new ones, make sure the bolt head supporting surface is free from slags, burrs or nicks.
Insert the new bolts by applying a load on their heads not exceeding 2,500 Kg.
After inserting the bolts, make sure they fit completely.

### Wheel hub reassembly

Before replacing the wheel hub cap (2, Figure 12), apply a layer of putty having 40 to 240°C heat resistance to the cap contact surface and hub housing.
To reassemble the phonic wheel (1, Figure 12), pre-heat the wheel to 150°C; when the phonic wheel has been fitted, make sure it is perfectly rested on the hub housing.

Figure 13



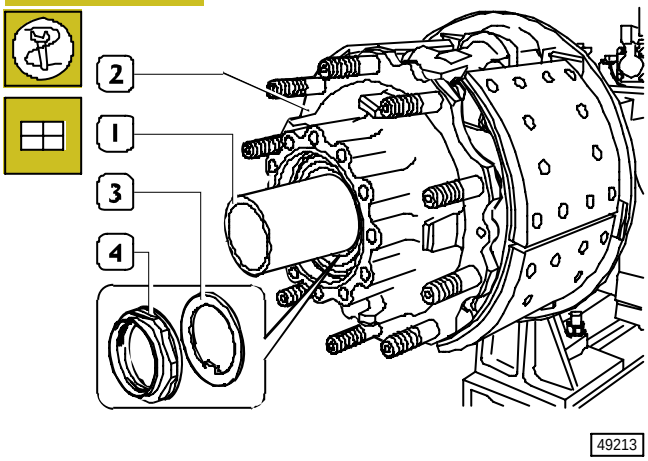

Put the bearing (2) on the wheel hub (3) with the seal (4) positioned as shown in the figure.

Fit the bearing (2) using a press and tool 99370706 (1).

**NOTE** The force for driving in the bearing with the press has to be 40,000 to 100,000 N.

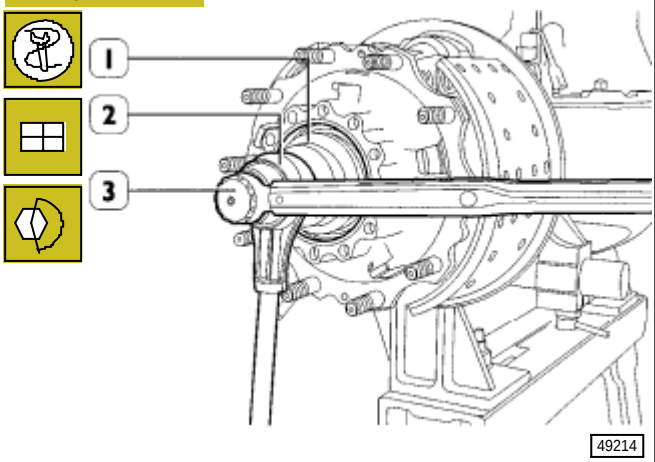
Make sure the bearing is properly inserted with the wheel hub shoulder.

Figure 14




Screw tool 99370700 (1) on the sleeve and assemble the wheel hub (2), complete with bearing. Remove tool 99370700 (1) and place the seal ring (3), inserting the tab into the sleeve slot, then screw the ring nut (4).

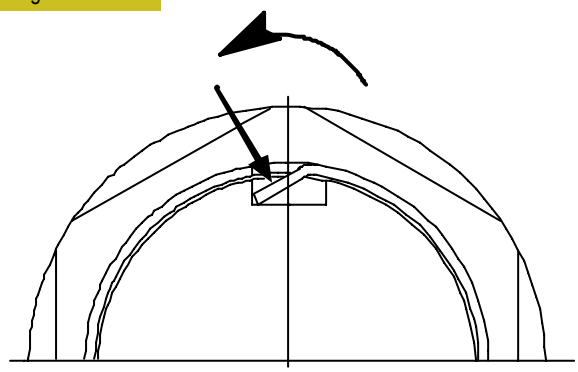
Figure 15




Using wrench 99355180 (1), multiplier (2) and torque wrench (3), tighten the ring nut (4, Figure 14) to the prescribed torque (834 to 1030 Nm).

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Figure 16



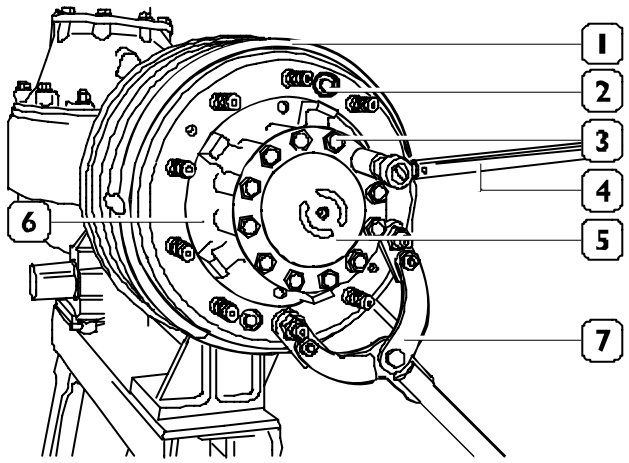
49213A

After tightening, using an appropriate tool, notch and bend the ring nut as shown so it cannot be unscrewed.

The arrow shows the direction of unscrewing the ring nut.

Using a fit tool key the spacer ring (5, Figure 18) and check that a play of 0 ÷ 0.145 mm between wheel hub outer side and spacer side, making two measures at 180º.

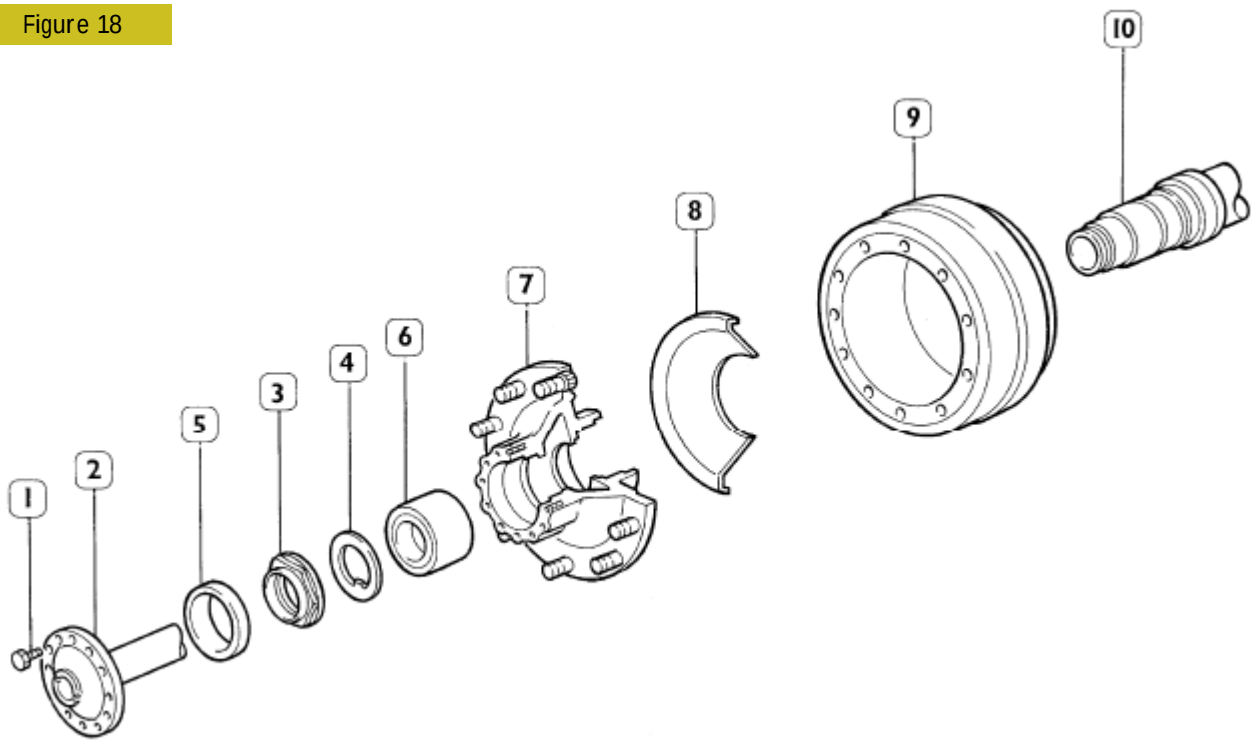
Figure 17




49216

Lock the wheel hub with tool 99370317 (7).
Fit the drum (1) to the wheel hub (6) and fasten it by tightening the screws (2) to the prescribed torque.
Apply sealant IVECO 1905685 (LOCTITE 14780) to both half-shaft flange and wheel hub contact surfaces.
Fit the screws (3) fastening the half-shaft (5) to the wheel hub (6) and tighten them with torque wrench (4) to the prescribed torque.
After these operations, replenish the axle housing with oil up to the right level.

Figure 18




WHEEL HUB COMPONENTS

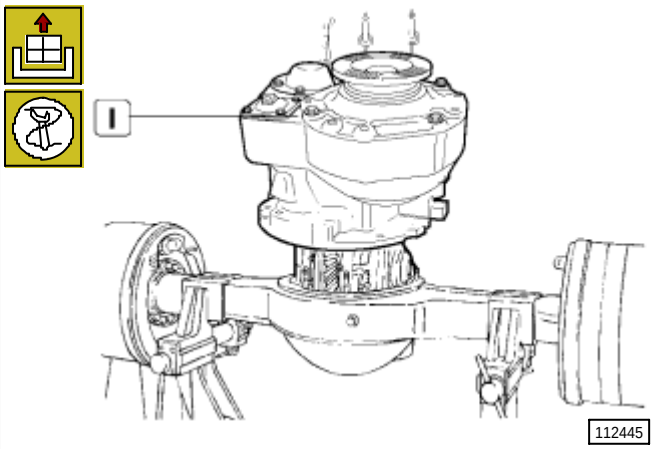
1. Screw - 2. Half-shaft - 3. Ring nut - 4. Safety ring - 5. Spacer ring - 6. Bearing - 7. Wheel hub - 8. Wheel hub cap - 9. Brake drum - 10. Axle sleeve

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## 526210 DIFFERENTIAL CARRIER REMOVAL

### Case removal

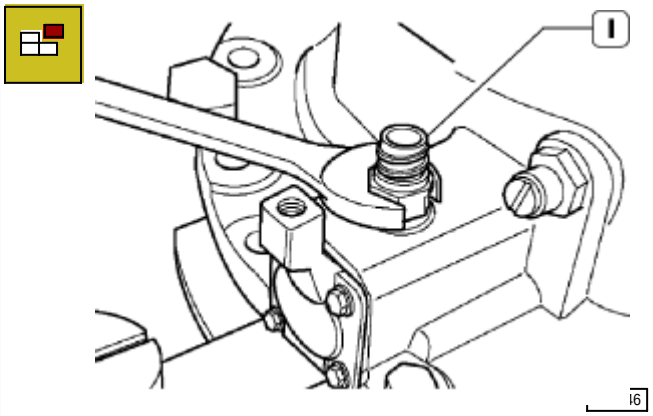
Figure 19




Slacken the differential carrier (1) fastening screws; withdraw the casing from the rear axle using metal eyelets and cables.

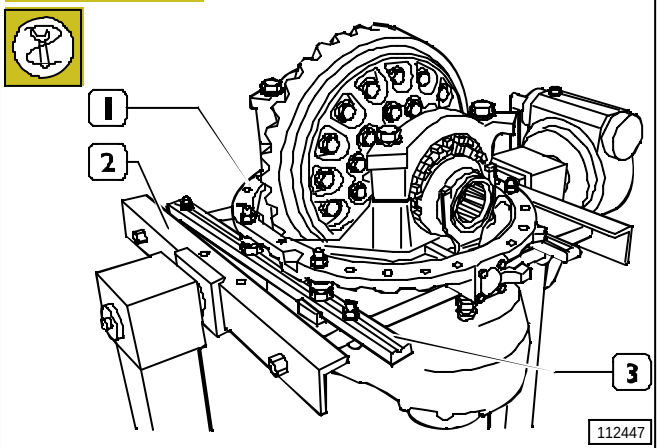
**NOTE** To remove the differential carrier with the rear axle fitted on the vehicle, use support 99370616.

Figure 20



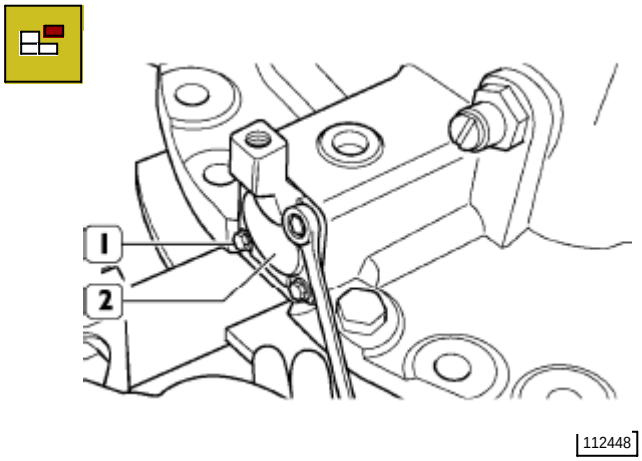

Remove the differential clamp warning switch (1) to fit the carrier on the stand.

Figure 21



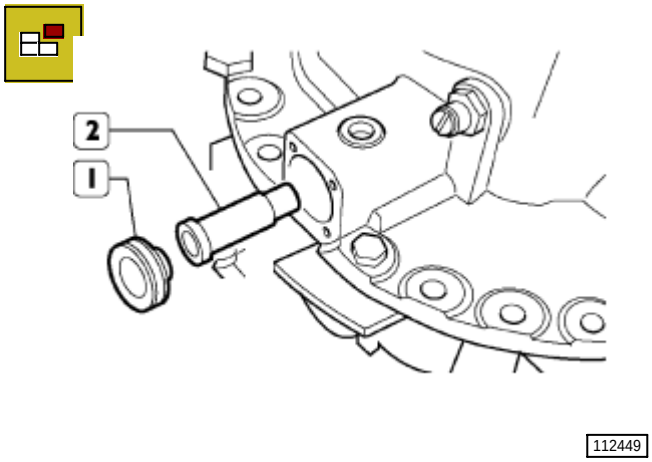

Put the differential carrier (1) on the rotating stand 99322205 (2) together with the support 99322225 (3).

Figure 22



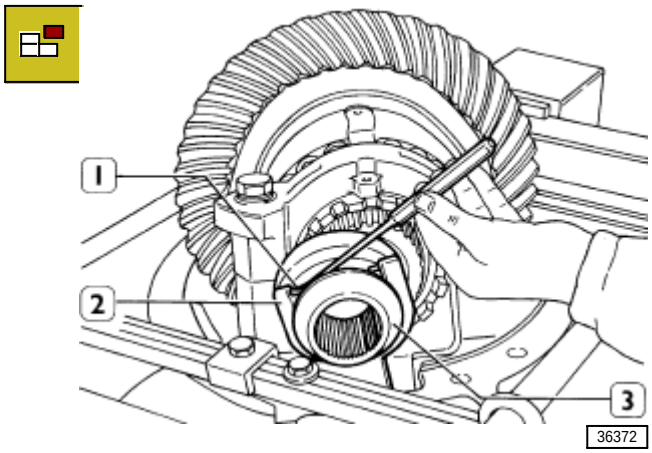

Remove the differential clamp cover (2) fastening screws (1). Take off the cover and the gasket.

Figure 23




Remove the piston (1) and the stem (2).

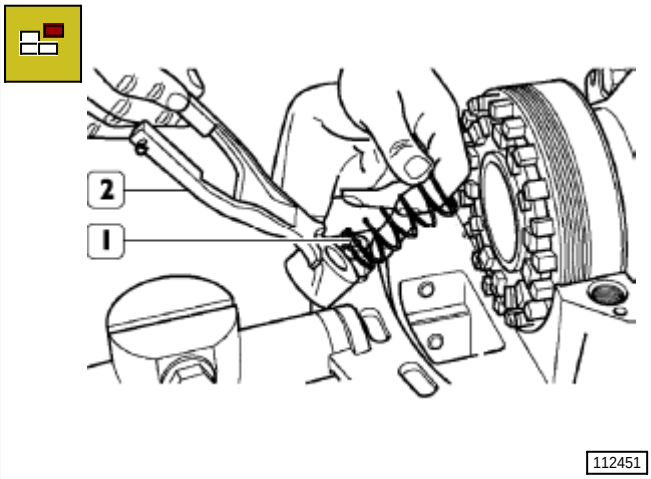
Figure 24




Use a punch to take back the fork (2) elastic pins (1) so that the fork can be released from the sleeve (3).
Remove the sleeve (3) from the carrier.

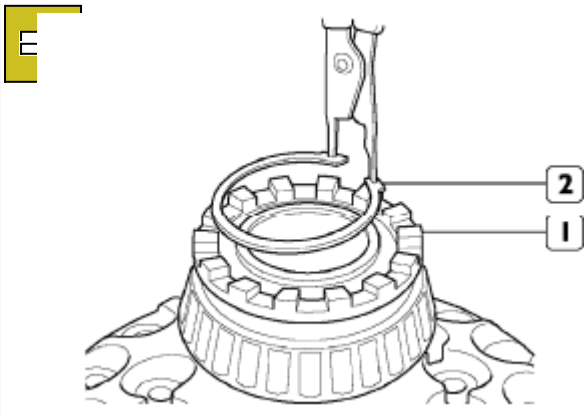
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Figure 25



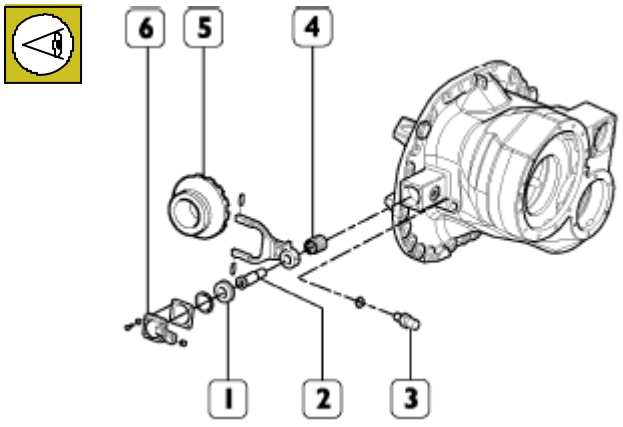

Press and remove the spring (1), then take off the fork (2).

Figure 26




Remove the seal ring (2), the spacer fitted below and the collar (1).

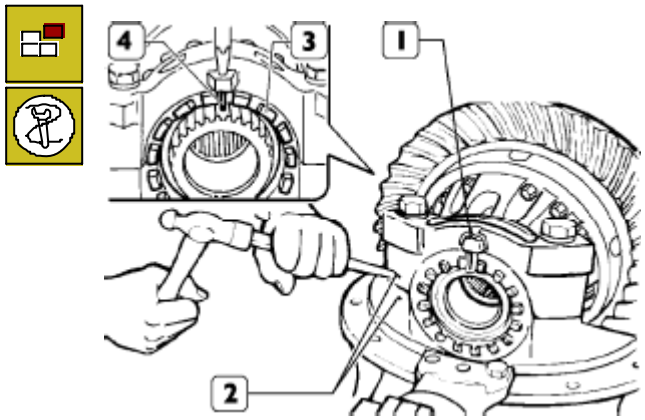
Figure 27




1. Plunger - 2. Stem - 3. Differential locking switch - 4. Spring - 5. Sleeve - 6. Cover

Clean and check the status of all differential lock assembly parts.

Figure 28



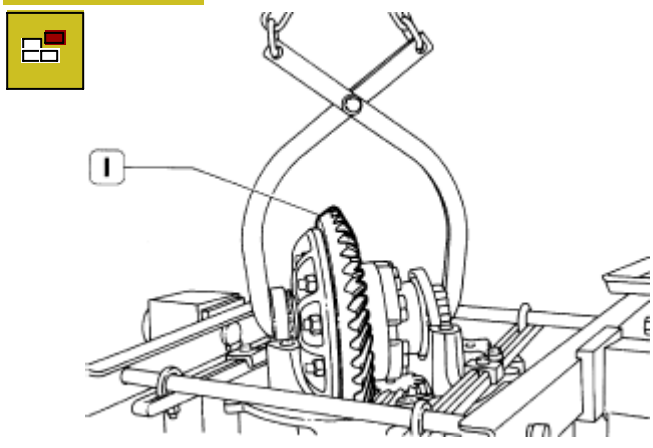

Remove the split pin (1) and the elastic pin (4).

Mark with a punch the caps (2) and the case to facilitate the assembly.

Slacken the ring nuts (3) with tool 99355025.

Remove the caps (2) and the ring nuts (5).

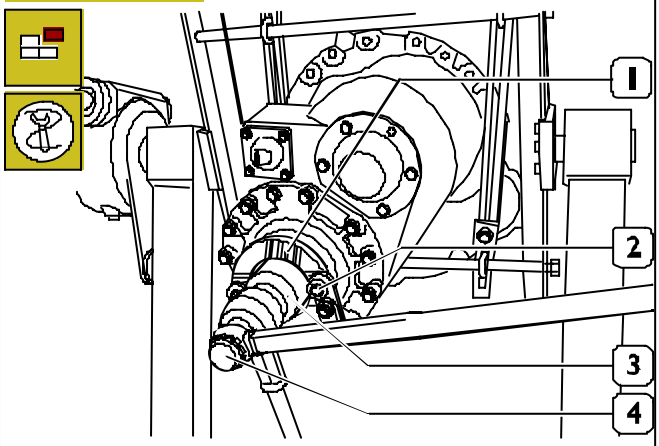
Figure 29




Use the suitable hook to remove the differential housing (1) with the ring bevel gear and the support bearings.

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Figure 30



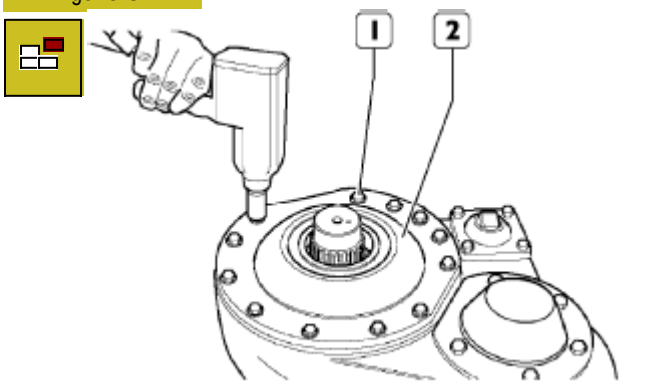

112456

Remove denting of nut checking flange (1).

Stop the flange rotation (1) through tool 99370317 (2); use wrench 99355069 (3) and the multiplier (4) to slacken the flange retaining nut (1).

Remove the motion input shaft flange (1).

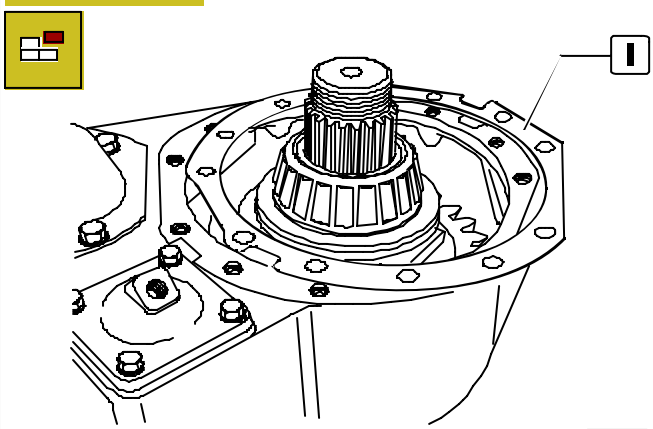
Figure 31




112457

Take off the screws (1) and remove the motion input shaft cover (2).

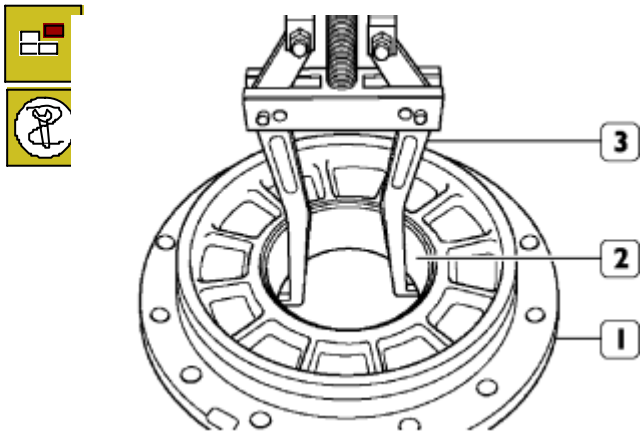
Figure 32




112458

Remove the shims (1).

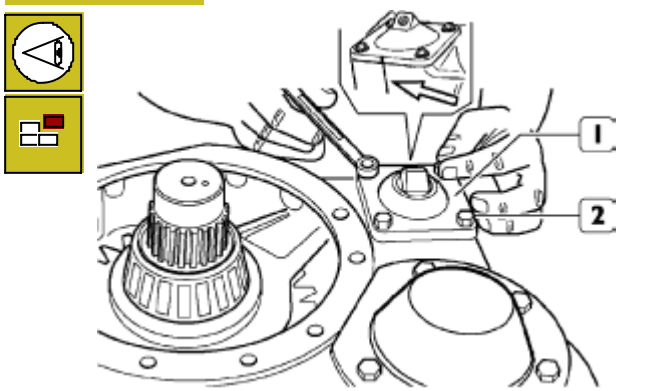
Figure 33




112459

Remove the bearing (2) outer ring from the cover (1) of the motion input shaft through the puller (3), if needed.

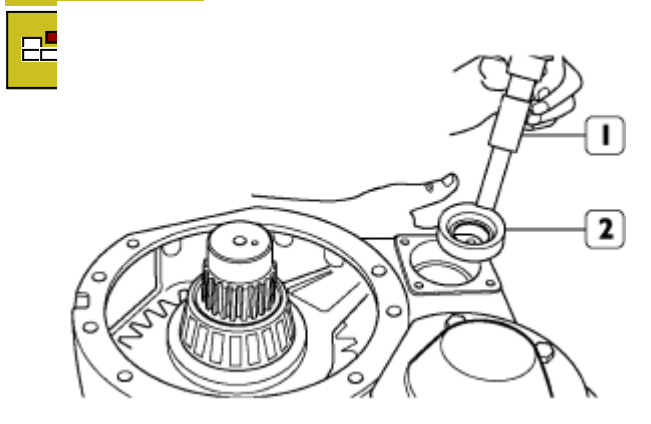
Figure 34




112460

Mark the longitudinal clamp cover (1) assembly position and take it off by slackening the fastening screws (2).

Figure 35

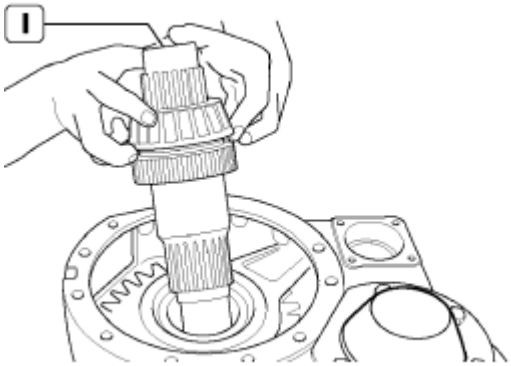



112461

Remove the control piston (1), the diaphragm seat (2) and the spring below it.

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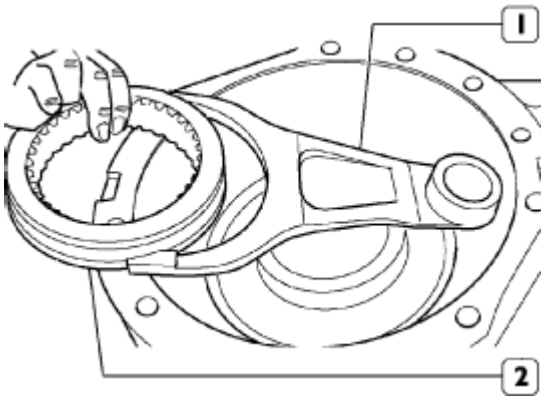
Figure 36




112462

Carefully remove the motion input shaft assembly (1).

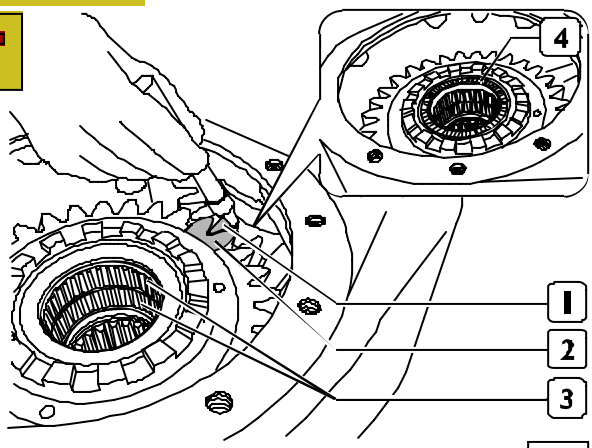
Figure 37




112463

Take off the fork (1) and the sleeve (2).

Figure 38




112464

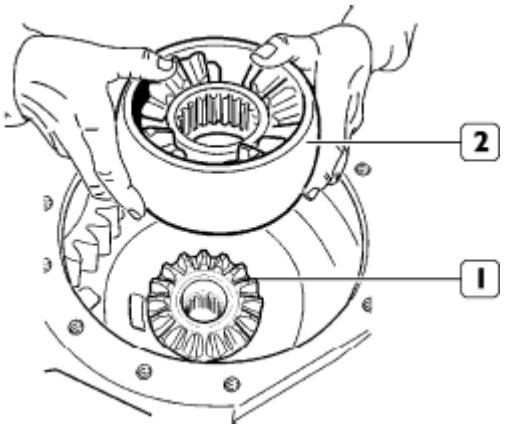
Remove the bearing (3).

Mark the gear (1,2) assembly position.

Remove the two roller cages (3) and the spacer (4) from the gear (2).

Remove the helical-tooth gear (1).

Figure 39

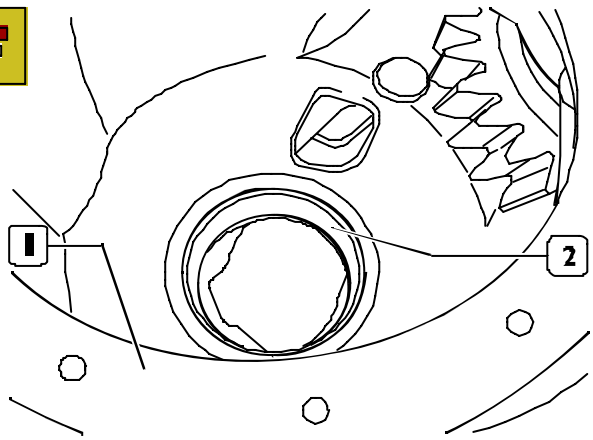



112466

Remove the crown wheel and planetary gear unit (2).

Remove the rear gear (1) with the bearing.

Figure 40

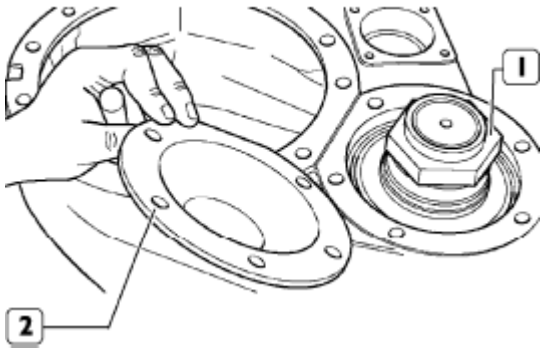



112467

Turn the differential case (1) and use a beater to remove the rear bearing outer ring (2), if needed.

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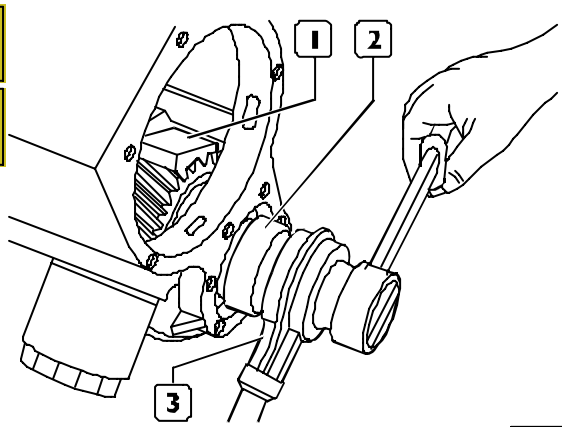
Figure 41




112468

Remove the cover (2) of the conic pinion.

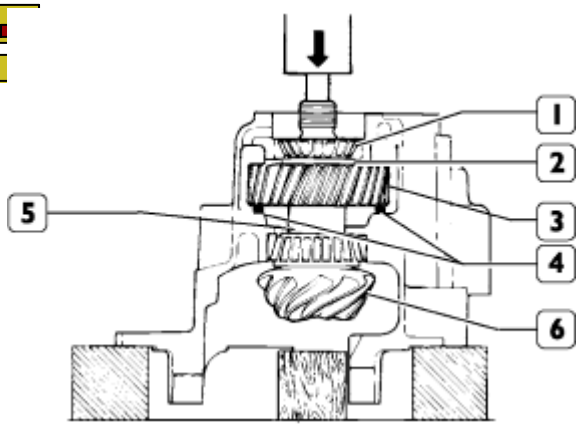
Figure 42




77237

Stop the conic pinion rotation with tool S.P.2373 (1); use wrench 99355069 (2) and the multiplier (3) to remove the bearing retaining nut (1, Figure 41) on the conic pinion and the washer below.

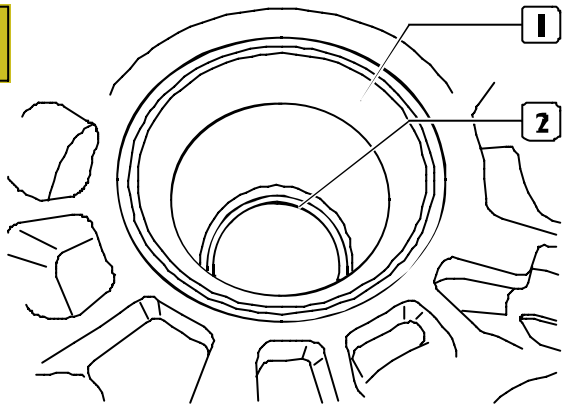
Figure 43




112470

Fit the two spacers (4) below the gear (3).
Under the press, pull out the conic pinion (6) and take off the bearing (1), the adjusting ring (2), the gear (3) and the spacer (5) from the conic pinion.

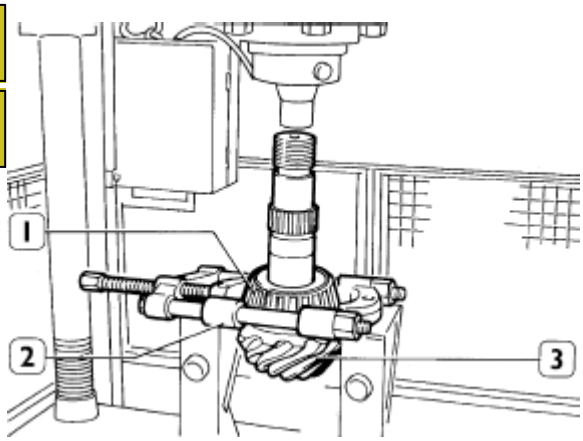
Figure 44




112471

Use a drift to remove outer races (1) and (2) with their shims.

Figure 45

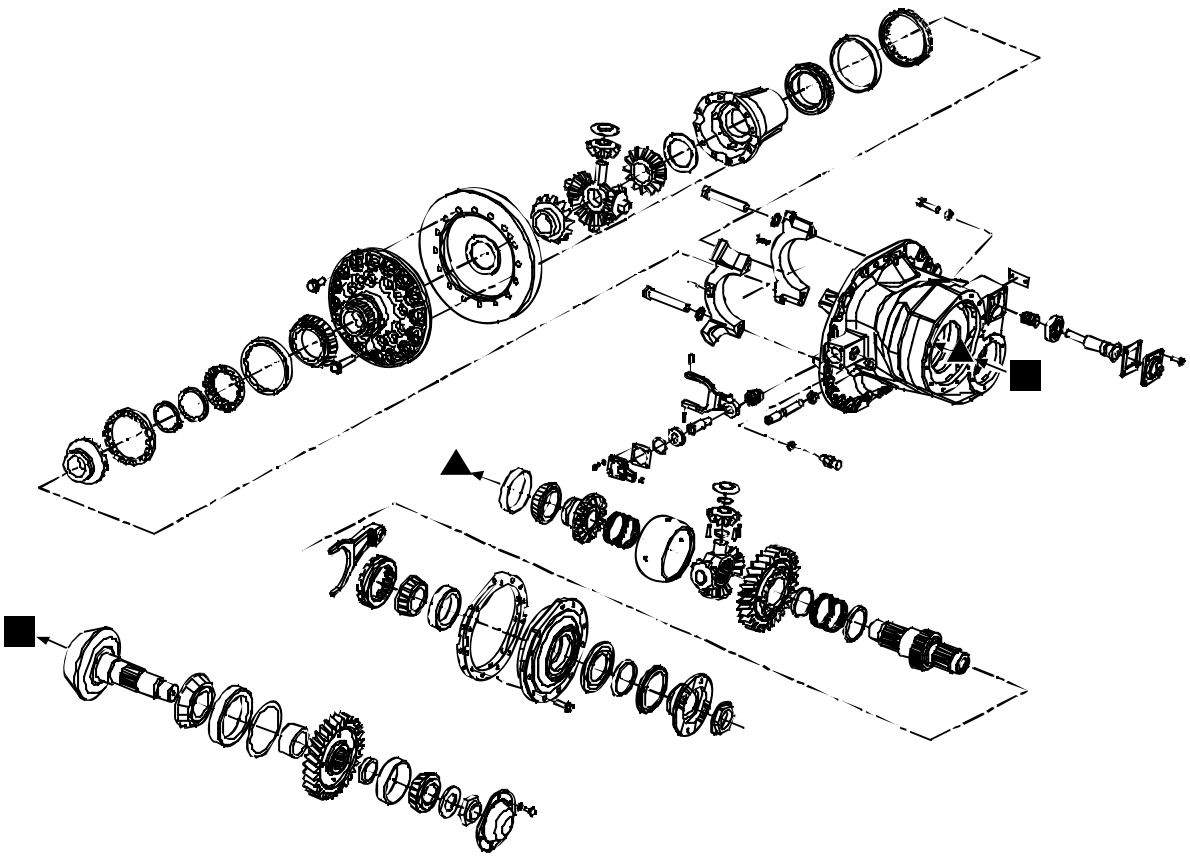



36381

Place tool 99348001 (2) under the taper roller bearing (1) and pull it off the bevel pinion (3) using a press.

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Figure 46



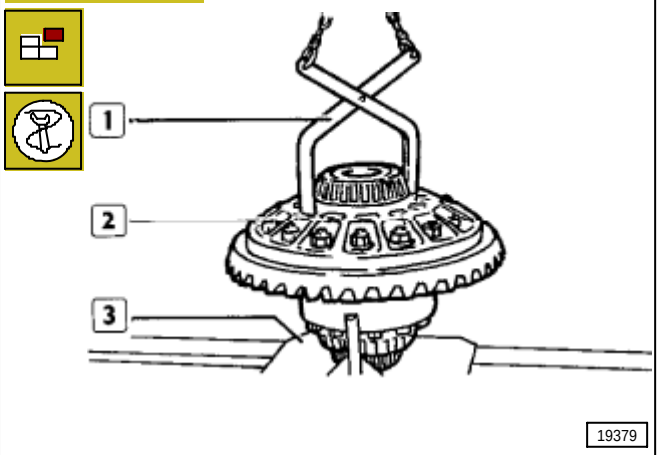
112472

INTER-AXLE DIFFERENTIAL COMPONENTS - EXPLODED VIEW

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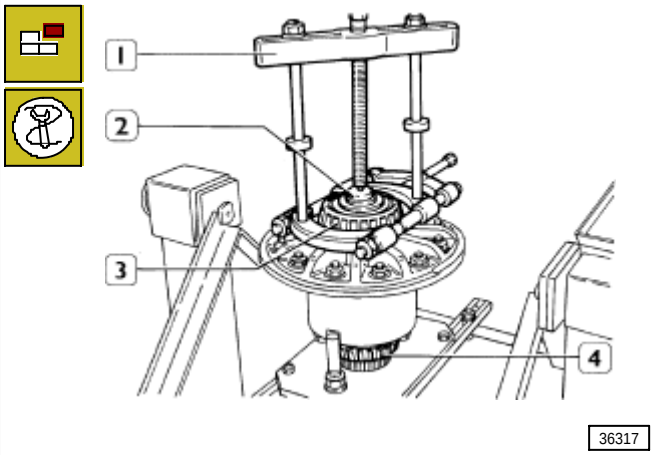
## Differential housing removal

Figure 47



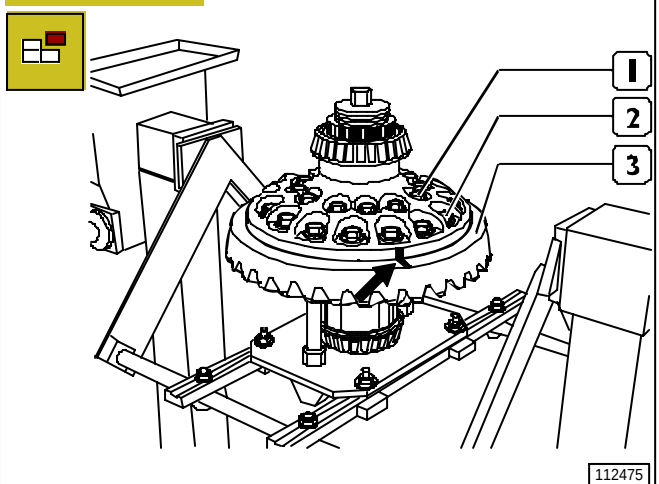

Use the suitable hook (1) to lift the whole differential housing (2) and put it on the supporting base 99371047 (3).

Figure 48



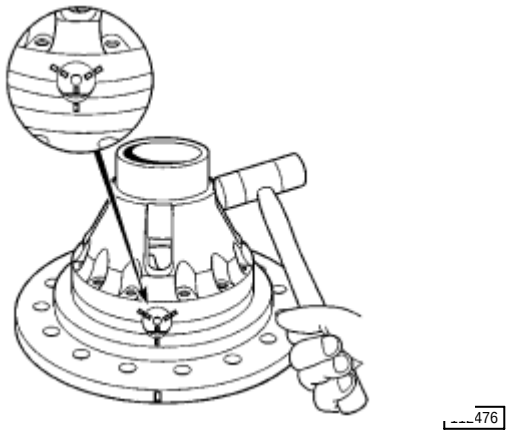

Use tool 99348001 (1) and the reaction block 99345055 (2) to pull out bearing (3) and bearing (4).

Figure 49



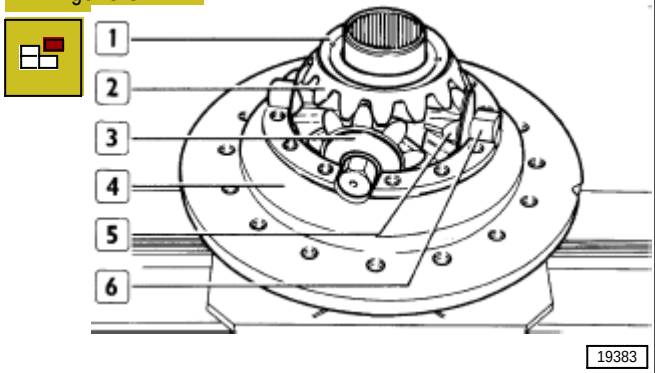

Mark the ring gear and the differential housing position as shown in the figure.
Remove the ring gear (3) fastening screws (1, 2).
Turn the case and remove the ring gear (3).
Remove the half-case fastening screws (1).
Turn the case.

Figure 50




Mark the two half-cases (2 and 3) and the cross as shown in the figure.
Split the half-cases.

Figure 51




Remove the crown wheel (2) and the offsetting washer (1).
Remove the cross (6) with the four planetary gears (5) and the shoulder washer (3); strip the cross-planetary gear unit.
Remove the other planetary gear and the shoulder washer from the half-case (4).

Aquila Trucks Centres

## Checking the differential components

Carefully clean the differential components.
Lubricate the bearings and rotate the roller cage freely: the rotation must be regular with no stiffness.
Check the contact surfaces of the bevel gear and the stop plate of the half-box to ensure that the crown wheel adheres properly. Any deformation of these surfaces will cause the vibration of the fastening screws jeopardising the unit functioning.

**NOTE** Carefully clean screw, stud and ring nut threads to ensure proper adjustments and exact tightening torque.

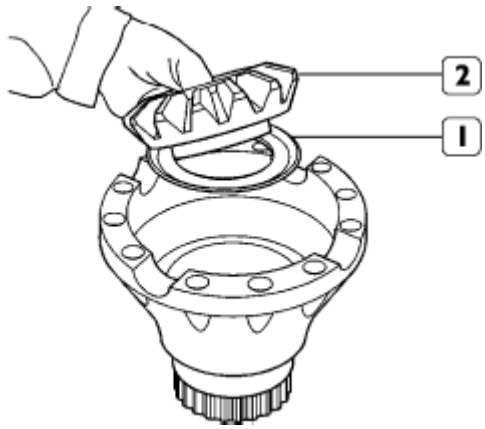
Check that the splined section for the flange connection onto the pinion is not worn. If it is replace the pinion.

Check the planetary gears and their shoulder washers, the spider and the crown wheels with their shoulder washers.
All sealing elements, the adjustment ring nut clip and safety washers must be replaced with new ones.

**NOTE** If it is necessary to replace the crown or the pinion, both elements must be changed as they are supplied in pairs.

## Refitting the differential housing

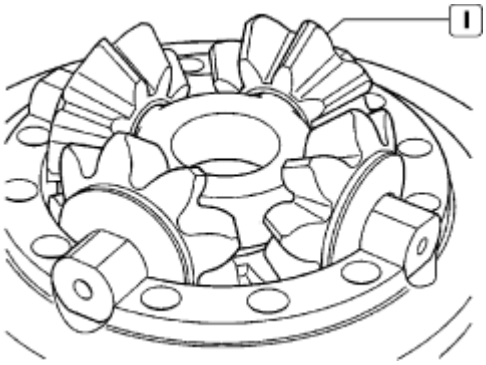
Figure 52




112478

Fit the shoulder washer (1) and the planetary gear (2) in the half-case.

Figure 53

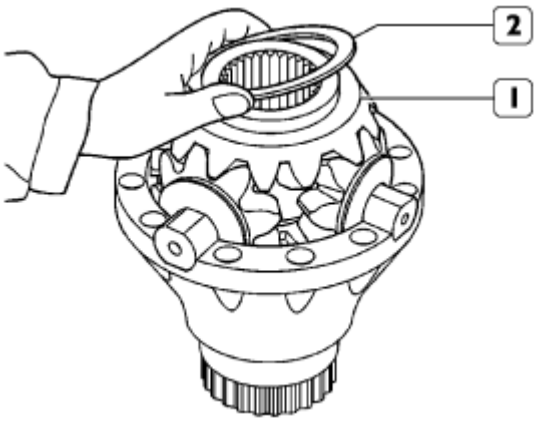



112479

Assemble the pinions (1) and the fit the assembly in the half-case.

**NOTE** If the assembly has not been previously mounted, make sure that the pinions are installed correctly.

Figure 54

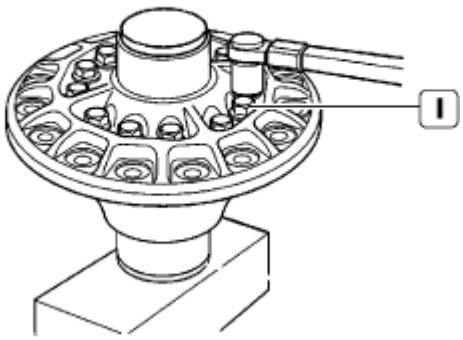



112480

Fit the shoulder washer (2) and the planetary gear (1) on the differential housing.

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Figure 55

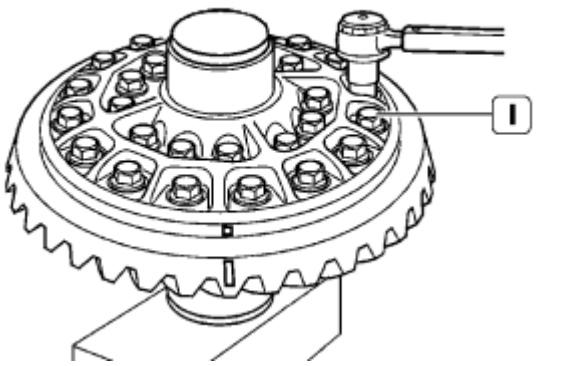



Lock the differential with the suitable tool; then fit it in the half-case. Make sure that the marks made at removal match. Apply some drops of "LOCTITE 270" on the screw threading (1). Tighten the screws (1) to the prescribed torque.

**NOTE** It is advisable to replace the screws (1) with new ones.

Heat the ring gear inside an air-circulation oven at 100°C for 15' and fit it in the seat on the differential housing, making sure that the holes for the fastening screws of the ring gear-differential housing coincide.

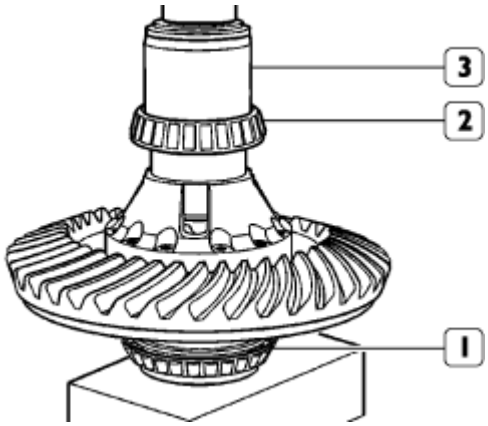
Figure 56




After the ring gear has cooled down, fit the screws and tighten the self-locking nuts (1) with the torque wrench to the prescribed torque.

**NOTE** It is advisable to replace the screws (1) with new ones.

Figure 57



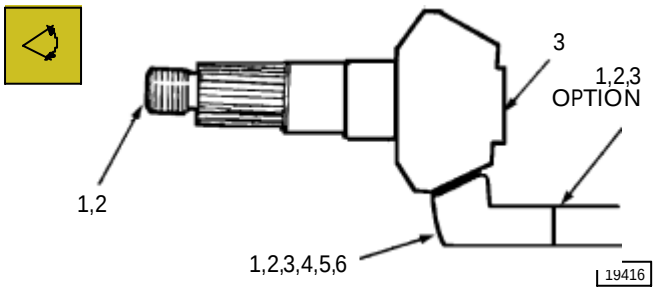

Heat the bearings (1,3) inside an air-circulation oven at 100°C for 15' and fit them in the differential housing by means of the suitable beater (3).

Aquila Trucks Centres

## ASSEMBLING DIFFERENTIAL CARRIER

### Calculating bevel pinion position in differential carrier

Figure 58




If a new final drive set is installed, it will be necessary to know the meaning of the markings on pinion and crown wheel in order to position the pinion correctly.

1. Part number
2. Tooth combination number.
   This number (example: 12/41) indicates that the pinion has 12 teeth and the crown wheel 41.
3. Pinion/crown wheel pair set number.
   All final drive sets are available as pairs: therefore pinion and crown wheel bear the same number which is stamped on head end for pinions and the outer face for crown wheels.

Never use a pinion and crown wheel set unless both components have the same number.

4. Variation number needed to determine the thickness of the shim pack interposed between pinion bearing cage and differential carrier (in the example below, this number is identified as CP).

Every crown wheel is marked with a variation number which indicates the nominal assembly distance. Use this number to calculate the thickness of the shim pack that is interposed between pinion bearing cage and differential carrier.
This number, expressed in mm, (e.g. P.C. + 0.1 or P.C. - 0.1) is marked on the external part of the ring gear.

5. Pinion/crown wheel set manufacturing and inspection month and year.
6. Specified pinion/crown wheel set clearance.

Part number and tooth combination number are stamped on threaded end of all pinions. Number may alternatively be located on outer diameter of crown wheel. On any pinion/crown wheel set, crown wheel will always bear an even stamped category number (e.g. 36786), whereas corresponding pinion will bear an odd number (e.g. 36787).

To determine the thickness of the shim pack to be interposed between bearing cage and differential carrier proceed as follows

1. Measure the thickness of the shim pack removed with the old final drive gear set. Use a micrometer or other suitable gauge and record the value found.
2. Read the CP marked on pinion to be replaced: if it is a plus (+) number or a minus (-) number respectively subtract or add it from the value obtained under 1. above.
   Take note of the result

**NOTE** The value obtained in 2. will be used to calculate the thickness of the shim to be interposed between pinion bearing cage and differential carrier for correct new final drive assembly.

3. Read the CP marked on the new pinion.
   Either add or subtract this value - depending on whether the sign is a plus or a minus - to or from the value noted under 2. above.
   The result indicates the thickness which the new shim pack should have.

Refer to the following examples which cover all the possible calculation cases

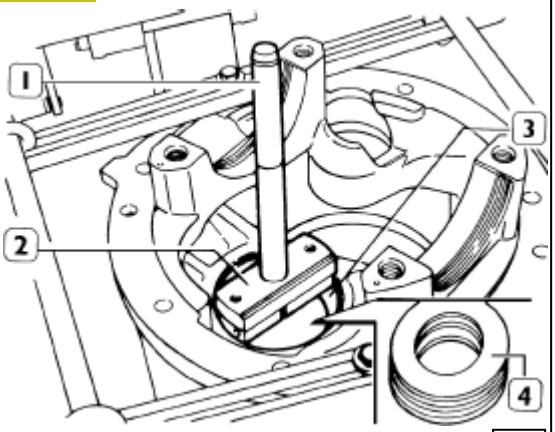
### EXAMPLES

| | |
|---|---|
| Case 1: | mm |
| Original shim pack thickness | 0.76 |
| CP marked on pinion + 0.05 | + 0.05 |
| Resulting value | 0,81 |
| CP marked on new pinion +0.12 | - 0.12 |
| Thickness for new shim pack | 0.69 |
| Case 2: | |
| Original shim pack thickness | 0.76 |
| CP marked on pinion - 0.05 | - 0.05 |
| Resulting value | 0.71 |
| CP marked on new pinion + 0.12 | - 0.12 |
| Thickness for new shim pack | 0.59 |
| Case 3: | |
| Original shim pack thickness | 0.76 |
| CP marked on pinion + 0.05 | + 0.05 |
| Resulting value | 0.81 |
| CP marked on new pinion - 0.12 | + 0.12 |
| Thickness for new shim pack | 0.93 |
| Case 4: | |
| Original shim pack thickness | 0.76 |
| CP marked on pinion - 0.05 | - 0.05 |
| Resulting value | 0.71 |
| CP marked on new pinion - 0.12 | + 0.12 |
| Thickness for new shim pack | 0.83 |

**NOTE** The difference between old pack and new pack thickness values must be added or subtracted - depending on cases - to or from the adjusting ring thickness (4, Figure 59).

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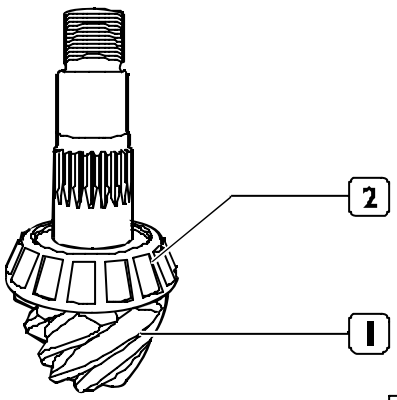
Figure 59




36383

Arrange shim pack (4) for adjusting bevel pinion position in carrier; then fit bevel pinion bearing cup (3) using handle 99370007 (1) and drift 99374093 (2).
Fit the remaining outer rings using beaters 99374093/94.

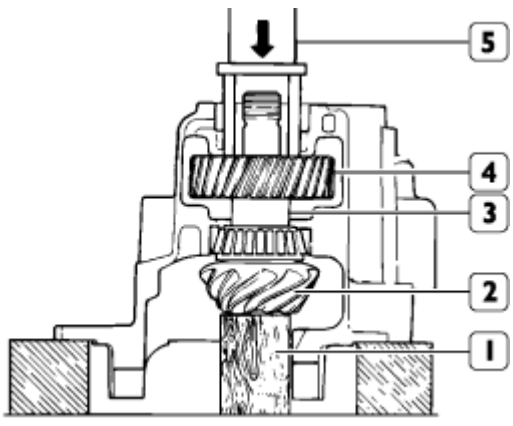
Figure 60




112485

Heat the bearing (2) to 100°C for 15 minutes and install it on bevel pinion (1) using a drift.

Figure 61

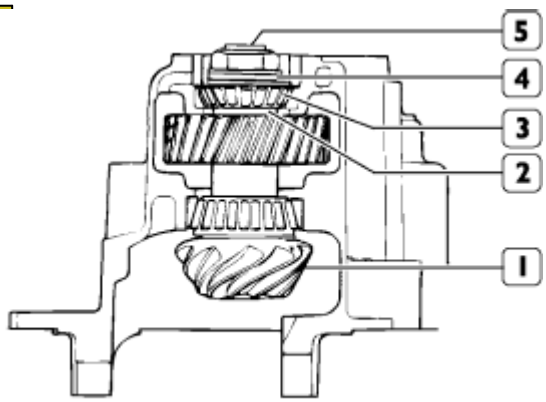



112486

Insert bevel pinion (2) in carrier and spline spacer (3) and gear (4) on it at the same time.
Mount reaction block (1) under pinion.

Drive gear (4) under press (5)

Figure 62




2487

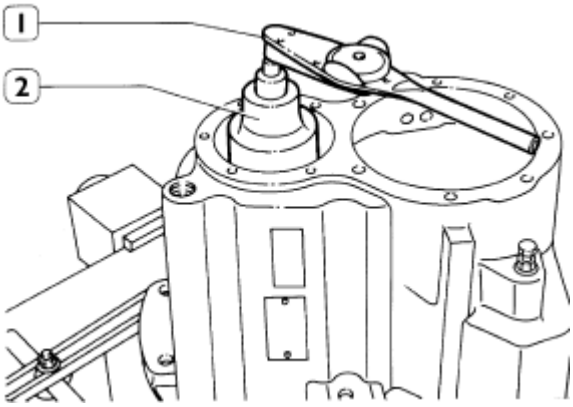
Block the rear axle position with tools 99341004 and 99341008.

Fit the adjusting ring (2).

Heat the bearing (3) at 100°C for 15' and fit it on the pinion.

Insert the washer (4) and the retaining nut (5).

Figure 63




36387

Tighten retaining nut bevel pinion using wrench 99355069 (2).

Remove tools 99341004 and 99341008.

Apply torque wrench (1) to bevel pinion retaining nut and check that rolling torque is:

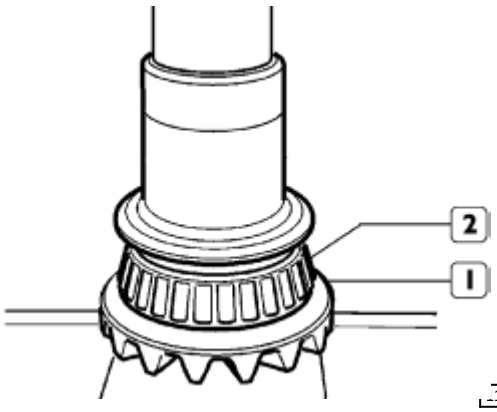
- 2.30 ÷ 7.40 Nm with new bearings,
- 3.00 ÷ 5.30 Nm with used bearing.

In case of a different reading, replace adjusting ring (2, Figure 62) with a thinner one if reading is higher than the specified figure and with a thicker one if the reading is lower than the specified figure.

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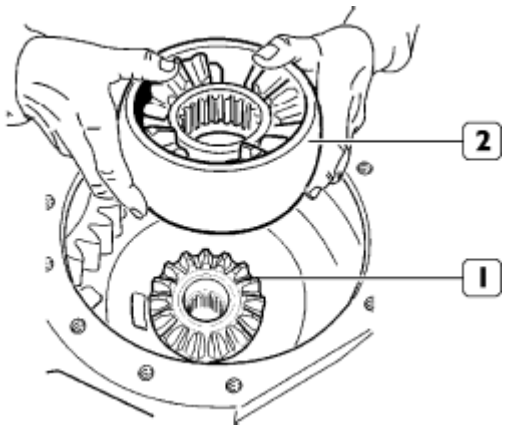
Apply a layer of sealer on the pinion cover and the screws. Fasten the cover by tightening the screws to the prescribed torque.

Figure 64



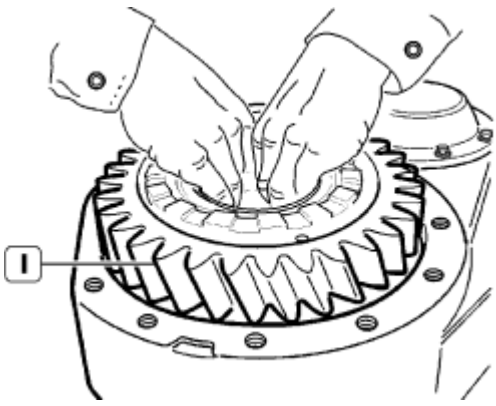

If previously removed, heat the bearing (2) at 100°C for 15' and fit it with the suitable beater on the rear gear (1).

Figure 65



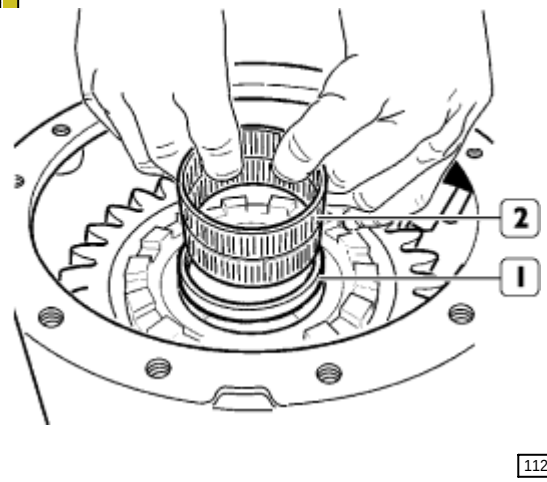

Fit the rear gear (1) and the crown wheel and planetary gear unit (2) in the case.

Figure 66



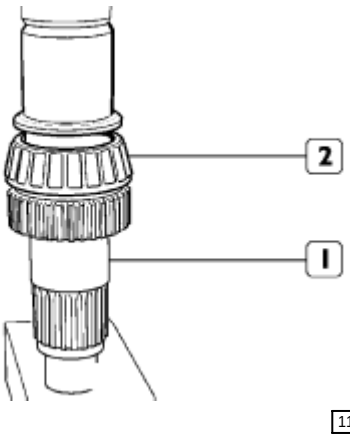

Fit the gear (1) making sure that it matches with the marks made at removal.

Figure 67




Fit the spacer (1) and the roller cages (2).

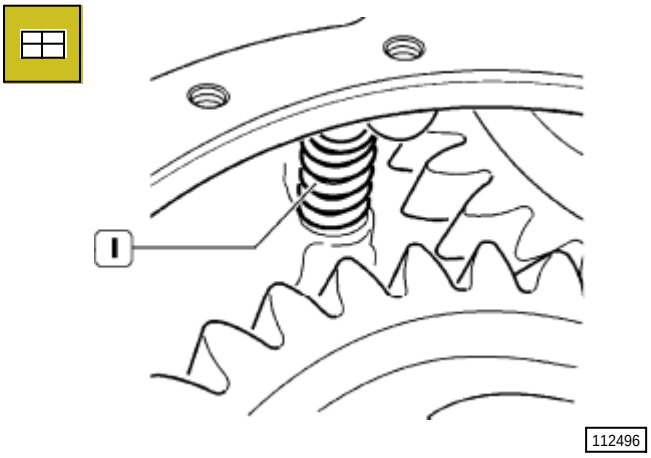
Figure 68




Heat the bearing (2) at 100°C for 15' and fit it with the suitable beater on the motion input shaft (1).

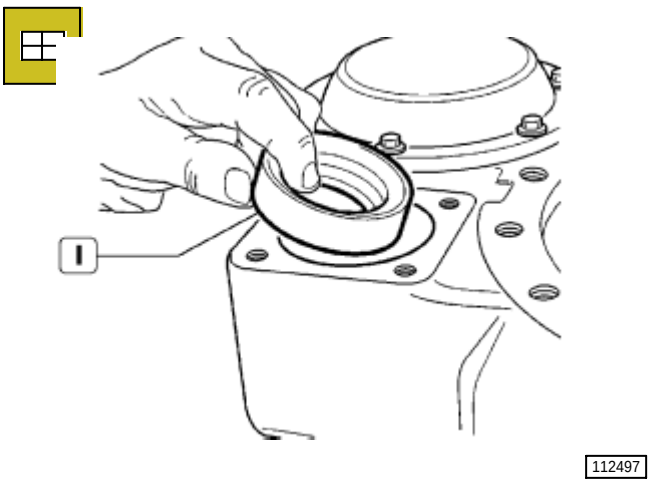
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Figure 69



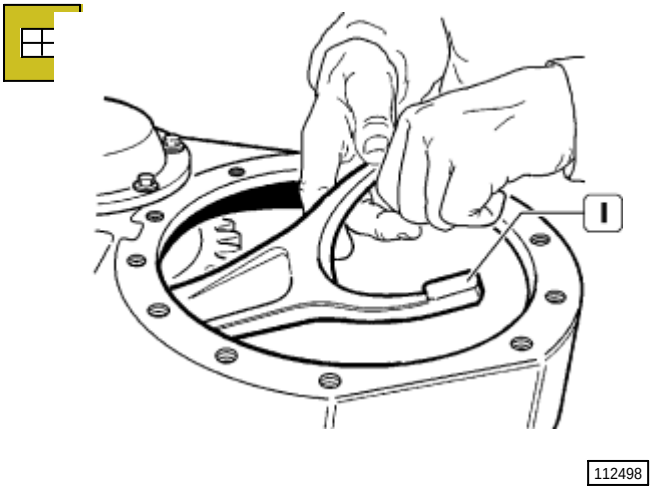

Fit the compression spring (1).

Figure 70



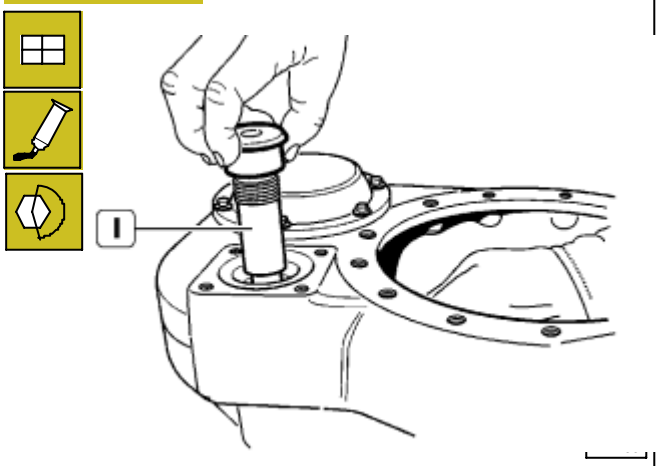

Fit the membrane seat (1).

Figure 71



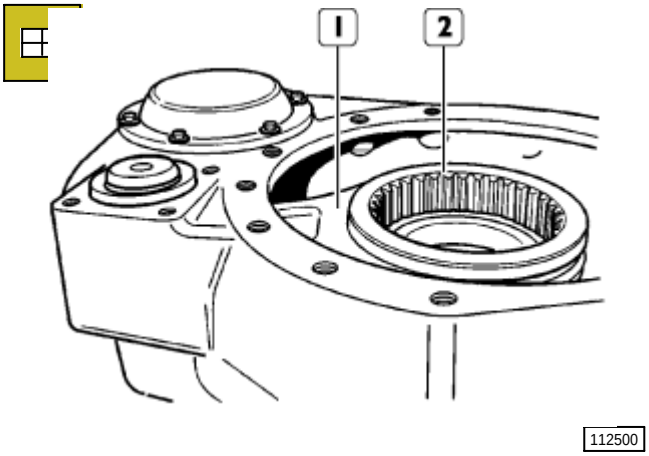

Fit the fork (1).

Figure 72




Apply some sealer on the piston threading (1). Insert the piston through the fork and the compression spring. Tighten to the prescribed torque.

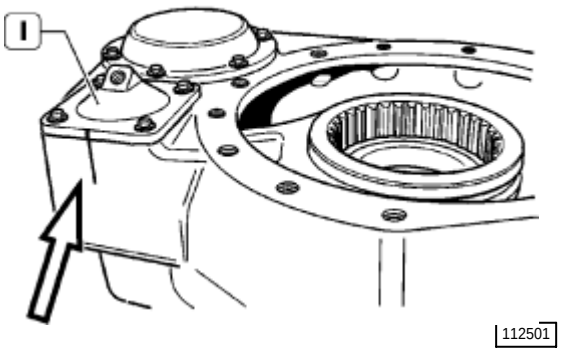
Figure 73




Insert the sleeve (2) in the fork (1).

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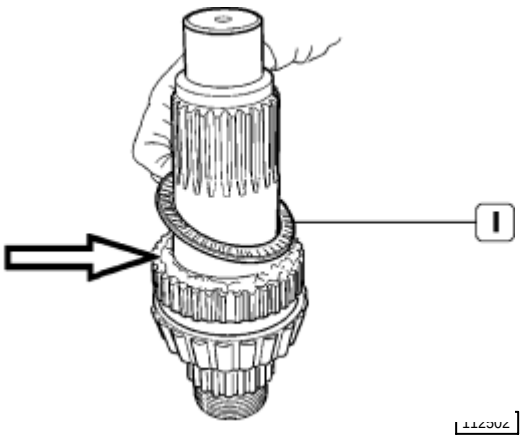
Figu




Fit the cover (1) and the membrane located below. Tighten to the prescribed torque.

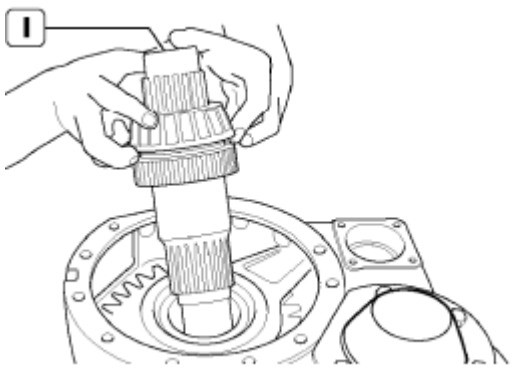
**NOTE** Fit the cover making sure that it matches with the marks made at removal.

Figure 75




Spread some vaseline as shown in the figure.
Fit the roller bearing (1).

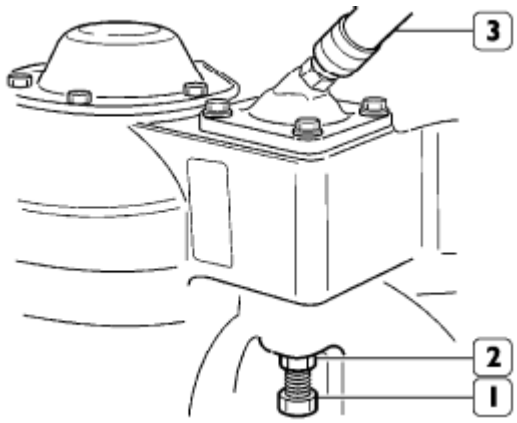
Figure 76




Fit the motion input shaft assembly (1) in the case.

## Adjust the limit switch of the differential interaxle lock control pin

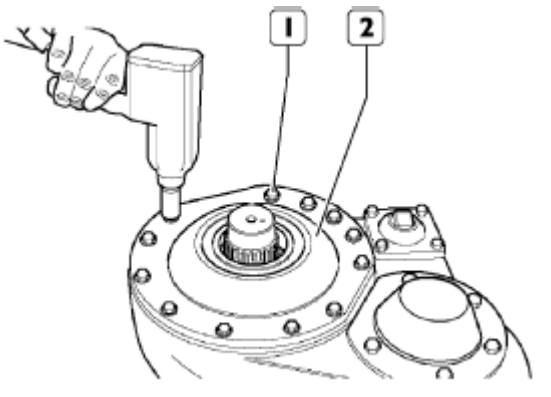
Figure 77




Adjust the limit switch of the control pin as follows:

- fill the cylinder (3) with 8-bar compressed air;
- tighten the screw (1) until it comes into contact with the control pin;
- further tighten the screw (1) by 1/4 ÷ 1/2 turn and lock the stop nut (2) to the prescribed torque.

Figure 78

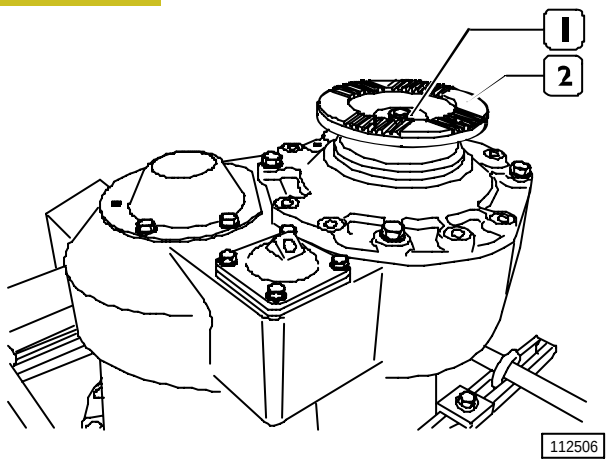



Fit the spacers (1, Figure 32) taken off at removal.

Fit the cover (2) tightening only 4 screws (1) to the prescribed torque.

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Figure 79

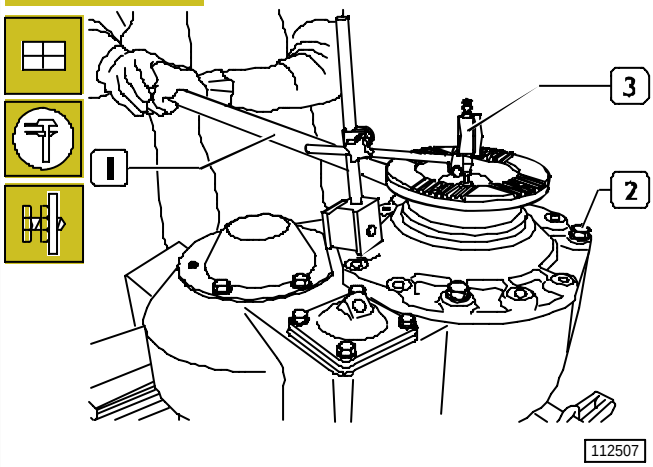



Fit the flange (2).

Tighten the retaining nut (1) to the prescribed torque.

## Adjusting drive input shaft bearing end float

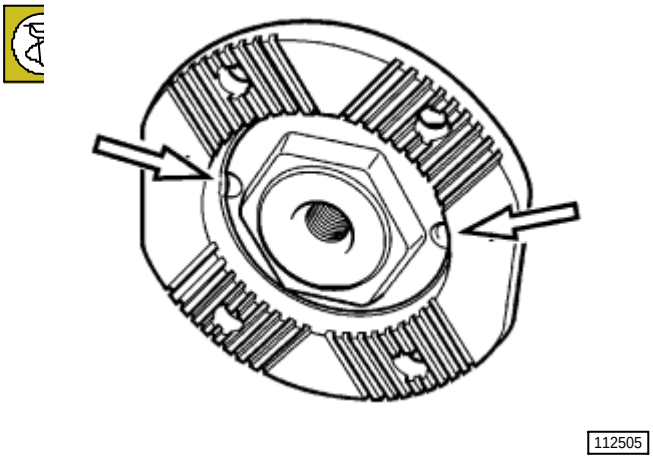
Figure 80




Proceed as follows to adjust shaft bearing end play;

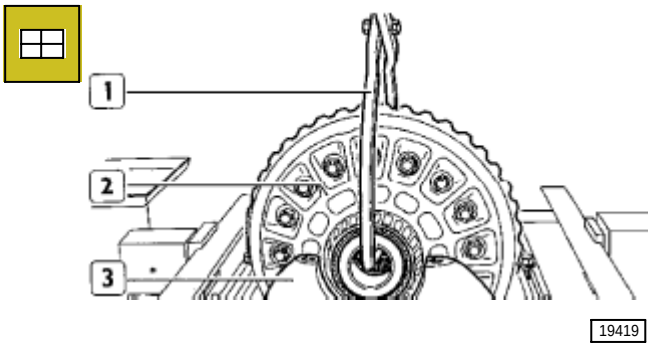
- turn the motion input shaft in the two directions to adjust the bearing;
- fit a dial gauge (3) and set to zero on the motion input shaft end;
- use a bar (1) and a support, if needed, to lever and check that the end play of the input shaft is between 0.01 ÷ 0.09 mm. If the end play is not included in this range, add or remove the shims (1 Figure 32) from the package previously inserted to obtain the required play;
- Tighten all the cover screws (2) to the prescribed torque.

Figure 81




Bruise the retaining nut (1) as shown in the figure.

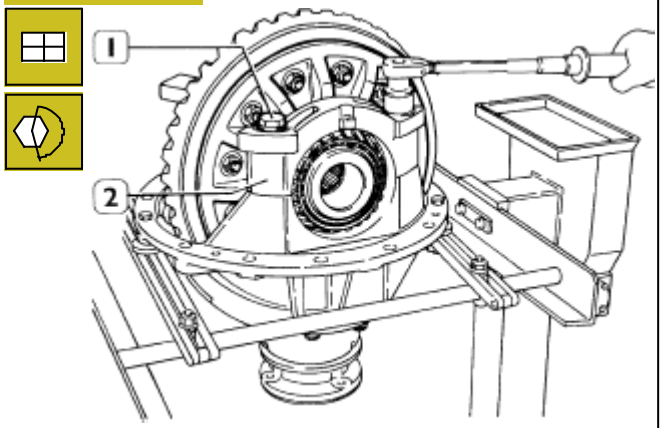
Figure 82




Using the proper hook (1) lift the previously assembled gear housing (2) and set it on the differential carrier (3).

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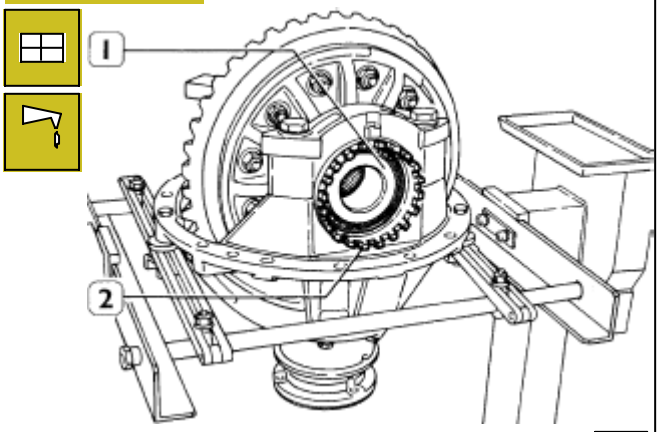
Figure 83




36330

Fit the caps (2), tighten the screws (1) and the washers to the prescribed torque.

Figure 84




36331

Grease the taper roller bearings (1) and set the outer rings on them.
Screw the adjustment ring nuts (2).

## ADJUSTING THE CAP SPREAD

Cap spread adjustment and check can be performed with two methods:

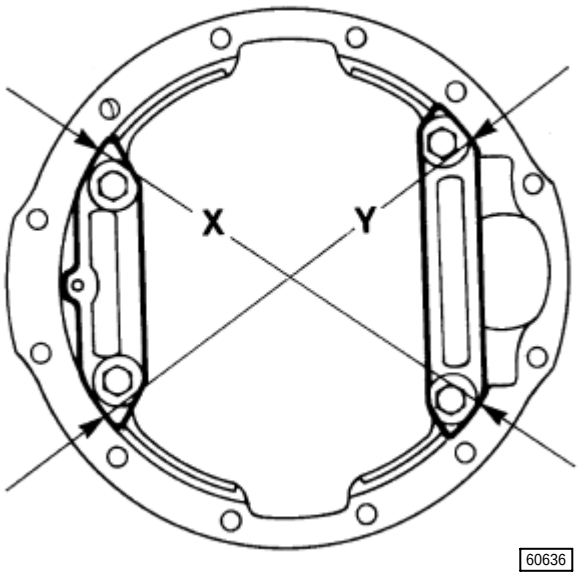
1st METHOD

1. Tighten bearing adjusting ring nuts (4) by wrench 99355025 (3, Figure 86) until removing the gap between pinion-crown and axle, ensure also that the crown is not forcing on pinion;
2. use a proper micrometer, set diagonally and centred on points (X-Y-arrows, Figure 85), to measure and mark cap distance;

2nd METHOD

A. Set diagonally and centred on the external machined seats of both caps (2, Figure 86), two magnetic base gauges (1) as shown in Figure 86.

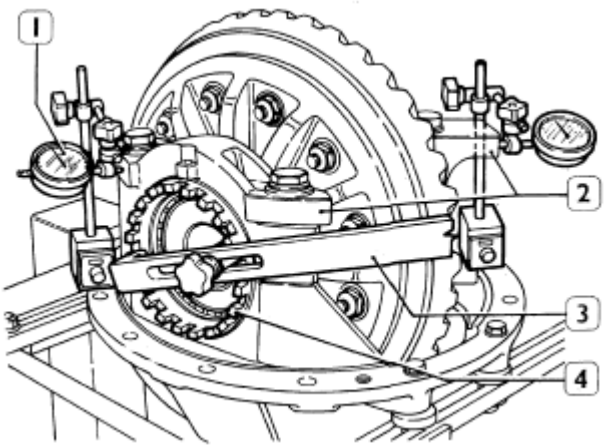
Figure 85




60636

3. retighten the two adjusting ring nuts (4, Figure 86) to obtain a cap angle (2, Figure 86), measured as described in point 2, of 0.15 - 0 33 mm which corresponds to a bearing preload of 1.7 - 3.9 Nm (0.17 - 0.39 kgm).

Figure 86

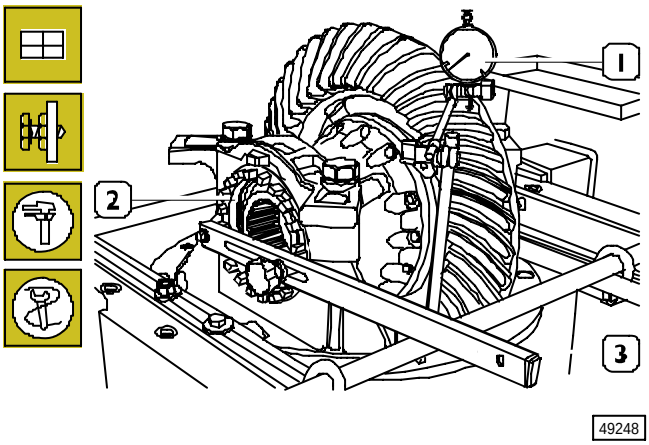



60635

B. proceed as described in point 1;
C. remove the end play, retighten the two adjusting ring nuts (4, Figure 86) to obtain a cap angle (2) of 0.05 - 0.23 mm which corresponds to sum of the values read on the gauges (1)

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Figure 87




49248

Adjust the end play between pinion-crown wheel teeth to obtain:

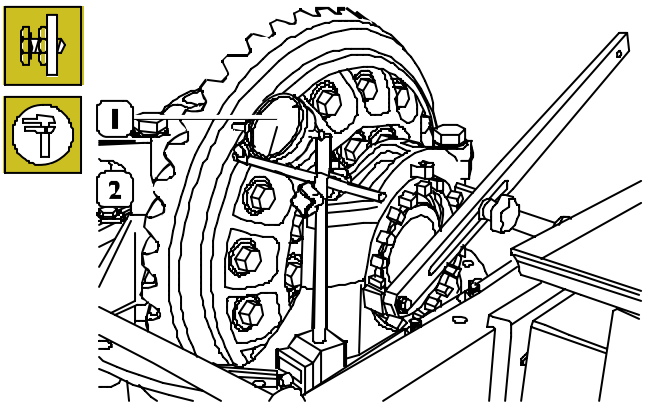
- 0.20 to 0.46 mm for already used units;
- 0.3 mm for new units

and proceed as follows:

- lock bevel pinion rotation using tool 99370317;
- position the gauge with magnetic base (1) as shown in the figure;
- using wrench 99355025 (3), loosen the adjusting ring nut on the crown side and tighten by the same amount the adjusting ring nut (2) on the opposite side. Taking this precaution the cap angle that has been previously adjusted is maintained;
- proceed as described until obtaining the prescribed value.

The end play value shall be checked on 4 equidistant points.

Figure 88




49246

Using a gauge with magnetic stand (1) check whether crown surging is not exceeding 0.20 mm, otherwise remove the differential unit and find the cause.

Re-assemble and repeat previously described adjustment operations.

Figure 89



19451

Using a brush apply a thin coating of Prussian blue on the crown wheel.
Turn the pinion and find the contact mark between the pinion teeth and the crown wheel teeth.
The following figures show the possible contact points and how to correct any errors.

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Figure 90



19452

Contacts are excessively set on crown wheel teeth bottom land.

Conditions C-D. The pinion is too deeply set and therefore it requires further adjustment.
To adjust the exact pinion position, shims must be added under the pinion support to obtain an exact contact.

Condition C. Measure the end play and restore after adding the shims.

Condition D. After adding the shims take end play to the minimum value.

Figure 91



19453

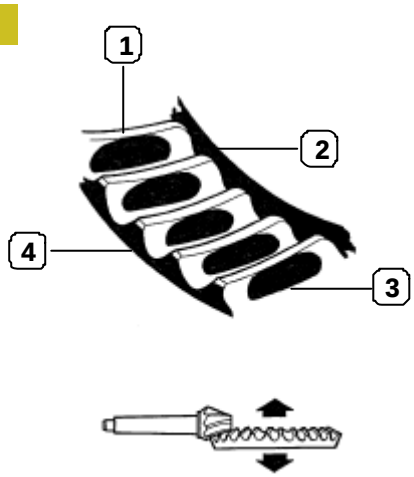
Contacts are excessively set towards crown wheel teeth crest.

Conditions A-B. The pinion is too far out and therefore it requires further adjustment.
To adjust the exact pinion position, shims must be removed from under the pinion support to obtain an exact contact.

Condition A. After removing the shims take end play to the maximum value

Condition B. Measure the end play and restore after removing the shims.

Figure 92




19454

THEORETICAL CONTACT AREA

1 Release, tooth concave side

2 Tip

3 Driving, tooth convex side

4 Heel

Condition E-F.

DRIVING. Central, tending towards the tip on tooth face and central on tooth contour.

RELEASE. Central, tending towards the heel on tooth face and central on tooth contour.

The pinion is positioned exactly.

Contact position can be modified by changing the pinion-crown end play.

Condition E. Reduce the end play.

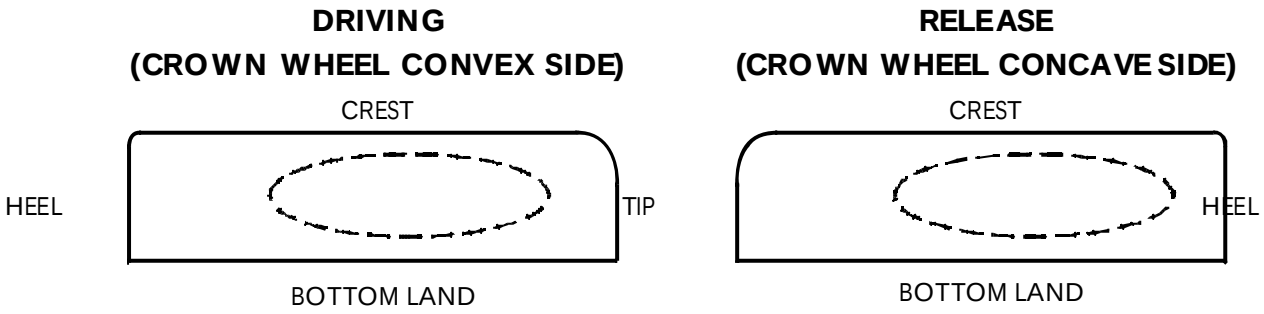
Condition F. Increase the end play.

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## CORRECTING THE BEVEL GEAR PAIR CONTACTS (AFTER FITTING IN PLACE)

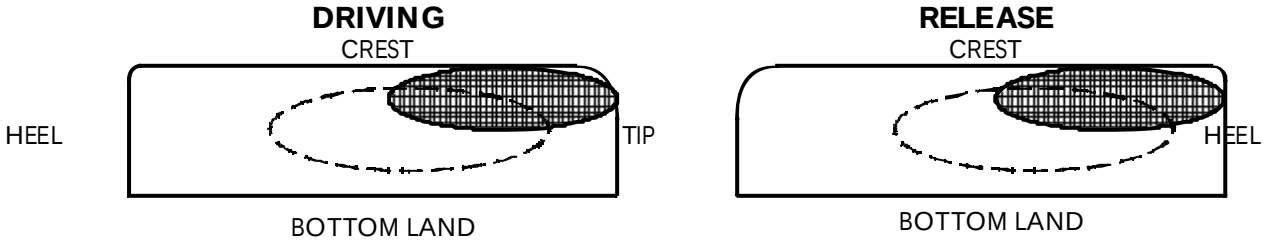
Figure 93

### THEORETICAL CONTACTS



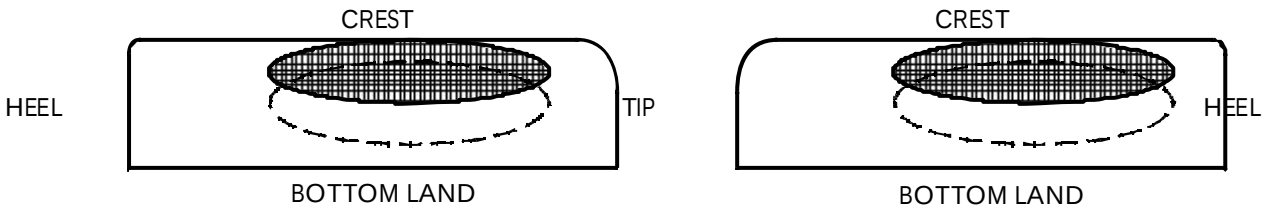

- DRIVING : CENTRAL, TENDING TOWARDS THE TIP ON TOOTH FACE AND CENTRAL ON TOOTH CONTOUR.
- RELEASE : CENTRAL, TENDING TOWARDS THE HEEL ON TOOTH FACE AND CENTRAL ON TOOTH CONTOUR.

### CONDITION "A"



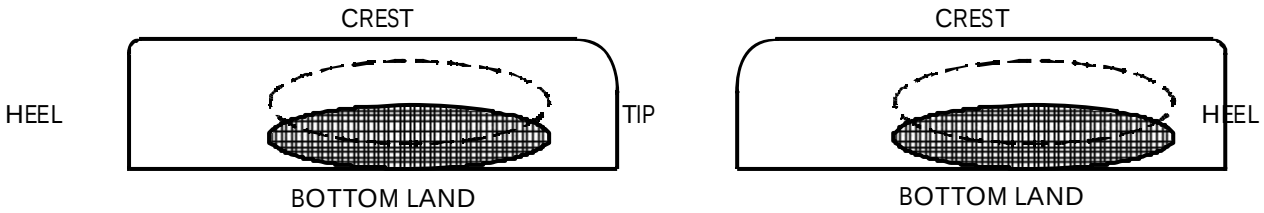

- DRIVING - RELEASE : EXCESSIVE CONTACTS TO CREST
- DRIVING : EXCESSIVE CONTACT TO TIP
- RELEASE: EXCESSIVE : CONTACT TO HEEL
- CORRECTIVE ACTIONS : REMOVE SHIMS AND INCREASE END PLAY TO MAX.

### CONDITION "B"




- DRIVING - RELEASE : EXCESSIVE CONTACTS TO CREST
- CORRECTIVE ACTIONS : MEASURE THE END PLAY, REMOVE SHIMS AND RESTORE END PLAY

### CONDITION "C"



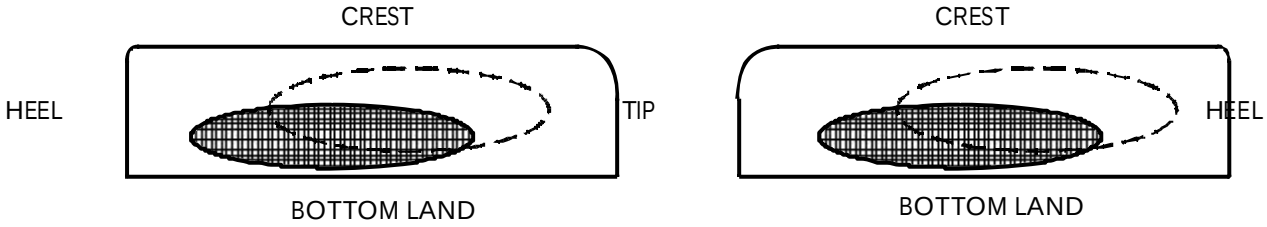

- DRIVING - RELEASE : EXCESSIVE CONTACTS TO BOTTOM LAND
- CORRECTIVE ACTIONS : MEASURE THE END PLAY, ADD SHIMS AND RESTORE END PLAY

60676

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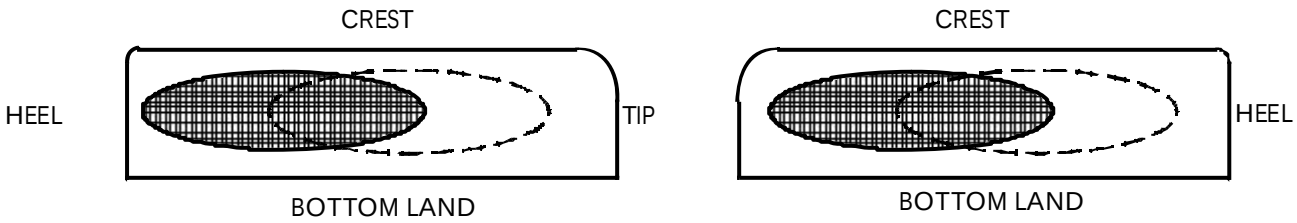
Figure 94

## CONDITION "D"



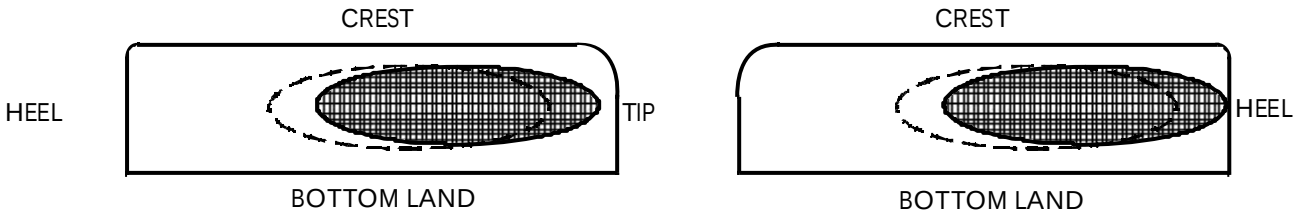

- DRIVING - RELEASE : EXCESSIVE CONTACTS TO BOTTOM LAND
- DRIVING : EXCESSIVE CONTACT TO HEEL
- RELEASE : EXCESSIVE CONTACT TO TIP
- CORRECTIVE ACTIONS : ADD SHIMS AND REDUCE END PLAY TO MIN.

## CONDITION "E"




- DRIVING : EXCESSIVE CONTACT TO HEEL
- RELEASE : EXCESSIVE CONTACT TO TIP
- CORRECTIVE ACTIONS : REDUCE END PLAY

## CONDITION "F"



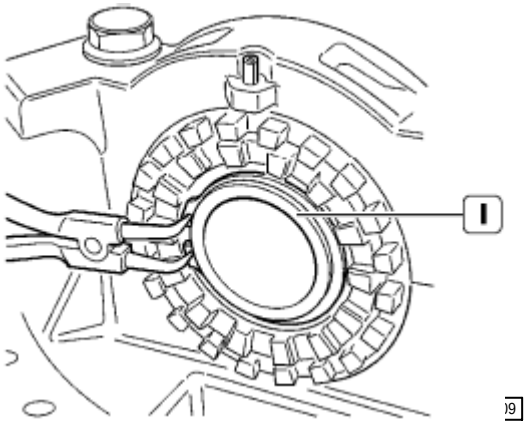

- DRIVING : EXCESSIVE CONTACT TO TIP
- RELEASE : EXCESSIVE CONTACT TO HEEL
- CORRECTIVE ACTIONS : INCREASE END PLAY

60677

Note: In case of pinions fitted without pilot bearing instead of "removing shims" it will be necessary to "add shims" and vice versa.
For the end play, the same conditions shown stand valid.
Contact marks are always referred to crown wheel teeth.

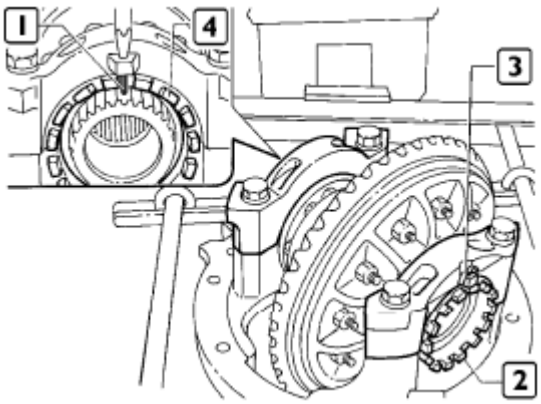
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Figure 95




Fit the seal ring (1) and the spacer below.

Figure 96

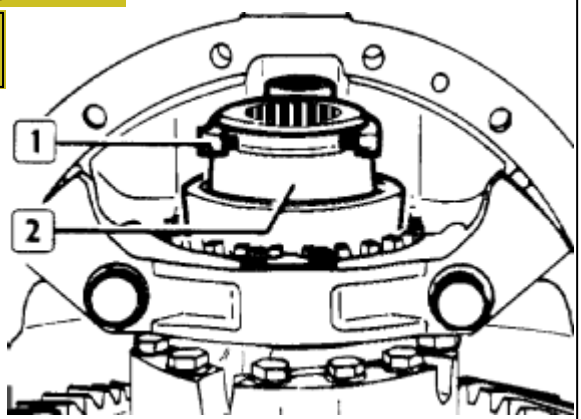



77248

Fit the elastic pin (1) and the split pin (3) to lock the ring nuts (2-4).

**NOTE** If the elastic pin or the split pin do not coincide with the respective seats on the ring nuts, slightly turn the ring nuts so that the elastic pin or the split pin can be fitted.

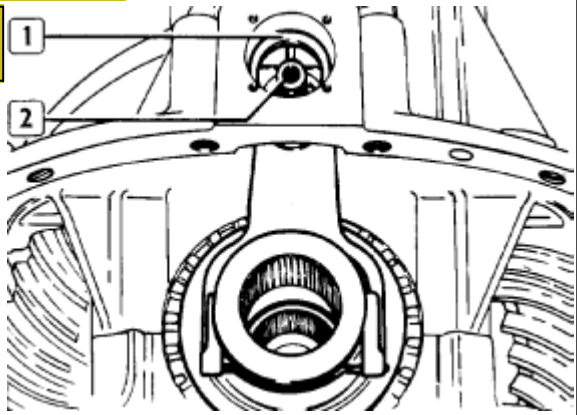
Figure 97




36335

Fit the sliding sleeve (2) on the fork (1) and drive in the two spring pins.
Position the fork including the sliding sleeve into its seat.

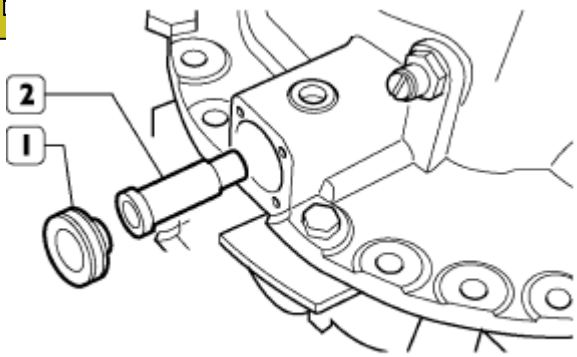
Figure 98




36782

Insert the return spring (2) and the plain washer (1).

Figure 99

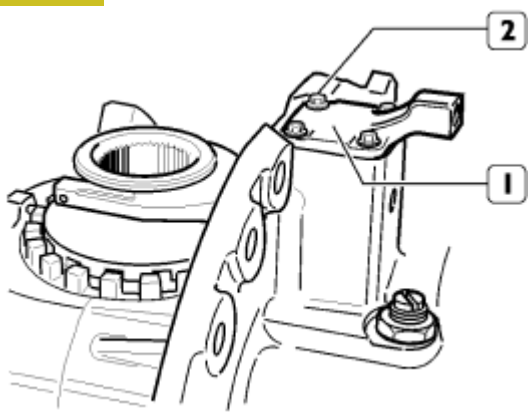



112449

Fit the stem (2) and the piston (1).

**NOTE** Use a new o-ring.

Figure 100



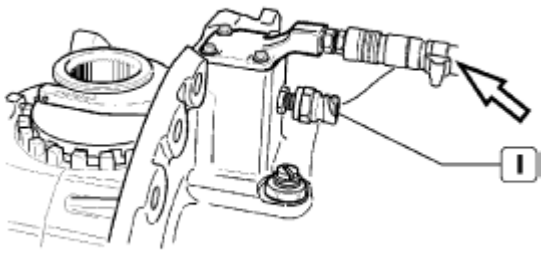

112511

Fit the cover (1) as shown in the figure with a new gasket.
Tighten the screws (2) to the prescribed torque.

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Remove the differential case from the stand and refit it on the rear axle case.

Figure




Fill the cylinder (see arrow) with 8-bar pressure.

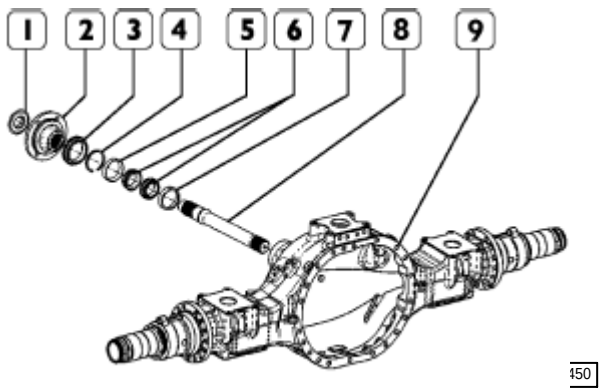
Apply some sealer on the differential clamping switch (1) and fit it in its seat.

Connect a multimetre to the differential clamping switch and tighten the switch until they touch.

Further tighten it by one turn and close with the lock nut to the prescribed torque.

## 526082 REMOVAL-OVERHAUL-REFITTING OF INTERAXLE SHAFT

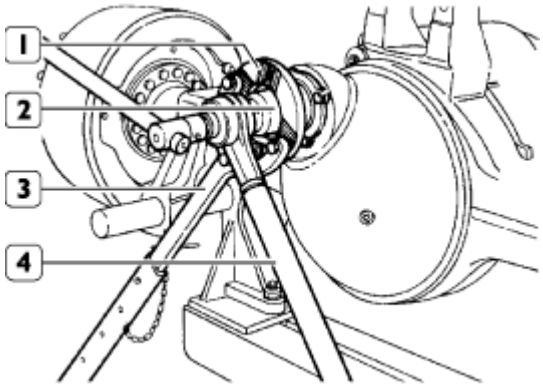
Figure 102




INTERAXLE SHAFT COMPONENTS

1. Nut - 2. Flange - 3. Seal ring - 4. Spacer ring - 5. Bearing outer ring - 6. Motion output shaft bearings - 7. Bearing outer ring - 8. Motion output shaft - 9. Rear axle case

Figure 103



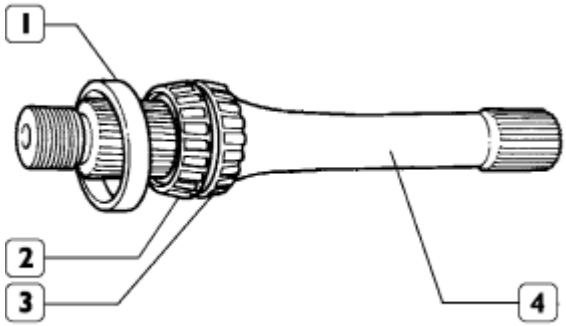

Stop rotation of flange (1) with retainer 99370317 (3). With wrench 99355131 (2) and torque adaptor (4) loosen shaft flange (1) retaining nut.

Use a lever and the suitable beater to remove the flange (1).

Remove and throw away the seal ring (3, Figure 102).

Remove the snap ring from the interaxle shaft (4, Figure 102).

Figure 104

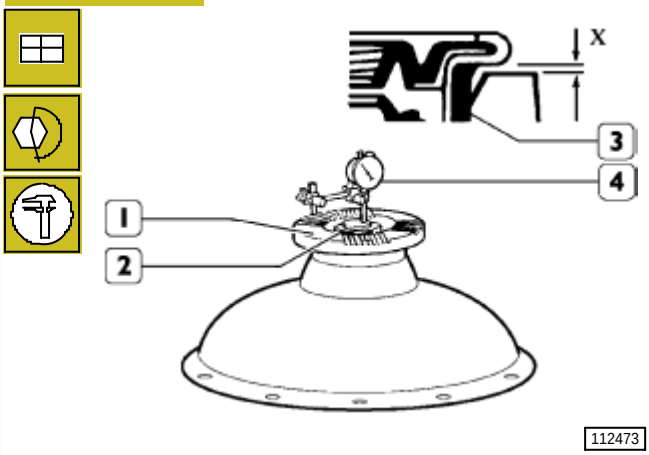



Pull out the interaxle shaft (4) together with the bearings (2 and 3) and the outer ring (1).
Use a suitable extractor to remove bearings (2 and 3) from interaxle shaft (4).

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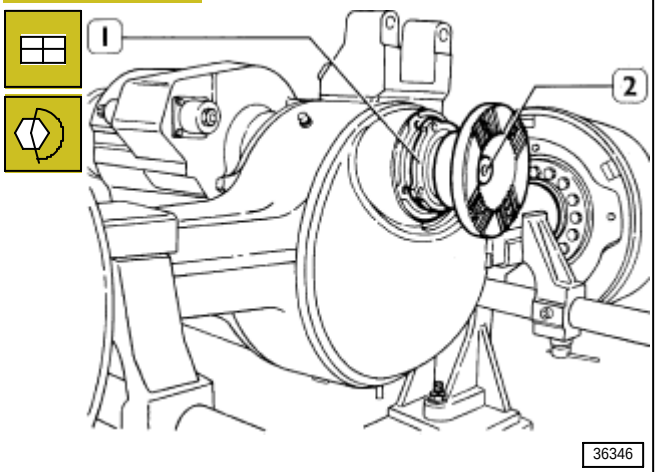
## Adjustment of interaxle shaft bearing end play

Figure 105




Reverse the removal operation sequence to reassemble the interaxle shaft unit.
After fitting sealing ring (3), use a feeler gauge to check distance X between sealing ring (3) and mounting at four equi-distant points. Distance X must be between 0.38 ÷ 0.76 mm.
Tighten nut (2) fastening flange (1) to the drive output shaft to the specified torque. Then check that end play is between 0.025 and 0.127 mm using a magnetic stand dial gauge positioned on shaft (4, Figure 104) .
If reading is other than specified, replace the snap ring (4, Figure 102) with one of the correct thickness.

Figure 106




Turn by 90° axle casing.
Set support (1) into axle casing comprising interaxle shaft (2) and tighten fixing nuts to the required torque.

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# 5250 Rear axles ARVINMERITOR MR11-155/2D


Page

DESCRIPTION . . . . . 237

LOCATION OF DIFFERENTIAL UNIT PLATES - REAR AXLE . . . . . 238

MAIN DATA . . . . . 239

TIGHTENING TORQUES . . . . . 240

TOOLS . . . . . 241

REAR AXLE ASSEMBLY OVERHAUL . . . . . 246

OVERHAULING THE WHEEL HUBS . . . . . 246

REMOVING AND REFITTING THE DIFFERENTIAL (WITH AXLE ON STAND 99322215) . . . . . 246

- Removal . . . . . 246
- Checking axle housing . . . . . 246
- Refitting . . . . . 246

REPAIRING THE DIFFERENTIAL . . . . . 247

- Removing the differential . . . . . 247
- Removing the differential housing . . . . . 248

REMOVING THE BEVEL PINION FROM THE SUPPORT . . . . . 250

- Differential component check . . . . . 250
- Fitting the differential housing . . . . . 251

FITTING THE MOUNT ON THE BEVEL PINION . . . . . 252

- Reassembling the differential carrier . . . . . 254

ADJUSTING THE CAP GAP . . . . . 256

CORRECTING THE CROWN WHEEL AND PINION CONTACTS (AFTER ASSEMBLY) . . 259

WORK ON THE VEHICLE . . . . . 262

REPLACING THE BEVEL PINION MOUNT SEAL . . . . . 262

- Disassembly . . . . . 262
- Assembly . . . . . 263

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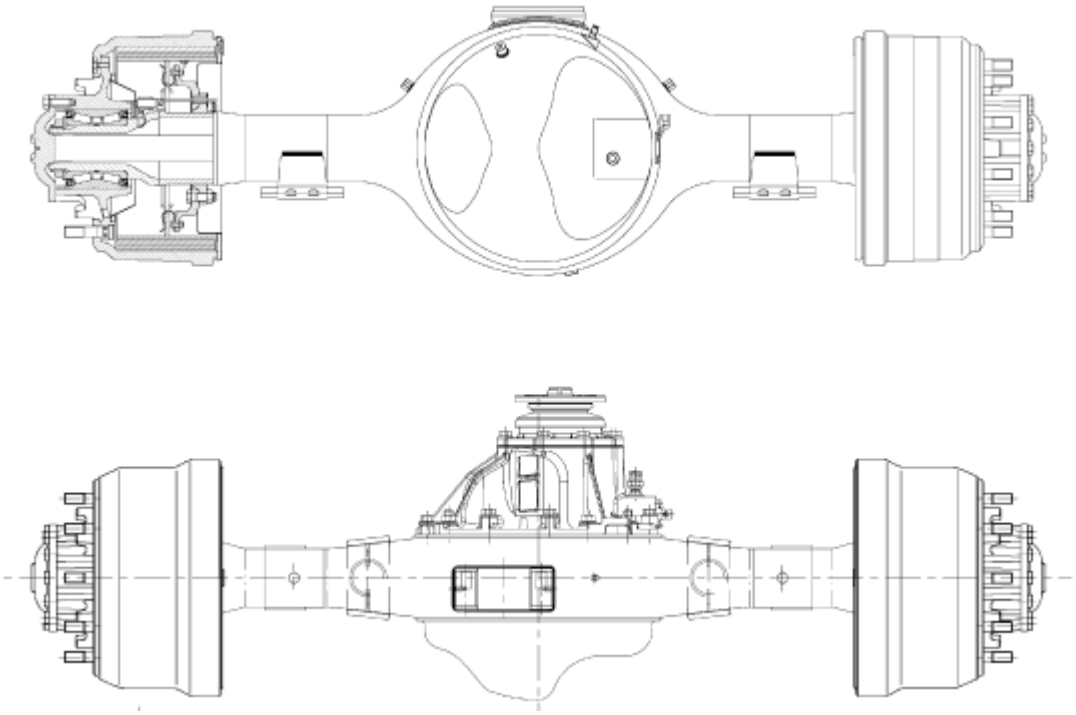
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## DESCRIPTION

The rear axle is the load bearing type with a single reduction. It is composed of a pressed sheet steel box appropriately strengthened.
The differential is characterized by a hypoid-toothed gear train. The pinion is supported by two tapered roller bearings and by a third cylindrical roller bearing.
The position of the bevel pinion, in relation to the ring bevel gear, is adjusted by changing the thickness of the pack of shims between the differential case and the bevel pinion mount.
The gearing box is supported by two tapered roller bearings and can be adjusted axially with two threaded ring nuts.
The rear axle is equipped with a differential locking device.
The bearings of the wheel hubs are the UNIT-BEARING type with permanent lubrication and need no adjustment.
Brakes are of the DUO - DUPLEX drum type.

Figure 1



107468

VIEWS OF THE ARVINMERITOR MT23-155 TANDEM AXLE ASSEMBLY

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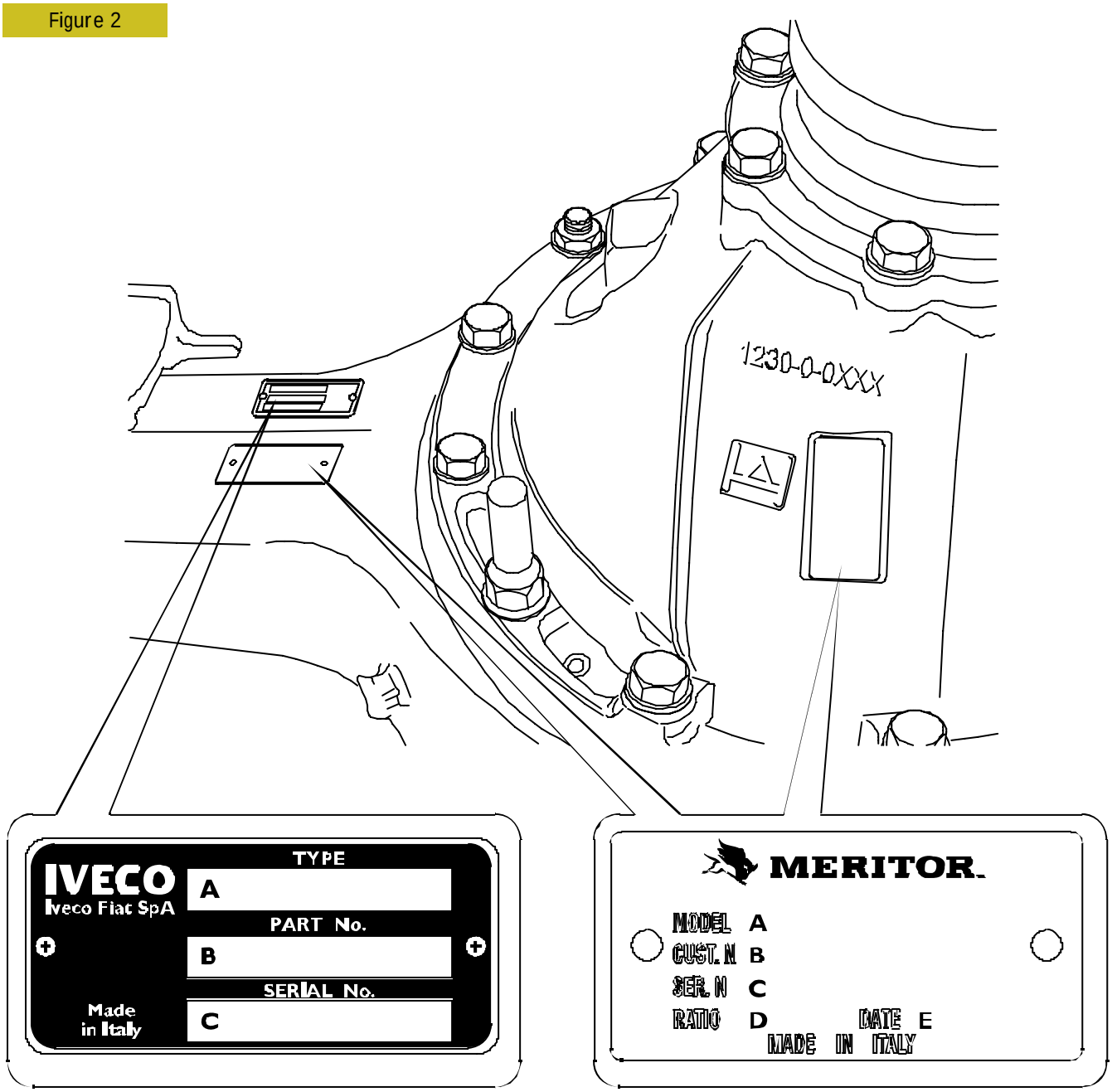
## LOCATION OF DIFFERENTIAL UNIT PLATES - REAR AXLE

The plates contain all information and details relating to either DIFFERENTIAL UNIT and REAR AXLE.

On real axle, two plates are present: one on the differential unit and one in same position on rear axle box. On the notifications of interventions under guarantee, rear axle box and differential unit plate data must always be shown. It is suggested always to read and copy out shown data before any repair so as to order correct spare parts and transmit correct information to either IVECO Service Network.

Plate is never to be removed from the unit.

Figure 2

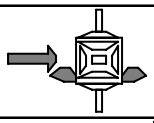
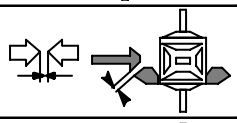
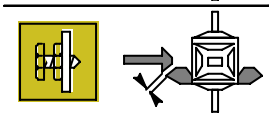
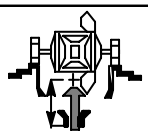
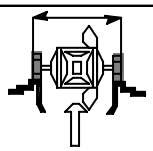
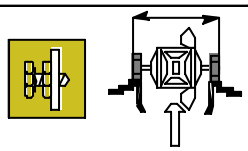
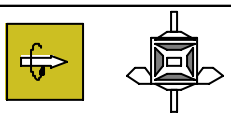
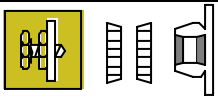



IVECO identification plate
- A = identifies rear axle type
- B = drawing number
- C = production progressive number

ARVINMERITOR identification plate
- A = identifies the family the item is belonging to / the model
- B = drawing number
- C = ArvinMeritor series number
- D = rear axle ratio
- E = production date

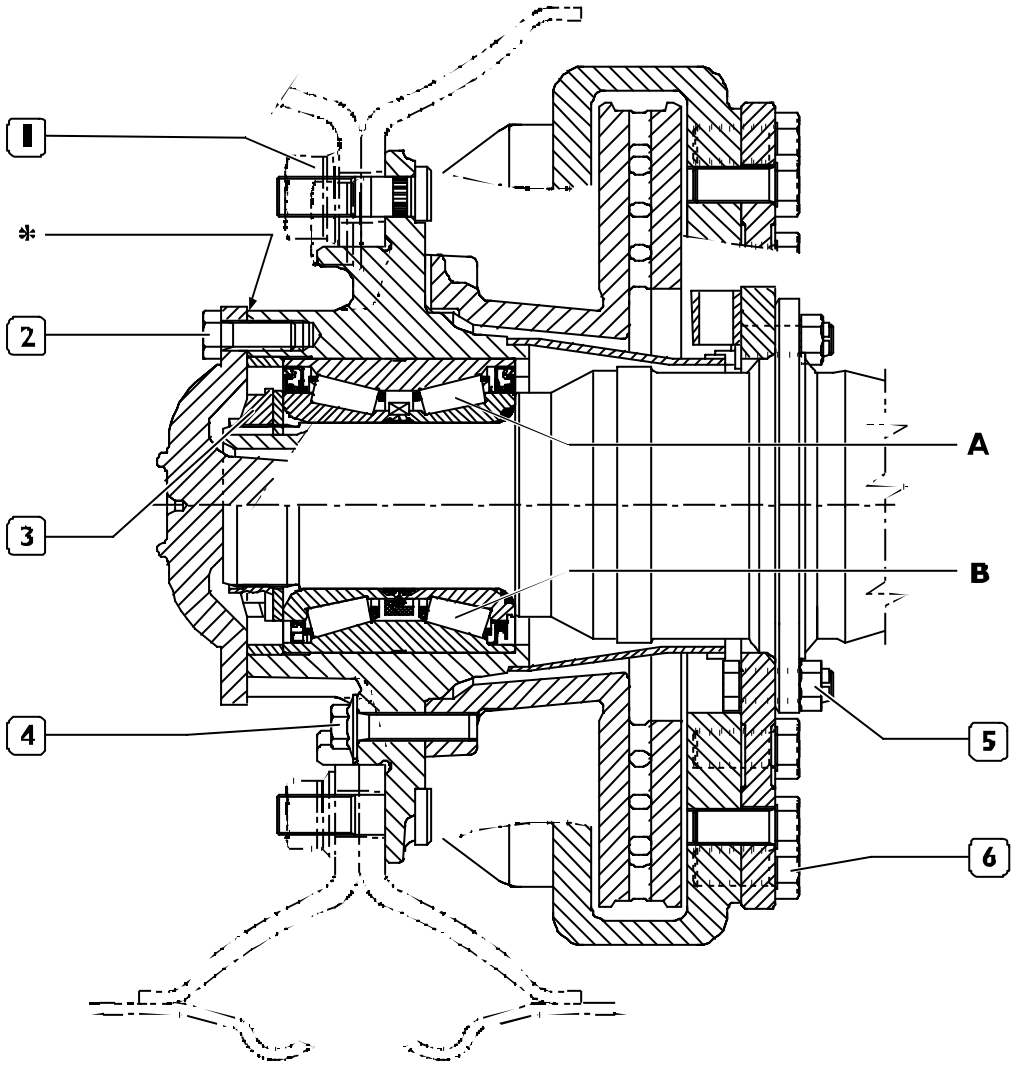
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## MAIN DATA

| | |
|---|---|
|  Rear axle | Load bearing with single reduction |
| Type | MT 23-155 |
|  Bevel pinion bearings | 2 with tapered rollers and 1 with cylindrical rollers |
|  DIFFERENTIAL ASSEMBLY | |
| Bevel gear pair reduction ratio | 4.50 (8/36) - 4.13 (8/33) - 3.78 (9/34) - 3.40 (10/34) |
|  Clearance between pinion and ring gear mm | 0.26 to 0.50 |
|  Adjustment of clearance between pinion and ring gear | With adjustment rings |
|  Bevel pinion position in relation to ring gear | With adjustment shims |
|  Cap gap mm | 0.15 to 0.33 |
|  Cap gap adjustment | With adjustment rings |
|  Rolling torque between planetary gears and crown wheels Nm<br>kgm | 68 max.<br>6.8 max. |
|  Thicknesses of adjustment rings between bevel pinion mount and differential case mm | 0.125 - 0.200 - 0.500 |
| Wobble of ring gear supporting surface on half box mm | 0.13 max. |
|  **WHEEL HUBS** | |
|  Wheel hub bearings | Two taper roller bearings |
|  Wheel hub bearing end float adjustment | By ring nut |
|  Axle oil | TUTELA W140/M-DA |
| Quantity Litres<br>(kg) | 18.5<br>(16.5) |
| Dry weight (Mechanical suspension) kg<br>(Pneumatic suspension) kg | 586<br>591 |
| Maximum capacity GRW kg | 11500 |

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Figure 3



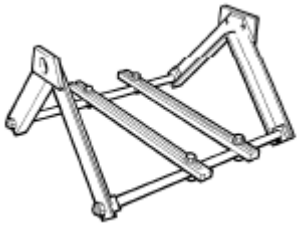
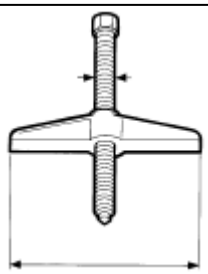
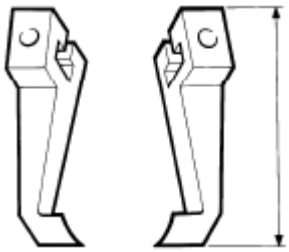

## TIGHTENING TORQUES

| | PART | TORQUE | |
|---|---|---|---|
| | | Nm | kgm |
| 1 | Nut fixing wheels | 732 to 599 | 73.2 to 59.9 |
| 2 | Screw fixing drive shaft flange | 235 to 289 | 23.5 to 28.9 |
| 3 | Ring nut retaining wheel hub bearing | 834 to 1030 | 83.4 to 103 |
| 4 | Screw fixing brake disc to wheel hub | 268 to 295 | 26.8 to 29.5 |
| 5 | Nut for screw fixing brake calliper mount | 275 to 304 | 27.5 to 30.4 |
| 6 | Screw fixing brake calliper to mount | 554 to 677 | 55.4 to 67.7 |

: Spread with sealant type IVECO 1905685 (LOCTITE 14780)
A TIMKEN bearing
B SKF bearing

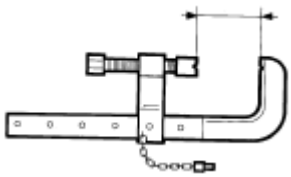
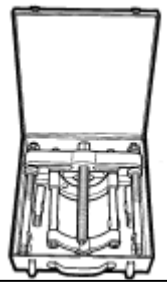
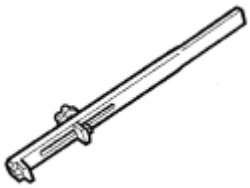
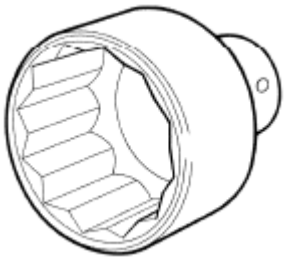
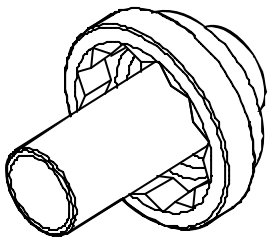
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## TOOLS

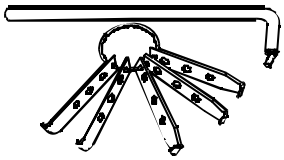
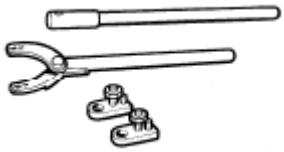
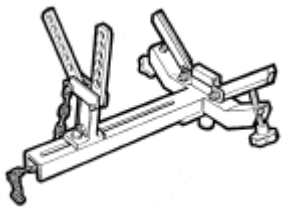
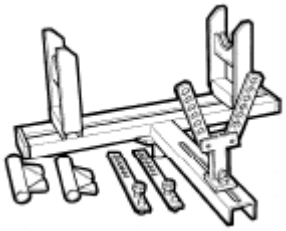
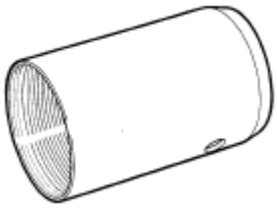
| TOOL NO. | DESCRIPTION |
|---|---|
| **99305121**  | Heater |
| **99322205**  | Rotary stand for overhauling assemblies (capacity 1000 daN, torque 120 daNm) |
| **99322215**  | Stand for axle overhauling |
| **99322225**  | Unit holder (to be mounted on stand 99322205) |
| **99341003**  | Single-acting lift |
| **99341009**  | Pair of brackets |

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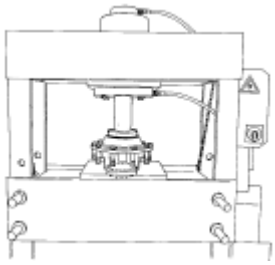
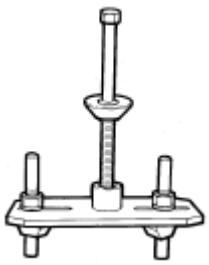
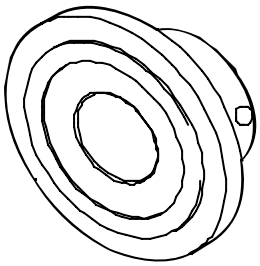
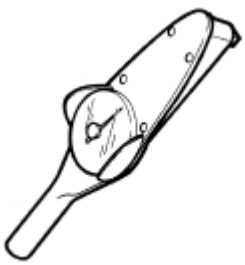
| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99341015** |  | Clamp |
| **99345049** |  | Reaction block for puller tools |
| **99348001** |  | Puller tool with clamping device |
| **99355025** |  | Wrench for differential gearcase bearing adjustment ring nuts |
| **99355088** |  | Wrench (60 mm) for differential bevel pinion nut<br>(to be used with 99370317) |
| **99355180** |  | Wrench (105 mm) for wheel hub bearing adjustment nut |

Aquila Trucks Centres

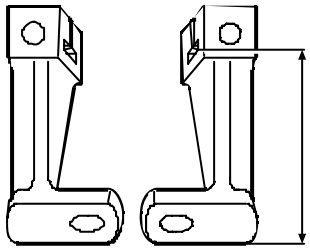
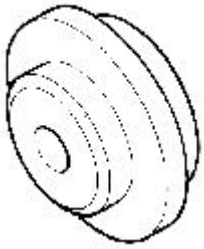
| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99363204** |  | Tool to extract gaskets |
| **99370317** |  | Reaction lever and extension for flange lock |
| **99370509** |  | Hook to remove differential gearcase half-housing |
| **99370616** |  | Support to remove-fit back differential |
| **99370617** |  | Universal support to remove-fit back rear axles |
| **99370700** |  | Guide to assemble wheel hub |

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Aquila Trucks Centres

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99370706** |  | Tool to fit wheel hub bearing |
| **99370708** |  | Tool for removing wheel hub bearing |
| **99371047** |  | Stand to hold differential half-housing when tightening crown wheel screws (to be used with 99322205 - 993222225) |
| **99374244** |  | Installing tool for assembling bevel pinion seal ring |
| **99389816** |  | 4 x torque multiplier, with square connection, 3/4" in, 1" out (maximum torque 2745 Nm). |
| **99389819** |  | Torque wrench (0 - 10 Nm) with 1/4" square fitting |

Aquila Trucks Centres

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99341017** |  | Pair of brackets with holes |
| **99345053** |  | Reaction block for puller tools |

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Aquila Trucks Centres

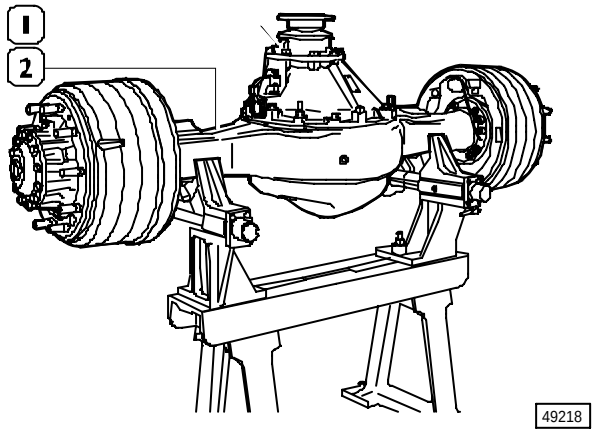
## 525010 REAR AXLE ASSEMBLY OVERHAUL

## 525030 OVERHAULING THE WHEEL HUBS

**NOTE** Wheel hub overhauling is similar to the intermediate axle overhauling described on page 208.

## 526210 REMOVING AND REFITTING THE DIFFERENTIAL (with axle on stand 99322215)

Figure 4




### Removal

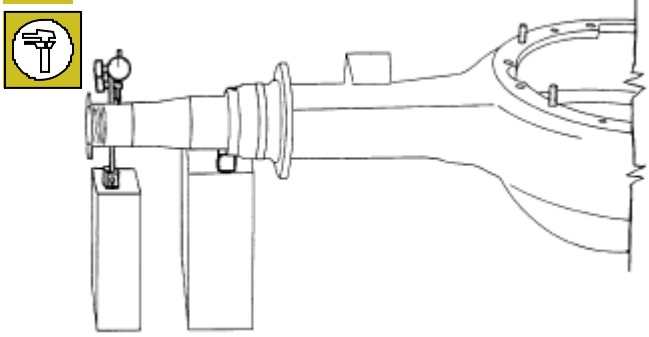
Take out the axle shafts, undo differential case (1) fastening screws and nuts, screw down three screws (which act as extractors in this phase) into the special threaded holes provided, then take the differential off rear axle case (2).

### Checking axle housing

It is necessary to check the alignment of the axle housing since any deformation will generate abnormal strain and make the assembly noisy.

**NOTE** To perform the checks on the axle housing, it is necessary to remove the wheel hubs.

Figure 5

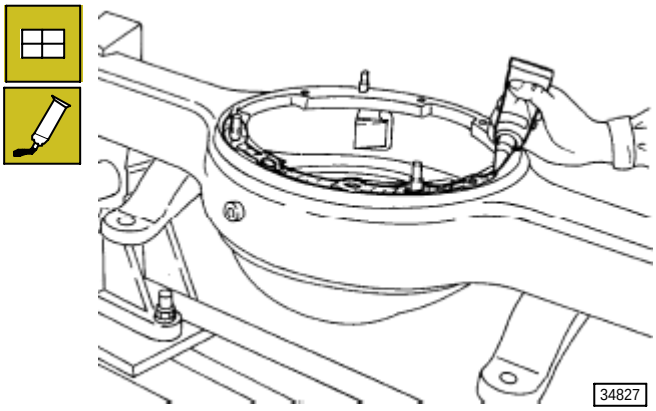


Set two parallels on a suitable check surface, rest the axle housing on it, taking care to protect the thread on the sleeves with the ring nuts.
Position a dial gauge with a magnetic base, put the rod on a ground portion of the sleeve and, turning the axle housing on its own axis, check it has suffered no deformation, with a maximum oscillation for the:

- air-suspension axle housing 0.3 mm

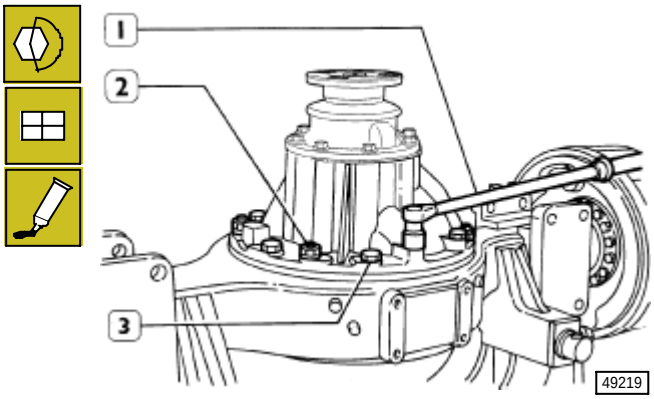
### Refitting

Figure 6



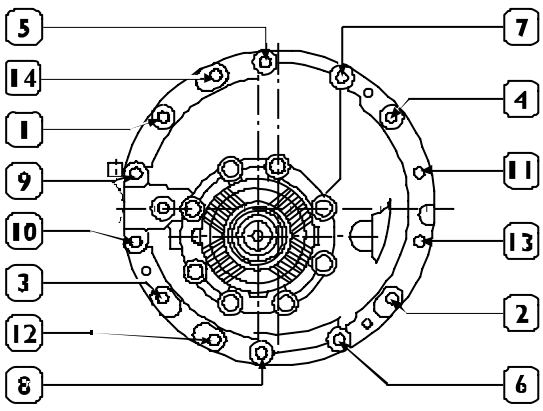

Spread the contact surface of the axle housing with IVECO 1905685 (LOCTITE 14780) sealant, after cleaning the contact surface.

Figure 7




Insert the differential into the axle housing, screw down the nuts (2) and screws (3) together with the safety washers and tighten them, with a torque wrench (1), to the required torque and in the sequence shown in Figure 8.
Fit the axle shafts into place.
Pour the required amount of oil into the axle housing.

Figure 8

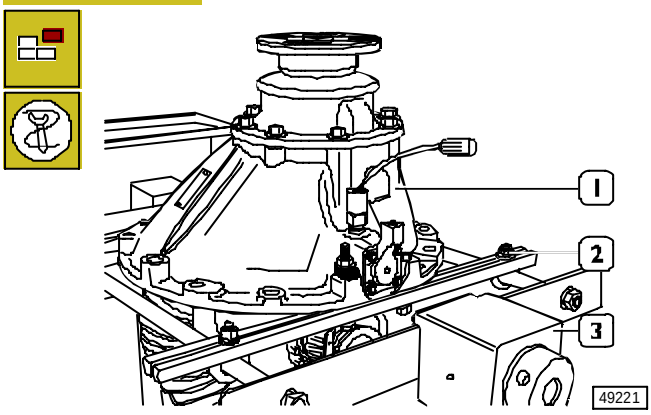



Tightening sequence diagram (differential case to axle housing)
(1 – 2 – 3 – 4 – Nuts)
(10 – 9 – 14 – 5 – 7 – 11 – 13 – 6 – 8 – 12 – Screws)

Aquila Trucks Centres

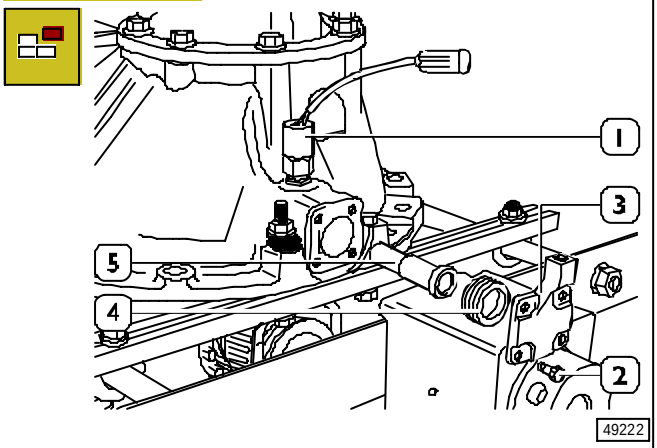
## 526210 REPAIRING THE DIFFERENTIAL
### Removing the differential

Figure 9



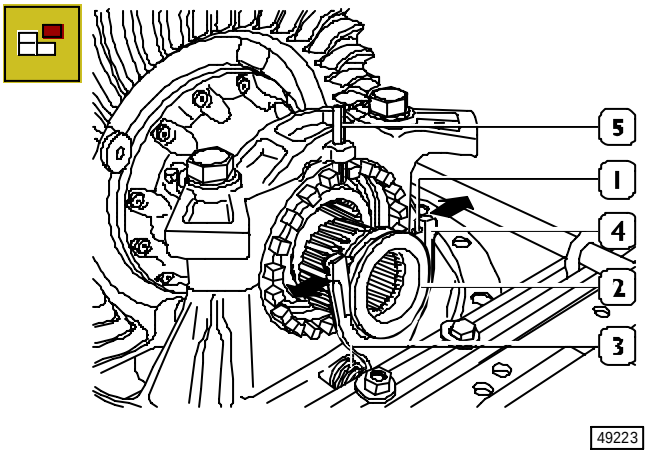

Remove the differential (1) as described in Figure 4.
Secure it to the stand 99322205 (3) with the mount 99322225 (2).

Figure 10



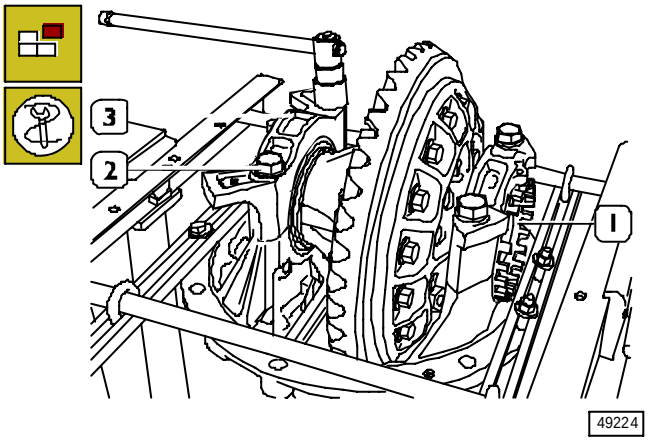

Unscrew the transmitter (1); unscrew the screws (2) and remove the parts 3 – 4 – 5.

Figure 11



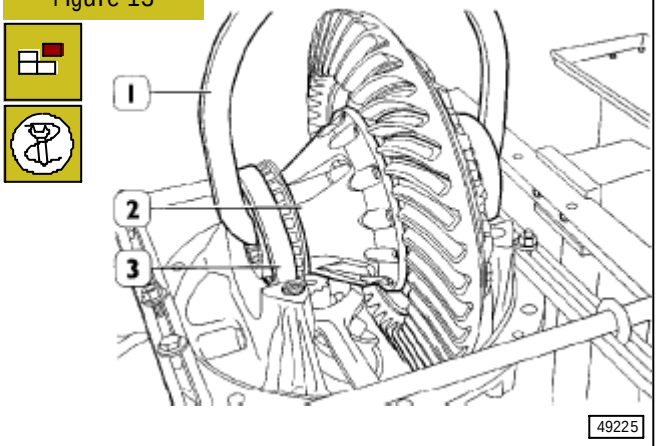

Push the split pins (1 →) outwards and extract the sliding sleeve (2).
Take out the spring (3), fork (4) and split pin (5).

Figure 12




Unscrew the ring nut (1) for adjusting the bearing. Using an appropriate wrench, unscrew and remove the screws (2) with their washers; repeat this process on the opposite side. Remove the supporting bearing caps (3).

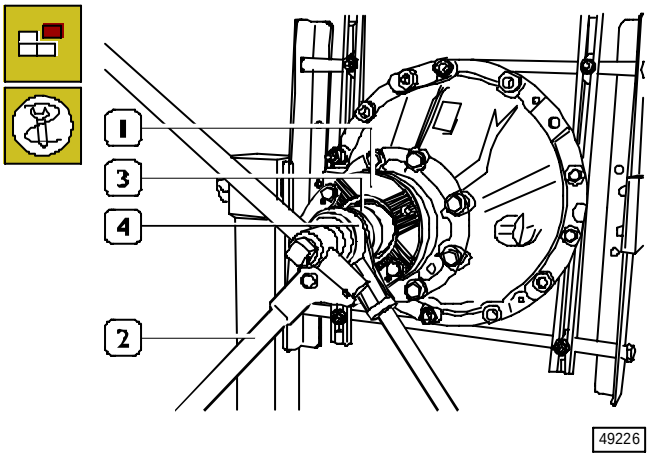
Figure 13




Using the hook 99370509 (1) extract the differential housing (2) together with the ring bevel gear and outer rings (3).

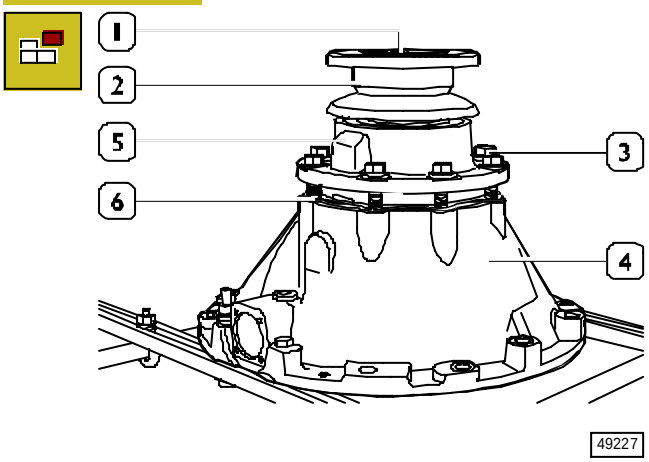
Aquila Trucks Centres

Figure 14




Using tool 99370317 (2), lock the flange (1).
Using wrench 9955088 (3) and multiplier (4), loosen the bevel pinion nut.

Figure 15

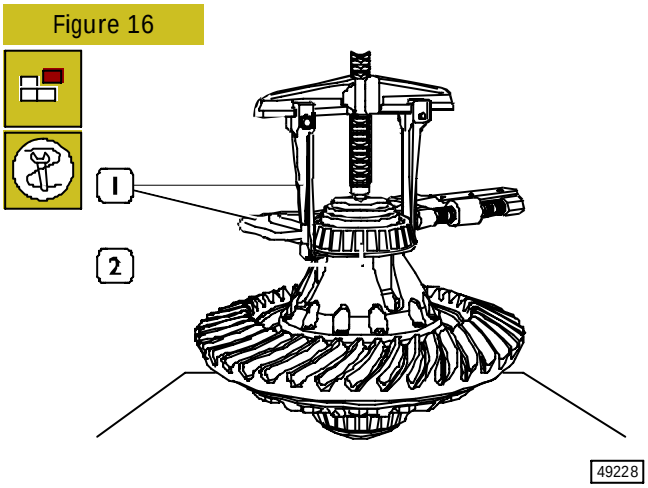



Remove the nut (1) and extract the flange (2).
Remove the screws (3) fastening the bevel pinion support to the differential carrier (4).
Remove the complete bevel pinion support (5) from the differential carrier. Remove the shims (6) for adjusting the pinion position in relation to the crown wheel and use a micrometer to measure the overall thickness.

**NOTE** Check that the seal ring is intact (O-ring), change it if damaged.

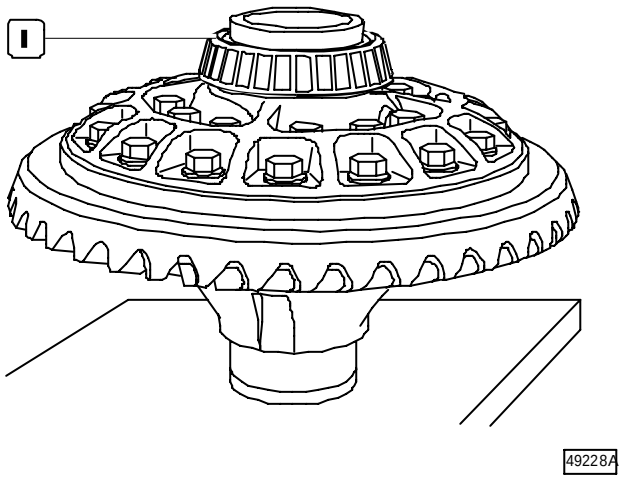
## Removing the differential housing

Figure 16



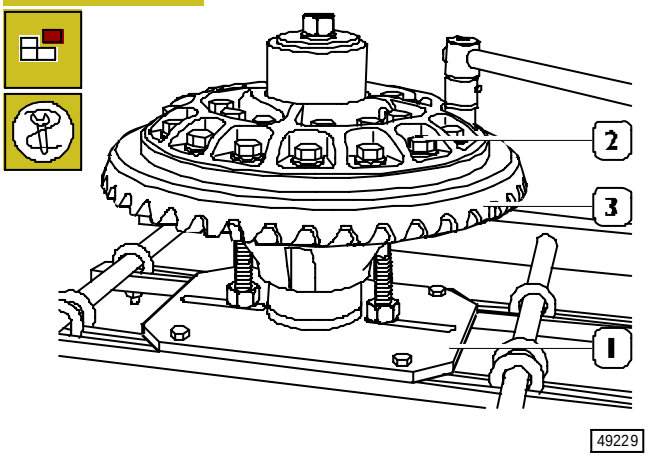

Using a suitable puller (1), extract the bearing (2).

Figure 17




Turn the gearcase upside down and remove the bearing (1). (This is a destructive operation).

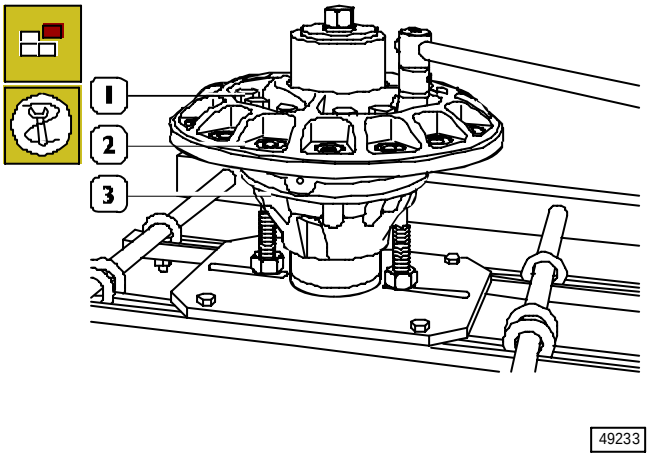
Figure 18




Place the gearcase on tool 9971047 (1).
Remove the locknuts (2) fastening the ring bevel gear (3) to the gearcase.
Using a bronze beater, remove the ring bevel gear.

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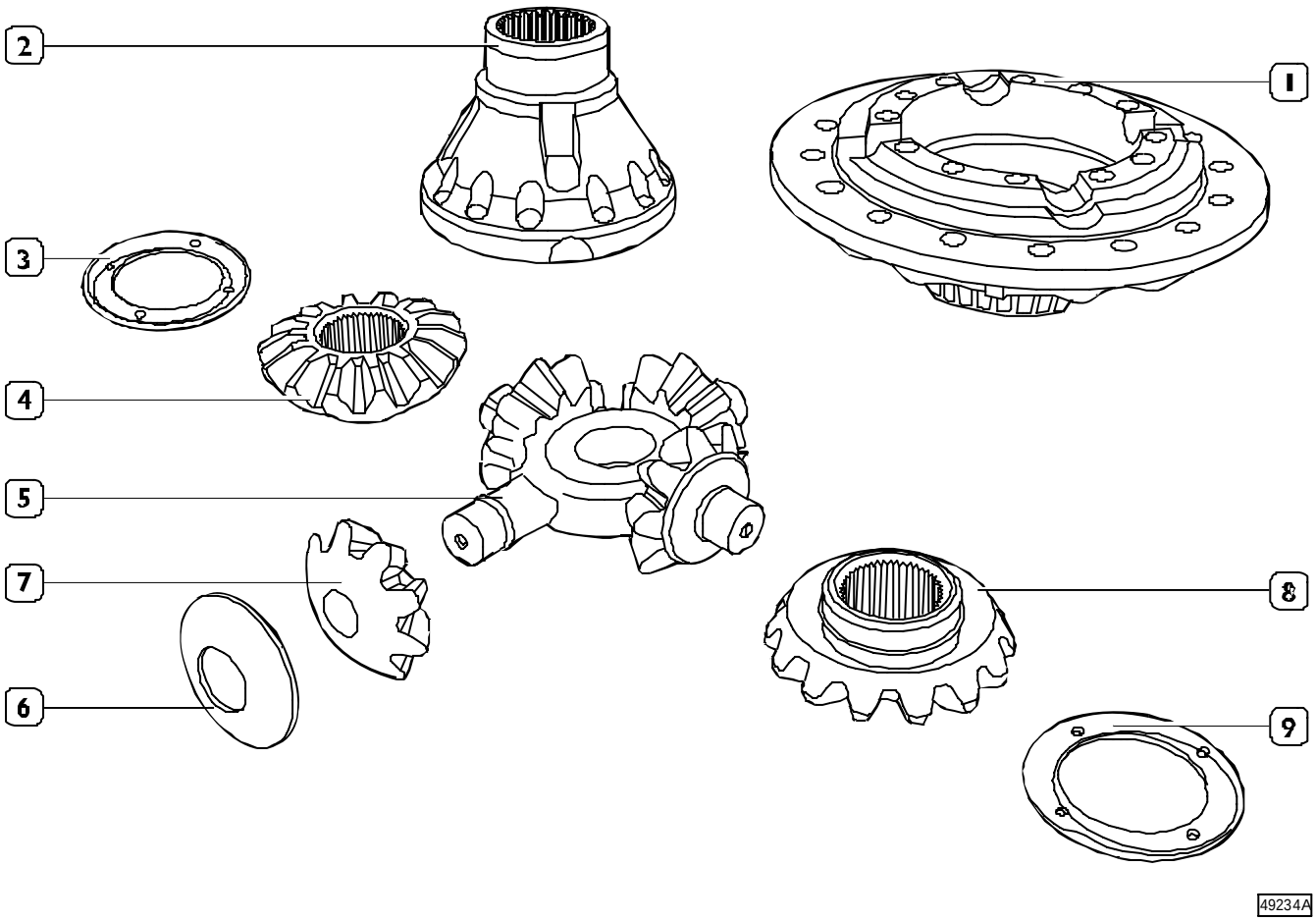
Figure 19




Mark the assembling position of the two half cases (2 and 3) and cross journal, to ensure correct matching and re-assembling. Remove the screws (1) and lift the half casing (2) off the unit.

Figure 20

Remove components (2 - 3 - 4 - 5 - 6 - 7 - 8 - 9) from the half casing (1).




DIFFERENTIAL HOUSING COMPONENTS

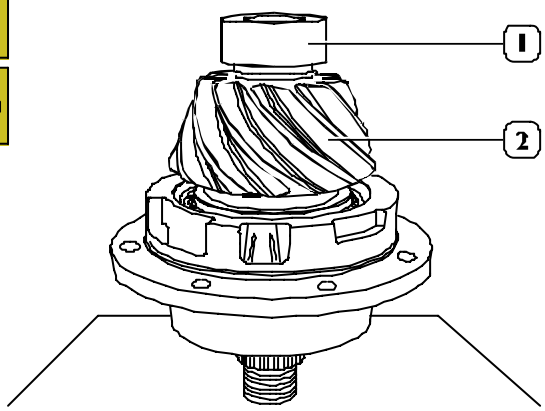
1. Half casing - 2. Half casing - 3. Crown wheel - 4. Planetary gear - 5. Spider - 6. Shoulder washer - 7. Planetary gears - 8 Crown wheel - 9 Shoulder washer

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## 526249 REMOVING THE BEVEL PINION FROM THE SUPPORT

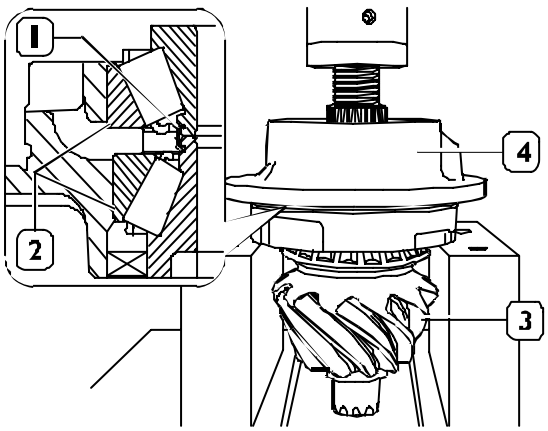
Figure 21




49230

Using tool 99348001, extract the bearing (1) from the bevel pinion (2).

Figure 22



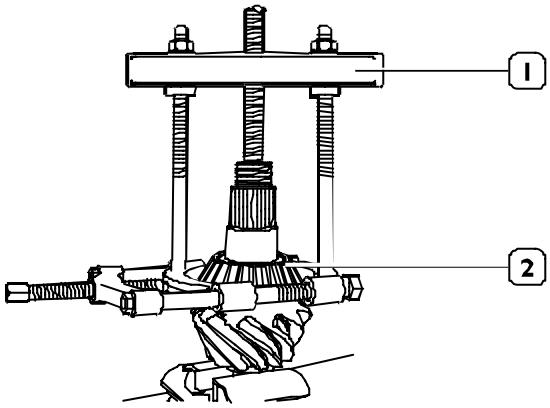

86721

Take off the bevel pinion (3) (under a press) from the support (4).

The mounting (4) is supplied as a spare part together with preassembled tapered roller bearings and seals.

Due to production requirements, the two bearings (2) of pinion (3) are kept assembled by means of a special metal ring (1) that is normally left in place, owing to its being unimportant. During the pinion disassembling phase, the ring is partially taken out, if still present.
If not taken out, the ring could be dangerous, since it could subsequently interfere with the bearings.
Prior to reassembling the pinion, it is therefore essential that you check for the presence of the ring and take it out fully.

Figure 23




49232

Using a suitable tool (1), extract the bearing (2).

### Differential component check

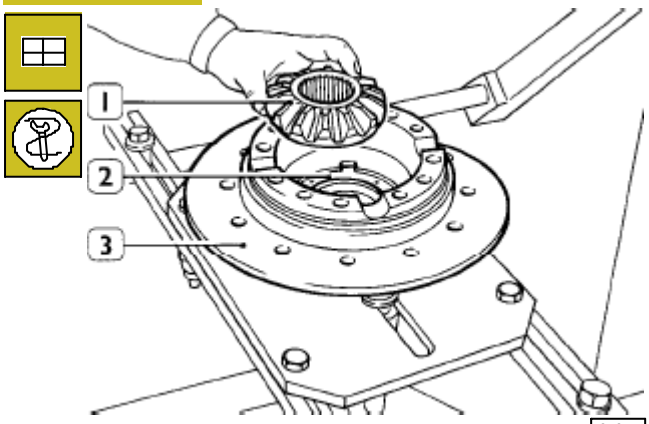
Carefully clean all differential components.
Lubricate the bearings and rotate the roller cage; it should rotate freely and smoothly.

Inspect the ring bevel gear and half casing contact surfaces, making sure the ring bevel gear perfectly adheres. Warped surfaces may cause ring bevel gear fastening screw vibration, thus undermining the unit operation.
Make sure the slotted section fastening the flange to the pinion is not worn. If it is, replace the pinion.

Aquila Trucks Centres

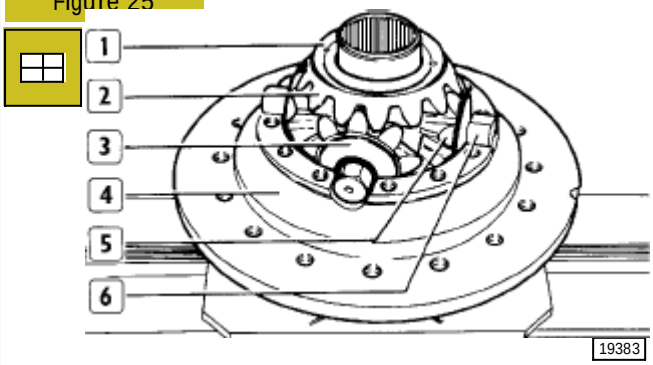
## Fitting the differential housing

Figure 24




Place the half casing (3) on tool 99371047.
Insert the crown wheel shoulder washer (2) into the half casing, then fit the crown wheel (1).

Figure 25



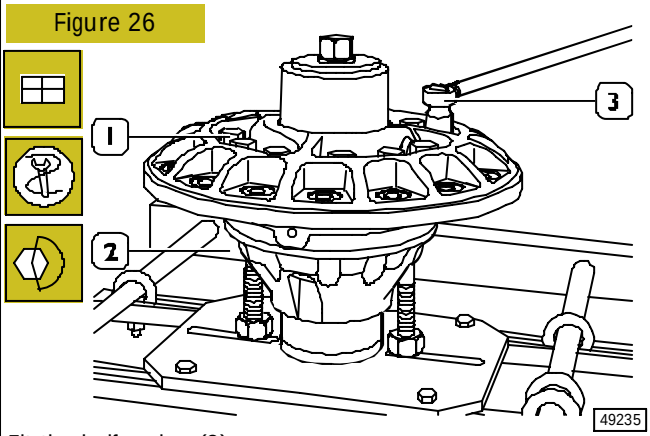

Fit the spider (6), complete with planetary gears (5) and shoulder washers (3), to the half casing (4).

**NOTE** If the spider has not been replaced, make sure the marks made on removal match.

Fit the second crown wheel (2) complete with shoulder washer (1).

**NOTE** Lubricate every component with axle oil.

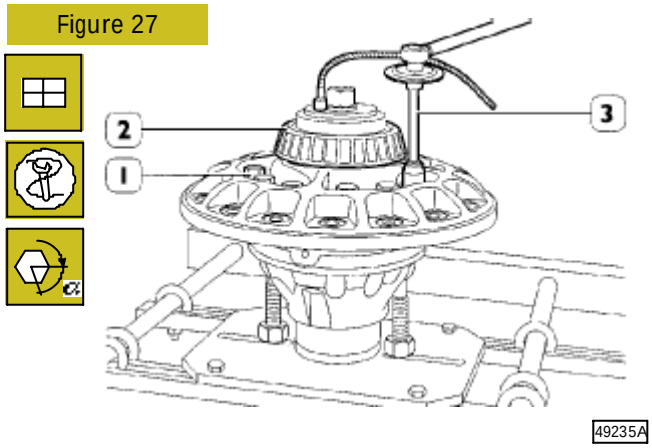
Figure 26




Fit the half casing (2).
Make sure the marks made on removal match. Insert the screws (1) and tighten as follows:

- 1st phase: tightening with a torque wrench (3) to a torque of 100 Nm (10 kgm).

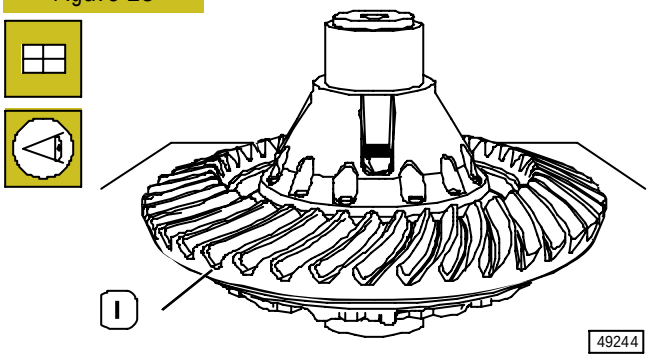
Figure 27




- 2nd stage: tighten the screws (1) by means of tool 99395216 (3) at 110° to 120° angle.

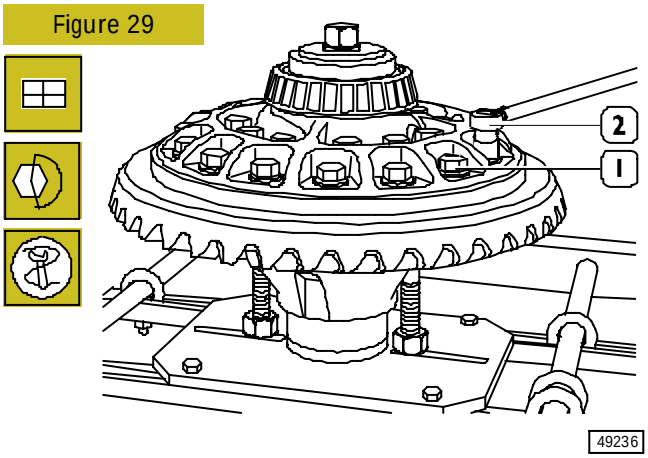
Heat the bearing (2) at 100°C for approx. 15 min. in a convection furnace and fit it, using a suitable beater.

Figure 28




Heat the ring bevel gear (1) to a temperature of 100°C ÷ 150°C in an air circulation oven and position it in its seat, in the gear housing, checking it turns freely and making the holes coincide for the screws fixing the ring bevel gear-gear housing by fitting the 4 manoeuvring screws.

Figure 29



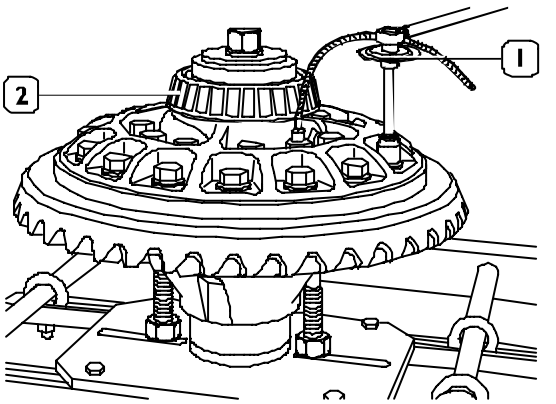

Let the ring bevel gear cool, then place the gearcase upside down on the tool.
Insert the screws (1) and tighten as follows:

- 1st stage: tighten to 100 Nm (10 kgm) torque by means of a torque wrench (2);
- replace the 4 manoeuvre screws with new ones and apply the same specified torque.

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Aquila Trucks Centres

Figure 30

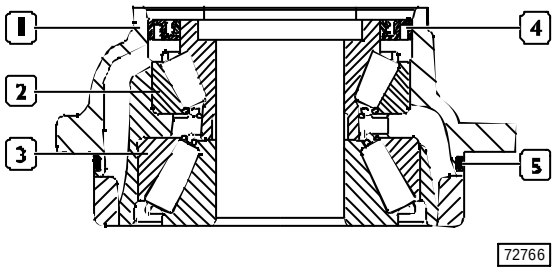



- 2nd phase: closing, with tool 99395216 (1) with an angle of 80 – 90°.

Heat the bearing (2) to a temperature of 100°C for approx. 15 min. in an air circulation oven and drive it in with an appropriate drift.

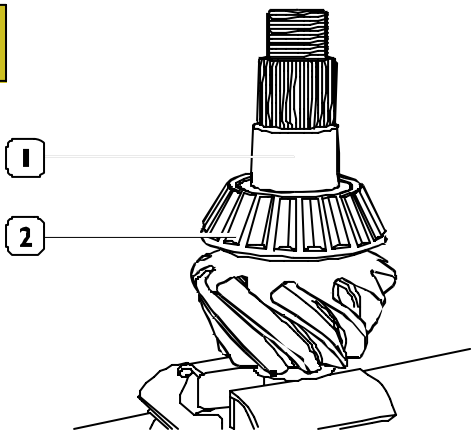
## 526249 FITTING THE MOUNT ON THE BEVEL PINION

Figure 31



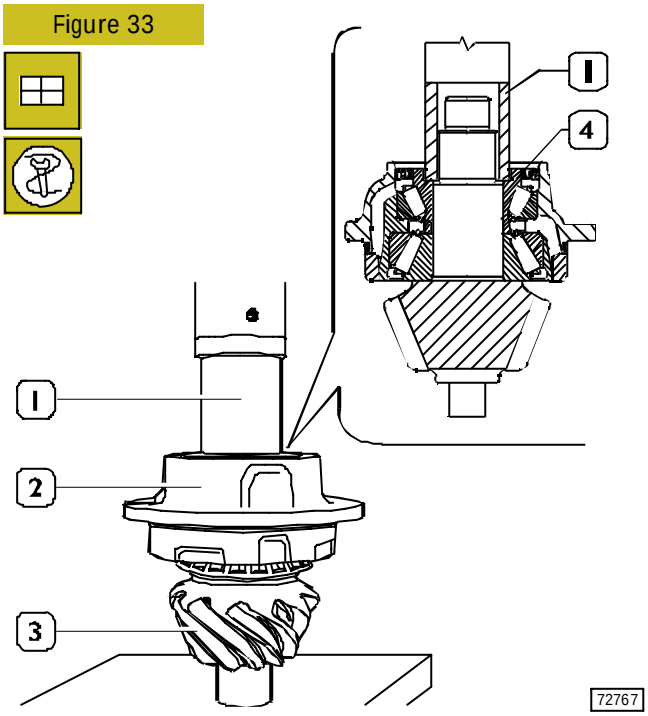

The bevel pinion mount (1) is supplied as a spare together with the tapered roller bearings (2 and 3) and the seals (4 and 5).

Figure 32



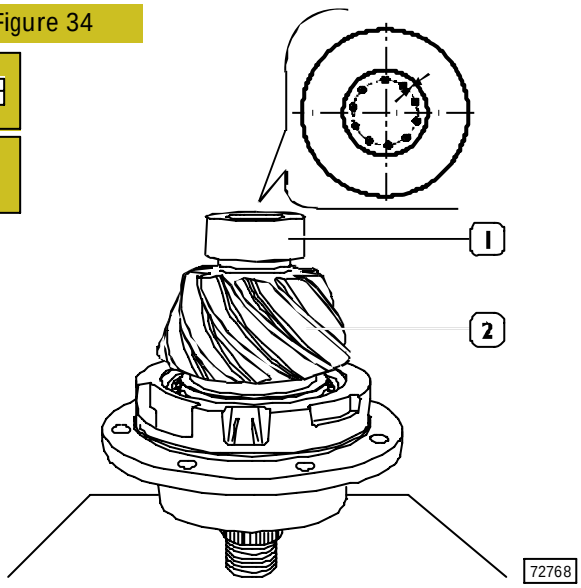

Heat the bearing (2) to a temperature of 100°C for 15 min. in an air circulation oven and mount it on the bevel pinion (1).

Figure 33




Using a press and a suitable tube (1) positioned on the inner ring of the roller bearing (4), fit the mount (2) on the bevel pinion (3).

Figure 34

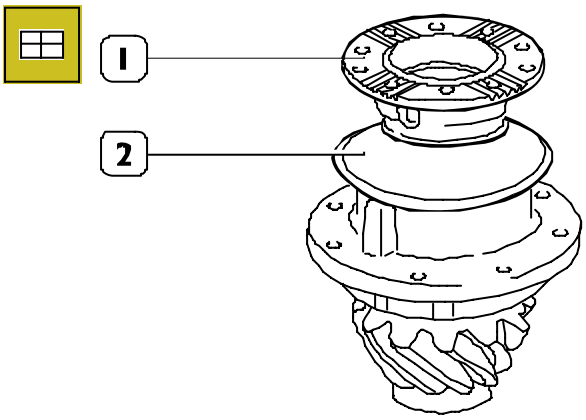



Heat the bearing (1) to a temperature of 100°C for 15 min. in an air circulation oven and mount it on the bevel pinion (2).
Lock the bearing by notching the bevel pinion at 10 equidistant points as shown in the figure. This should be done conscientiously with a suitable punch.

The diameter of the impression has to be between 3.40 – 4.10 mm, corresponding to a depth of 0.30 – 0.44 mm respectively, using a load of 4000 kg with a ball with a 10 mm diameter.

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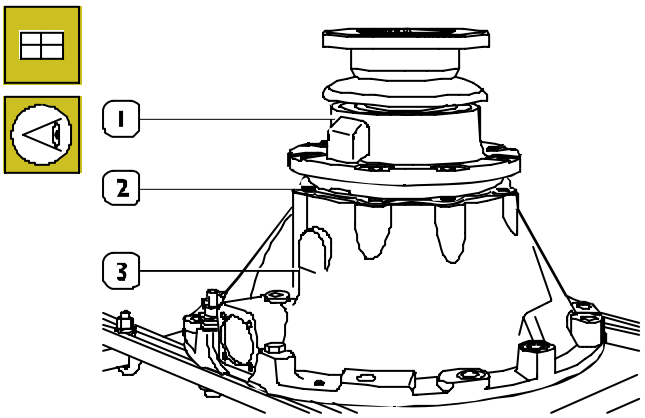
Figure 35




49239

Place the transmission fitting flange (1), complete with baffle (2), and fit it using a suitable beater. The use of a vice is recommended. Temporarily tighten the lock nut.

Figure 36

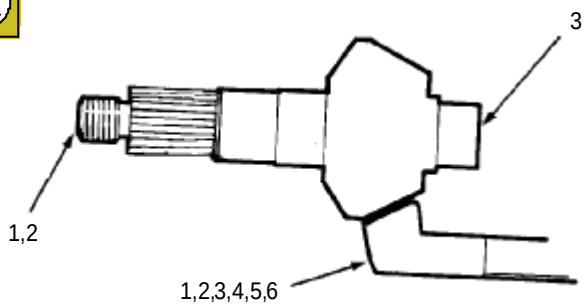



49240

If the same pinion-crown wheel unit previously removed is reinstalled, fit the relative adjusting shims (2) and bevel pinion support with the seal ring (O-ring) (1) to the differential carrier (3). Make sure the lubrication oil slot is properly aligned.

**NOTE** Replace the seal ring (O-ring) in the event that it is damaged, to avoid oil leaks through the shims.

Figure 37




19416

Before assembling a new pinion-crown wheel unit, it is mandatory to understand the meaning of the marks stamped on both pinion and crown wheel, in order to find out the proper pinion position.

1. Part number
2. Tooth play number
3. Pinion-crown wheel unit coupling number
4. Adjustment number, to define the thickness of the shims to be fitted between pinion support and differential housing (this number is called CP in the following examples)
5. Pinion-crown wheel unit date of manufacturing and testing (month and year)
6. Pinion-crown wheel unit rated backlash.

Part and tooth play numbers are marked on the pinion threaded end.
On crown wheels, the same numbers are generally marked on the front face.
As an alternative, they may be found on the crown wheel outer diameter.
For any pinion-crown wheel unit, the crown wheel part number shall always be even (for instance, 36786), whereas the corresponding pinion part number shall be odd (for instance, 36787).
The tooth play number (for example, 10-41) means the pinion features 10 teeth and crown wheel 41, corresponding to 4.10 : 1 transmission ratio.

**NOTE** Never use pinion-crown wheel units bearing different numbers.

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Each crown wheel has an adjustment number specifying the rated mounting clearance.
Use this number to calculate the thickness of the adjusting shims to be fitted between pinion support and differential housing.
This number (for example, C.P. +0.1, or C.P. -0.1 mm), is stamped on the crown wheel outer diameter.

To calculate the thickness of the adjusting shims to be fitted between pinion support and differential housing, proceed as follows:

1. Measure the thickness of the shims fitted on the pinion-crown wheel unit to be replaced. Use a micrometer or gauge and note the measurement.
2. Read the C.P. stamped on the crown wheel to be replaced. If positive (+), subtract this number from the previously taken measurement (see "1"). If the number represents a negative value (-) add it to the measurement taken (see "1").

Note the result.

**NOTE** The measurement obtained at "2" shall be used to calculate the thickness of the adjusting shims to be fitted between pinion support and differential housing, in relation to the new pinion-crown wheel unit to be installed.

3. Read the C.P. stamped on the new crown wheel. Add or subtract this value (add if +, subtract if -) to/from the previously taken measurement (see item "2").

The obtained value indicates the thickness of the new shims to be fitted.

Refer to the following examples, covering all possible combinations.

Examples of calculation

Example 1:

| | | |
|---|---|---|
| Original shim thickness | mm | 0.75 |
| Crown wheel C.P. + 0.05 | | - 0.05 |
| Result | mm | 0.70 |
| New crown wheel C.P. + 0.10 | | + 0.10 |
| New shim thickness to be used | mm | 0.80 |

Example 2:

| | | |
|---|---|---|
| Original shim thickness | mm | 0.65 |
| Crown wheel C.P. - 0.05 | | + 0.05 |
| Result | mm | 0.70 |
| New crown wheel C.P. + 0.15 | | + 0.15 |
| New shim thickness to be used | mm | 0.85 |

Example 3:

| | | |
|---|---|---|
| Original shim thickness | mm | 0.70 |
| Crown wheel C.P. + 0.05 | | - 0.05 |
| Result | mm | 0.65 |
| New crown wheel C.P. - 0.05 | | - 0.05 |
| New shim thickness to be used | mm | 0.60 |

Example 4:

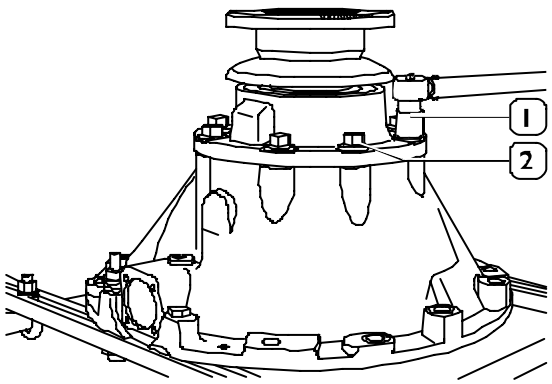
| | | |
|---|---|---|
| Original shim thickness | mm | 0.85 |
| Crown wheel C.P. - 0.10 | | + 0.10 |
| Result | mm | 0.70 |
| New crown wheel C.P. - 0.15 | | - 0.15 |
| New shim thickness to be used | mm | 0.80 |

**NOTE** Spare parts shims, to be fitted between pinion support and differential housing, are provided with the following thickness: 0.125 - 0.200 - 0.500 mm.

A number, specifying the rated backlash between pinion and crown wheel after manufacturing, is stamped on all units.
This number is found on the crown wheel outer diameter.

## Reassembling the differential carrier

Figure 38



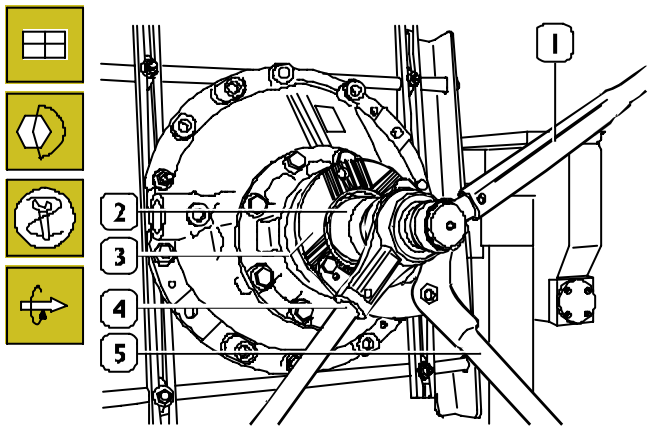

49241

Insert the screws (2) and tighten to the prescribed torque, using a torque wrench (1).

- 1st step: tighten using the torque wrench (1) to a torque of 100 Nm (10 kgm);
- 2nd step: tighten the screw (2) using tool 9935216 with an angle of 60° ÷ 70°.

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Figure 39

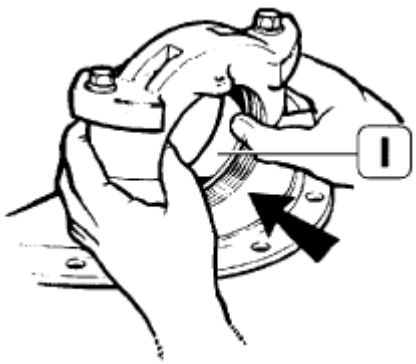



49242

Turn the unit by 90°.
Using tool 99370317 (5), lock the flange (3). Using wrench 99355088 (2), multiplier (4) and torque wrench (1), tighten the pinion lock nut to the prescribed torque (1350 to 1370 Nm). Place the caps, making sure reference tabs match. Tighten the screws, complete with washers, to the prescribed torque by means of a torque wrench.

**NOTE** Check that the multiplication factor of the multiplier (4) is correct.

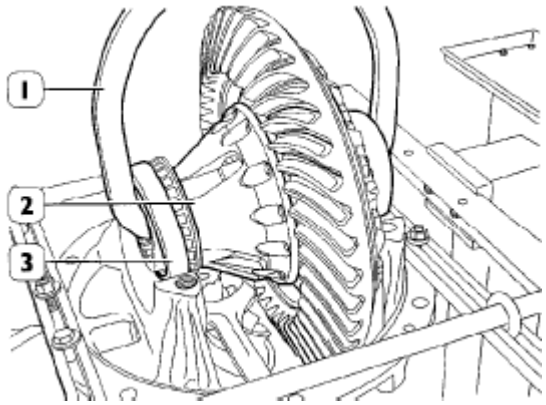
Figure 40




20670

Then, slightly push the bearing outer rings (1), to make sure they slide smoothly within their housings.
Remove the screws, complete with washers, and caps.

Figure 41

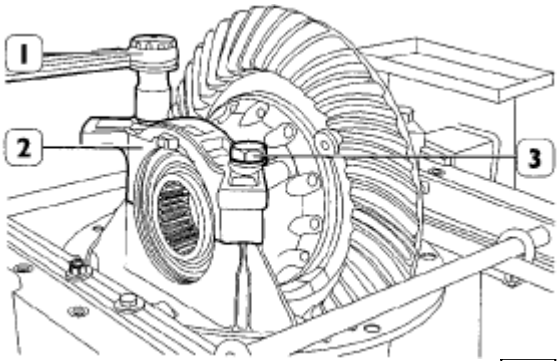



49225

Position the external rings (3) of the bearings

Using hook 99370509 (1), lift the previously assembled gearcase (2) and place it onto the differential housing.

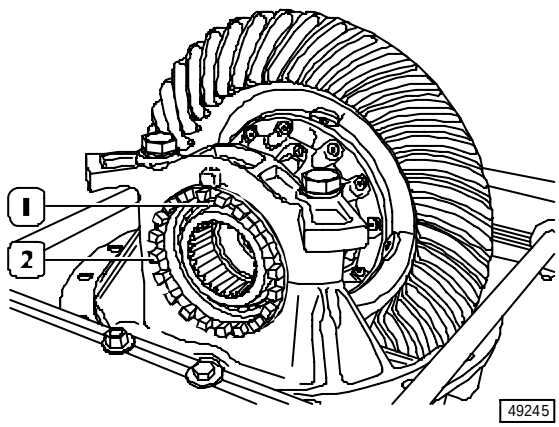
Figure 42




49244

Position the caps (2), suitably settle them using a hammer and insert the screws (3), complete with washers. Tighten the screws to the prescribed torque, using a torque wrench (1).

Figure 43




49245

Lubricate the conical roller bearings (1), manually tighten the ring nuts (2) until they touch the external bearing rings; tighten the screws (3, Figure 42) to the prescribed torque.

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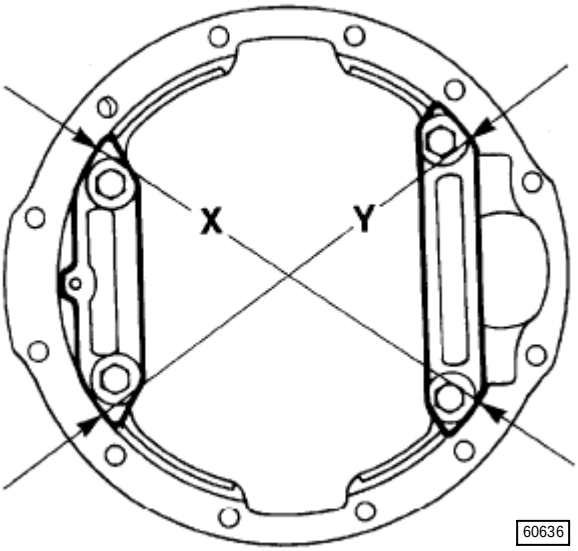
## ADJUSTING THE CAP GAP

Adjusting and checking retraction of the caps can be done with two methods:

1st METHOD

1. Use wrench 99355025 (3, Figure 45) to tighten the adjustment lock rings (4) of the bearings until eliminating the pinion-crown wheel clearance and end float. At the same time check that the crown wheel does not force on the pinion;
2. using a suitable micrometer positioned diagonally and centrally in points (X-Y-arrows, Figure 44); measure and note the distance of the caps;

Figure 44

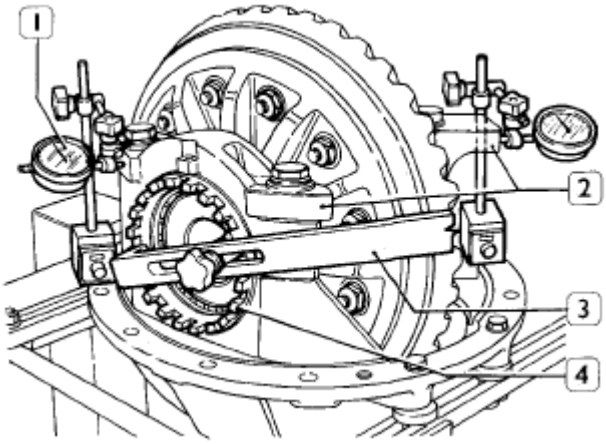



3. further tighten the two adjustment lock rings (4, Figure 45) to obtain a retraction of the caps (2, Figure 45), measured on Axis X or on axis Y as described in point "2" of: 0.15 to 0.33 mm which corresponds to a preload on the bearings of 1.7 to 3.9 Nm (0.17 to 0.39 kgm).

2nd METHOD

A. Diagonally and centrally on the outer machined seats of both caps (2, Figure 45) position two dial gauges (1) with magnetic stand as shown in Figure 45;

Figure 45

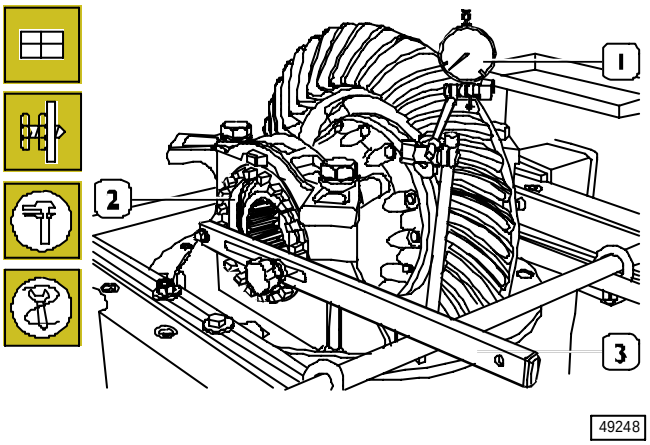



B. proceed as described in point "1";

C. after eliminating the end float further tighten the two adjustment lock rings (4) to obtain a retraction of the caps (2) of 0.15 to 0.33 mm, which corresponds to the sum of the readings on the dial gauges (1).

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Figure 46

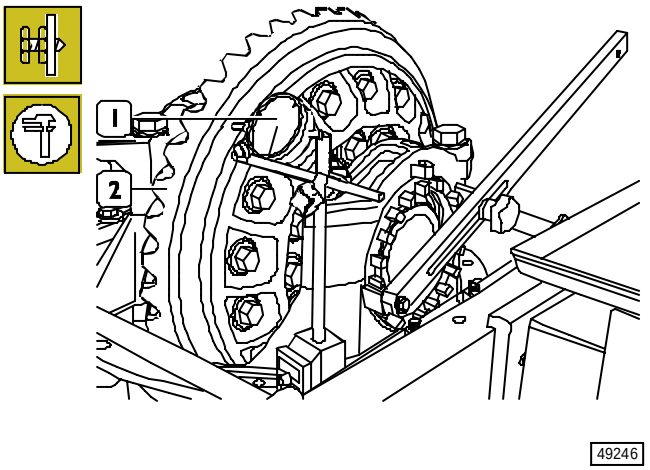



Adjust the axial clearance between the teeth of the pinion - crown wheel unit which must be 0.26 to 0.50 mm proceeding as follows:

- stop the bevel pinion from turning using tool 99370317;
- position the magnetic-based dial gauge (1) as illustrated;
- using wrench 99355025 (3) slacken the adjustment lock ring on the crown wheel side and tighten, to the same extent, the adjustment lock ring (2) of the opposite side. The purpose of this is to leave the previously-adjusted cap retraction unchanged;
- proceed as described until obtaining the specified clearance.

The clearance should be checked on 4 points the same distance apart.

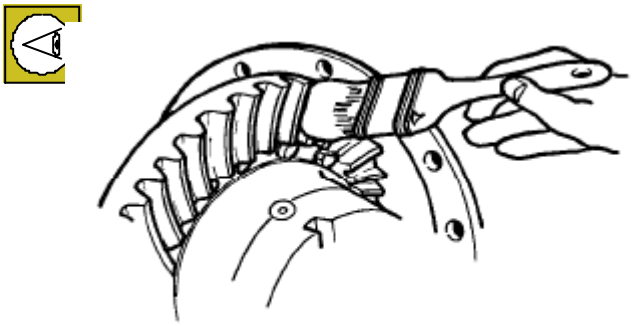
Figure 47




Use a magnetic-based dial gauge (1) to check that the crown wheel (2) does not have any upper wobble above 0.20 mm. If it does, disassemble the differential unit and find the cause.

Refit and repeat the adjustment operations described previously.

Figure 48




Apply a light layer of Prussian blue on the crown wheel. Turn the pinion and measure the impression of the contact of the pinion teeth on the crown wheel teeth.
The following figures show possible contacts and how to correct any errors.

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Figure 49



19452

Contacts too much on crown wheel teeth bottom land

Conditions C-D. Indicates that the pinion is fastened too deeply and needs further adjustment.
To adjust the exact position of the pinion shims should be added under the pinion support to obtain the exact contact.

Condition C. Measure the clearance and restore it after adding shims.

Condition D. After adding shims, take the clearance towards minimum.

Figure 50



19453

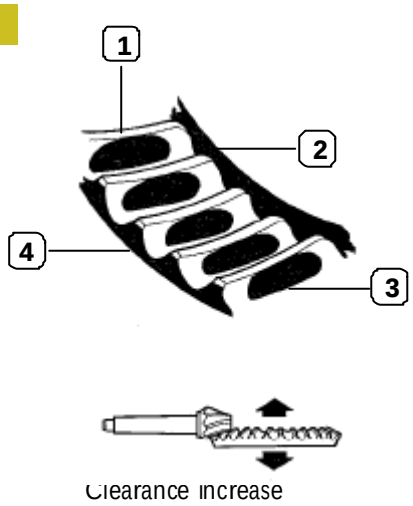
Contacts too much towards the crown wheel teeth top land

Conditions A-B. Indicates that the pinion is fastened to much towards the outside and therefore needs further adjustment.
To adjust the exact position of the pinion, remove shims under the pinion support to obtain the exact contact.

Condition A. After removing the shims, take the clearance towards maximum.

Condition B. Measure the clearance and restore it after removing shims.

Figure 51




19454

THEROETICAL CONTACT AREA

1. Release, concave side of tooth
2. Top land
3. Pulling, convex side of tooth
4. Heel

PULLING. Central tending towards the top land on the tooth face and central on the tooth profile.

RELEASE. Central tending to the heel on the tooth face and central on the tooth profile.

Indicates that the pinion is fastened correctly.

The contact position can be further changed by changing the pinion-crown wheel clearance.

Condition E. Lower the clearance.

Condition F. Increase the clearance.

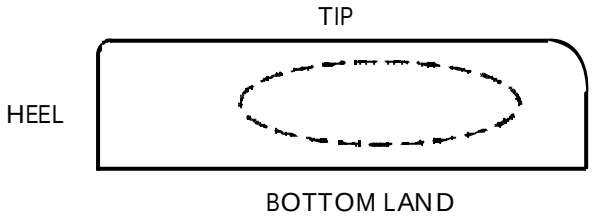
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## CORRECTING THE CROWN WHEEL AND PINION CONTACTS (AFTER ASSEMBLY)

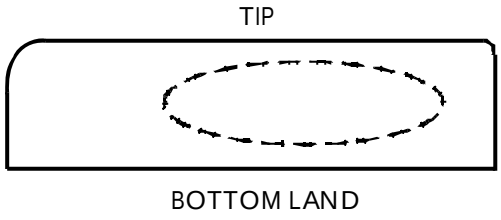
Figure 52

### THEORETICAL CONTACTS

**PULLING**
**(CONVEX SIDE OF RING GEAR)**



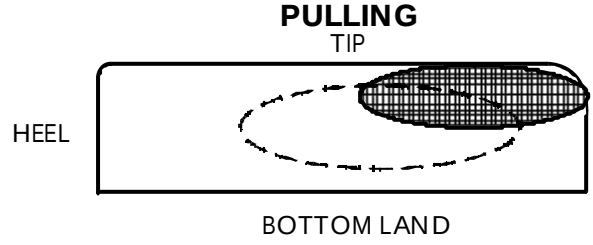

**RELEASE**
**(CONCAVE SIDE OF RING GEAR)**



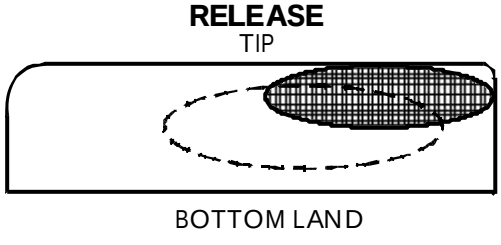

- PULLING : CENTRAL TENDING TOWARDS THE TOP LAND ON THE TOOTH FACE AND CENTRAL ON THE TOOTH PROFILE
- RELEASE : CENTRAL TENDING TOWARDS THE HEEL ON THE TOOTH FACE AND CENTRAL ON THE TOOTH PROFILE

### CONDITION "A"

**PULLING**

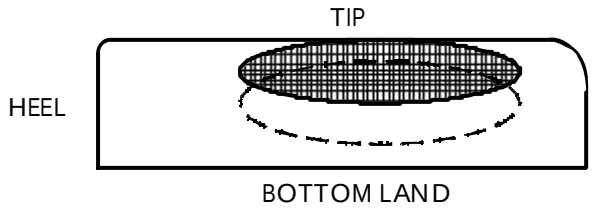


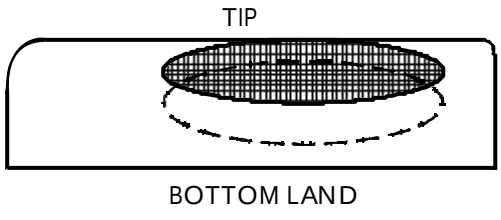

**RELEASE**




- PULLING RELEASE : CONTACTS TOO MUCH AT TIP
- PULLING : CONTACT TOO MUCH AT TOP LAND
- RELEASE : CONTACT TOO MUCH AT HEEL
- CORRECTIVE ACTION : REMOVE SHIMS AND INCREASE CLEARANCE TO MAXIMUM

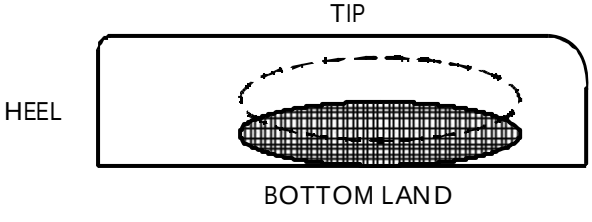
### CONDITION "B"

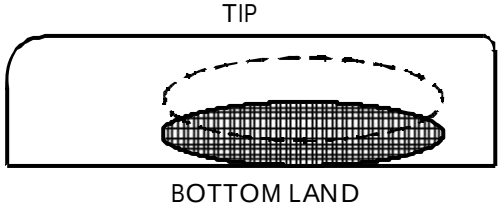



- PULLING - RELEASE : CONTACTS TOO MUCH AT TIP
- CORRECTIVE ACTION : MEASURE THE CLEARANCE AND RESTORE THE CLEARANCE

### CONDITION "C"




- PULLING - RELEASE : CONTACTS TOO MUCH ON BOTTOM LAND
- CORRECTIVE ACTION : MEASURE THE CLEARANCE, ADD SHIMS AND RESTORE CLEARANCE

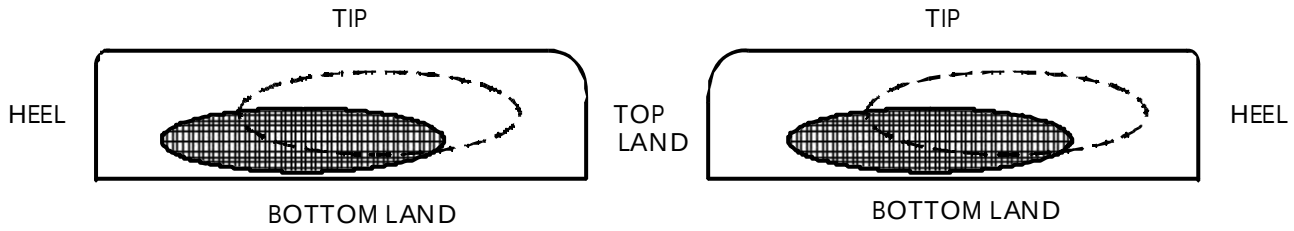
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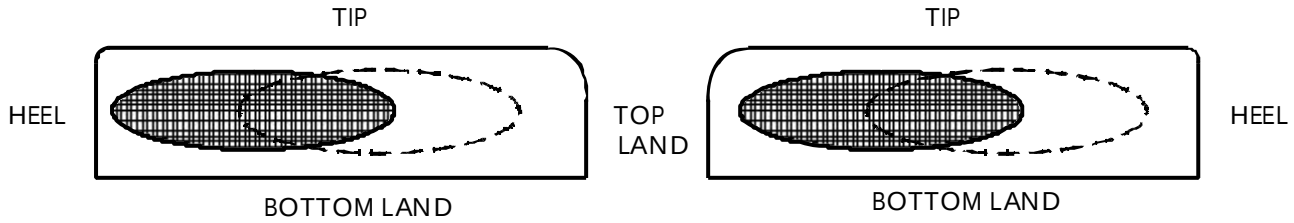
Figure 53

## CONDITION "D"



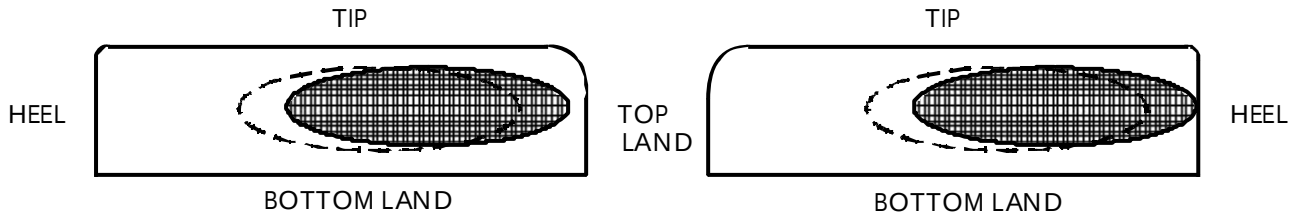

- PULLING - RELEASE : CONTACTS TOO MUCH ON BOTTOM LAND
- PULLING: : CONTACT TOO MUCH AT HEEL
- RELEASE : CONTACT TOO MUCH AT TOP LAND
- CORRECTIVE ACTION : ADD SHIMS AND REDUCE CLEARANCE TO MINIMUM

## CONDITION "E"




- PULLING : CONTACT TOO MUCH AT HEEL
- RELEASE : CONTACT TOO MUCH AT TOP LAND
- CORRECTIVE ACTION : REDUCE CLEARANCE

## CONDITION "F"

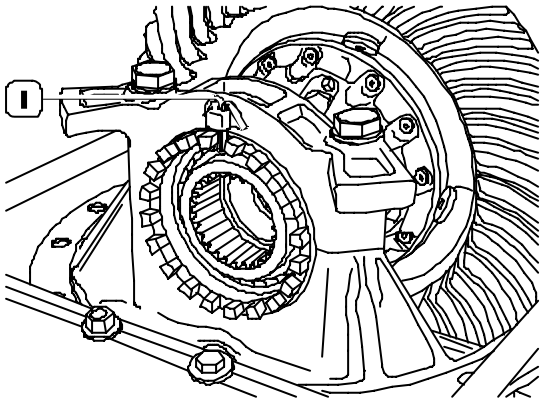



- PULLING : CONTACT TOO MUCH AT TOP LAND
- RELEASE : CONTACT TOO MUCH AT HEEL
- CORRECTIVE ACTION : INCREASE CLEARANCE

60677

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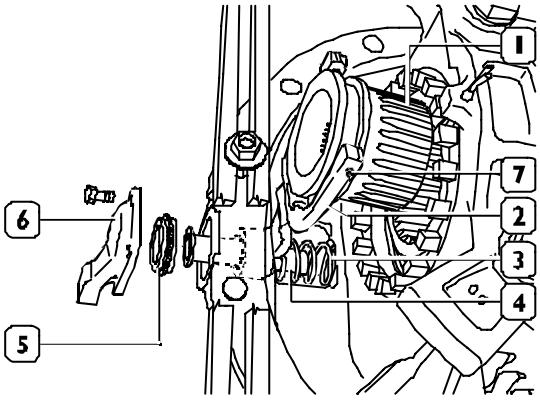
Figure 54




49249

Replace the safety split pin (1) and fold it; repeat this operation on the opposite side.

Figure 55




49250

Place the pin (4) into its housing.
Fit the fork (2) and spring (3) to the pin (4) and push it in all the way. Fit the piston (5), complete with ring and cover (6), then fit the sliding sleeve (1) and spring plugs (7).

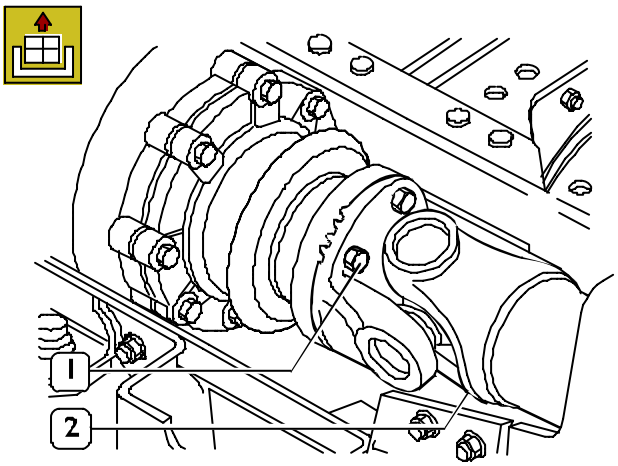
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## WORK ON THE VEHICLE

### REPLACING THE BEVEL PINION MOUNT SEAL

#### Disassembly

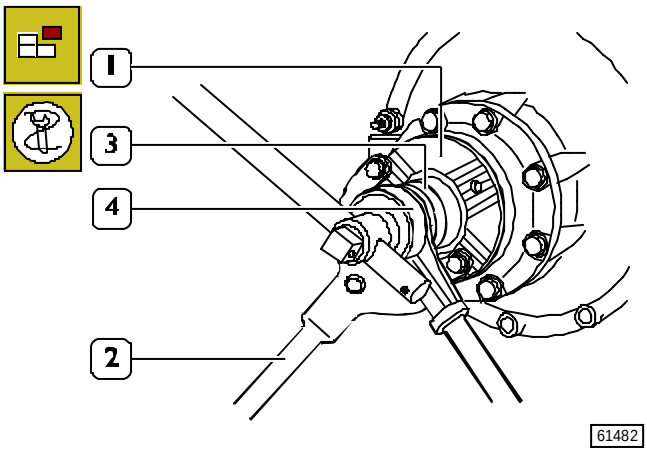
Figure 56




61481

Slacken the nuts (1) fastening the flange. Disconnect the transmission shaft (2), fastening it to the frame.

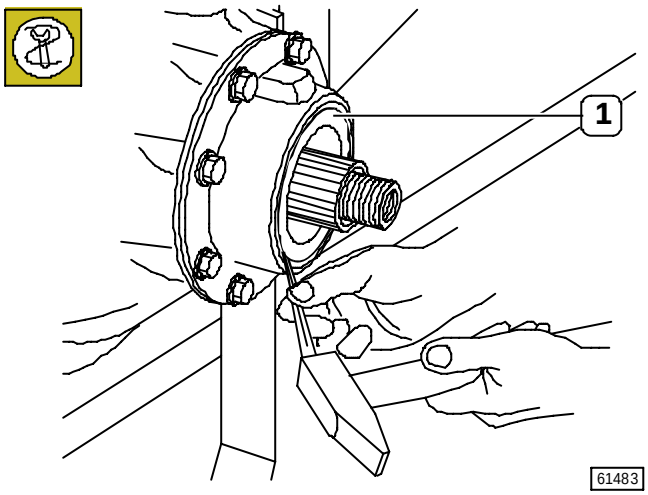
Figure 57




61482

Prevent the flange (1) from turning using retainer tool 99370317 (2).
Using wrench 99355088 (3) and the multiplier (4) slacken the nut for the bevel pinion and withdraw the flange (4).

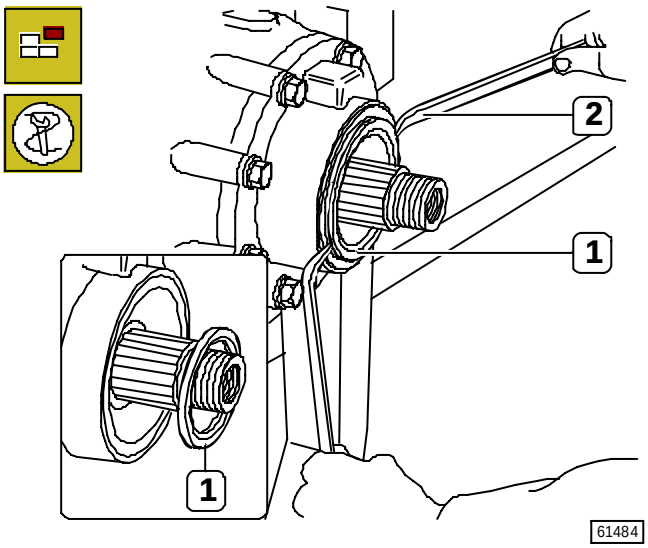
Figure 58




61483

Using a suitable tool raise the outer edge of the ring (1) in two opposed points

Figure 59

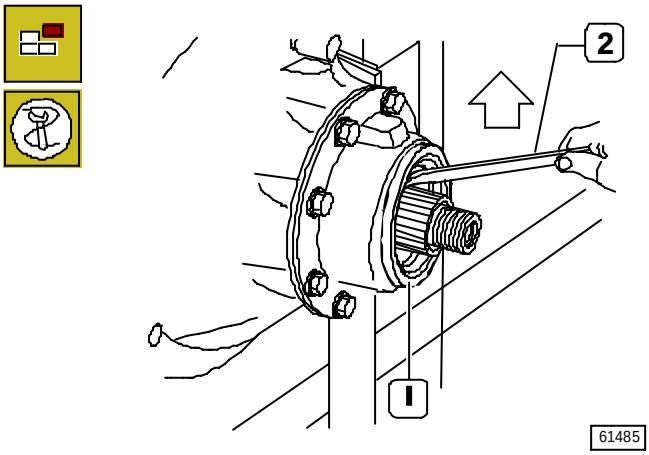



61484

Using the two levers (2) remove the inner ring (1).

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Figure 60

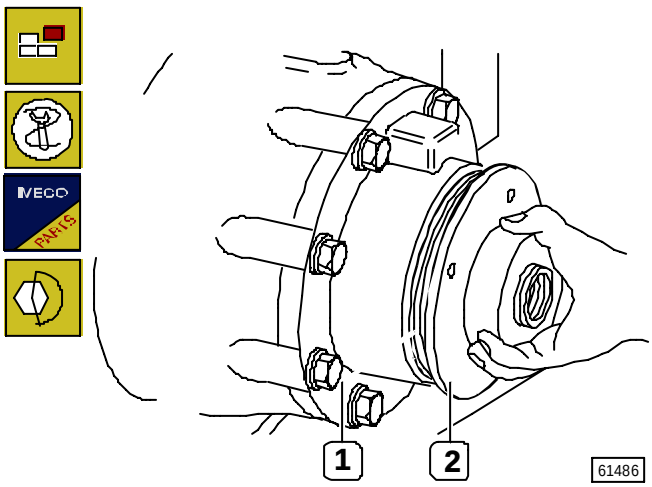



With tool 99363204 (2) positioned as shown in the figure, remove the seal (1) from the bevel pinion mount.

## Assembly

Thoroughly clean the seat of the seal of all debris and traces of oil.

Figure 61




Position the new seal (1).
Apply the keying device 99374244 (2), screw a manoeuvring nut onto the bevel pinion and mount the seal down to the stop.

Unscrew the manoeuvring nut, take out the keying device 99374244 (2), fit the flange back on and screw down a new nut, locking it with a torque wrench and multiplier to the required torque.
Fit the propeller shaft back on and tighten the fixing nuts to the required torque.

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SECTION 9

# 5250 Front axles


| | Page |
|---|---|
| FRONT AXLE 5886/D | 3÷24 |
| WHEEL ALIGNMENT | 25÷34 |

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Aquila Trucks Centres

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# Front axle 5886/D


| | Page |
|---|---|
| DESCRIPTION | 5 |
| - Front axle | 5 |
| MAIN DATA | 6 |
| TROUBLESHOOTING | 8 |
| TIGHTENING TORQUES | 9 |
| TOOLS | 10 |
| REMOVING AND REFITTING THE AXLE | 14 |
| - Removal | 14 |
| - Refitting in place | 15 |
| VEHICLE CHECKS | 16 |
| - Ball joints | 16 |
| - Tie rods | 16 |
| TRACK ROD AND DRAG LINK BALL JOINTS SLACK CHECK | 16 |
| FRONT AXLE ASSEMBLY OVERHAUL | 17 |
| REMOVING - REFITTING WHEEL HUBS | 17 |
| - Removal | 17 |
| - Refitting wheel hubs | 18 |
| REMOVING AND REFITTING IN PLACE THE TRACK ROD | 18 |
| REPLACING TRANSVERSE TIE ROD BALL JOINTS | 19 |
| REMOVING AND REFITTING LEVER FOR TRANSVERSE TIE ROD | 19 |
| REMOVING AND REFITTING LEVER FOR LONGITUDINAL TIE ROD | 19 |
| REMOVING AND REFITTING PIN FOR STUB AXLE | 19 |
| - Removal | 19 |
| - Replacing kingpin bearing | 20 |

https://truckmanualshub.com/
Aquila Trucks Centres

Page

- Refitting . . . . . 21

- Stub axle-axle end play check and adjustment . 22

AXLE BODY CHECKS AND MEASUREMENTS . . 22

- Checking leaf spring supporting surface levelness with reference to kingpin holes using proper equipment . . . . . 22

- Kingpin seats camber angle check . . . . . 24

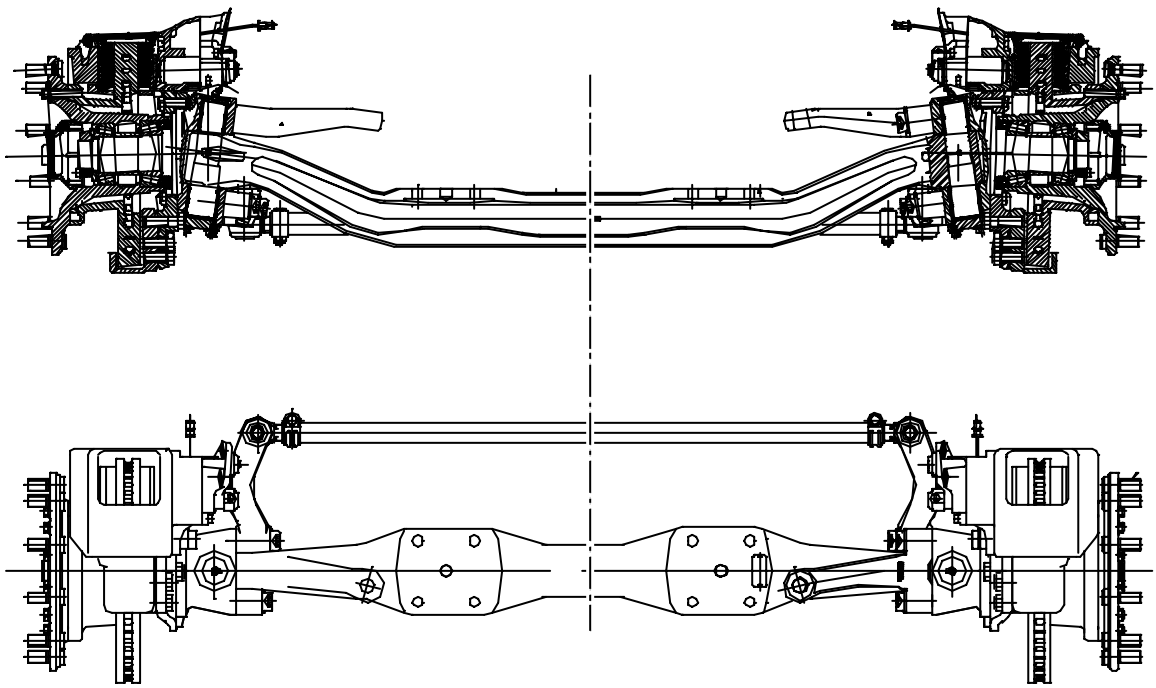
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## DESCRIPTION
### Front axle

The front axle is a steel structure with a double-T cross-section at the end of which the stub axles are articulated. The stub axle articulation is made with tapered pins integral with the axle body and by means of four bearings with rollers driven in with interference in the holes of the stub axle overhangs.

The wheel hubs are supported by two tapered roller bearings, set right lubricated with oil, mounted on the shank of the stub axle and adjustable with the threaded ring nut.
The brake is the Knorr-type disc.

Figure 1

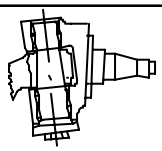
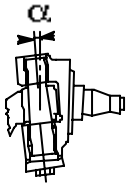
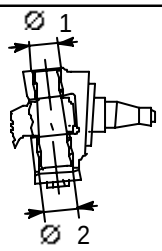
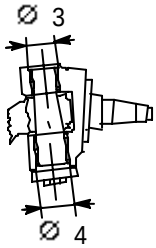
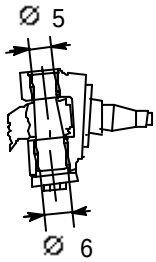
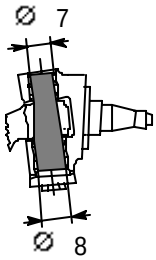


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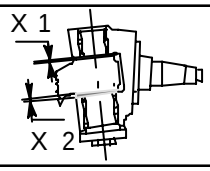
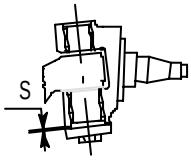
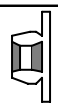
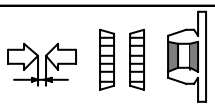
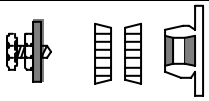
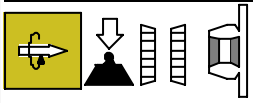
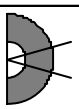
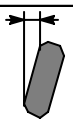
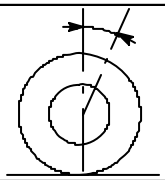
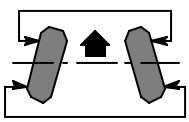
FRONT AXLE 5886/D

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## MAIN DATA

| | | | |
|---|---|---|---|
|  | Type of axle | | 5886/D |
|  | **KINGPINS** | | |
|  | Angle of seats for kingpin | | 7° |
|  | Diameter of roller bearing seats on the stub axle:<br>- top seat Ø 1<br>- bottom seat Ø 2 | <br>mm<br>mm | <br>51.967 ÷ 51.986<br>59.967 ÷ 59.986 |
|  | Outside diameter of roller bearings for stub axle:<br>- top bearings Ø 3<br>- bottom bearings Ø 4 | <br>mm<br>mm | <br>52<br>60 |
|  | Stub axle bearings | mm | 0.014 ÷ 0.033 |
|  | Inside diameter of roller bearings for stub axle:<br>- top bearings Ø 5<br>- bottom bearings Ø 6 | <br>mm<br>mm | <br>43<br>53 |
|  | Diameter of pin for stub axle<br>- top Ø 7<br>- bottom Ø 8 | <br>mm<br>mm | <br>42.984 ÷ 43.000<br>52.981 ÷ 53.000 |
|  | Top bearings - pin | mm | 0 ÷ 0.016 |
|  | Bottom bearings - pin | mm | 0 ÷ 0.019 |

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| | | | |
|---|---|---|---|
|  | | 5886/D | |
|  | Backlash between axle and stub axle upper shim X 1<br>Clearance between axle and stub axle lower shim X 2 | mm<br>mm | 0.10 ÷ 0.35<br>0.25 |
|    | Adjustment shims X1 ; X2<br>0.25 mm S | mm | 0.25 ÷ 1.75 |
|  | **WHEEL HUBS** | | |
|  | Wheel hub bearings | 2, with taper rollers | |
|  | Hub bearings end play | mm | max 0.16 |
|  | Wheel hubs backlash | through ring nut | |
|  | Rolling torque Bearings pre-load | daNm | 0.50 max. |
|  | Oil for wheel hub bearings | Tutela W 140/M DA | |
| | Amount for each hub litres (kg) | 0.33 (0.35) | |
|  | **WHEEL ALIGNMENT** | | |
|  | Wheel camber angle (unloaded vehicle) | 1° | |
|  | Wheel caster angle (unloaded vehicle) | 4x2 6x4 Models<br>2° 30' | 8x4x4<br>1st axle 2° 30'<br>2nd axle 2° 30' |
|  | Wheel toe-in (unloaded vehicle) mm<br>Adjustment tolerance mm<br>Check tolerance mm | 4x2 6x4 Models<br>1<br>± 0.75<br>± 2 | 8x4x4<br>0<br>± 0.75<br>± 2 |
| | Axle weight kg<br>Maximum capacity (GRW) kg | -<br>9000 | |

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## TROUBLESHOOTING

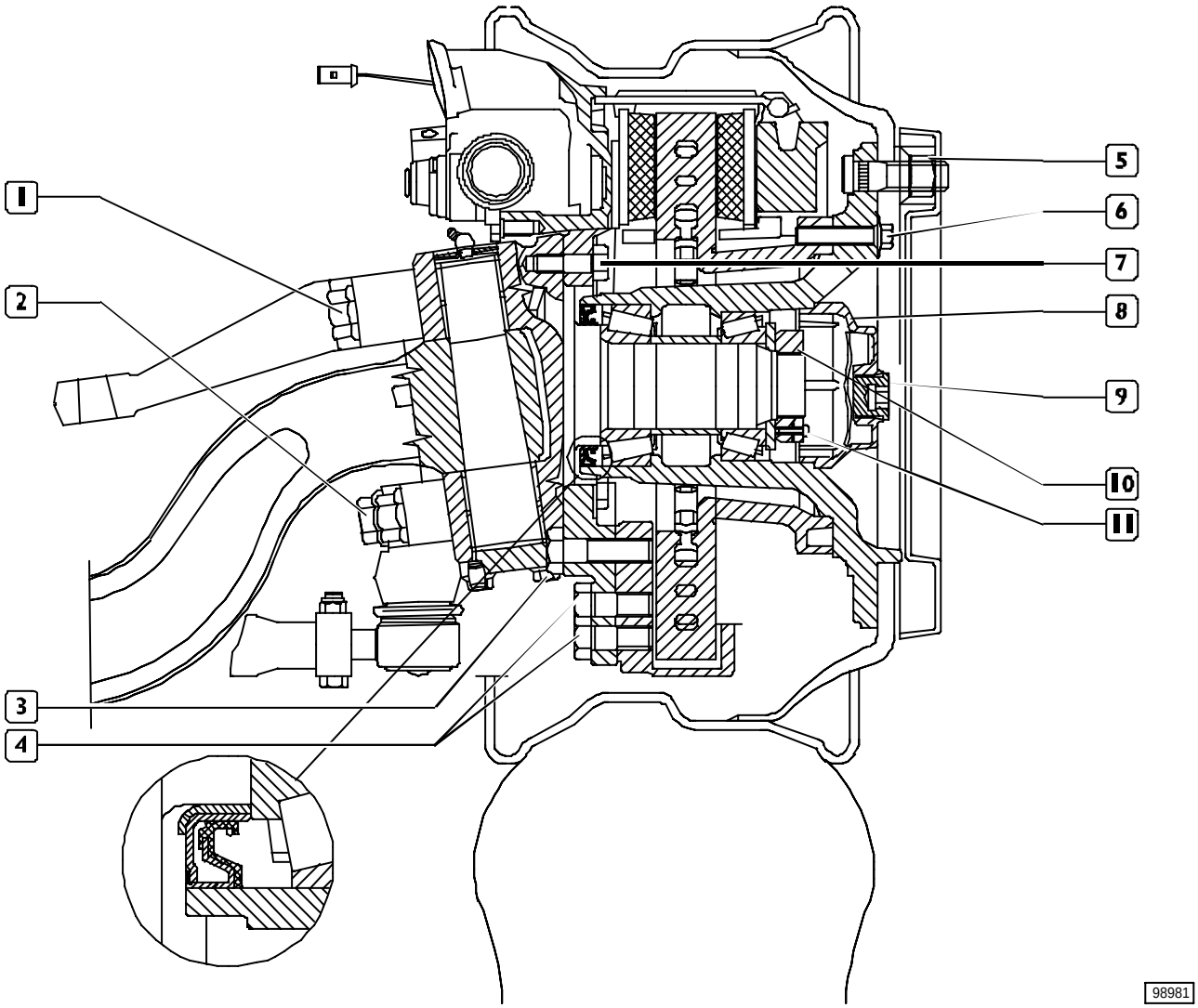
### Main operating faults of a mechanical nature

| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Hard steering | Front axle badly aligned. | Restore alignment and tighten leaf spring bracket nuts to correct torque. |
| | Irregular toe-in. | Make accurate toe-in adjustment on front wheels. |
| | Uneven tyre pressure | Inflate tyres to prescribed pressure. |
| | Insufficient lubrication in joints. | Carefully lubricate the joints. |
| | Wrong stub axle-axle adjustment. | Make an accurate adjustment of the stub axis-axis end play. |
| | Stub axle elements for rotation on pin are inefficient. | Check and replace strained parts. |
| Wobbling | Uneven wheel camber | Check axle mounting, repair or replace the strained parts. |
| | Front axis not aligned. | Restore alignment and tighten leaf spring bracket nuts to specified torque. |
| | Uneven toe-in. | Adjust toe-in. |
| | Steering rod kingpins inefficient. | Replace strained parts. |
| | Irregular backlash on wheel hub bearings. | Adjust end play after making necessary replacements. |
| | Wheels are eccentric:<br>trued rim, strained<br>tyre badly fitted on rim. | Replace faulty rim<br>Deflate and centre tyre on rim. |
| | Unbalanced wheels. | Balance the wheels. |
| Noise | Wheel hub bearings insufficiently lubricated. | Top up oil level in wheel hubs. |
| | Wheel hub bearings are worn. | Replace faulty bearings and adjust end play. |
| | Too much slack between stub axle and needle bearings. | Check and replace worn parts. |

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## TIGHTENING TORQUES

Figure 2




CROSS-SECTION OF FRONT AXLE - WHEEL SIDE

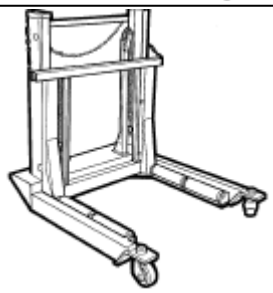
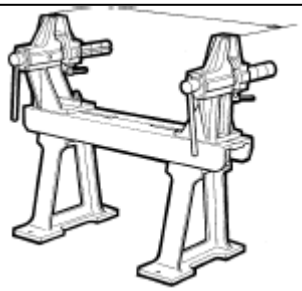
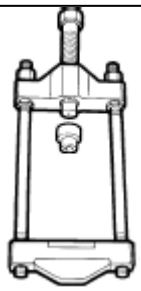
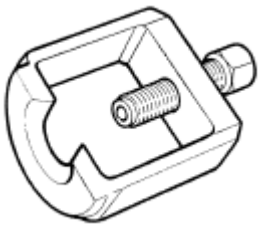
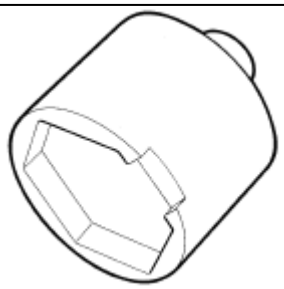
| | DESCRIPTION | TORQUE | |
|---|---|---|---|
| | | Nm | (kgm) |
| 1 | Flanged screw to secure cross tie bar lever on steering knuckle | 1400 ÷ 1250 | (140 ÷ 125) |
| 2 | Flanged screw to secure side lever on steering knuckle | 1400 ÷ 1250 | (140 ÷ 125) |
| 3 | Lower thrust bearing flanged hexagonal screw on steering knuckle | 111 ÷ 123 | (11.1 ÷ 12.3) |
| 4 | Self-locking hex screw M20x1.5 fixing brake callipers | 554 ÷ 677 | (55.4 ÷ 67.7) |
| 5 | Nut fixing wheels | 565 ÷ 690 | (56.5 ÷ 69) |
| 6 | Hex screw fixing brake disc to wheel hub | 268 ÷ 295 | (26.8 ÷ 29.5) |
| 7 | Self-locking hex screw M16x1.5 fixing brake calliper mount to stub axle | 298 ÷ 329 | (29.8 ÷ 32.9) |
| 8 | Cover for wheel hub • | 120 ÷ 140 | (12 ÷ 14) |
| 9 | Conical threaded plug for wheel hub | 55 ÷ 60 | (5.5 ÷ 6) |
| 10 | Ring nut fixing wheel bearing | 490 ÷ 540 | (49 ÷ 54) |
| 11 | Cylindrical screw with recessed hex locking ring nut | 25 ÷ 30 | (2.5 ÷ 3) |
| - | Notched nut for steering knuckle pin | 300* | 30* |
| - | Collar nut fixing brackets fixing leaf spring to axle | 410 ÷ 510 | (41 ÷ 51) |

D Apply LOCTITE 574 on cover/wheel hub contact surface

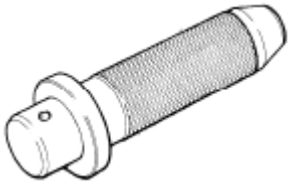
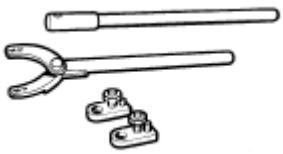
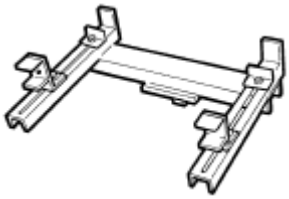
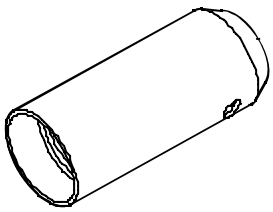
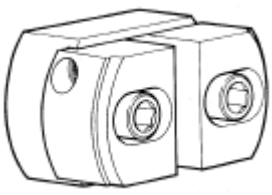
* Minimum torque - Maximum torque, tighten up to first notch matching to split pin hole

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## TOOLS

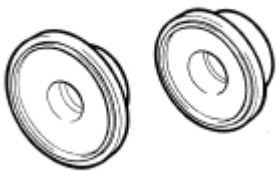
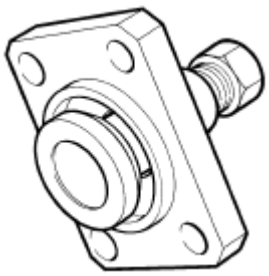
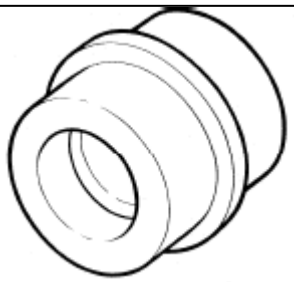
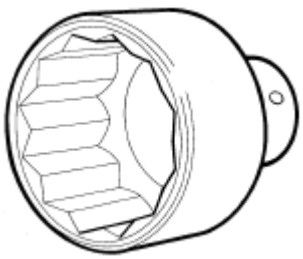
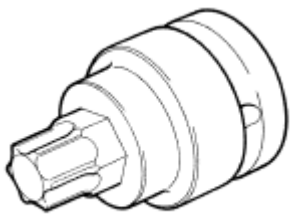
| TOOL NO. | | DESIGNATION |
|---|---|---|
| **99305354** |  | Wheel geometry portable optical testing equipment |
| **99321024** |  | Hydraulic truck to remove and re-fit in place the wheels |
| **99322215** |  | Stand for axle testing |
| **99347047** |  | Puller for stub axle pin |
| **99347068** |  | Puller for drag link kingpins |
| **99354207** |  | Wrench for wheel hub cup |

Aquila Trucks Centres

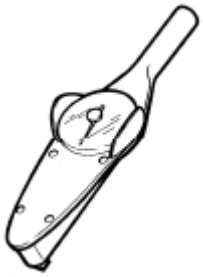
| TOOL NO. | | DESIGNATION |
|---|---|---|
| **99370006** |  | Handle for interchangeable beaters |
| **99370007** |  | Handle for interchangeable beaters |
| **99370317** |  | Lever and relevant extension bar |
| **99370628** |  | Stand for axle removal and installation |
| **99370715** |  | Guide for wheel hub assembly |
| **99374093** |  | Beater to fit in place bearing outer tracks (to be used with 99370007) |

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| TOOL NO. | | DESIGNATION |
|---|---|---|
| **99374132** |  | Tool for fitting wheel hub internal gasket (to be used with 99370006) |
| **99374173** |  | Elements to fit in place kingpin gasket (to be used with 9937007) |
| **99374405** |  | Tool to fit kingpin |
| **99374530** |  | Beater to remove/re-fit in place kingpin bearing (to be used with 99370007) |
| **99388001** |  | Wrench (80 mm) for wheel hub bearing adjustment ring nut |
| **99388002** |  | Wrench for screws to secure cross and side tie bar lever to steering knuckle |

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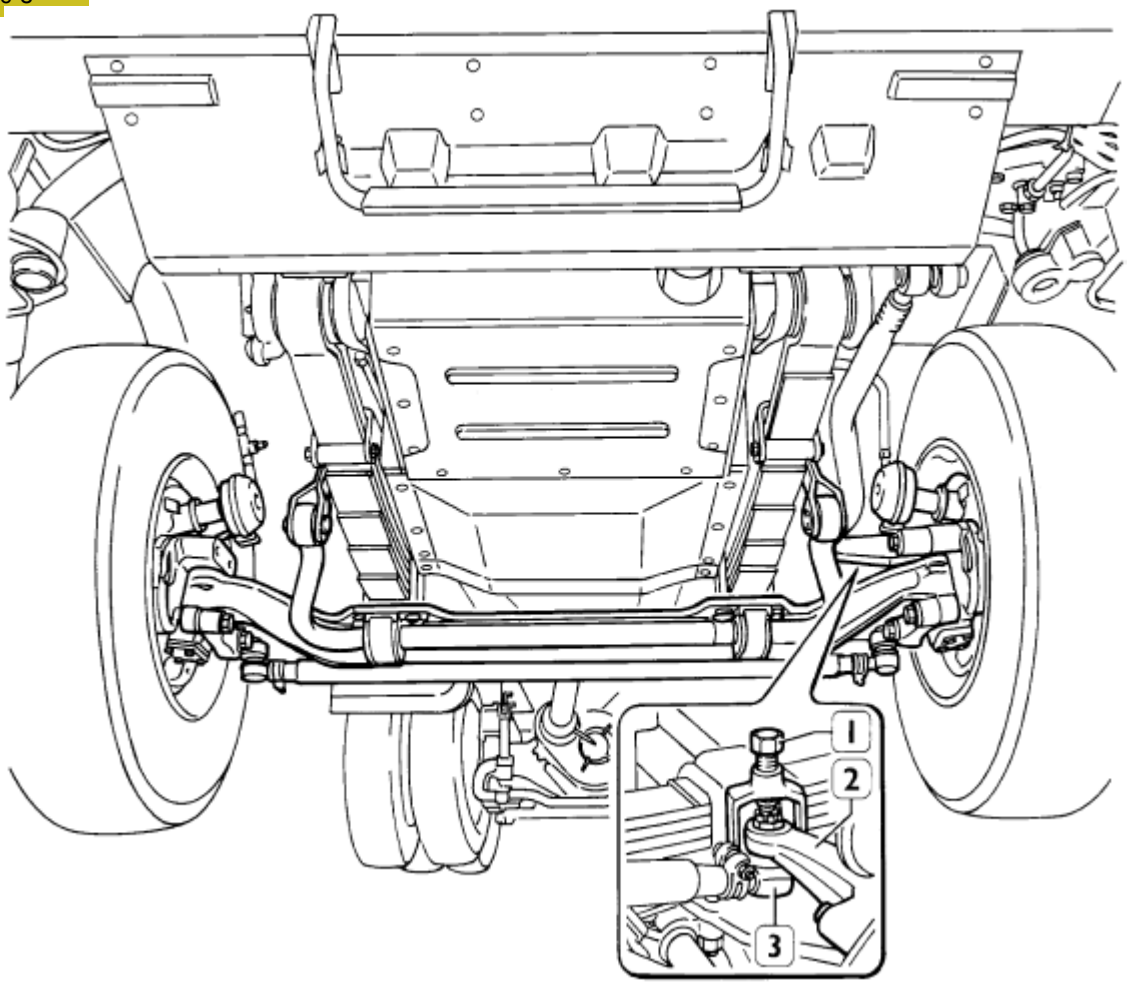
| TOOL NO. | | DESIGNATION |
|---|---|---|
| **99389819** |  | Torque wrench (0 - 10) with square 1/4" connection |
| **99395026** |  | Tool for testing hubs rolling torque (to be used with 99389819) |

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## 520610 REMOVING AND REFITTING THE AXLE

### Removal

Figure 3



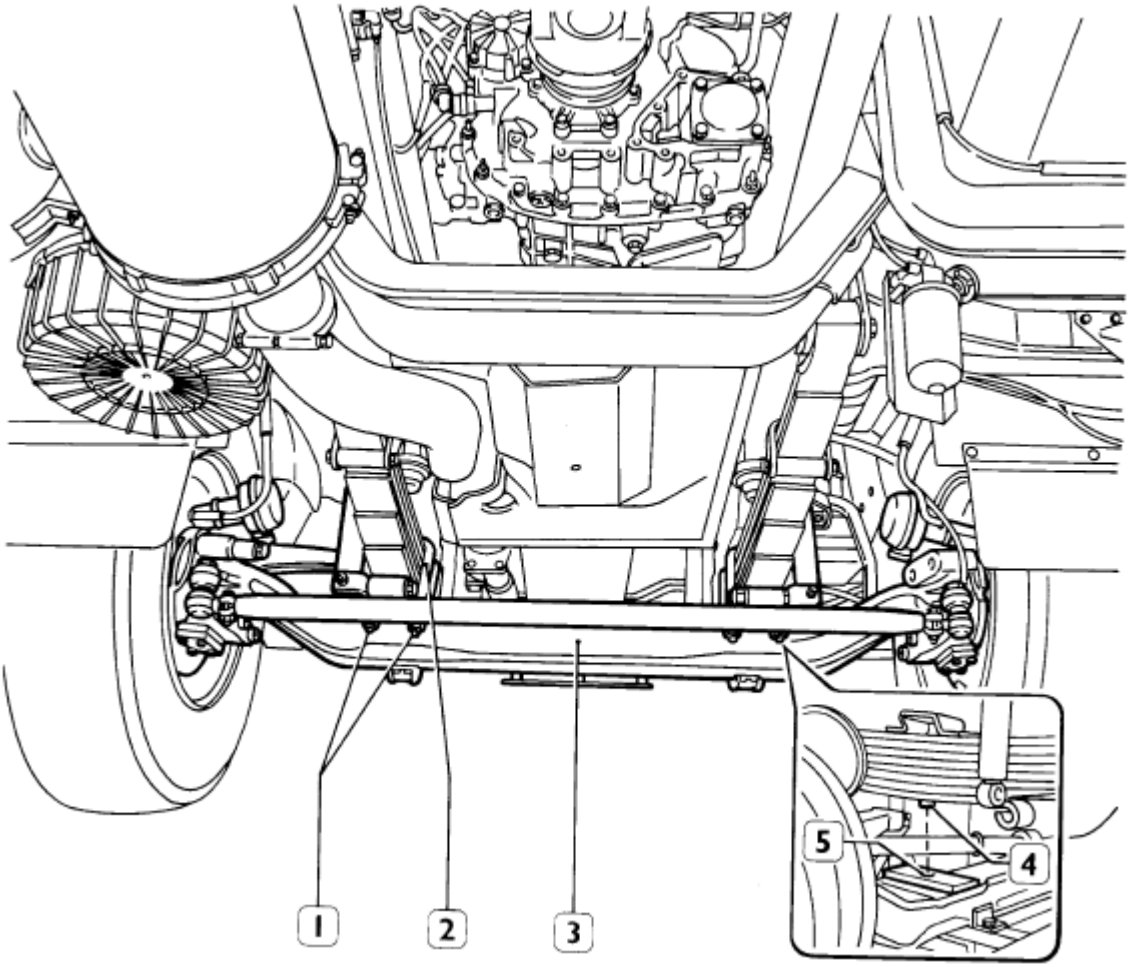

Place the vehicle on flat ground and lock the rear wheels.
Loosen the front wheel fastening nuts.
Using a hydraulic jack lift the front of the vehicle and rest it on two stands.
Take out the wheel nuts and remove the wheels with hydraulic truck 99321024.

Using puller 99347068 (1) remove the tie-rod (3) king pin on the arm (2)
Disconnect:

- Air delivery hoses from brake diaphragm cylinders;
- ABS transmitter electric cable;
- Brake linings wear indicator cable if the vehicle is equipped with this device.

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Figure 4




Set a hydraulic jack fitted with stand 99370628 under the axle (3).
Unscrew the nuts (1) and take away the leaf spring to axle fastening brackets (2).
Lower the hydraulic jack and remove the axle (3).

## Refitting in place

By means of the hydraulic jack fitted with stand 99370628 lift the axle so that the leaf spring connection pins (4) located on the spring support planes on the axle.

To re-fit in place, follow the removal instructions in reverse order.

All bolts are to be tightened to the prescribed driving torques indicated in the table on page 11.

Check and adjust the front wheel geometry.

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## VEHICLE CHECKS

### Kingpins

Clean the traverse and drag link kingpins. Check that the king pin components are not strained or broken If they are, replace them.

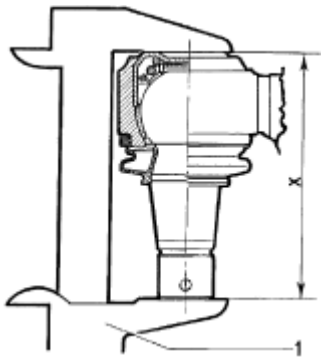
### Tie rods

Check the clamp screws and nuts, make sure they are not worn and that they are tightened to the prescribed torques. Check for strain or damage and if necessary replace them.

## TRACK ROD AND DRAG LINK BALL JOINTS SLACK CHECK

Do not lift the vehicle. With a gauge (1, Figure 5) measure distance "X" with the vehicle in straight running position. Measure again with the vehicle in full left-hand (X 1) and right-hand (X 2) steering positions; note the values found.

Figure 5




36914

Calculate slack "A" using the following formula:

A = B - X

where B is the greater value found from measurements X1 and X2.

If the value is more than 2 mm replace the kingpin.

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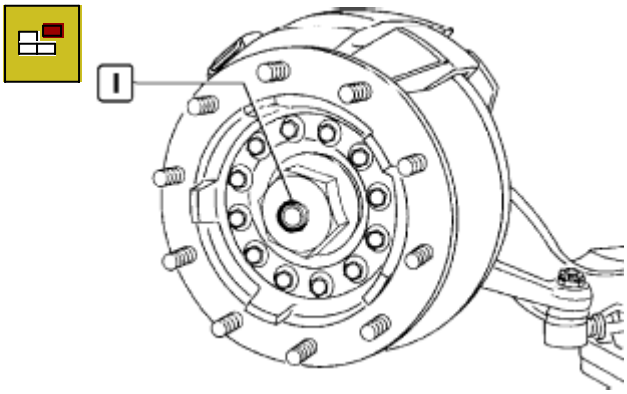
## 520610 FRONT AXLE ASSEMBLY OVERHAUL

Using a lift, position and secure the axle assembly (1) on the stand 99322215 (2) for overhaul.

## 520620 REMOVING - REFITTING WHEEL HUBS

### Removal

Figure 6

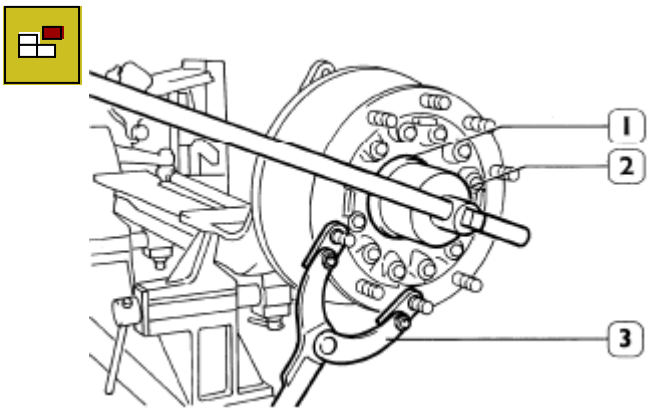



77206

Remove the brake callipers as described in the "BRAKE AIR SYSTEM" section.

Arrange special oil recover container at safety distance. Rotate wheel hub in such away as to take thread plug (1) downwards; unscrew plug (1) and drain oil into the container.

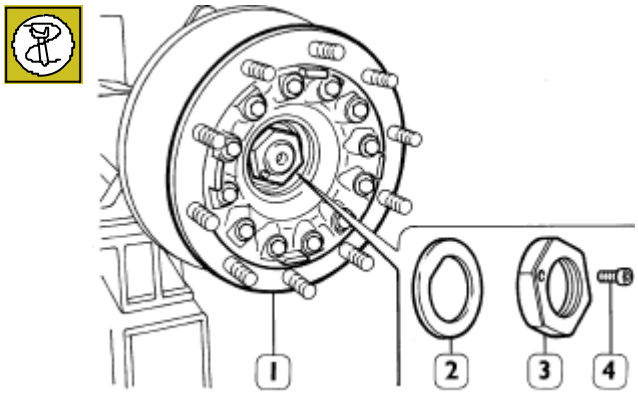
Figure 7




49178

Using the reaction lever 99370317 (3), lock the rotation of the wheel hub and, using wrench 99354207 (2), unscrew the oil cover (1). Drain oil completely.

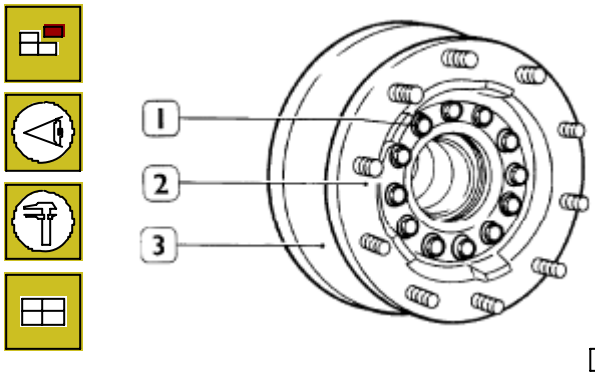
Figure 8




49179

Undo the screw (4), take out the adjustment nut (3) with the wrench 99388001, extract the washer (2), the outer bearing and remove the wheel hub (1) together with the spacer and internal bearing.

Figure 9



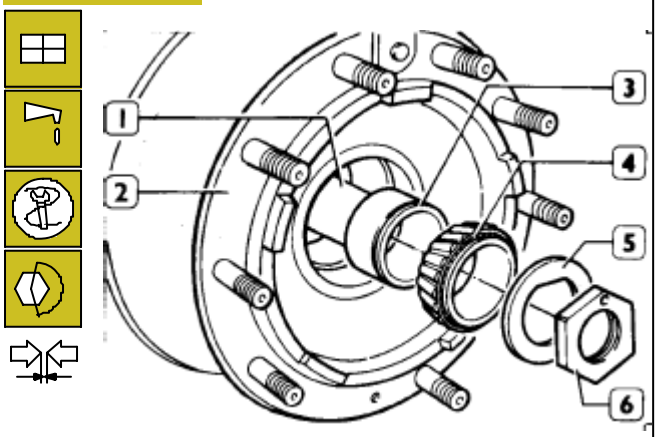

38597

Examine the state of wear of the brake disc (3) as described in the "BRAKE AIR SYSTEM" section.
To remove the brake disc (3), take out the screws (1) and disconnect it from the wheel hub (2).

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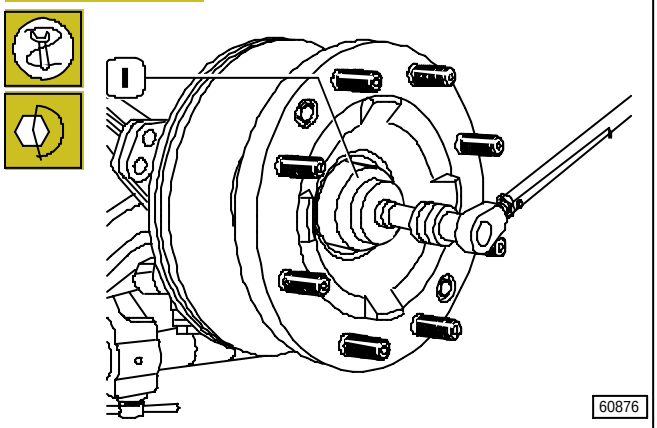
## Refitting wheel hubs

Figure 10




Screw the tool 99370715 (1) onto the kingpin and lubricate the outer surface of the kingpin with TUTELA W140/M-DA oil.
Carefully key the wheel hub (2) onto the kingpin so as not to damage the seal.
Fit on the spacer (3), inner ring (4) of the tapered roller bearing.
Unscrew the tool 99370715 (1).
Key on the washer (5) and screw down the stop nut (6).

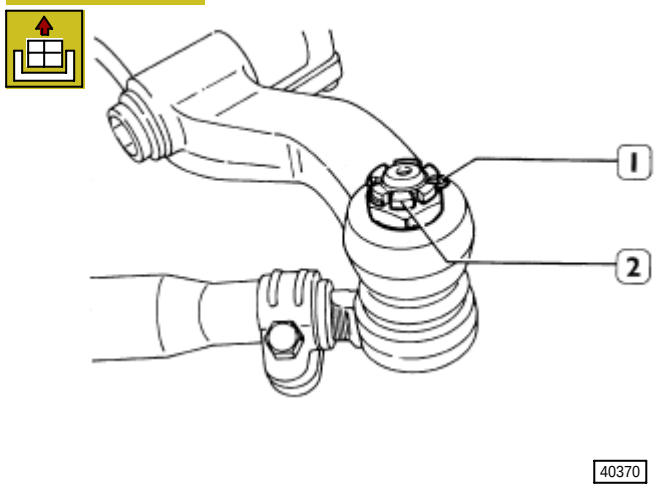
Figure 11




Using the wrench 99388001 (1) tighten the nut (6, Figure 10) to the required torque.

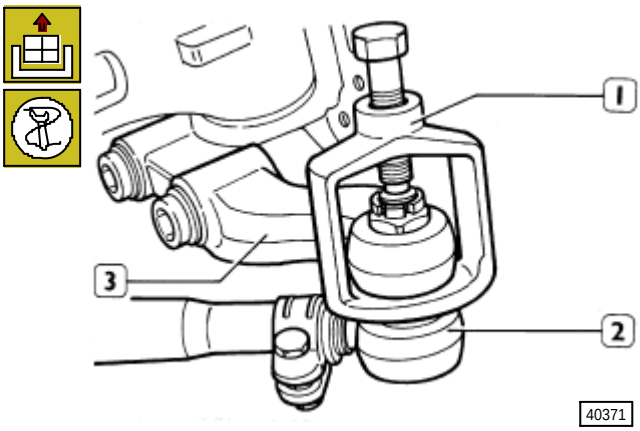
## 520635 REMOVING AND REFITTING IN PLACE THE TRACK ROD

Figure 12




Straighten and remove the split pin (1).
Loosen the nut (2) and partially unscrew to avoid the tie-rod falling when being removed.

Figure 13




Using puller 99347068 (1) release the kingpin (3) from lever (2). Repeat the same operations on the opposite side, unscrew the nuts completely and remove the track rod.

To re-fit in place follow the removal operations in reverse order.

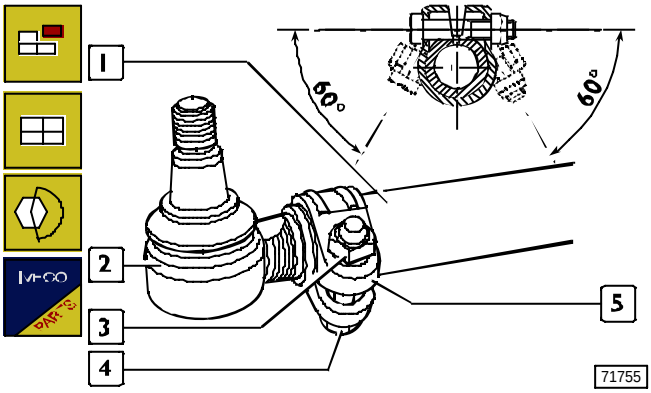
Tighten the taper pin nuts to the prescribed torque.

Check that the nut notches match the traverse holes on the taper pins; if the split pins do not enter, progressively increase the driving torque of the nuts until they enter correctly (lowest angle 60°)

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## 520635 REPLACING TRANSVERSE TIE ROD BALL JOINTS

Figure 14




Lock the screw (4), loosen the nut (3) and unscrew the articulation (2) from the transverse tie rod (1).

**NOTE** To make it easier to refit the transverse tie rod and then adjust the wheel toe-in, note down the number of turns needed to unscrew each single articulation so as to screw the new ones on with the same number of turns.

Screw the new articulation into the tie rod and lock it in position by tightening the locking nut (3) to the required torque.

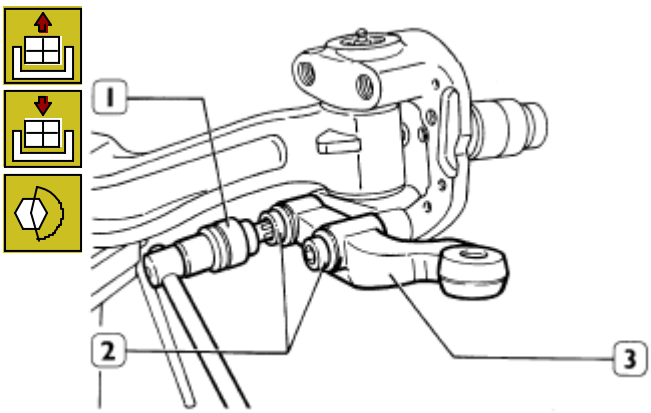
**NOTE** The nut (3) has to be tightened with the clamp (5) positioned in one of the set-ups shown in the figure.

Refit the transverse tie rod.

Check and if necessary adjust the toe-in of the front wheels as described under the section heading "Wheel Geometry".

## 520631 REMOVING AND REFITTING LEVERS FOR TRANSVERSE TIE ROD

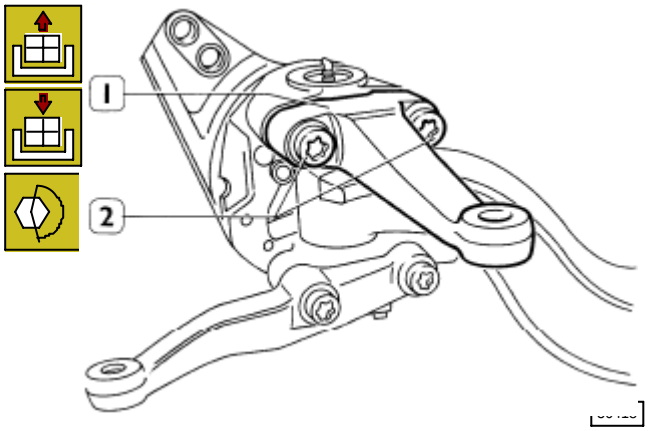
Figure 15




Using wrench 99388002 (3) unscrew the screws (2) and remove the lever (1). To refit it, carry out the operations in reverse order, locking the fixing screws to the required torque.

## 520632 REMOVING AND REFITTING LEVER FOR LONGITUDINAL TIE ROD

Figure 16

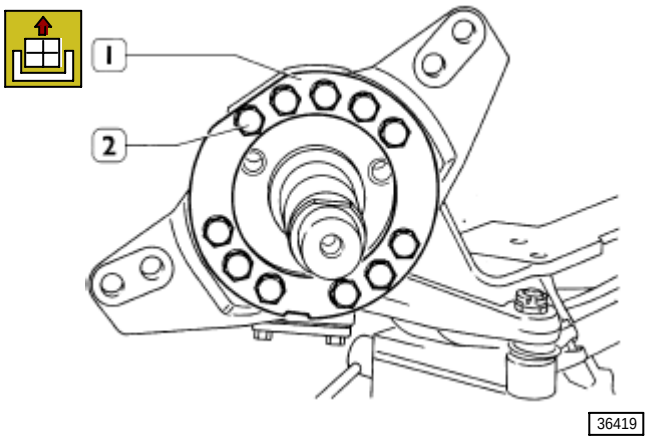



Using wrench 99388002 (1, Figure 14), unscrew the screws (2, Figure 15) and remove the lever (1). To refit it, carry out the operations in reverse order, locking the screws to the required torque.

## 520611 REMOVING AND REFITTING PIN FOR STUB AXLE

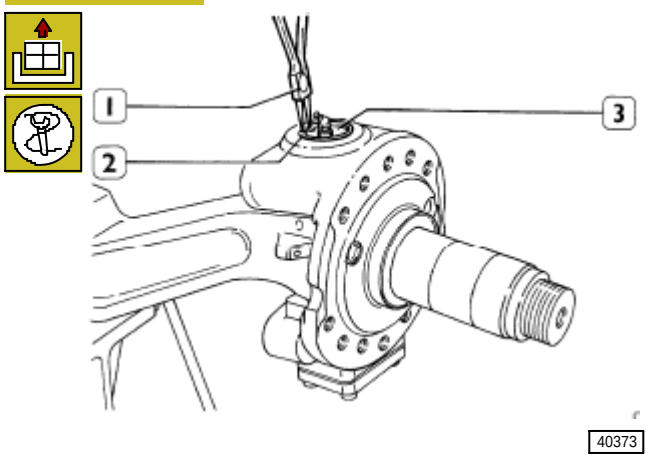
### Removal

Figure 17




Undo the screws (2) and detach the mount (1).

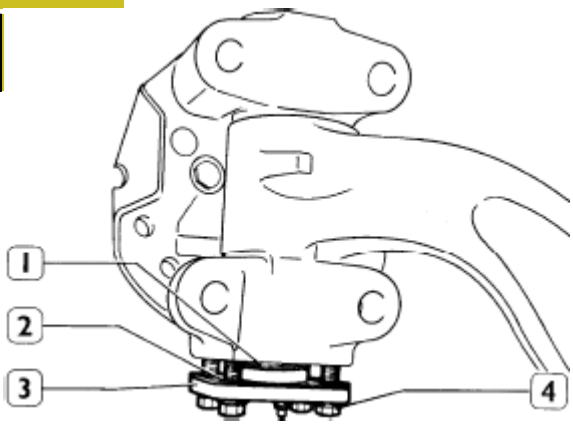
Figure 18




Using specific pliers (1), take out the retaining ring (2) and extract the cover (3) together with the grease nipple.

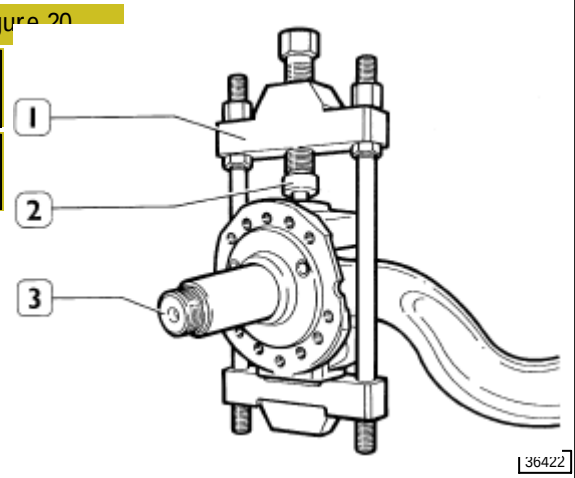
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Figure 19




Undo the screws (4) and remove the bottom cover (3), adjustment plates (2) and fifth wheel (1).

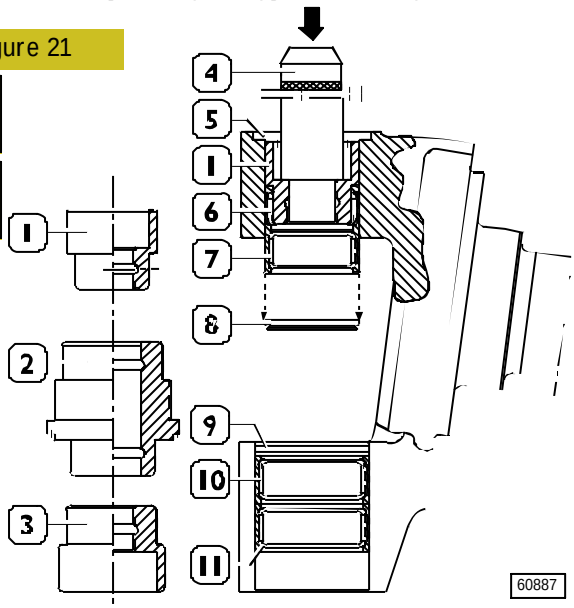
Figure 20




Using the tool 99347047 (1) and part (2), free the kingpin (3); remove the tool and take out the pin.

## 520615 Replacing kingpin bearing

Figure 21

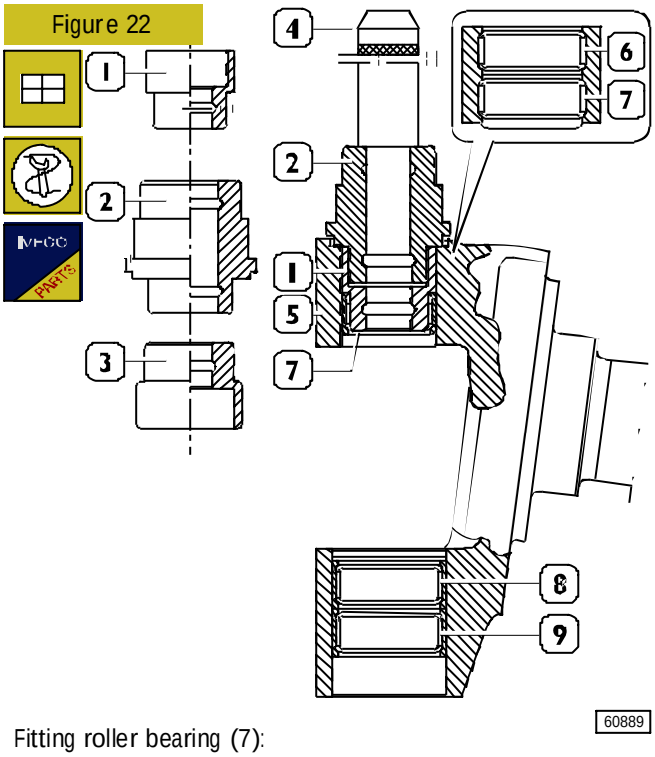



The kingpin bearings (5) are replaced by using parts (1-2-3) of drift 99374530 and grip 99370007 (4) to disassemble and assemble them.

**NOTE** The parts mentioned in the following text are shown in Figure 21.

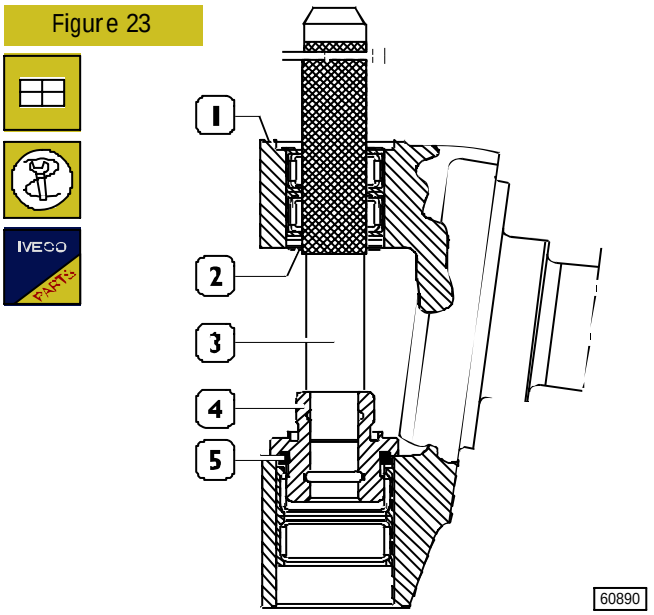
Use part (1) and grip (4) to remove the seal (8) and roller bearings (6-7) on the top side.
Use part (3) and grip (4) to remove the seal (9) and roller bearings (10-11) on the bottom side.

Figure 22




Fitting roller bearing (7):
use parts (1 and 2) and grip (4).
Fitting roller bearing (6):
use part (2) and grip (4).
Fitting roller bearing (8):
use parts (3 and 2) and grip (4).
Fitting roller bearing (9):
use part (2) and grip (4).

Figure 23

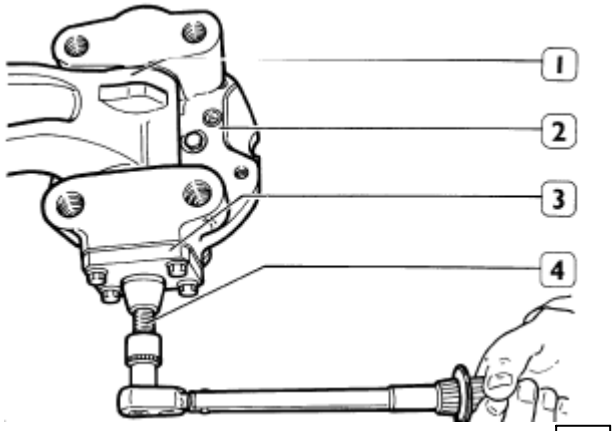



Using the drift 99374173 (4) and grip 99370007 (3), fit the seals (2 and 5) in the stub axle (1).

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## Refitting

Figure 24



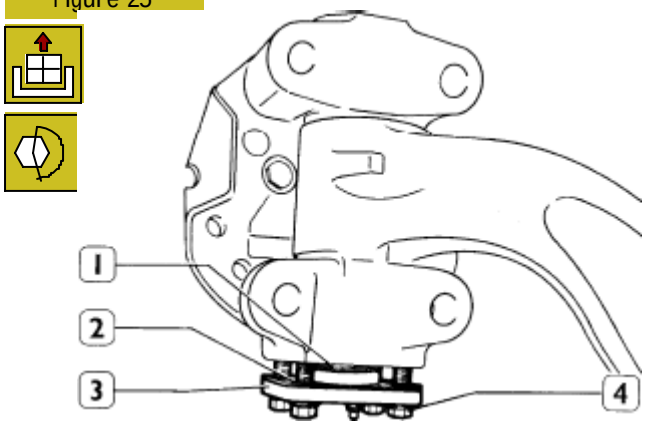

40374

Set on the axle (1) the stub axle (2) and fit the pin into its seat; apply tool 99374405 (3) to the stub axle and fasten it with the lower cover screws, tightening to a suitable torque.
Fit the pin in the axle tapered seat, tightening the pressure screw (4) to a torque of 15 ÷ 16 daNm.
Remove tool 99374405 from the stub axle.

**NOTE** Before fitting the pin make sure that the tapered seat on the axle and the pin surface are perfectly clean and dry to avoid oil film that could cause the pin to rotate in its seat when fitting it in.

Before fitting in place, dampen the lower cover collar with Tutela MR2.

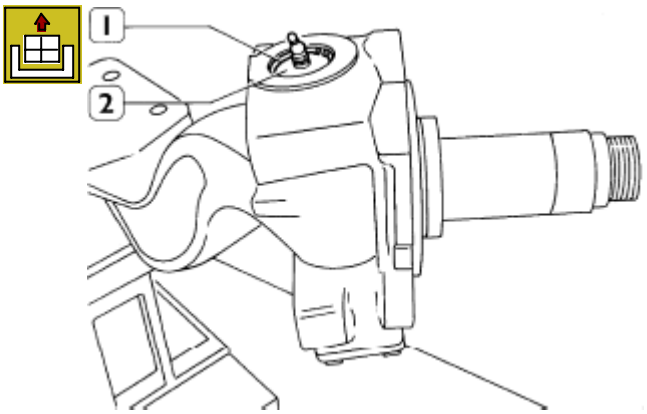
Figure 25




36421

Set the lower cover (3) with the collar (1) and shims (2); tighten the fastening screws (4) at prescribed torque.
Repeat the same operation for the opposite axle.

Figure 26



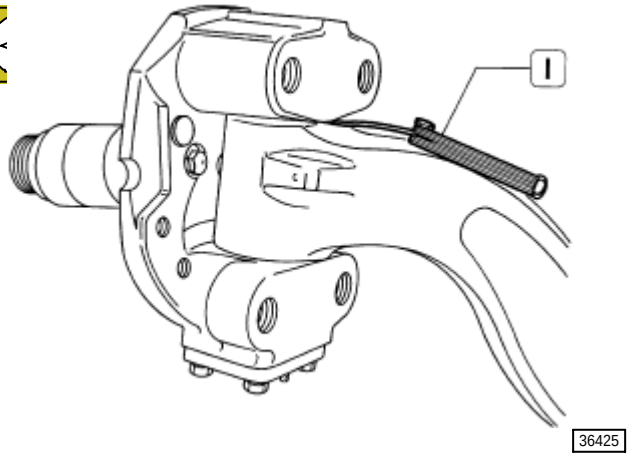

36420

Fit the upper cover (2) into its housing together with the seal gasket; set the grease nipple as shown in the figure, then fit the circlip (1) making sure that the ring expansion takes place correctly.

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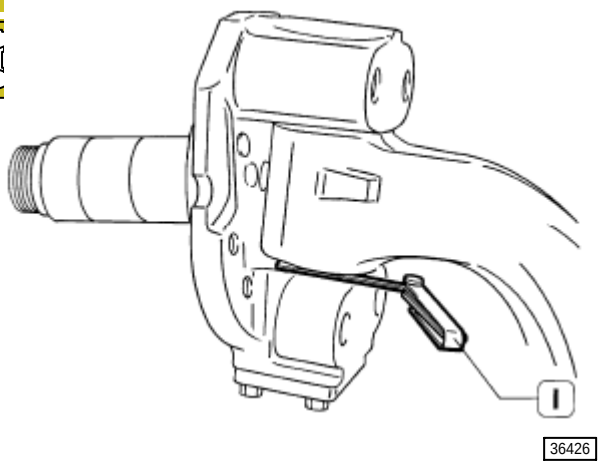
## Stub axle-axle end play check and adjustment

Figure 27




Lift the stub axle so that it is in contact with the lower shim of the axle. Use a feeler gauge (1) to check the clearance between the stub axle upper shim and the axle. The allowed range is between 0.10 and 0.15 mm.

Figure 28




After the clearance between the upper shim of the stub axle and the axle has been checked, use a feeler gauge (1) to check that between the lower shim of the stub axle and that of the axle there is a clearance of not less than 0.25 mm.

If end play adjustment is necessary, replace the shims with other spares that have suitable thicknesses.

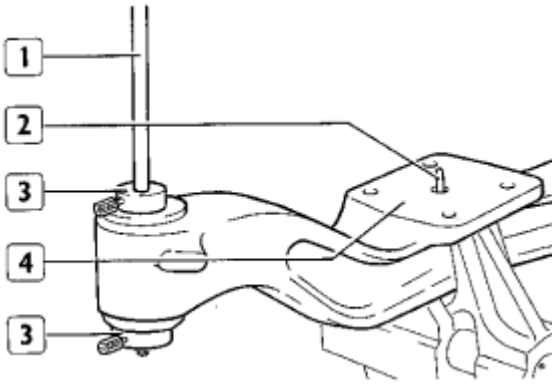
The thicknesses of the spare rings are indicated in the SPECIFICATIONS AND DATA table (page 6).

Grease the complete upper and lower joint with MR2 making sure that the grease flows through the baffle lip of the gaskets.

## 520618 AXLE BODY CHECKS AND MEASUREMENTS

### Checking leaf spring supporting surface levelness with reference to kingpin holes using proper equipment

Figure 29



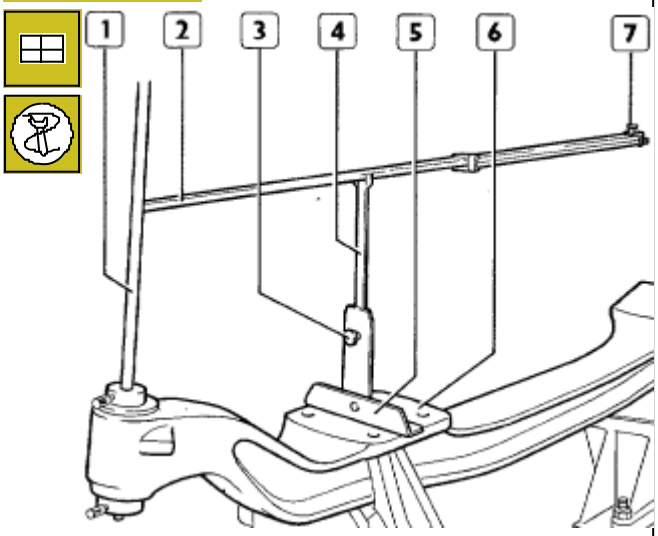

Set the two rods (1) with the cones (3) in the kingpin holes; press down the cones and lock them in position with the screws on the rod.
Insert the two set screws (2) in the seats on the leaf spring contact surface.

Set the bases (5, Figure 30) with goniometers on the surfaces (6) and insert the set screws.

**NOTE** Before placing the bases with the goniometers, make sure that there is no paint or roughness on the contact surfaces.

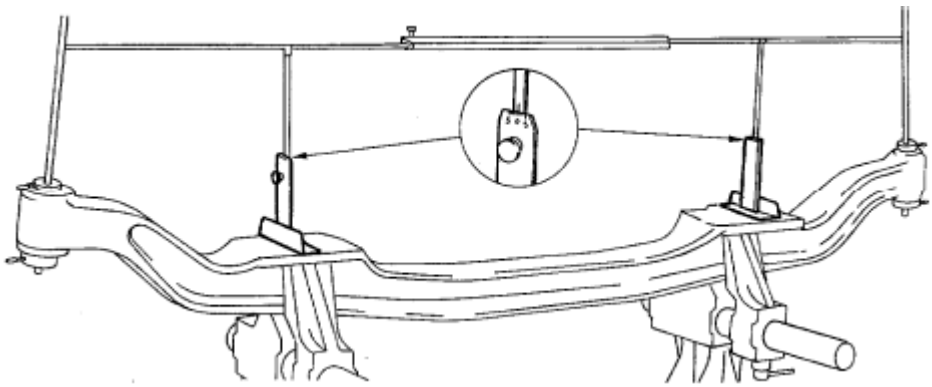
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Figure 30




Set the sliding bar (2) on the goniometer rods, adjusting the length so that the shaped ends remain inserted in the rods (1) Lock the clamp screw (7) and the screws (3) that fasten the goniometer to the rods (4)

Figure 31

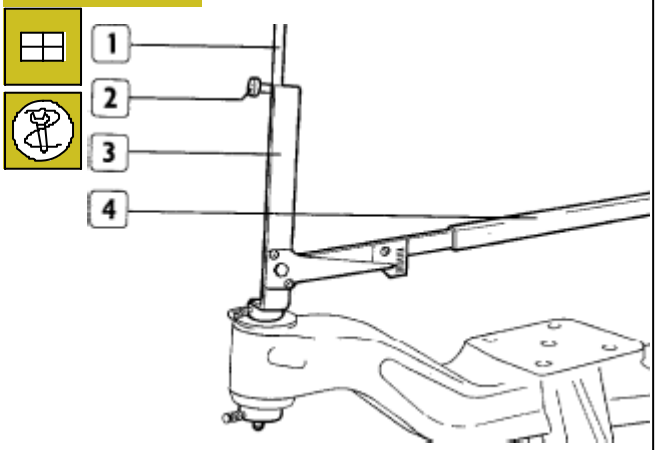


Check for deviation angles on the goniometer scaled sections indicated by the arrows.
The goniometer indicators do not indicate any angular displacement when the planarity of the leaf spring contact surface with reference to the stub axle pin holes is correct.
Remove the sliding bar and the bases with goniometer.

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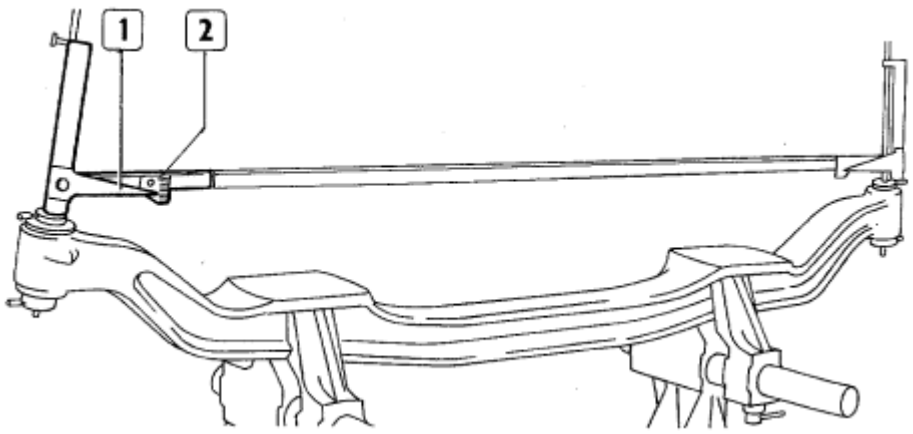
## Kingpin seats camber angle check

Figure 32




Set the supports (3) with goniometers on the rods (1) and slightly turn the screws (2) without locking them.
Insert the coupling track rod (4) and tighten the screws (2) that fasten the supports in the rods (1)

Figure 33




Read the kingpin holes camber angle value in the relevant scaled sectors (2) according to the indicators (1).

The camber angle value for the kingpin holes is to be 7° ± 0°3'

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# Wheel alignment


| | Page |
|---|---|
| GENERAL INFORMATION | 27 |
| - Steering wheel angles | 27 |
| FRONT WHEEL ALIGNMENT (4X2 VEHICLES) | 28 |
| - Positioning clips and headlights | 28 |
| - Electronic compensation of rim eccentricity | 29 |
| - Wheel alignment | 29 |
| - Checking wheel toe-in | 30 |
| - Checking wheel deviation | 30 |
| - Checking camber | 30 |
| - Checking kingpin angle and caster | 31 |
| - Checking rear axle alignment | 32 |
| WHEEL ALIGNMENT OF VEHICLES WITH ADDED CENTRAL AXLE (8X4X4) | 32 |
| - Checking steering angles | 34 |

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# GENERAL INFORMATION

## Steering wheel angles

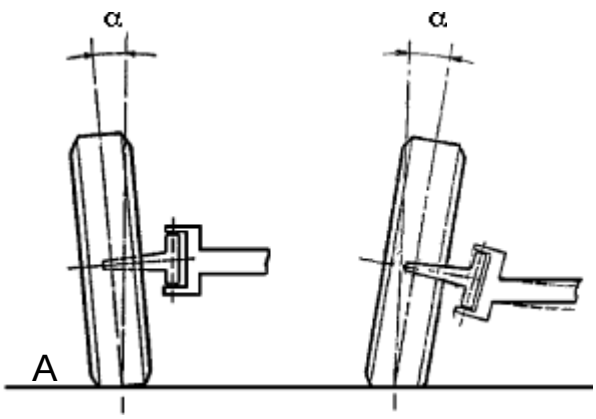
To ensure satisfactory road holding performance, low tyre wear and to allow driving wheels in the steering stage to return spontaneously to straight ahead running position, front wheels are given the following fitting angles:

- camber;
- kingpin angle;
- caster;
- toe-in.

These angles, suitably calculated, produce the right balance of the forces created when the vehicle is moving, in different load conditions, which tend to alter the position of the wheels on the ground.

Figure 1

Camber

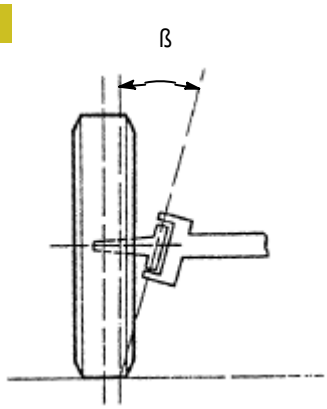



32956

The camber (α) is the angle formed by the axis passing through the centre line of the wheel and the vertical to the ground when observing the vehicle from the front.
The angle is positive (A) when the top of the wheel tilts outwards, negative (B) when the top of the wheel tilts inwards.

Kingpin angle

Figure 2

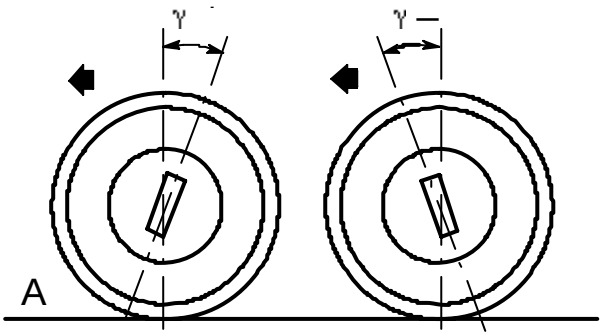



32957

The kingpin angle (ß) is the angle formed by the axis passing through the kingpin and the vertical to the ground when observing the vehicle from the front.
When the extension of the kingpin axis approaches the wheel at its point of contact with the ground (opposite to the camber), the angle is positive; it is extremely difficult, if not impossible, to have a negative kingpin angle.
The camber (α) and kingpin angle (ß) make it possible for the axes of the wheel and kingpin to come as close as possible to the centre of support of the tyre on the ground.
This produces low tyre consumption and a low steering torque.

Caster

Figure 3



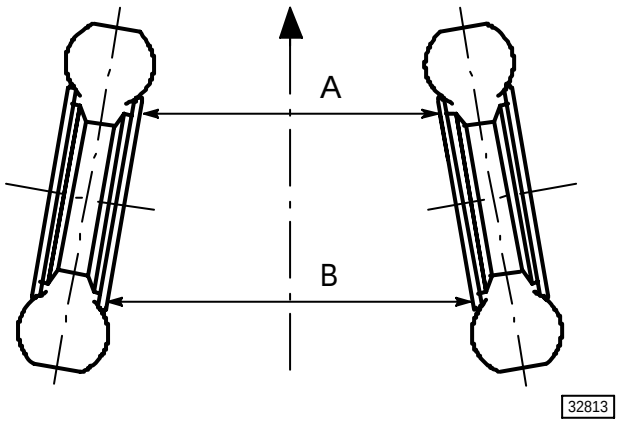

32958

The caster (γ) is the angle formed by the kingpin axis with the vertical to the ground when observing the vehicle from the side.
If the extension of the kingpin axis falls forwards to the point where the wheel rests on the ground, in the direction of travel of the vehicle, the caster is by convention positive (A); it is negative (B) if it falls behind the point where the wheels rest on the ground, and zero if it is exactly vertical to the point where the wheels rest on the ground.
This angle makes it possible to keep the front wheels straight when the vehicle is travelling in a straight line and for them to return straight on their own after the position they take in a bend as soon as the driver lets go of the steering wheel.

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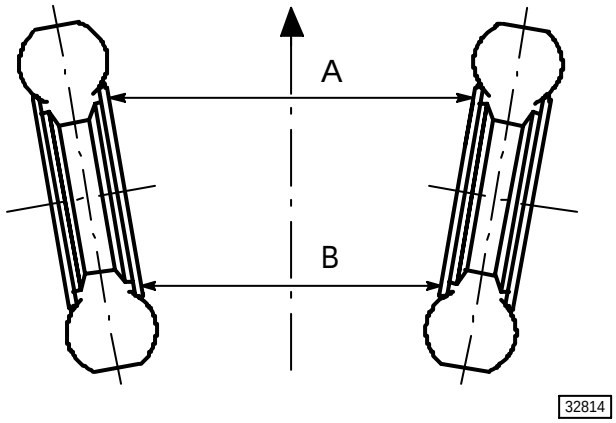
Wheel toe-in

Figure 4



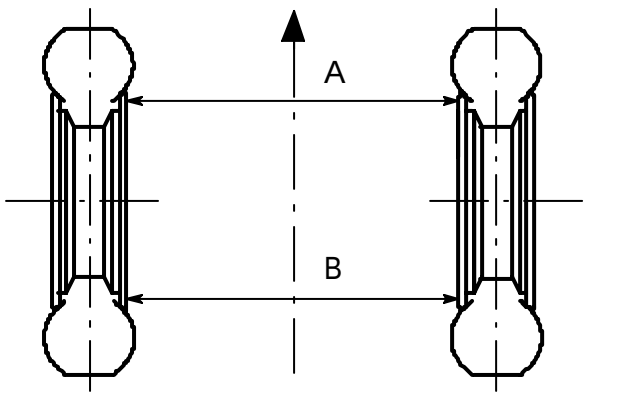

The toe-in is the result of the difference between the distances A and B (in mm) measured on the horizontal axis of the rims, when observing the vehicle from above.
This produces light driving and low tyre consumption.
Toe-in is positive if B is greater than A.

Figure 5




Toe-in is negative if B is less than A.

Figure 6




Toe-in will be zero if B is equal to A.

## FRONT WHEEL ALIGNMENT (4X2 VEHICLES)

Before moving on to the checks, it is necessary to make a preliminary inspection of some parts of the vehicle that may affect wheel geometry. If any trouble is found, it will have to be rectified in order to avoid incorrect measurements. The checks to make are the following:

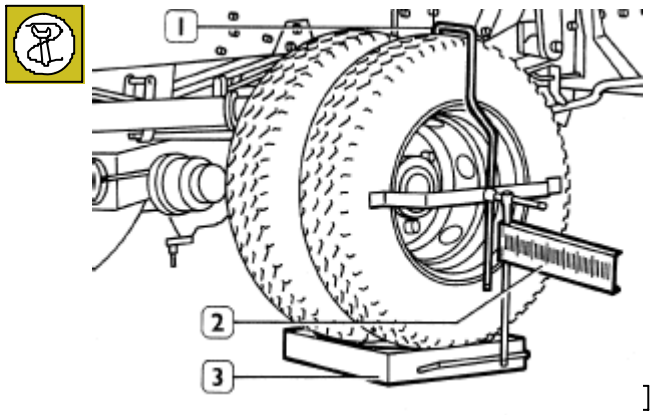
- tyre pressure;
- wheel hub bearing clearance;
- clearance between steering tie-rod pins and levers on stub axles;
- efficiency of shock absorbers;
- wheel rims, which must have no buckling out of tolerance.

Check the wheel geometry with the instrument 99305354.

The checks and any work on the wheel geometry must be done with the vehicle with a static load. Periodically make sure the light clusters are set correctly.

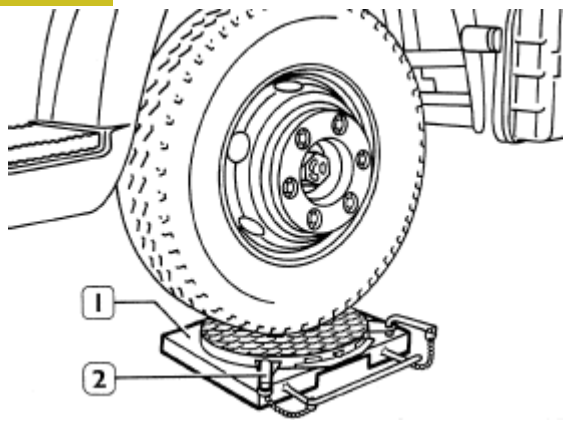
### Positioning clips and headlights

Figure 7




Set the vehicle with its wheels in the position of straight-line travel on a flat surface. Lift the rear of the vehicle and place the boards (3) under the wheels. Lower the vehicle, brake the rear wheels and fit on the hook (1) with the rule (2).

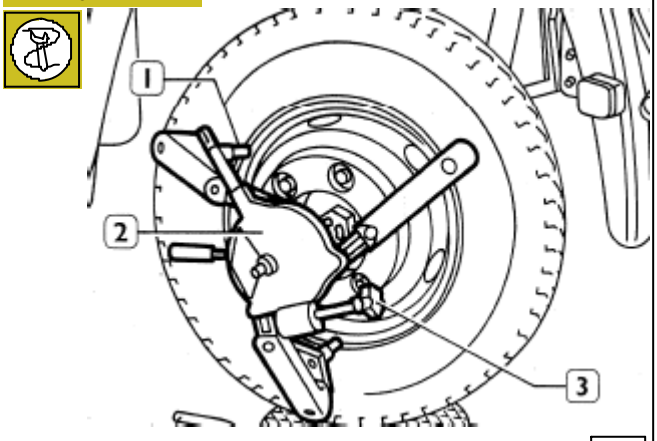
Figure 8




Lift the front of the vehicle and place oscillators (1) under the wheels, locking them with the clamps (2).

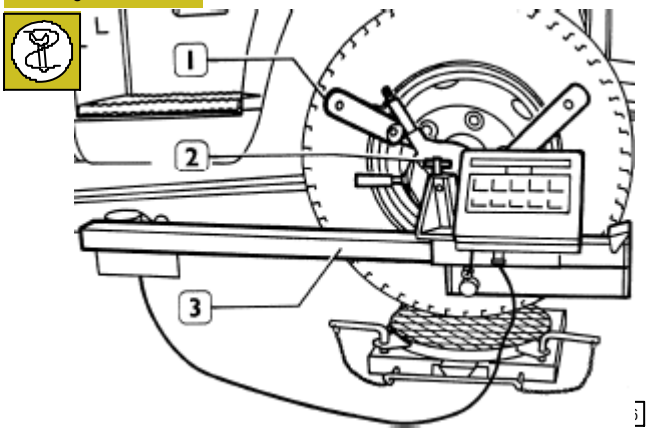
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Figure 9




Position the self-centring clip (2), fitted with appropriate fixing pins (1), on the rim of the wheel. Using the knob (3), lock the clip on the wheel, checking it is properly anchored.

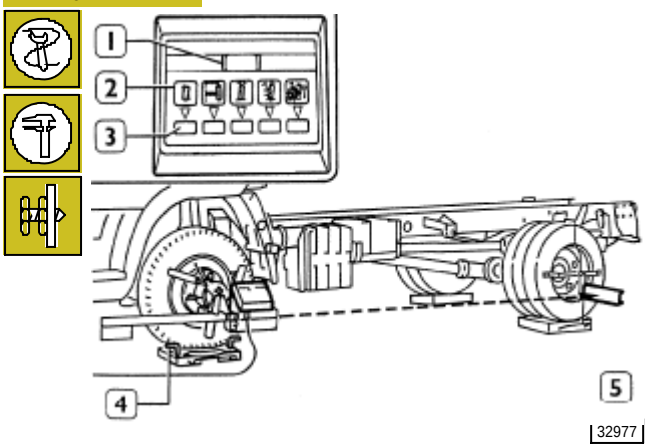
Figure 10




Fit the measuring unit (3) on the clips (1) and fasten it with the screw (2). Repeat these steps on the other wheel.

## Electronic compensation of rim eccentricity

Figure 11



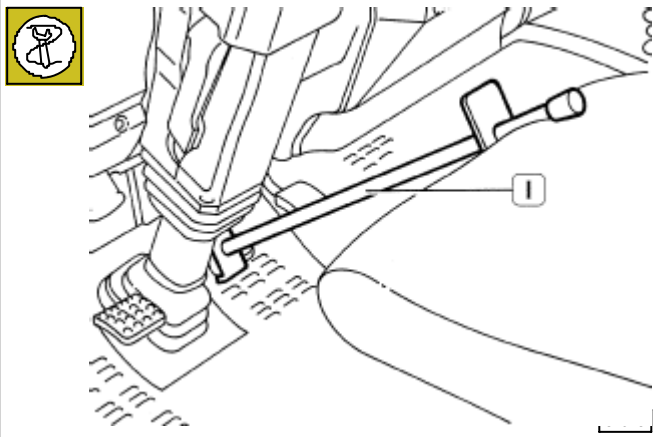

Connect the plugs of the measuring unit to the transformer and turn on the switch. Loosen the locking screw of the measuring unit and lift the lens shield. Press the "off centre" button (3) for at least two seconds, five lines will appear on the display (1).

Turn the wheel slowly by hand and project the light signal onto the corresponding scale of the rule (5).
Measure and note down the minimum and maximum travel of the light signal: e.g., 12 and 8.
Calculate the mean travel: 12+8 = 20:2 = 10 and position the wheel on the mean value calculated, marking its position.
Press the "off centre" button (3) again till the wheel toe-in LED (2) comes on and the digital indicator (1) shows an artificial value.
Repeat these steps on the other wheel.

Take care the laser beam does not hit anyone's eyes: it would severely damage their sight.

Lower the vehicle so that the wheels, in the marked position, rest completely in the middle of the oscillating plates, and free these from their bases, taking out the pins (4).

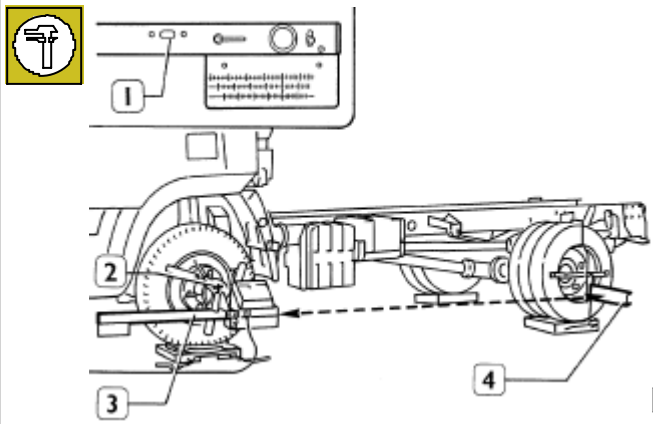
Figure 12




Press the brake pedal and lock it in position with the tool (1) positioned against the seat, thereby keeping the vehicle braked for the entire cycle of measurement.

## Wheel alignment

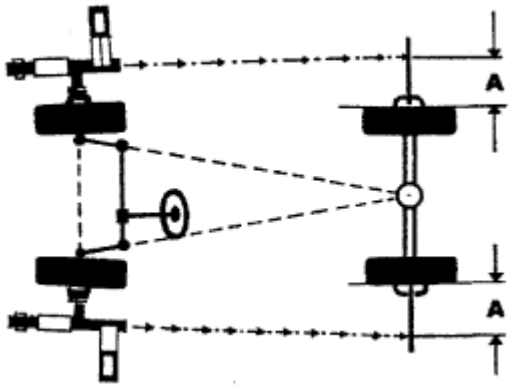
Figure 13




Level the measuring units (3) with the spirit level (1) and lock them in position with the screw (2).
Move the rules (4) until they are centred by the light signal emitted by the measuring unit and note down the values given.

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Figure 14

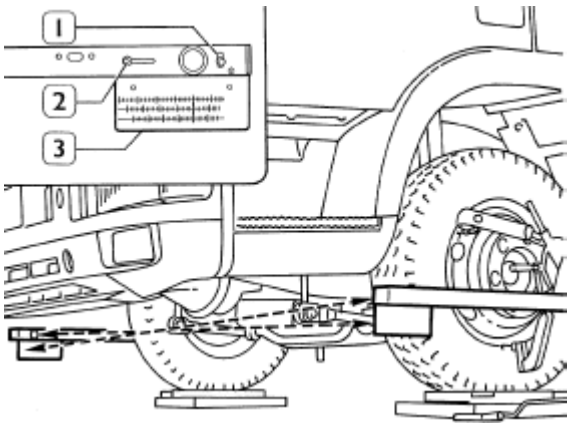



13952

If the values are not the same, turn the wheels until the pointers of the light signals are on two equal values (A), exactly the mean value of the two readings made beforehand. This produces perfect wheel alignment.

## Checking wheel toe-in

Figure 15




32980

With the measuring units still level and the wheels perfectly aligned, using the lever (1), move the lens shield.
Using the lever (2), direct the pointer of the light signal onto the millimetre scale of the rule (3) corresponding to the diameter of the rim.
Repeat these steps on the opposite measuring unit and read off the value of the toe-ins given in mm on the millimetre scales.
The algebraic sum of these two measurements must give the required value.

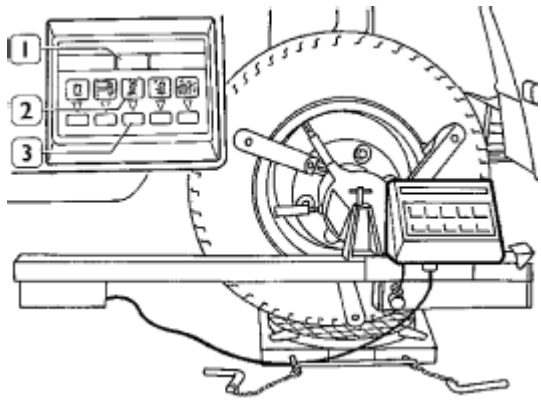
The toe-in is adjusted with the transverse tie rod so as, for each wheel, to have a toe-in equal to half the required value.

## Checking wheel deviation

The deviation is checked while reading the toe-in.
The partial value of the toe-in measured on the rule (3) has to be equal to the value measured on the rule on the other wheel.
If, however, there is a difference in these values, e.g. -2 and +3, the total toe-in is +1 and is therefore correct, but at the same time it indicates a deviation between the wheels (one wheel further forward than the other) of 5 lines.
This number of lines is calculated with the algebraic sum of the values measured: +3-(-2) = 5, or more simply by counting the lines between the two values.
Each line corresponds to a deviation of 2 mm.
When the deviation is greater than 10 lines (20 mm), it is necessary to make additional checks, to verify the state of the leaf springs (whether one of these has given way, or whether the chassis or axle are out of shape).

## Checking camber

Figure 16




32981

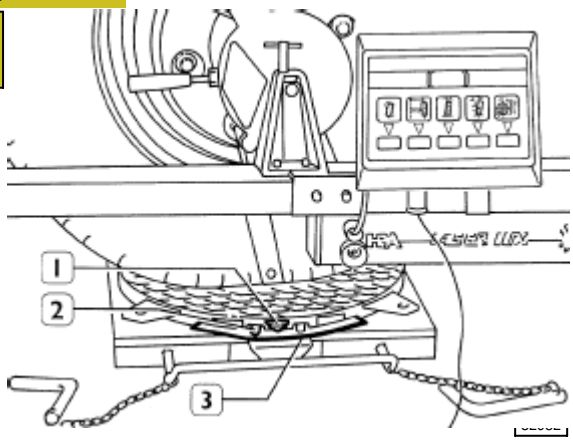
With the front wheels aligned with the rear ones and the measuring units level, press the camber button (3); the LED (2) will come on and the display (1) will show the value of the camber, that has to be 1º.

**NOTE** The camber is a fixed value that cannot be adjusted. Therefore, if you find the value is not as required, detach and remove the axle to make the relevant checks and replacements if necessary.

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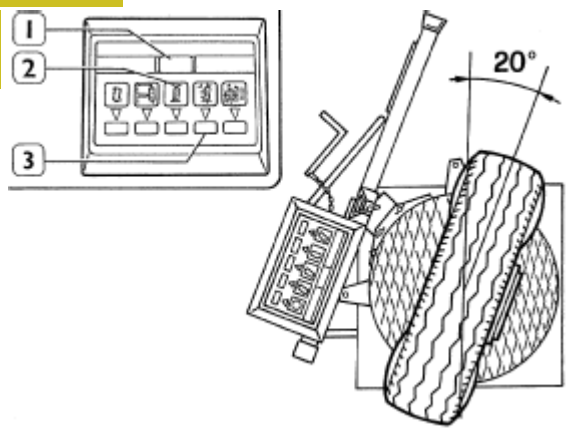
## Checking kingpin angle and caster

Figure 17



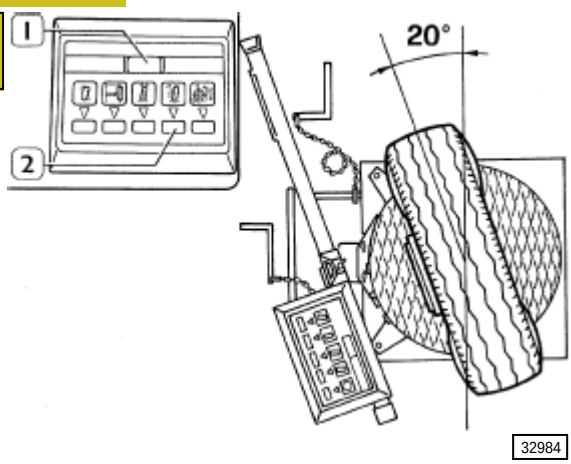

Still with the front wheels aligned with the rear ones, loosen the knurled knobs (2) and reset the graduated sector (3) on the pointer (1) of the oscillating plate.

Figure 18



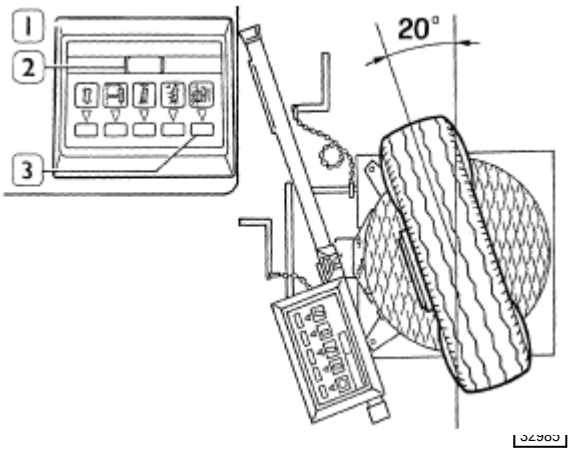

Turn the wheels 20° inwards and press the kingpin angle button (3) twice; the LED (2) will come on and the display (1) will show nine horizontal lines.

Figure 19




Turn the wheels 20° outwards and press the kingpin angle button (3) again; the display (1) will show the value of the kingpin angle that has to be 7°.

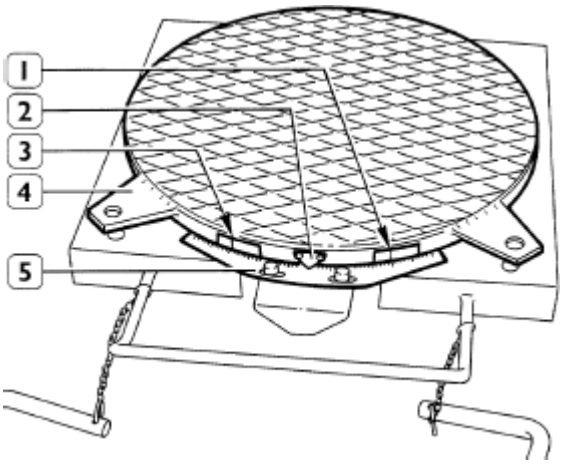
Figure 20




Without moving the wheel, press the caster button (3). The LED (1) will come on and the display (2) will show the value of the caster, which has to be the required value.

**NOTE** The caster and kingpin angle are fixed values that cannot be adjusted.
Therefore, if you find the values are not as required, detach and remove the axle to make the relevant checks and replacements if necessary.

Figure 21

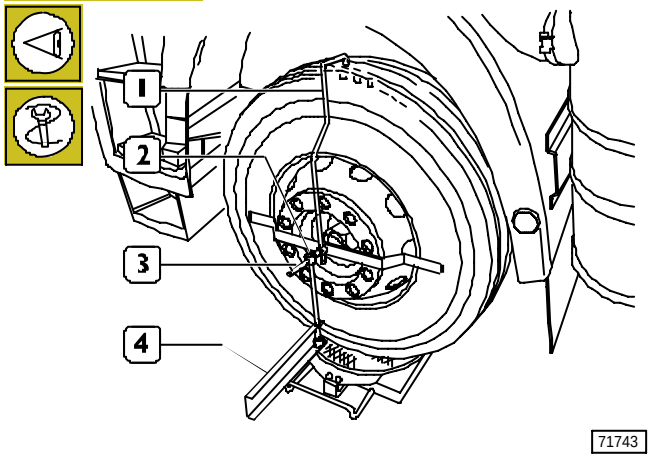



With the wheels turned straight, reset the graduated sectors (5) on the pointer (2) of the oscillating plates (4).
If the steering angles to be measured are greater than 30°, it is necessary to use the 20° mark (1) on the oscillating plate and the corresponding one of the graduated sector as "0°" reference indices.
Turn the wheels to reach a required angle (internal or external wheel angle).
Then check that the steering angle (external or internal wheel angle) of the opposite wheel corresponds to the required value, remembering to use the corresponding scale with the sign shown on the oscillating plate to read off the angle.

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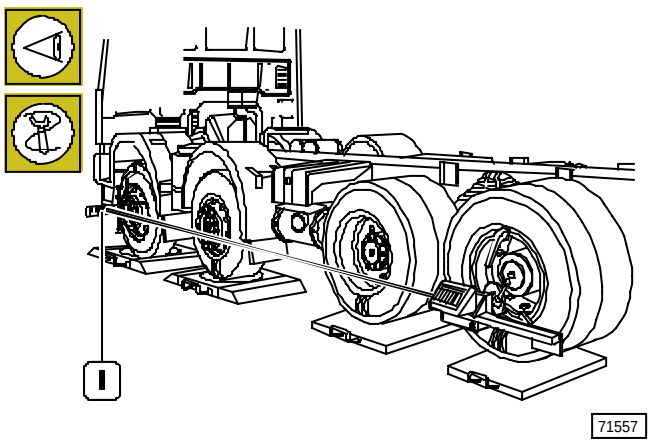
## Checking rear axle alignment

Figure 22




Fit the rule (4) on the front wheels, checking the slide (2) is exactly in the middle of the two annular grooves of the shaft (3).
Fit the measuring units on the rear wheels as described above for the wheels of the front axle.

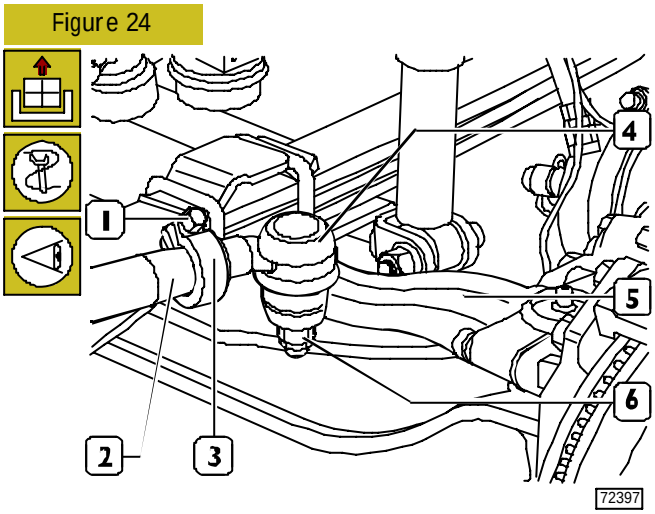
Figure 23




Project the light signal on the rule (1) and note down the value shown.
Repeat this measurement on the other wheel and check that the value shown is the same as the one noted down; if it is not, thoroughly check over the assembly of the rear axle on the vehicle: if you find no trouble, check the chassis has not lost its shape, following the procedures described in the "Bodywork - Chassis" section.

## WHEEL ALIGNMENT OF VEHICLES WITH ADDED CENTRAL AXLE (8X4X4)

Figure 24

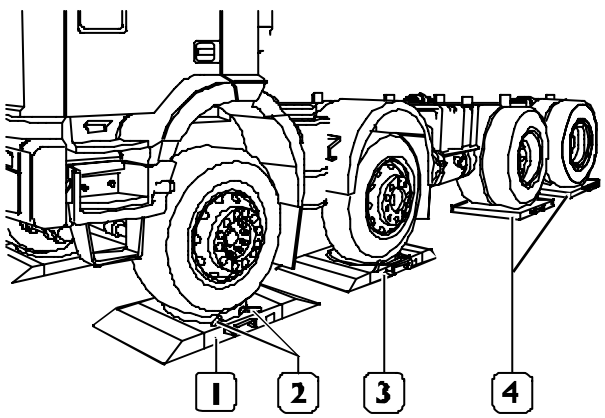



Detach the swivel head (4) of the rear longitudinal tie rod (2) from the steering lever (5) of the central axle with the extractor 99347068.

Check the distance between the centre distances of the swivel heads of the tie rod (2). It must be 953 ± 10 mm. If it is not, loosen the screw (1) fixing the collar (2) and turn the tie rod (2) appropriately.

Provisionally fit the swivel head (4) back onto the lever (5) and screw down the fixing nut (6) without fully locking it.

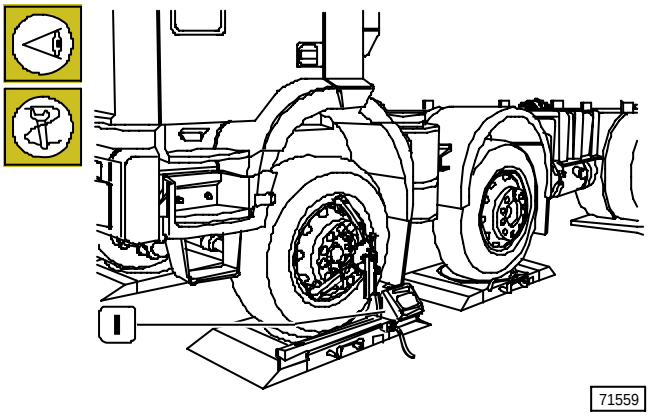
Figure 25




Lift the vehicle, position the oscillating plates (1 and 4) of the device 99305123 under the wheels of the steering axles, locking them with the specific clamps (2) and place the boards (3) under the rear wheels.

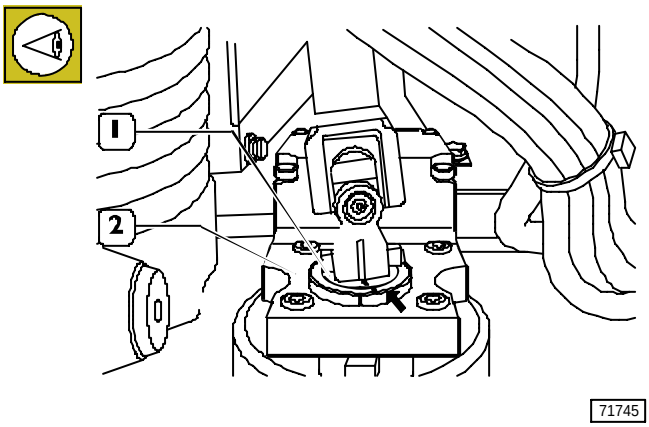
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Figure 26



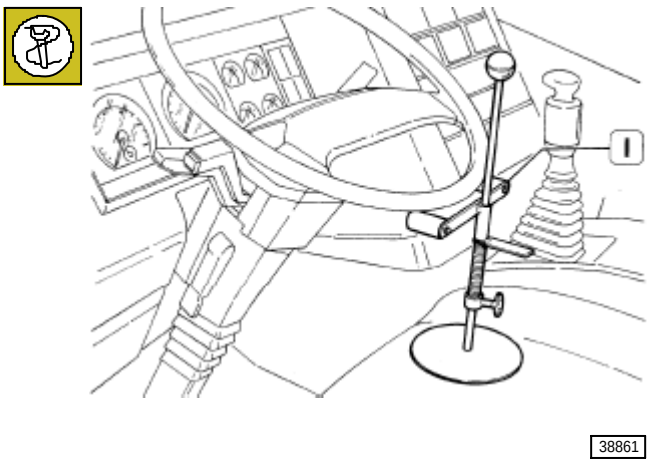

Check front axle wheel geometry using device 99305123 (1) according to procedure described and illustrated for 4X2 vehicles.

Figure 27



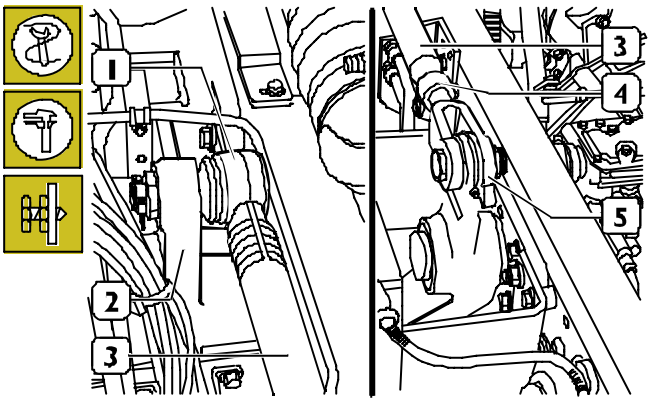

After checking and adjusting the toe-in, if necessary, set the wheels straight and check the steering box is in the "steering centre" position, that is the notch ⇐ of the shaft (1) coincides with the notch ⇒ of the steering box (2).

Figure 28




Lock the steering wheel with the tool (1).

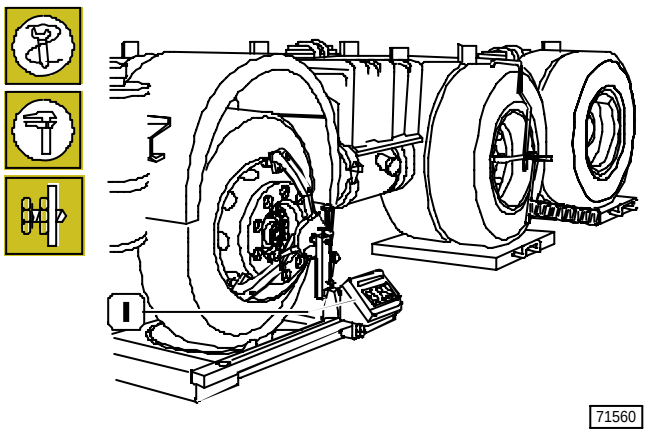
Figure 29




Check that the distance between the centre distances of the swivel head (1) and of the fork (5) of the middle longitudinal tie rod (3) is 1735 ± 2 mm.
If this is not so, disconnect the swivel head (1) from the lever (2) with the extractor, loosen the collar (4) and turn the tie rod (3) appropriately to get the required distance; then, fit the swivel head (1) back onto the lever (2).

**NOTE** Each turn of the tie rod (3) corresponds to a change in its length of 0.75 mm.

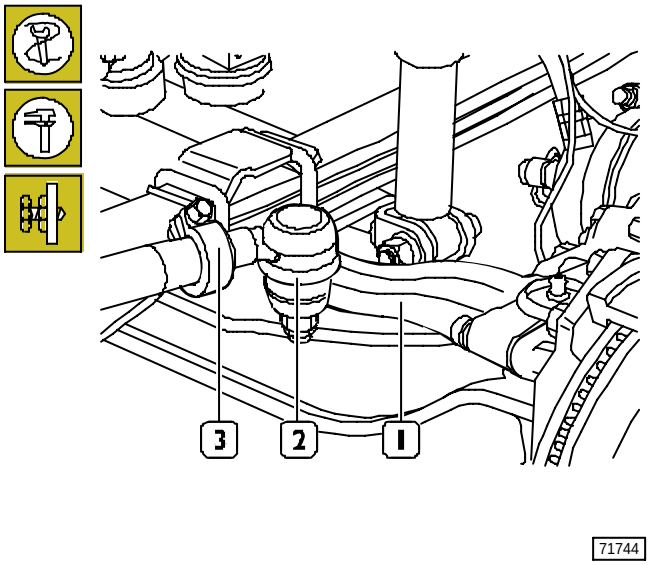
Figure 30




Disconnect the swivel heads (1, Figure 29) from the steering lever (2, Figure 29) from the central axle.
Fit the light cluster (1) of the device 99305123 onto the wheels of the central axle, repeat the checks and, if necessary, adjust the toe-in as done for the front axle.

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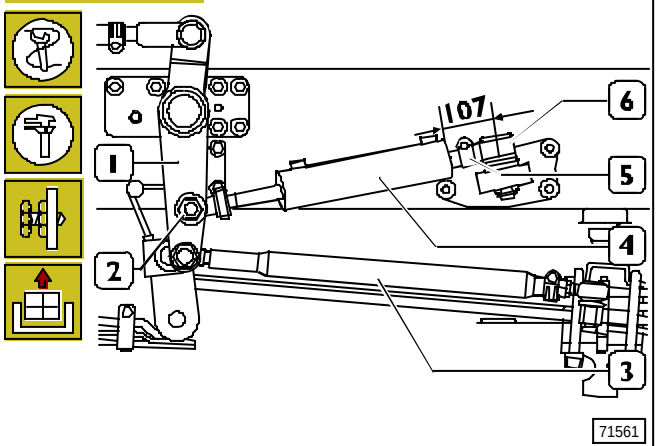
Figure 31




71744

With the wheels straight and the steering box in the "steering centre" position, check that the pin of the swivel head (2) goes exactly into the tapered hole of the lever (1). If it does not, loosen the collar (3) fixing the swivel head to the tie rod and turn the swivel head appropriately to achieve the above condition.
In this way, the wheels of the central axle will be aligned with those of the front axle (permitted alignment tolerance 0 ± 0.5 mm).
Fit the swivel head back onto the respective lever permanently by tightening the nuts to the required torque.

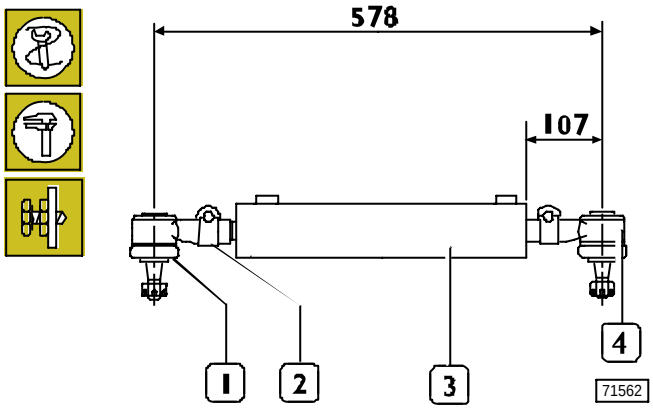
Figure 32




71561

Position the steering box in the steering centre position. Check there is 107 mm between the face of the driving cylinder (4) and the centre distance of the swivel head (6); if this is not so, disconnect this with the extractor, loosen the collar (5), turn the swivel head (6) appropriately to obtain the required distance and fit the swivel head back on in this position.
Disconnect the swivel head (2) from the idler arm (1) and take the cylinder (4) into its closed position.

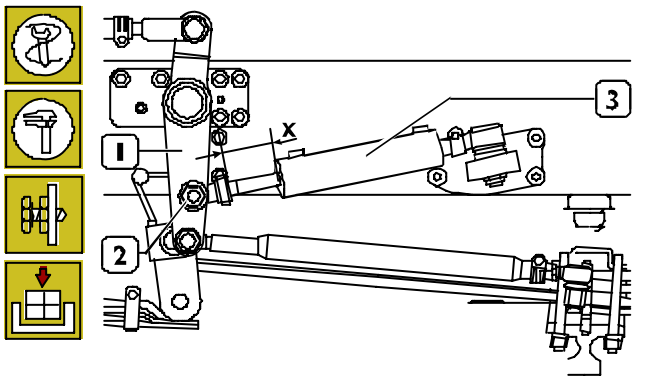
Figure 33




71562

Check that the distance between the centre distance of the swivel head (4) and the centre distance of the swivel head (1) is 578 mm. If this is not so, loosen the collar (2) and turn the swivel head (1) appropriately to obtain the required distance.

Figure 34

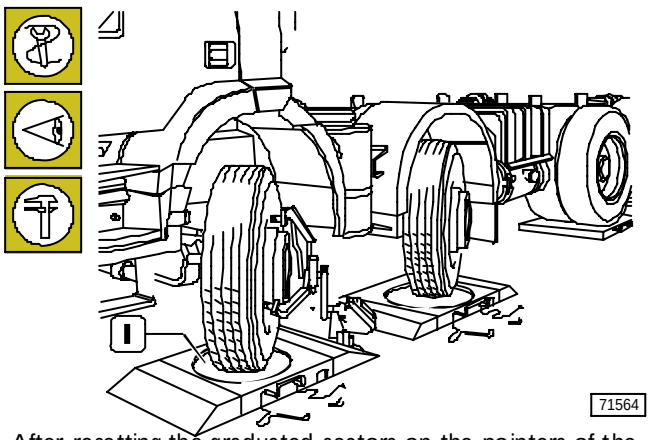



71563

Fit the swivel head (2) back onto the idler arm.
With the steering box in the steering centre position, the distance X between the swivel head (2) and the face of the cylinder (3) is 140 ± 2 mm.

## Checking steering angles

Figure 35




71564

After resetting the graduated sectors on the pointers of the oscillating plates (1), turn the wheels so that the left front wheel is positioned on the internal steering angle and check that the other wheels are turned by the required angle.
Repeat the check on the steering angles, positioning the left front wheel on the external steering angle.

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SECTION 10

# Suspensions


| | Page |
|---|---|
| FRONT AND REAR MECHANICAL SUSPENSIONS | 3 |
| - Description | 3 |
| MAIN DATA | 14 |
| FRONT SHOCK ABSORBERS | 23 |
| REAR SHOCK ABSORBERS | 24 |
| AIR SUSPENSION | 25 |
| - Chassis frame lifting, lowering and self-levelling with remote control | 25 |
| - Saving Levels | 25 |
| AIR SUSPENSION SYSTEM DIAGRAMS | 26 |
| - Rear air suspension main diagram for 4x2T/P tractors | 26 |
| - Rear air suspension main diagram for 4x4 vehicles (trucks) | 27 |
| - Working diagram of pneumatic rear suspensions for 6x4 - 8x4 vehicles (trucks and tractors) | 28 |
| MAIN DATA | 29 |
| - Pneumatic system | 29 |
| MAIN COMPONENTS OF THE PNEUMATIC SYSTEM | 30 |
| - Relief valve | 30 |
| - Fault diagnosis | 30 |
| - Level sensor | 30 |
| - Electropneumatic distributor | 31 |
| - Air low pressure manometer switch | 31 |
| - Air spring | 31 |
| CHASSIS ADJUSTMENT | 32 |
| - Rear pneumatic suspension for vehicles 4x2 - 4x4 | 32 |
| - Rear pneumatic suspension for vehicles 6x4 - 8x4 with SR rear axles | 33 |
| - Rear pneumatic suspension for vehicles 6x4 - 8x4 with HR rear axles | 34 |

Aquila Trucks Centres

Page

DIAGNOSTICS . . . . . 35
- Diagnosis Instruments . . . . . 35
- Diagnosis on Cluster . . . . . 37
- DTC - FMI error codes . . . . . 39

TIGHTENING TORQUES . . . . . 68

TOOLS . . . . . 69

EXPERIMENTAL TOOLS . . . . . 73

FRONT LEAF SPRING REMOVAL-REFITTING . . 75
- Removal . . . . . 75
- Refitting . . . . . 75

REMOVAL-REFITTING OF INTERMEDIATE AXLE LEAF SPRING (8X4 VEHICLES) . . . . . 76
- Removal . . . . . 76
- Refitting . . . . . 76

REMOVAL-REFITTING OF REAR LEAF SPRING (4X2 - 4X4 VEHICLES) . . . . . 77
- Removal . . . . . 77
- Refitting . . . . . 77

REMOVAL-REFITTING OF REAR LEAF SPRING ON CANTILEVER TYPE SUSPENSIONS (6X4 - 6X6 - 8X4 - 8X8 VEHICLES) . . . . . 78
- Removal . . . . . 78
- Refitting . . . . . 78
- Procedure for assembly of the slipper block and mounting brackets for the longitudinal bars . . . 79
- Tightening the U-bolts clamping the leaf spring to the central pivot . . . . . 79

REAR CANTILEVER SUSPENSION (6X4 - 6X6 - 8X4 - 8X8 VEHICLES) . . . . . 80
- Removal-refitting of central pivot . . . . . 80
- Removal-refitting of central pivot shaft . . . . . 80
- Renewal of bearings . . . . . 80
- Removal-refitting of hanger bracket . . . . . 80
- Removal of the central pivot . . . . . 80

Page

- Removal of the central pivot shaft . . . . . 80
- Removal of the hanger bracket . . . . . 80
- Renewal of the bearings . . . . . 80
- Refitting the hanger bracket . . . . . 81
- Refitting the central pivot shaft . . . . . 82
- Refitting the central pivot . . . . . 82

REMOVAL-REFITTING OF REAR AXLE LONGITUDINAL ARM . . . . . 84

REMOVAL-REFITTING OF INTERMEDIATE AXLE LONGITUDINAL ARM . . . . . 84

REMOVAL-REFITTING OF REAR AXLE TRIANGULAR ARM FOR VEHICLES WITH AIR SUSPENSION . . . . . 84
- Removal . . . . . 84
- Refitting . . . . . 84

REPLACING THE SUSPENSION ARM FLEXIBLE PIN . . . . . 85
- Dismounting . . . . . 85
- Mounting . . . . . 85

REPLACING TRIANGULAR SWINGING ARM BALL ARTICULATED JOINT . . . . . 85
- Dismounting . . . . . 86
- Mounting . . . . . 86

SHOCK ABSORBERS . . . . . 88
- Removal . . . . . 88
- Refitting . . . . . 88

ANTI-ROLL BARS . . . . . 88

ANTI-ROLL BAR . . . . . 89

FRONT ANTI-ROLL BAR . . . . . 89

AUXILIARY AXLE ANTI-ROLL BAR (8X4 VEHICLES) . . . . . 89

REAR ANTI-ROLL BAR . . . . . 89

INTERMEDIATE AXLE ANTI-ROLL BAR (6X4 - 6X6 - 8X4 - 8X8 VEHICLES) . . . . . 89
- Removal . . . . . 89
- Refitting . . . . . 89

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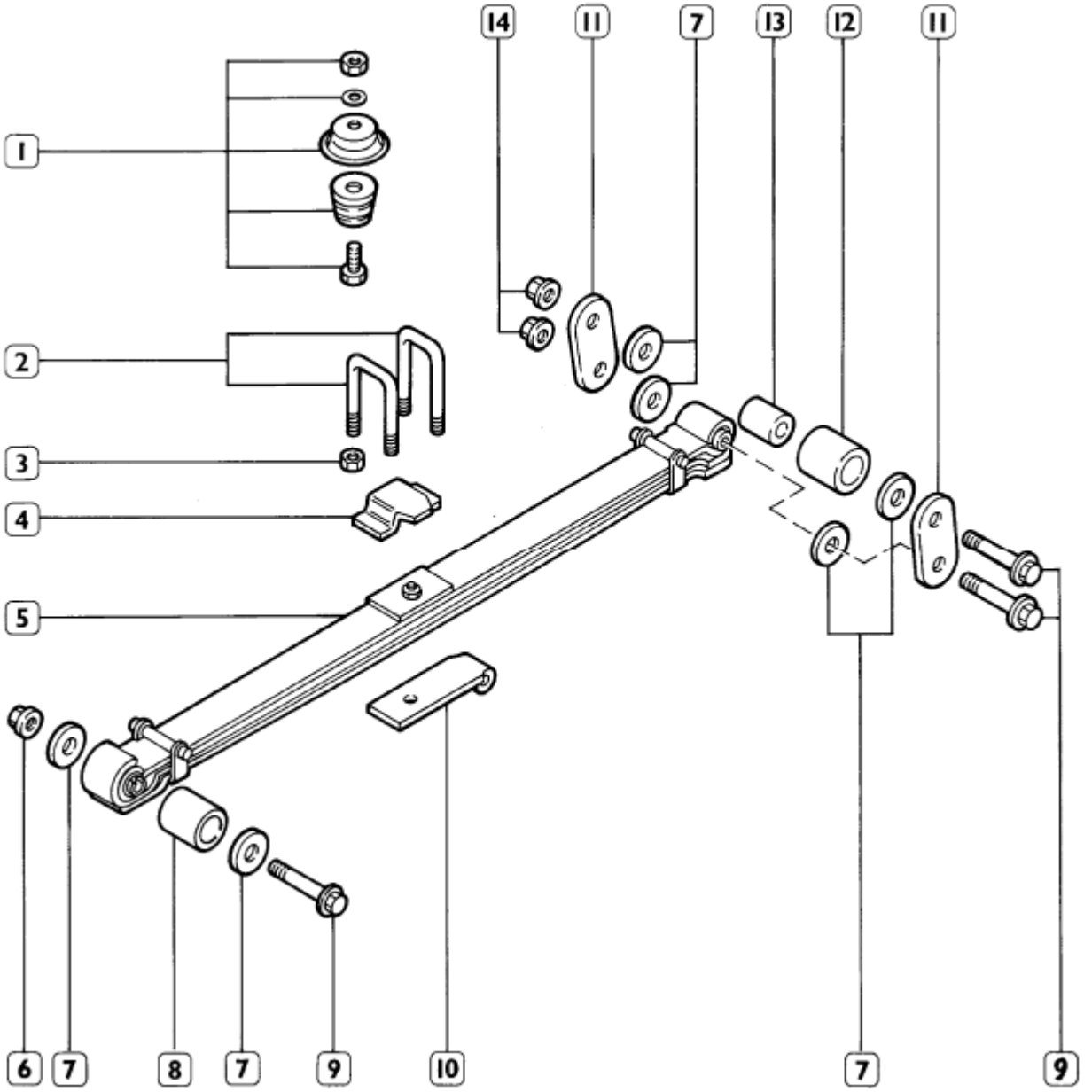
# FRONT AND REAR MECHANICAL SUSPENSIONS

## Description

FRONT SUSPENSION
The front suspension system is comprised of parabolic or semi-elliptic leaf springs with double-acting hydraulic shock absorbers and an anti-roll bar.

REAR SUSPENSION
4x4 - 4x2 vehicles: parabolic or semi-elliptic leaf springs with double-acting hydraulic shock absorbers and anti-roll bars.
6x4 - 6x6 - 8x4 - 8x8 vehicles: cantilever leaf springs and anti-roll bars.

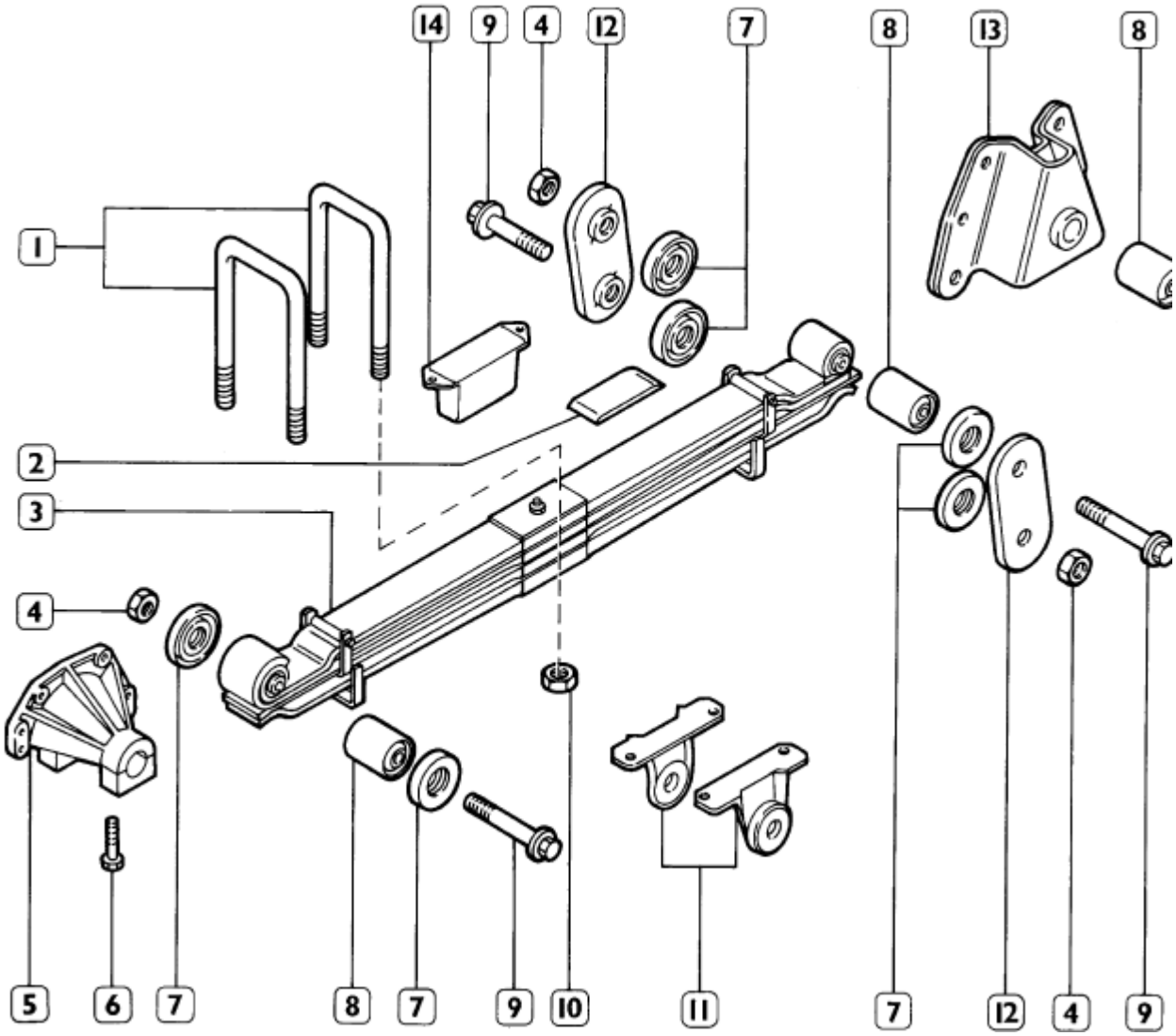
Figure 1




FRONT SUSPENSION COMPONENTS
1. Bump stop with fixings - 2. Clamping U-bolts - 3. Nut - 4. Plate - 5. Leaf spring - 6. Nut - 7. Washers - 8. Bush - 9. Shackle pins - 10. Plate - 11. Shackle plate - 12. Rubber bush - 13. Metal bush - 14. Nuts

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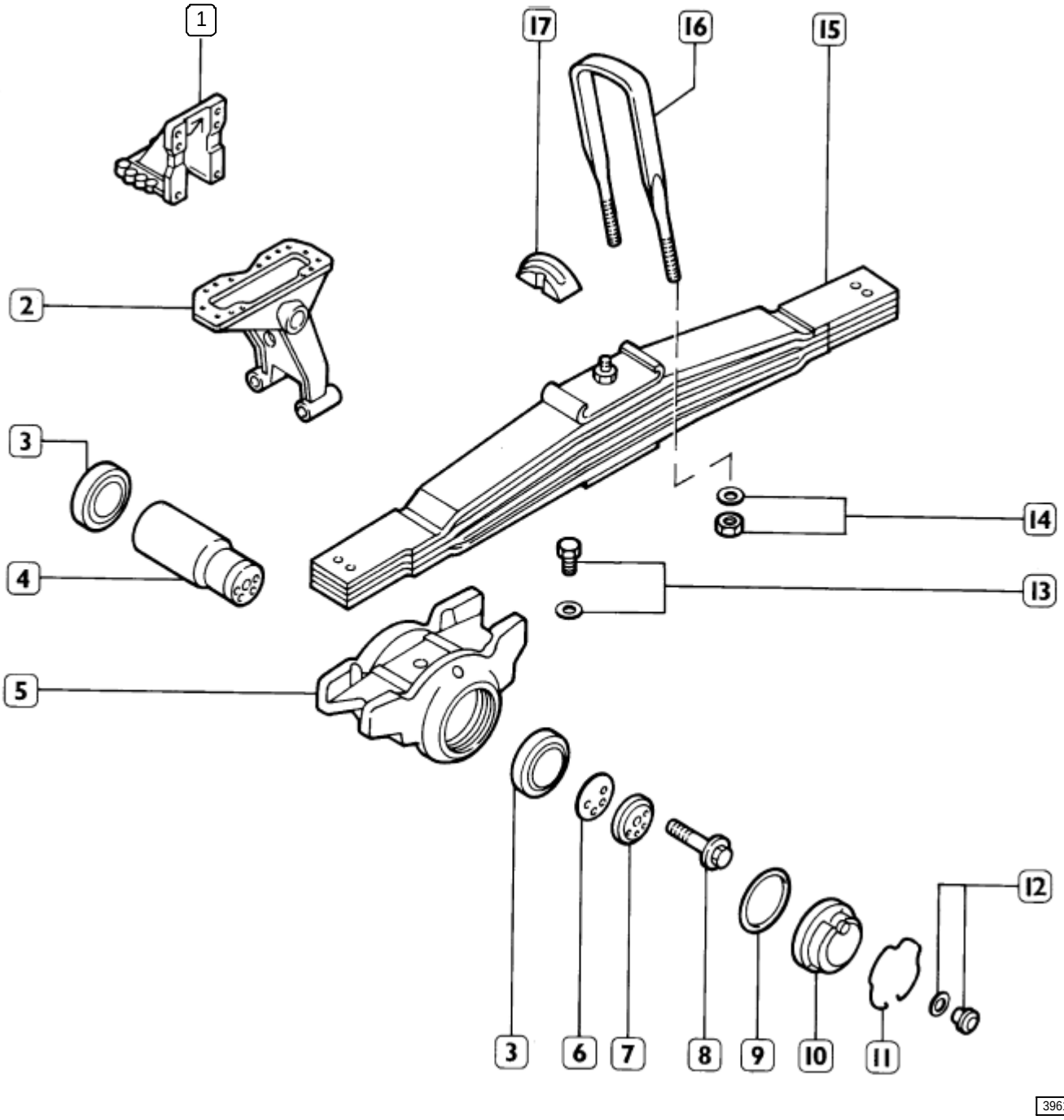
Figure 2




REAR SUSPENSION COMPONENTS
1. Clamping U-bolts - 2. Plate - 3. Leaf spring - 4. Nut - 5. Hanger - 6. Screw - 7. Washers - 8. Bushes - 9. Shackle pins - 10. Nut - 11. Clamping plates - 12. Shackle plates - 13. Hanger - 14. Bump stop

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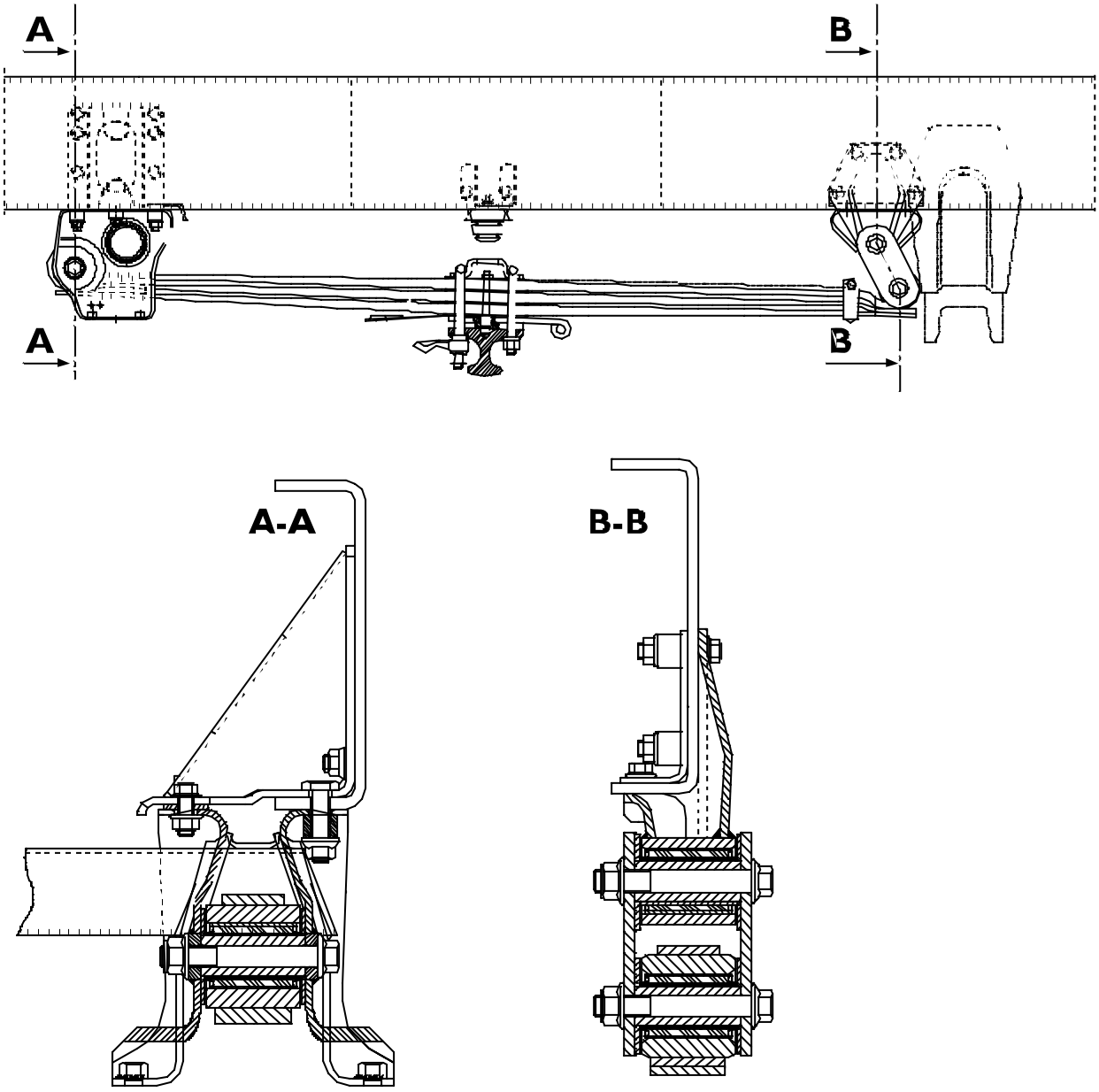
Figure 3




REAR CANTILEVER SUSPENSION COMPONENTS
1. Hanger bracket - 2. Hanger bracket - 3. Angular contact bearing - 4. Central pivot shaft - 5. Central pivot - 6. Adjustment shim - 7. Plate - 8. Bolt - 9. Seal - 10. Cap - 11. Spring clip - 12. Plug with gasket - 13. Plug with gasket - 14. Nut with washer - 15. Leaf spring - 16. Clamping U-bolt - 17. Spacer

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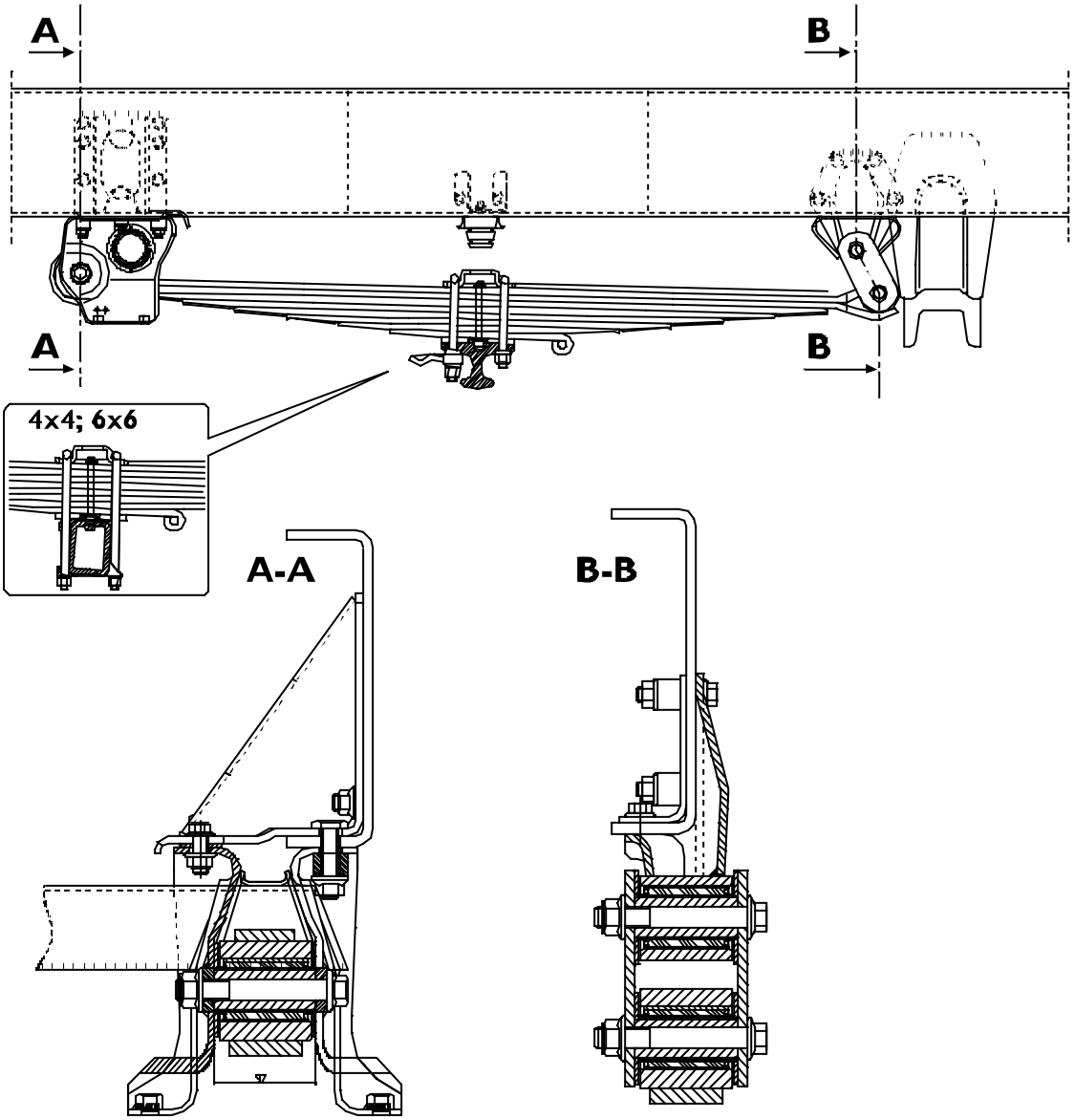
Figure 4




FRONT SUSPENSION WITH PARABOLIC LEAF SPRINGS: 4x2 - 6x4 VEHICLES

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Figure 5

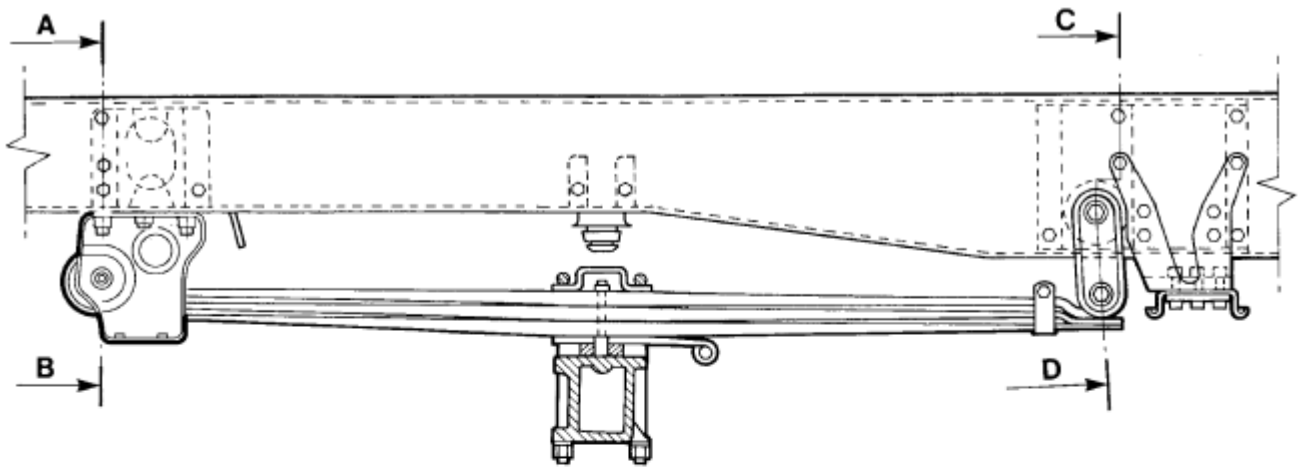


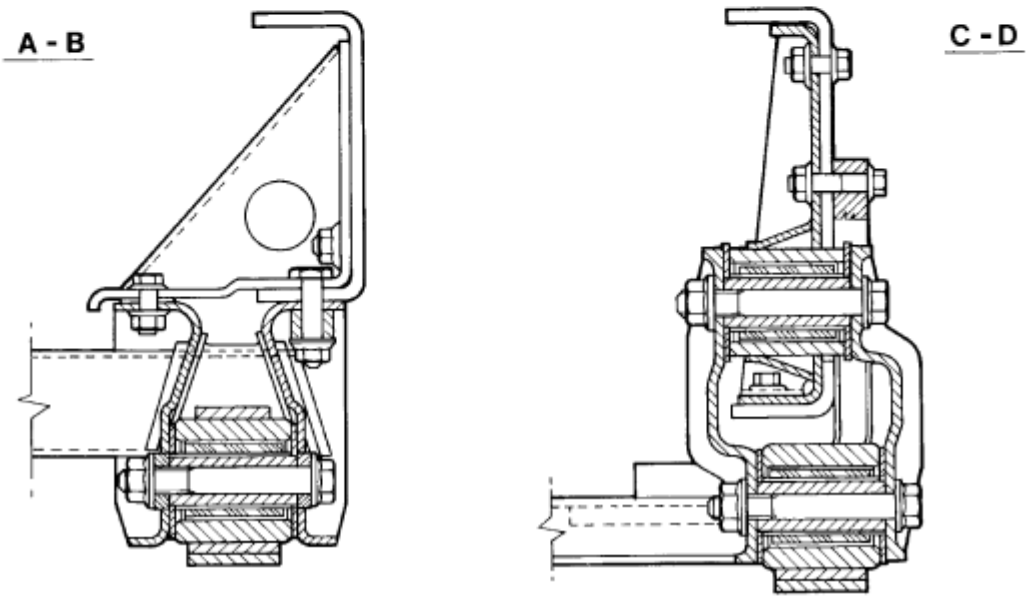

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FRONT SUSPENSION WITH SEMI-ELLIPTIC LEAF SPRINGS: 4x2 - 4x4 - 6x4 - 6x6 VEHICLES

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Figure 6



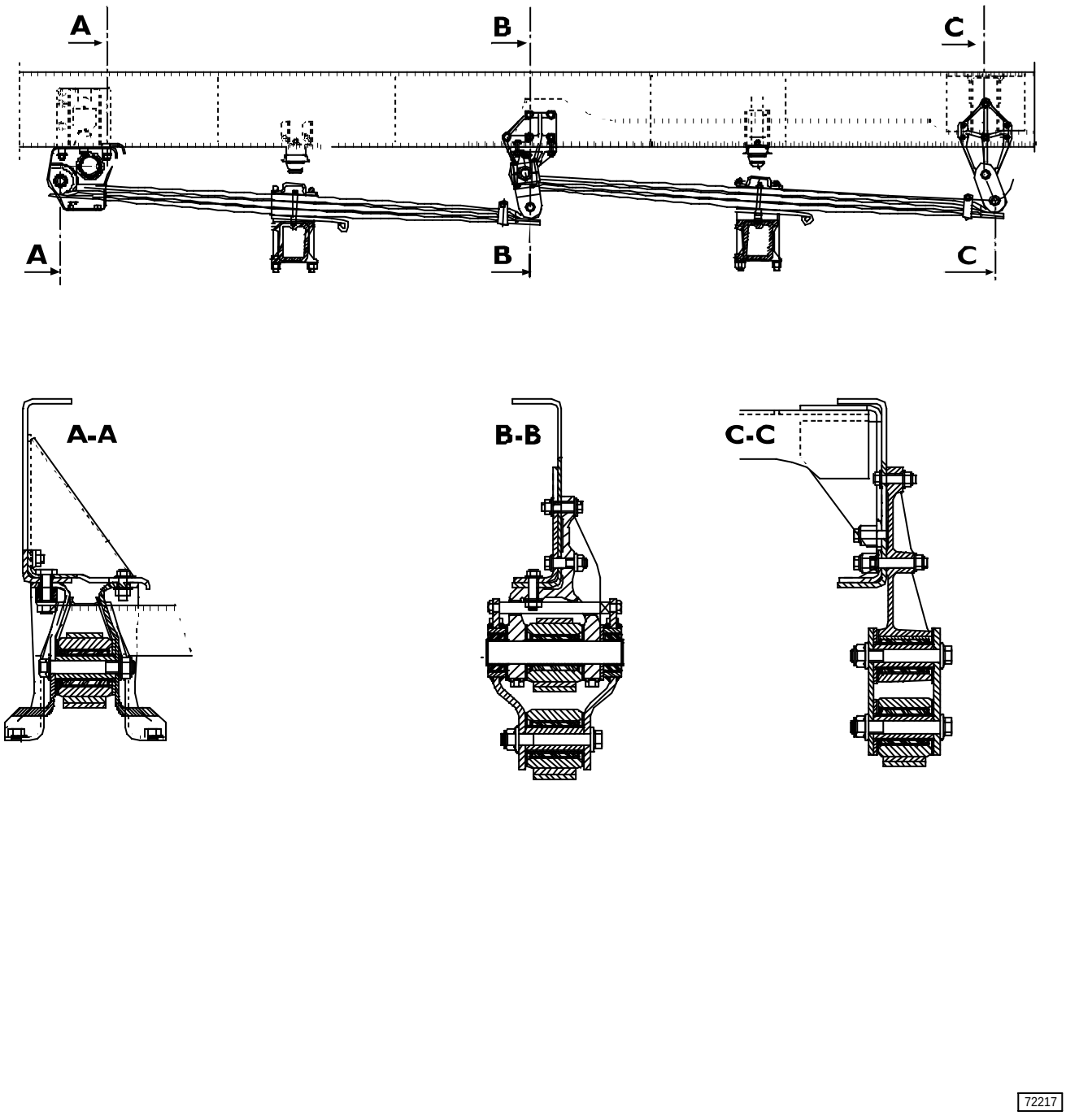




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FRONT SUSPENSION WITH PARABOLIC LEAF SPRINGS: 4x4 - 6x6 VEHICLES

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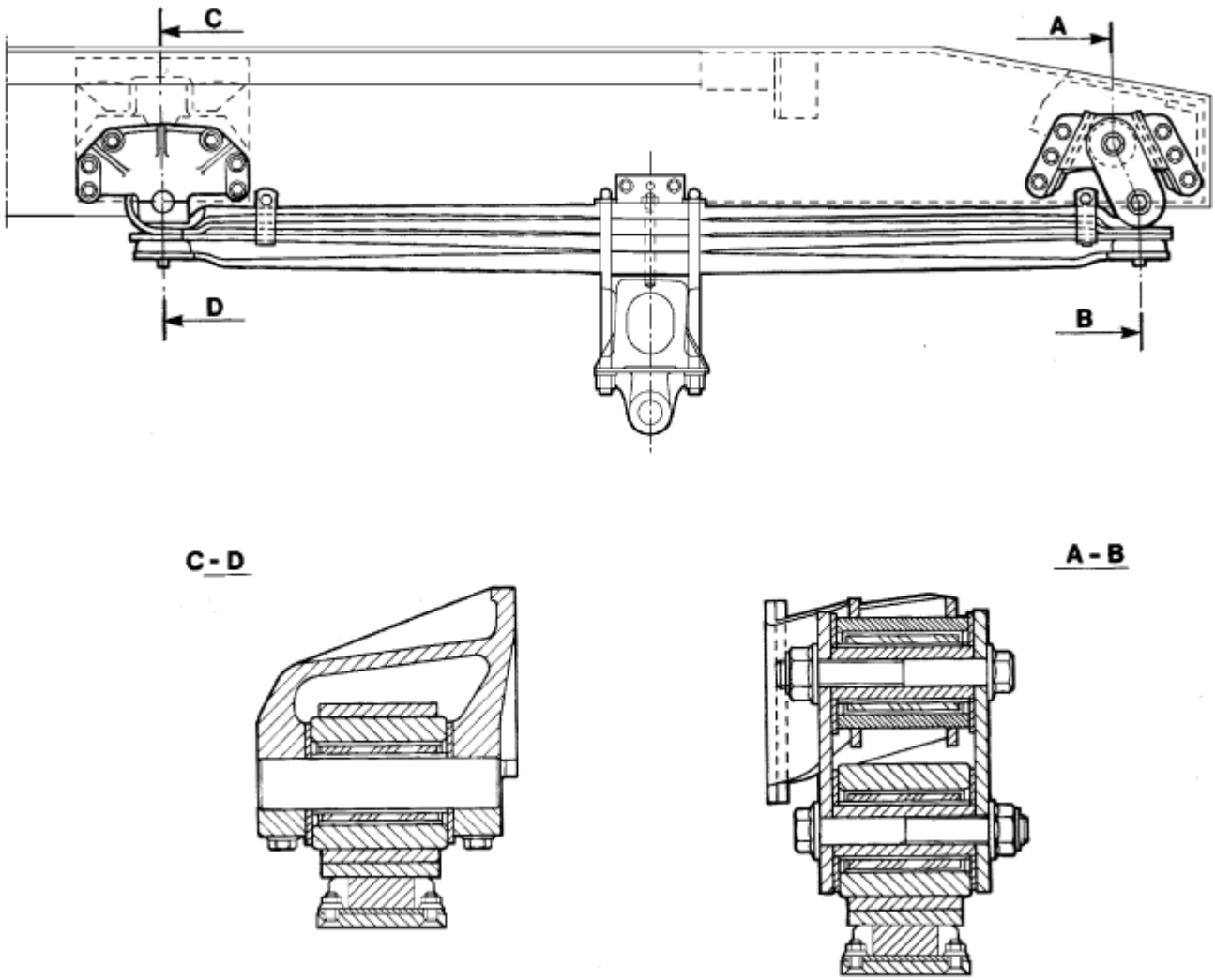
Figure 7




FRONT SUSPENSION WITH PARABOLIC LEAF SPRINGS: 8x4 - 8x8 VEHICLES

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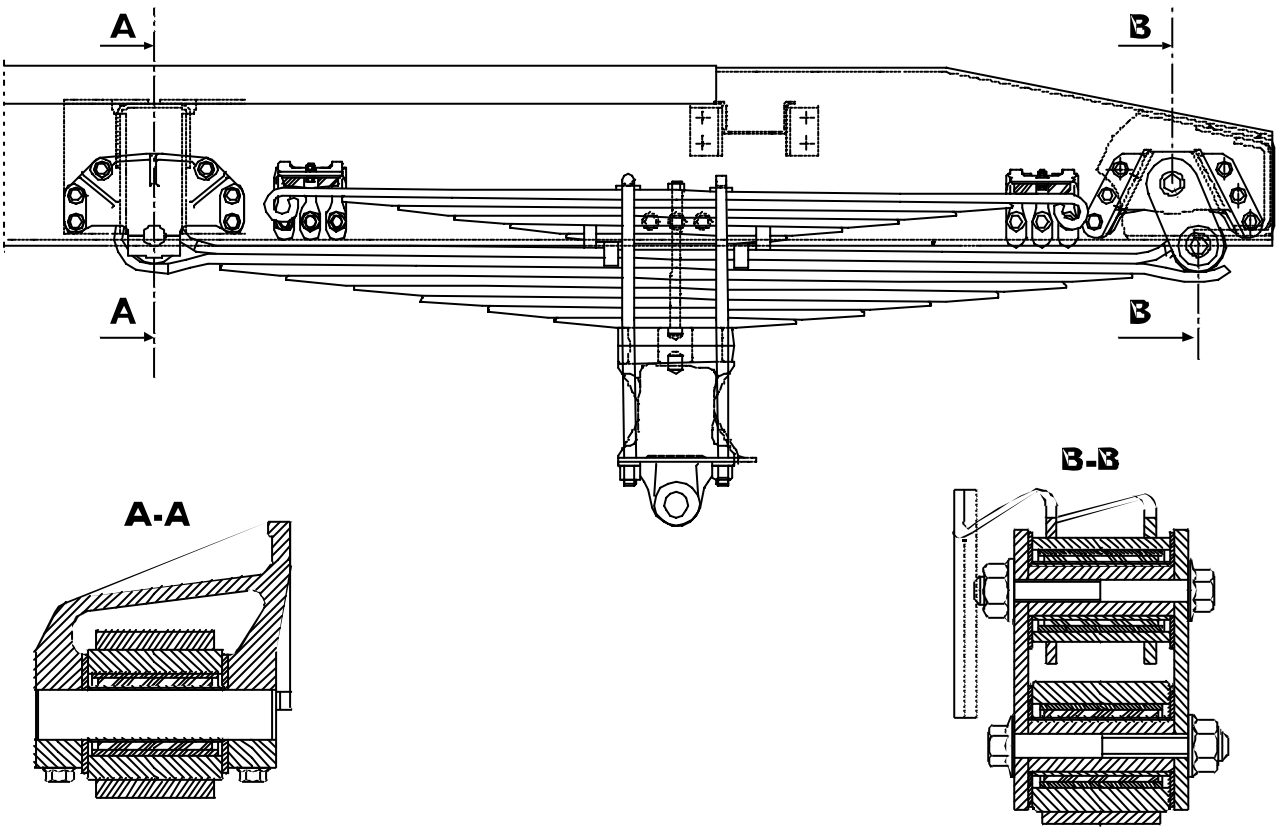
Figure 8




REAR SUSPENSION WITH PARABOLIC LEAF SPRINGS: 4x2 - 4x4 VEHICLES

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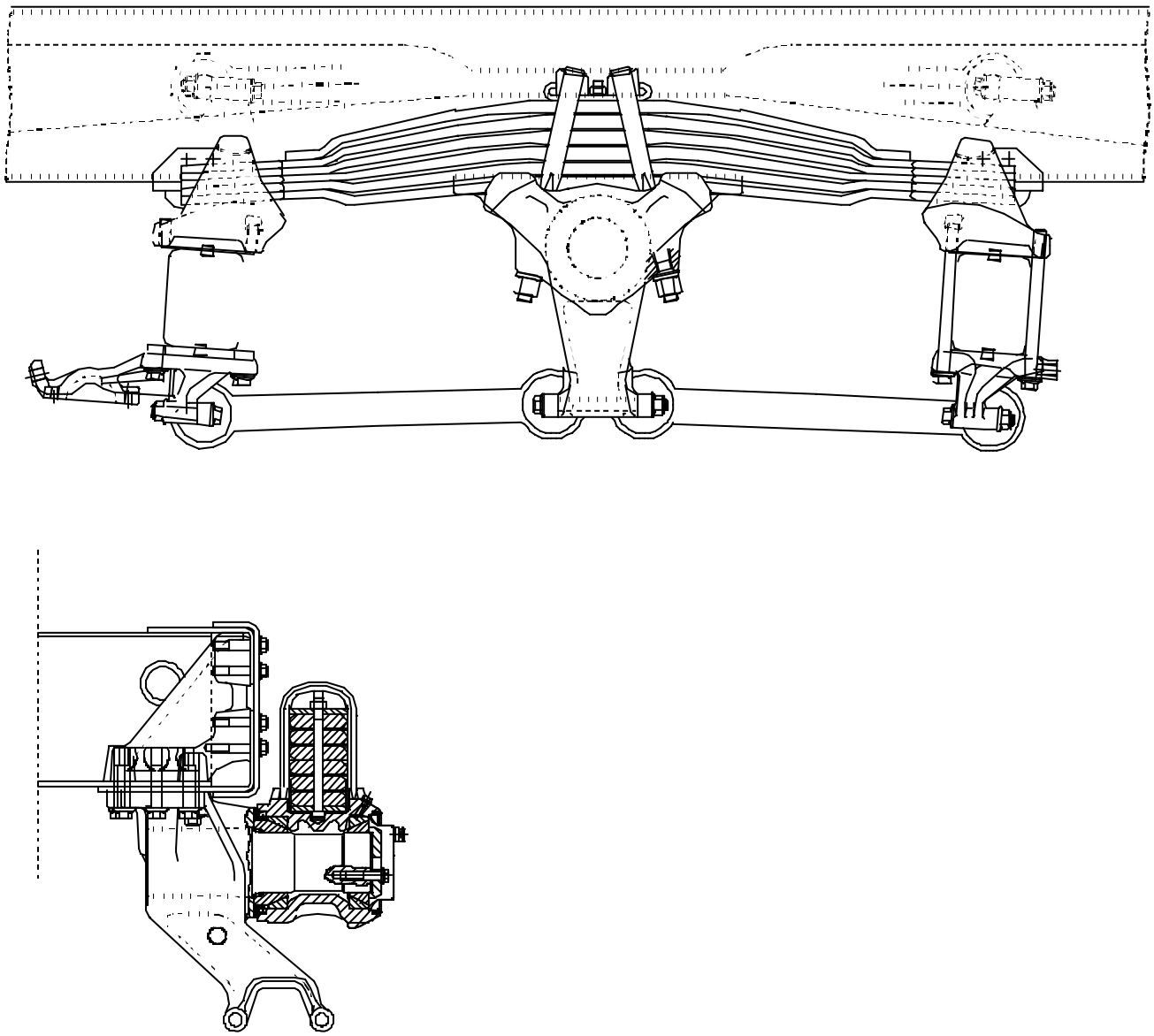
Figure 9




REAR SUSPENSION WITH SEMI-ELLIPTIC LEAF SPRINGS: 4x2 - 4x4 VEHICLES

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Figure 10

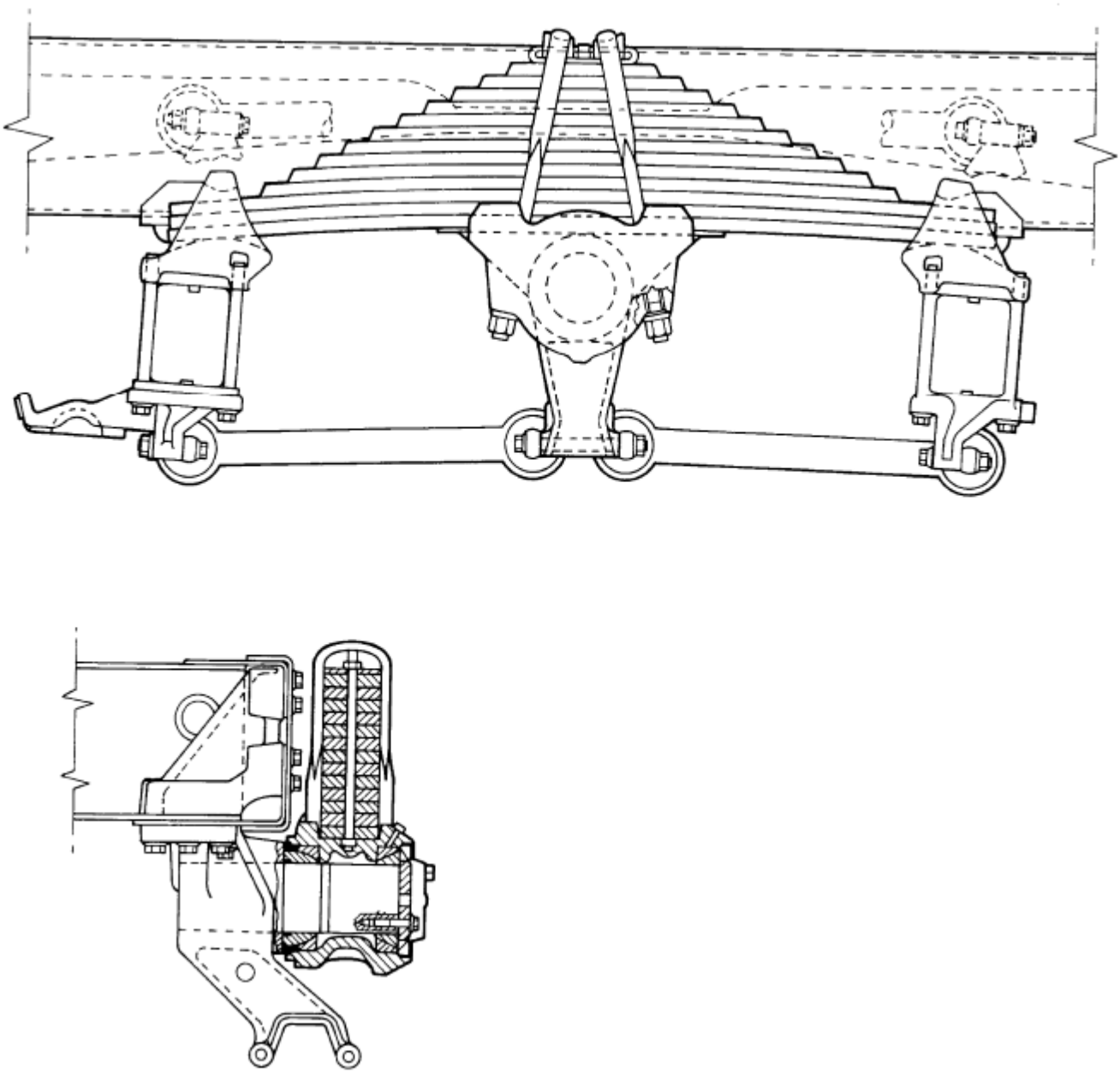


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REAR CANTILEVER SUSPENSION WITH PARABOLIC LEAF SPRINGS: 6x4 - 6x6 - 8x4 - 8x8 VEHICLES

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Figure 11



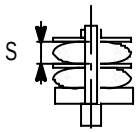
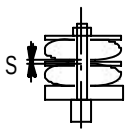
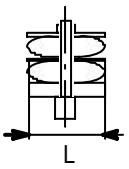
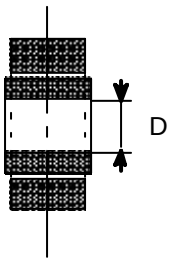
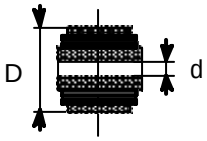
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REAR CANTILEVER SUSPENSION WITH SEMI-ELLIPTIC LEAF SPRINGS: 6x4 - 6x6 - 8x4 - 8x8 VEHICLES

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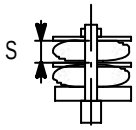
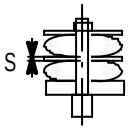
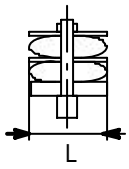
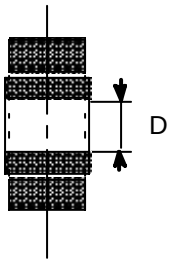
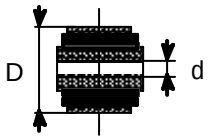

Aquila Trucks Centres

## MAIN DATA
## FRONT SUSPENSION: 4x2 - 4x4 - 6x4 - 8x4 MODELS

| | | mm |
|---|---|---|
|  | 8 tons parabolic leaf springs | No. 2<br>No. 4 |
|  | Spring length<br>(measured at eye centres) | $1900\ ^{+0}_{-6}$ |
|  | Leaf thickness (measured at centre)<br>- 1st - 2nd leaf<br>- 3rd leaf | 30<br>22 |
|  | Distance between leaves | 3 |
|  | Leaf width | 90 ± 0.5 |
|  | Inside diameter of master leaf eye<br>(bush seat) | 60.1 ÷ 60.2 |
|  | D = outside diameter of eye<br>d = inside diameter of eye | 20.2 ÷ 20.5 |
| NEW LEAF SPRING CHECK DATA | | |
| | Flexibility mm/KN | 4.2 ± 6% |

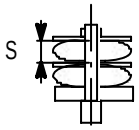
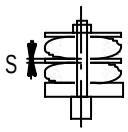
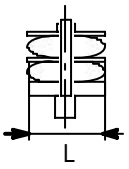
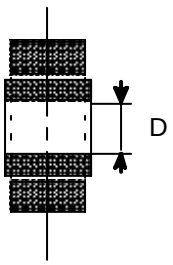
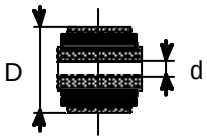
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## FRONT SUSPENSION: 6x6 - 8x4 - 8x8 MODELS

| | | mm |
|---|---|---|
|  | 8 tons parabolic leaf springs | No. 2<br>No. 4 |
|  | Spring length<br>(measured at eye centres) | $1900^{+0}_{-6}$ |
|  | Leaf thickness (measured at centre)<br>- master leaf<br>- 2nd - 3rd leaf | 25<br>26 |
|  | Distance between leaves | 3 |
|  | Leaf width | 90 |
|  | Inside diameter of master leaf eye<br>(bush seat) | 60.1 ÷ 60.2 |
|  | D = outside diameter of eye<br>d = inside diameter of eye | 20.2 ÷ 20.5 |
| NEW LEAF SPRING CHECK DATA | | |
| | Flexibility mm/KN | 4.41 |

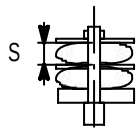
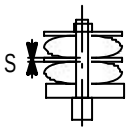
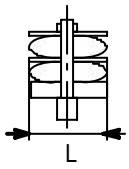
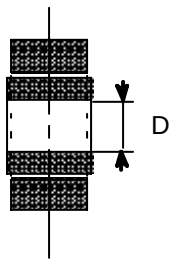
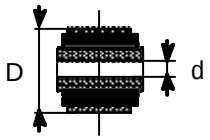
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## FRONT SUSPENSION: 4x2 - 4x4 - 6x4 - 6x6 - 8x4 - 8x8 MODELS

| | | mm |
|---|---|---|
|  | 9 tons parabolic leaf springs: | No. 2<br>No. 4 |
|  | Spring length<br>(measured at eye centres) | 1900 $^{+0}_{-6}$ |
|  | Leaf thickness (measured at centre)<br>- master leaf<br>- 2nd - 3rd leaf | 27<br>28 |
|  | Distance between leaves | 3 |
|  | Leaf width | 90 |
|  | Inside diameter of master leaf eye<br>(bush seat) | 60.1 ÷ 60.2 |
|  | D = outside diameter of eye<br>d = inside diameter of eye | 20.2 ÷ 20.5 |
| NEW LEAF SPRING CHECK DATA | | |
| | Flexibility mm/KN | 3.63 |

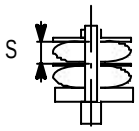
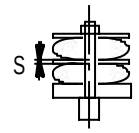
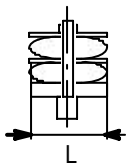
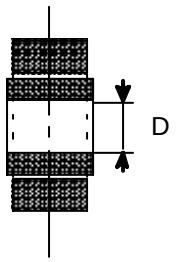
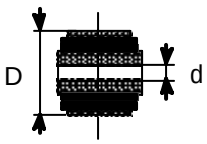
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## FRONT SUSPENSION: 4x2 - 4x4 - 6x4 - 6x6 MODELS

| | | mm |
|---|---|---|
|  | 9 tons semi-elliptic leaf springs: | No. 2 |
|   | Spring length (measured at eye centres) | 1900 $^{+0}_{-6}$ |
|   | Leaf thickness (1st ⇒ 9th leaf) | 16 |
|   | Distance between leaves | 3 |
|   | Leaf width | 90 |
|   | Inside diameter of master leaf eye (bush seat) | 60.1 ÷ 60.2 |
|   | D = outside diameter of eye<br>d = inside diameter of eye | 20.2 ÷ 20.5 |
| NEW LEAF SPRING CHECK DATA | | |
| | Flexibility mm/KN | 3.21 |

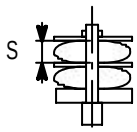
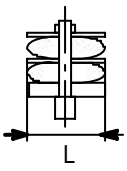
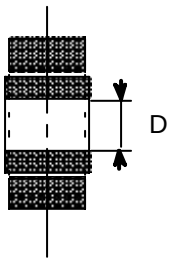
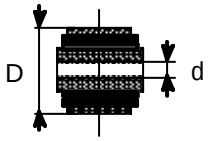
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## REAR SUSPENSION: 4x2 - 4x4 MODELS

| | | mm |
|---|---|---|
|  | 13.5 tons parabolic leaf springs: | No. 2 |
|  | Main spring length (measured at eye centres)<br>Helper spring length (measured at block centres) | 1800 ± 3<br>1800 ± 3 |
|  | Thickness of main spring leaves (measured at centre)<br>Thickness of helper spring leaf (measured at centre) | 26<br>40 |
|  | Distance between leaves | 3 |
|  | Leaf width | 100 |
|  | Inside diameter of master leaf eye (bush seat) | 60.1 ÷ 60.2 |
|  | D = outside diameter of eye<br>d = inside diameter of eye | 20.2 ÷ 20.5 |
| NEW LEAF SPRING CHECK DATA | | |
| | Flexibility mm/KN<br>Flexibility after intervention of helper spring mm/KN | 3.45<br>1.47 |

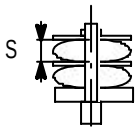
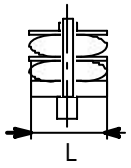
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## REAR SUSPENSION: 4x2 - 4x4 MODELS

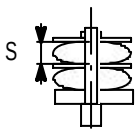
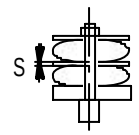
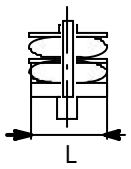
| | | mm |
|---|---|---|
|  | 14 tons semi-elliptic leaf springs: | No. 2 |
|  | Main spring length (measured at eye centres)<br>Helper spring length | 1800 ± 3<br>1360 ± 3 |
|  | Thickness of main spring leaves ($1^{st} \Rightarrow 8^{th}$ leaves)<br>Thickness of helper spring leaves ($1^{st} \Rightarrow 6^{th}$ leaves)<br>Distance between main and helper spring | 17<br>15<br>10 |
|  | Distance between leaves | 100 |
|  | Inside diameter of master leaf eye (bush seat) | 60.1 ÷ 60.2 |
|  | D = outside diameter of eye<br>d = inside diameter of eye | 20.2 ÷ 20.5 |
| NEW LEAF SPRING CHECK DATA | | |
| | Flexibility mm/KN<br>Flexibility after intervention of helper spring mm/KN | 2.27<br>0.9 |

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## REAR SUSPENSION: 6x4 - 6x6 MODELS

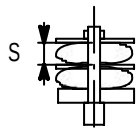
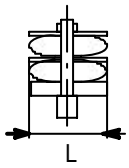
| | | mm |
|---|---|---|
|  | 13 tons semi-elliptic leaf springs: | No. 2 |
|   | Spring length | 1485 ± 2 |
|   | Leaf thickness (measured at centre) | 22 |
|   | Leaf width: 1st ⇒ 3rd leaves<br>Leaf width: 4th ⇒ 8th leaves | 96<br>100 |
| NEW LEAF SPRING CHECK DATA | | |
| | Flexibility mm/KN | 0.34 |

## REAR SUSPENSION: 6x4 - 8x4 MODELS

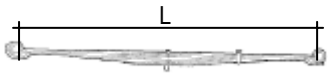
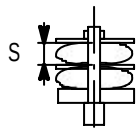
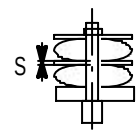
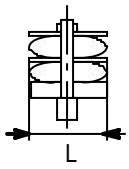
| | | mm |
|---|---|---|
|  | 16 tons parabolic leaf springs: | No. 2 |
|   | Spring length: 1st - 2nd - 3rd leaves<br>4th leaf | 1480 ± 2<br>1040 |
|   | LLeaf thickness: 1st - 2nd - 3rd leaves<br>4th leaf (measured at centre) | 27<br>58 |
|   | Distance between leaves | 3 |
|   | Leaf width: 1st ⇒ 3rd leaves<br>Leaf width: 3rd ⇒ 4th leaves | 96<br>100 |
| NEW LEAF SPRING CHECK DATA | | |
| | Flexibility mm/KN | 0.23 |

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## REAR SUSPENSION: 6x4 - 6x6 MODELS

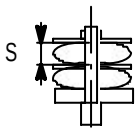
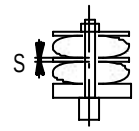
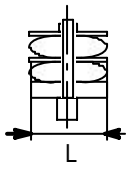
| | | mm |
|---|---|---|
|  | 16.5 tons semi-elliptic: | No. 2 |
|  | Spring length | 1475 ± 2 |
|  | Leaf thickness (measured at centre) | 22 |
|  | Leaf width: 1st ⇒ 3rd leaves<br>Leaf width: 4th ⇒ 11th leaves | 96<br>100 |
| NEW LEAF SPRING CHECK DATA | | |
| | Flexibility mm/KN | 0.25 |

## REAR SUSPENSION: 6x4 - 6x6 - 8x4 MODELS

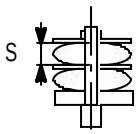
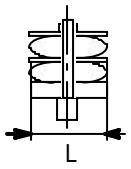
| | | mm |
|---|---|---|
|  | 10.5 tons parabolic leaf springs: | No. 2 |
|  | Spring length: 1st - 2nd - 3rd leaves<br>4th leaf | 1480 ± 2<br>1040 |
|  | LLeaf thickness: 1st - 2nd - 3rd leaves<br>4th leaf (measured at centre) | 26<br>43 |
|  | Distance between leaves | 3 |
|  | Leaf width: 1st ⇒ 3rd leaves<br>Leaf width: 3rd ⇒ 4th leaves | 96<br>100 |
| NEW LEAF SPRING CHECK DATA | | |
| | Flexibility mm/KN | 0.39 |

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## REAR SUSPENSION: 6x4 - 6x6 - 8x4 - 8x8 MODELS

| | | mm |
|---|---|---|
|  | 13 tons parabolic leaf springs: | No. 2 |
|   | Leaf thickness: 1st - 2nd - 3rd leaves<br>4th leaf | 1480 ± 2<br>1040 |
|   | Leaf thickness: 1st - 2nd - 3rd leaves<br>4th leaf (measured at centre) | 26<br>53 |
|   | Distance between leaves | 3 |
|   | Leaf width: 1st ⇒ 3rd leaves<br>Leaf width: 3rd ⇒ 4th leaves | 96<br>100 |
| NEW LEAF SPRING CHECK DATA | | |
| | Flexibility mm/KN | 0.29 |

## REAR SUSPENSION: 6x4 - 6x6 - 8x4 - 8x8

| | | mm |
|---|---|---|
|  | 16 tons semi-elliptic leaf springs: | No. 2 |
|   | Spring length | 1480 ± 2 |
|   | Leaf thickness<br>(measured at centre) | 22 |
|   | Leaf width: 1st ⇒ 3rd leaves<br>Leaf width: 4th ⇒ 13th leaves | 96<br>100 |
| NEW LEAF SPRING CHECK DATA | | |
| | Flexibility mm/KN | 0.22 |

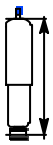
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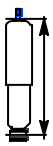
## FRONT SHOCK ABSORBERS

| SHOCK ABSORBERS | | MANNESMANN SACHS | ARVIN |
|---|---|---|---|
|  | Length between the eye centre and the end: | | |
| L | Open | 778 ± 3 | 777 ± 3 |
| | Closed | 448 ± 3 | 452 ± 3 |
| | Stroke | 330 | 324 |
| MODELS 4x2 - 6x4 | | | |

| SHOCK ABSORBERS | | MANNESMANN SACHS | ARVIN |
|---|---|---|---|
|  | Length between the eye centre and the end: | | |
| L | Open | 754 ± 3 | 751 ± 3 |
| | Closed | 434 ± 3 | 435 ± 3 |
| | Stroke | 320 | 316 |
| TRACTORS 4x2 - 6x4 | | | |

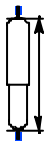
| SHOCK ABSORBERS | | MANNESMANN SACHS | ARVIN |
|---|---|---|---|
|  | Length between the eye centre and the end: | | |
| L | Open | 754 ± 3 | 754 ± 3 |
| | Closed | 434 ± 3 | 432 ± 3 |
| | Stroke | 320 | 322 |
| CABIN TRUCK 4x2 - 6x4 | | | |

| SHOCK ABSORBERS | | MANNESMANN SACHS | ARVIN |
|---|---|---|---|
|  | Length between the eye centre and the end: | | |
| L | Open | 754 ± 3 | 754 ± 3 |
| | Closed | 434 ± 3 | 432 ± 3 |
| | Stroke | 320 | 322 |
| MODELS 8x4 - 8x8 | | | |

| SHOCK ABSORBERS | | MANNESMANN SACHS | ARVIN |
|---|---|---|---|
|  | Length between the eye centre and the end: | | |
| L | Open | 689 ± 3 | 693 ± 3 |
| | Closed | 409 ± 3 | 413 ± 3 |
| | Stroke | 280 | 280 |
| MODELS 4x4 - 6x6 | | | |

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## REAR SHOCK ABSORBERS

| SHOCK ABSORBERS | | SACHS BOGE | ARVIN |
|---|---|---|---|
|  | Length between rubber bush mounting surfaces: | | |
| L | Open | 720 ± 3 | 720 ± 3 |
| | Closed | 410 ± 3 | 412 ± 3 |
| | Stroke | 310 | 308 |
| MODELS 4x2 - 4x4 | | | |

| SHOCK ABSORBERS | | SACHS BOGE | |
|---|---|---|---|
|  | Length between rubber bush mounting surfaces: | | |
| L | Open | 762 ± 3 | - |
| | Closed | 432 ± 3 | - |
| | Stroke | 330 | - |
| MODELS 4x4 | | | |

| SHOCK ABSORBERS | | MANNESMANN SACHS | ARVIN |
|---|---|---|---|
|  | Length between rubber bush mounting surfaces: | | |
| L | Open | 652 ± 3 | 652 ± 3 |
| | Closed | 402 ± 3 | 404 ± 3 |
| | Stroke | 250 | 248 |
| MODELS 4x2 - 4x4 - 6x4 - 6x6 - 8x4 | | | |

| SHOCK ABSORBERS | | MANNESMANN SACHS | ARVIN |
|---|---|---|---|
|  | Length between rubber bush mounting surfaces: | | |
| L | Open | 840 ± 3 | 839 ± 3 |
| | Closed | 500 ± 3 | 500 ± 3 |
| | Stroke | 340 | 339 |
| MODELS 6x4 - 6x6 - 8x4 - 8x8 | | | |

Aquila Trucks Centres

## AIR SUSPENSION

The air suspensions are highly flexible; they have a considerable vibration-damping capacity and, above all, irrespective of the load on the vehicle, due to the system's self-adjustment, the "chassis frame – road surface" distance stays constant. By simply pressing a push-button the air suspensions can change the "chassis frame – road surface" distance and therefore the height of the vehicle's loading deck. Besides the well-known benefits provided by the air suspension, the ECAS system provides:

- considerable reduction in air consumption;
- ready response to the various adjustment processes;
- simplified systems;
- wide safety margins;
- full system diagnosis.

The ECAS (Electronically Controlled Air Suspension) system automatically controls the nominal level of the vehicle's air suspensions.

All the above operations anyhow have the constraint of specific operating conditions and the associated safety devices of the systems connected to them.

The ECAS electronic control unit automatically controls the level (distance off the road surface) of the chassis frame with the actual values supplied by the sensors, comparing them with the nominal values saved in memory.

In the event of moving away or the attitude changing, the electronic control unit governs the electro-pneumatic assemblies with which the actual level is corrected compared to the nominal one set or saved previously by the driver.

The system has a remote control for lifting/lowering and levelling the chassis frame and it is possible to work with the vehicle either stationary or moving.

Besides lifting, lowering and self-levelling, the remote control makes it possible to save other chassis frame attitude levels and call them up when required.

### Chassis frame lifting lowering and self-levelling with remote control

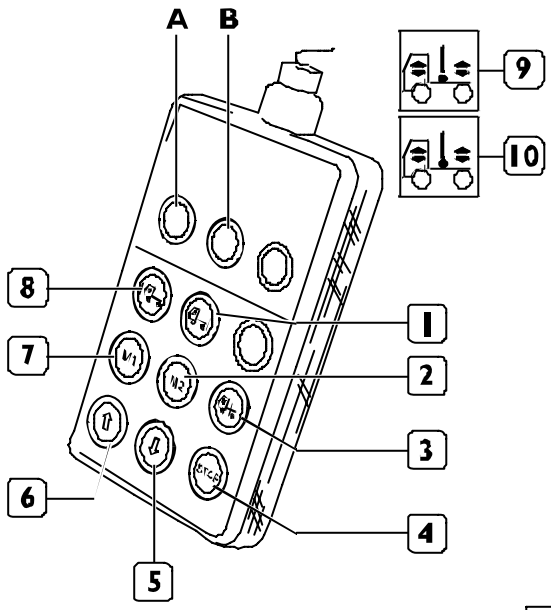
Lifting, lowering and levelling the vehicle before loading and unloading it is done with the remote control located next to the driver's seat.

The remote control can be removed from its mounting so these manoeuvres can be done from the ground too.

When unloading heavy loads or containers (with a crane), lower the chassis frame completely.

Do not stop the engine if the indicator light (10) comes on. If the indicator light (9) comes on while driving, stop the vehicle and turn the ignition key onto "STOP"; after approximately (7) seconds, turn the key onto MAR (start). If after approximately two seconds the indicator light (9) does not go out, call the Service Network.

Figure 12




Lift/lower the chassis frame as described below:

- Turn the ignition switch onto MAR (start). The yellow and red indicator lights (9) and (10) will come on for approximately 3 seconds.
- Press the push-button (1 and 8) to select the rear axle. The indicator light A-B comes on to show the selection made (to cancel the selection, press the button again).
- Pressing the buttons (5 and 6) and keeping them pressed lifts or lowers the chassis frame.

Briefly press the push-button (3), the chassis frame will go back into its normal self-levelling position.

The indicator light (9) goes out as soon as the normal level is reached.

The "STOP" push-button (4) stops any action the system is performing.

After loading/unloading and before starting off again, you must bring the vehicle back into its normal self-levelling position by pressing the button (3).

### Saving Levels

With buttons (2) and (7), it is possible to save and call up two chassis-frame positions:

- Take the chassis frame to the required height by following the above instructions.
- Press the STOP button (4) and keep it pressed while pressing one of the buttons (2) or (7).
- Release the button (4). The chassis-frame position has been saved.

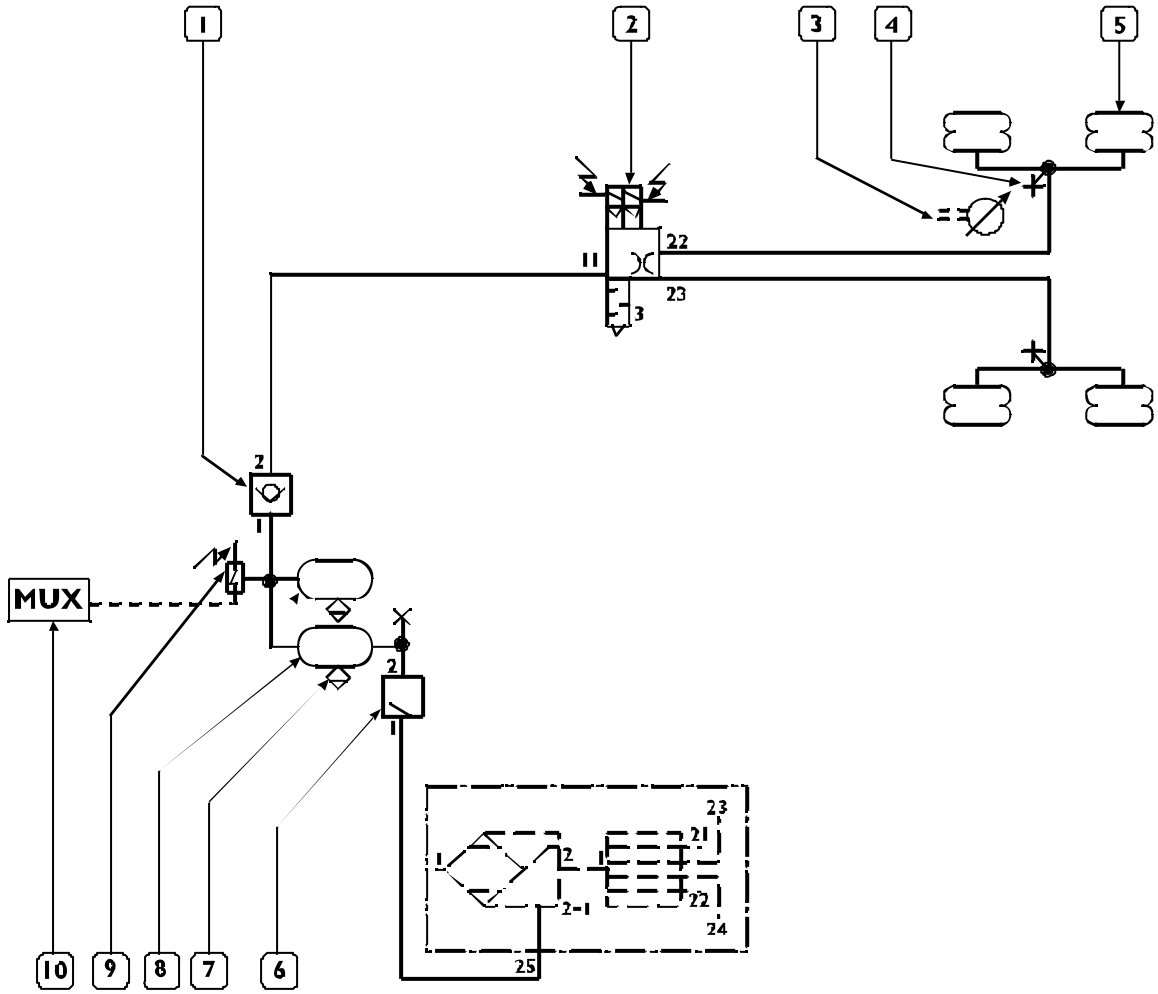
To call up a saved position, press the associated button (2) or (7).

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## AIR SUSPENSION SYSTEM DIAGRAMS

### Rear air suspension main diagram for 4x2T/P (tractors)

Figure 13

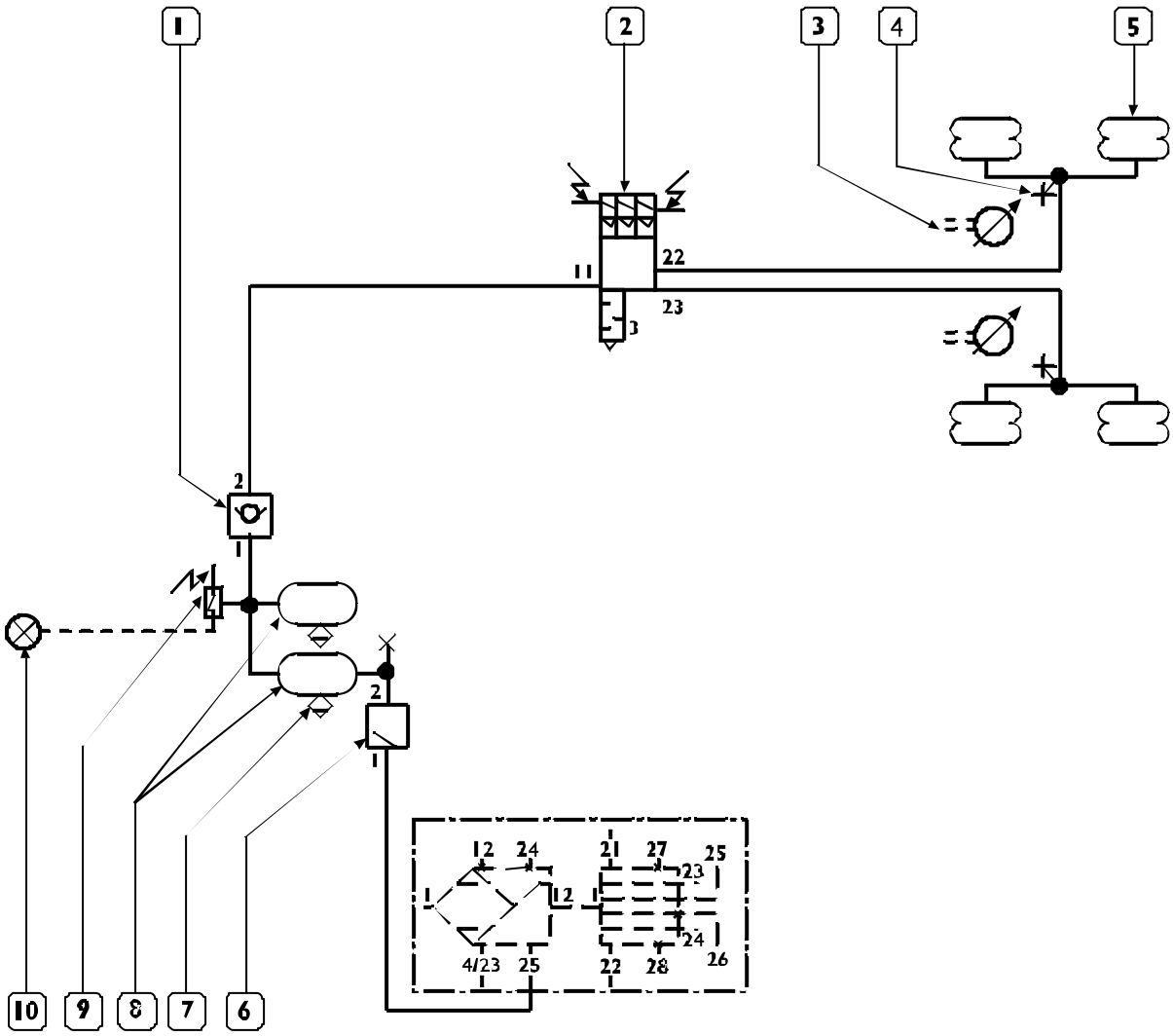



1. Check valve - 2. Rear axle electropneumatic distributor - 3. Rear level sensor - 4. Pressure control intake - 5. Rear axle air spring - 6. Pressure relief valve with limited return - 7. Condensate hand bleeder - 8. 20 lt. air reservoirs - 9. Pressure gauge (opening pressure 8 bar) - 10. Pilot lamp (air suspension low pressure).

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## Rear air suspension main diagram for 4x4 vehicles (trucks)

Figure 14

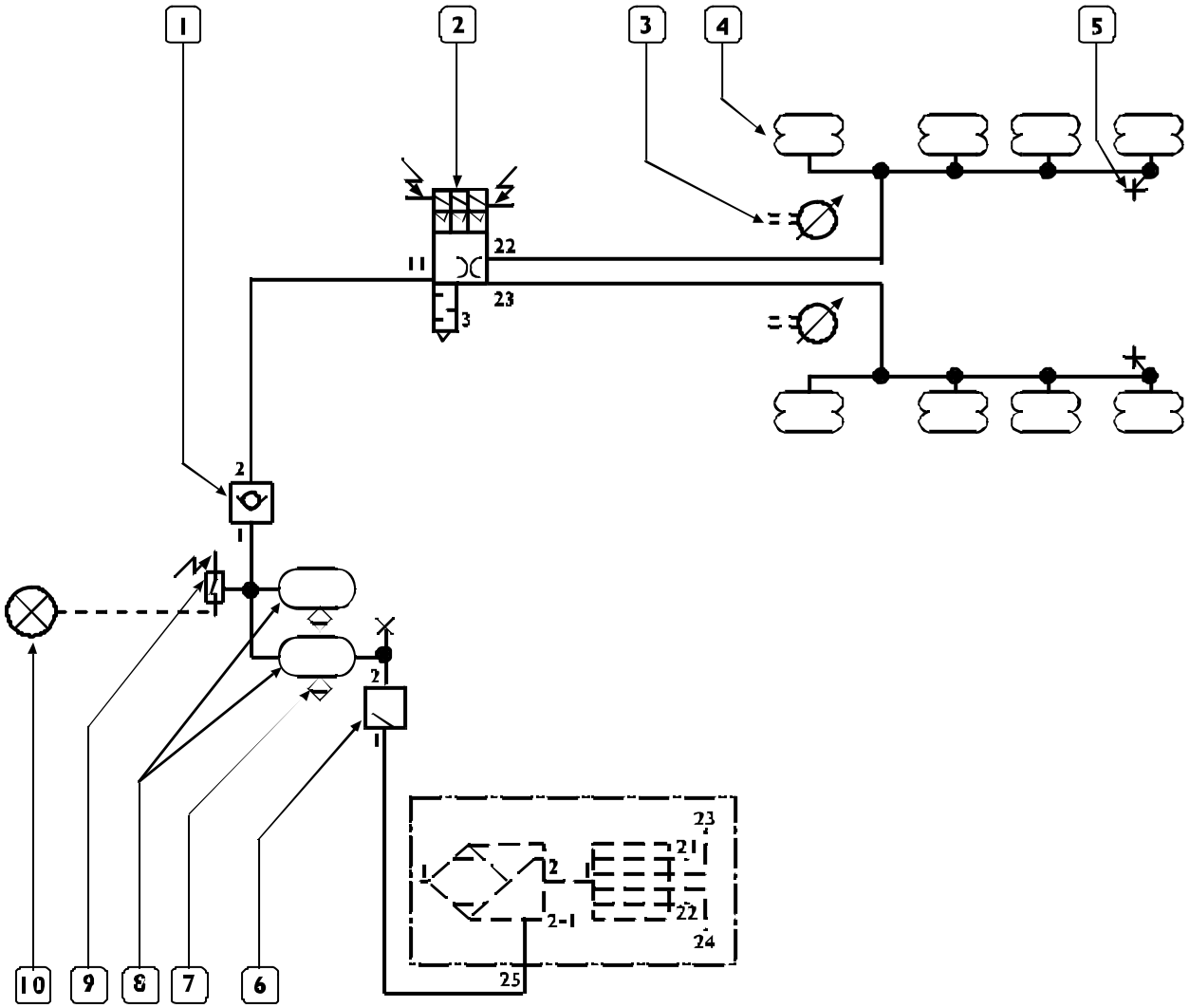



1. Check valve - 2. Rear axle electropneumatic distributor - 3. Rear level sensor - 4. Pressure control intake - 5. Rear axle air spring - 6. Pressure relief valve with limited return - 7. Condensate hand bleeder - 8. 20 lt. air reservoirs - 9. Pressure gauge (opening pressure 8 bar) - 10. Pilot lamp (air suspension low pressure).

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**Working diagram of pneumatic rear suspensions for 6x4 - 8x4 vehicles (trucks and tractors)**

Figure 15




1. Check valve – 2. Rear axle electro-pneumatic control valve – 3. Rear level sensor – 4. Rear axle air spring – 5. Pressure test point – 6. Controlled pressure valve with limited return (opening pressure 8.5 bars) – 7. Manual condensate bleed valve – 8. 30-litre air tanks – 9. Pressure switch (opening pressure 8 bars) – 10. Pilot lamp (air suspension low pressure)

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## MAIN DATA
### Pneumatic system

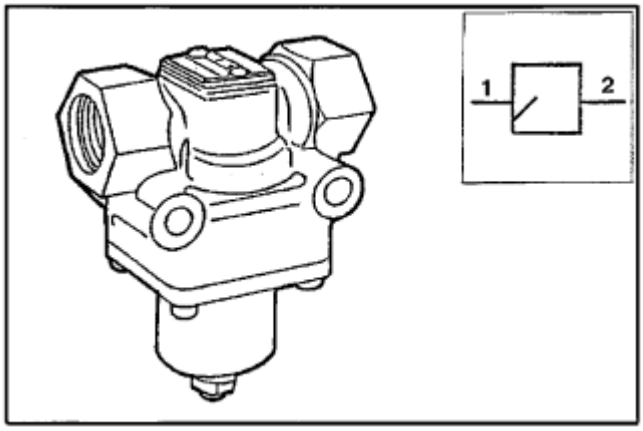
| DESCRIPTION | |
|---|---|
| Relief valve | |
| - Type: KNORR-BREMSE DR 4248 - WABCO 434 100 232 | |
| Opening pressure | 8,5 $^{+0}_{-0,3}$ bar |
| Electropneumatic distributors | |
| - Type: WABCO 472 880 001 | |
| Power supply voltage | 24 $^{+6}_{-4.4}$ V |
| Rated current | 0.34A |
| Operating pressure | 5 ÷ 13 bar |
| Level sensors | |
| - Type: WABCO 441 050 0120 | |
| Power supply voltage | Pulse 8 to 16 V |
| Measurement criteria | Inductive |
| Current absorption | Max 90 mA |
| Lever angle | Max 100° |
| Air low pressure manometer switch | |
| - Type: TDS F13046 S | |
| Operating voltage | 12/24 V |
| Electric load allowed | 0.001 ÷ 1 A |
| Max. operating pressure | 12 bar |
| Hand condensate bleeder | |
| - Type: VOSS 52089975 | |
| Max. operating pressure | 13 bar |
| Air reservoirs | |
| Reservoirs | 20 Litres |
| Electronic unit | |
| - Type: WABCO 446 170 211 | |
| Supply voltage | 24 V |

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## MAIN COMPONENTS OF THE PNEUMATIC SYSTEM

### 793824 Relief valve

Figure 16




This is a limited-return valve carrying out two functions:

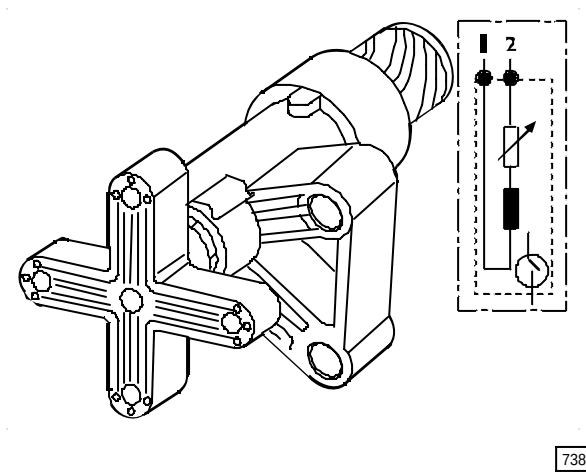
- Stopping the flow of compressed air feeding the reservoirs when the pressure inside the latter decreases under a set value (calibration) due to a malfunction or to excessive withdrawals.
- Feeding these reservoirs as soon as the braking system achieves a value ensuring a perfect efficiency in braking.

### Fault diagnosis

| INCONVENIENT | POSSIBLE CAUSE | SOLUTION |
|---|---|---|
| **Breathing at outlet** | Leak from the membrane | Overhaul the equipment replacing worn components |
| **Air leak form the two half-body connection** | Leak from the membrane fixing | |
| **Delivery breathing (in the atmosphere) with feeding at a pressure lower than the rated one** | Leak form the intake valve or form the relevant seat | Overhaul the equipment replacing worn components. |

### Level sensor

Figure 17




The lever sensor constantly informs the electronic control unit on the changes in the chassis attitude with respect to the roadway.

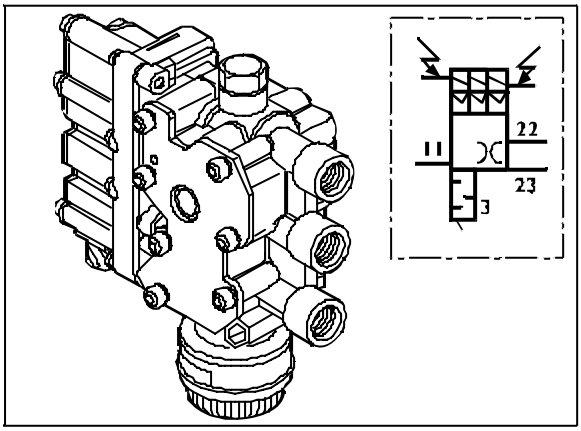
The sensor consists of a coil, fixed to the chassis, where a piston connected by means of a cam to the lever secured to the vehicle axle is moved.

At a change in the distance between chassis and vehicle axle, the lever rotates and moves the piston causing the consequent change of the self-inductance of the coil electrically connected to the electronic control unit.

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## Electropneumatic distributor

Figure 18



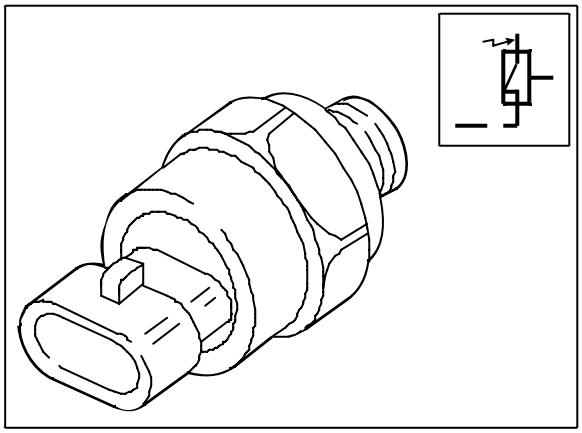

73810

The electropneumatic distributor consists of a group of solenoid valves, whose concentration reduces both the structure volume and the use of connections.

The solenoid valves are directly controlled by the electronic control unit and allow to increase, decrease or keep the volume of air in the pneumatic cells.

## Air low pressure manometer switch

Figure 19



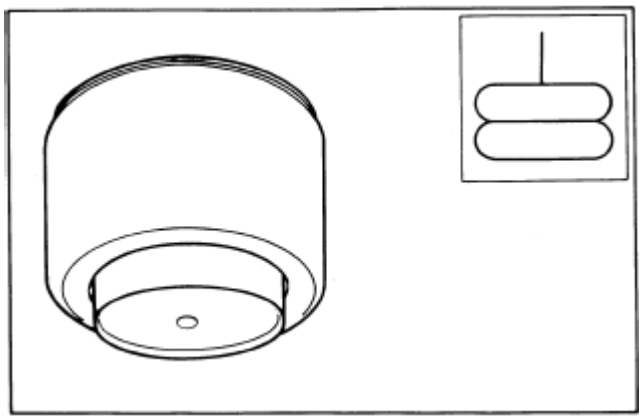
52723

The manometer switch is located near the service air reservoir, on the delivery piping for the air spring suspensions.

Its function is to indicate low (< 8 bar) feed pressure through an optical indicator on the dashboard

## 5007 Air spring

Figure 20



30106

It is a flexible element containing air under pressure and able to change its extension irrespective of the value of the applied load.

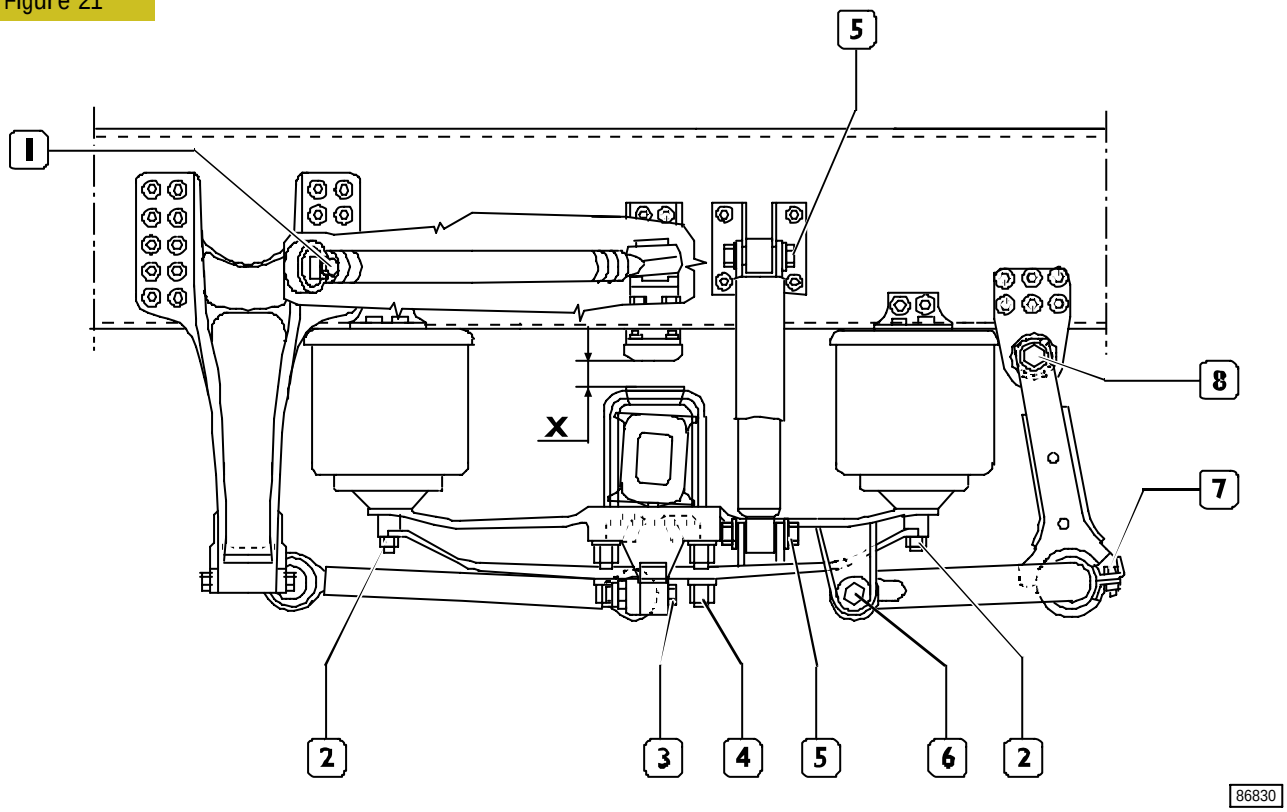
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## CHASSIS ADJUSTMENT

Adjustment is carried out by using pads 99342647 and adjusting levelling valves in order to realise X distances shown in the figures.

### Rear pneumatic suspension for vehicles 4x2 - 4x4

Figure 21




REAR SUSPENSION ASSEMBLY DRAWING

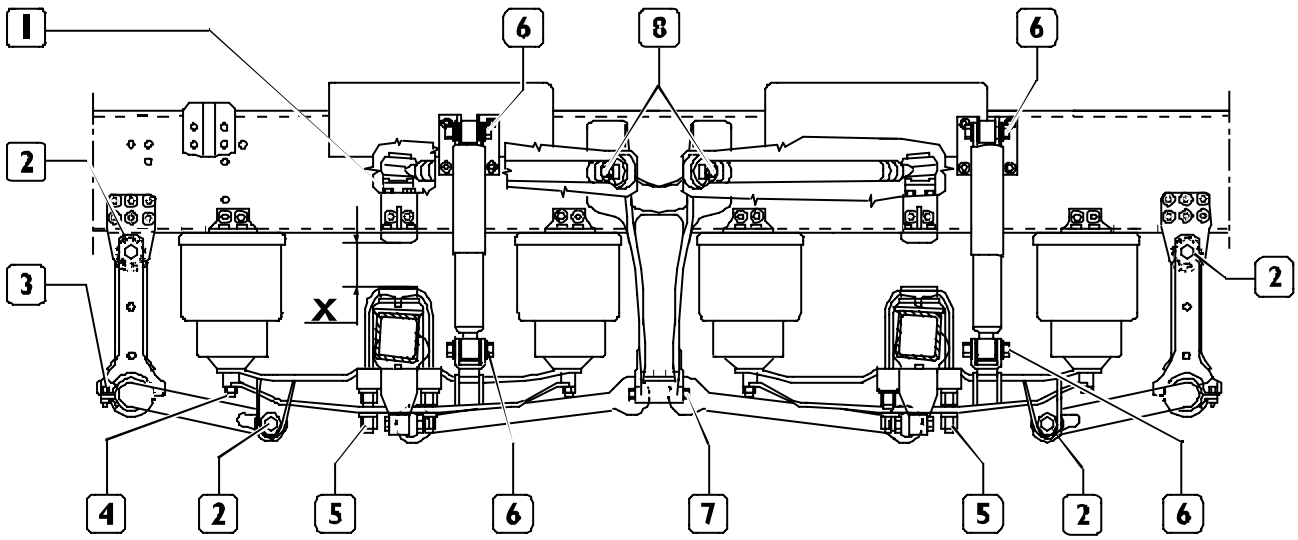
| DESCRIPTION | | TORQUE | |
|---|---|---|---|
| | | Nm | kgm |
| 1 | M18 x 1.5 screw fixing triangular arm to bracket | 320 to 385 | 32 to 38.5 |
| 2 | Nut fixing air springs to the mounting | 83 to 101 | 8.3 to 10.1 |
| 3 | M18 x 1.5 nut for screw fixing longitudinal rod | 375 to 460 | 37.5 to 46 |
| 4 | M24 x 2 nut with collar for brackets fixing rear axle to rear mounting | 576 to 704 | 57.6 to 70.4 |
| 5 | M20 nut for screw fixing top and bottom shock absorber | 210 to 250 | 21 to 25 |
| 6 | M20 nut for pin fixing stabilizer bar to mounting | 636 to 777 | 63.6 to 77.7 |
| 7 | M12 nut for bolt fixing stabilizer bar to link rod | 165 to 200 | 16.5 to 20 |
| 8 | M20 nut for pin fixing link rod to mounting | 636 to 777 | 63.6 to 77.7 |

X = 60 mm

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## Rear pneumatic suspension for vehicles 6x4 - 8x4 with SR rear axles

Figure 22




REAR SUSPENSION ASSEMBLY

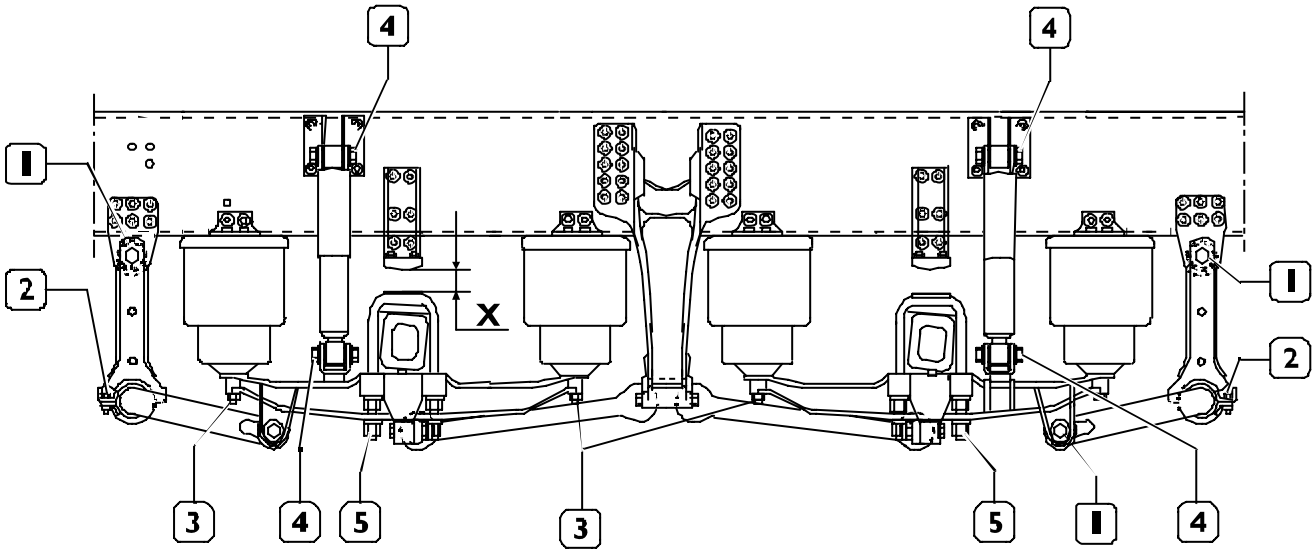
| | DESCRIPTION | TORQUE Nm | TORQUE (kgm) |
|---|---|---|---|
| 1 | Triangular arm screw M18 at rear axle casing | 270 to 300 | (27 to 33) |
| 2 | Flanged nut M20 to secure stabiliser bar on air spring support and to secure articulated connecting rod on chassis bracket | 636 to 777 | (63.6 to 77.7) |
| 3 | Nut for screw to secure elastic anchoring member to articulated connecting rod | 165 to 200 | (16.5 to 20) |
| 4 | Nut to secure air spring to support | 83 to 101 | (8.3 to 10.1) |
| 5 | Nut M24 with collar for brackets to secure rear axle to suspension support | 576 to 704 | (57.6 to 70.4) |
| 6 | Nut M20 to secure rear axle shock absorber on top and bottom | 210 to 250 | (21 to 25) |
| 7 | Nut M18x1,5 to secure side rods | 375 to 460 | (37.5 to 46) |
| 8 | Screw M18 to secure triangular arm to bracket | 320 to 385 | (32 to 38.5) |

X = 125 mm

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**Rear pneumatic suspension for vehicles 6x4 - 8x4 with HR rear axles**

Figure 23




REAR SUSPENSION ASSEMBLY

| | DESCRIPTION | TORQUE Nm | TORQUE (kgm) |
|---|---|---|---|
| 1 | Flanged nut M20 to secure stabiliser bar on air spring support and to secure articulated connecting rod on chassis bracket | 636 to 777 | (63.6 to 77.7) |
| 2 | Nut for screw to secure elastic anchoring member to articulated connecting rod | 100 to 122 | (10 to 12) |
| 3 | Nut to secure air spring to support | 83 to 101 | (8.3 to 10.1) |
| 4 | Nut M20 to secure rear axle shock absorber on top and bottom | 210 to 250 | (21 to 25) |
| 5 | Nut M24 with collar for brackets to secure rear axle to suspension support | 540 to 660 | (54 to 66) |

X = 64 mm

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## DIAGNOSTICS

Fault diagnosis comprises two sections:

- The first one, organized by error codes (DTC-FMI), concerns faults that may be identified by the ECAS control unit directly. These faults are mainly of an electric – electronic – pneumatic nature.
- The second one, organized by symptoms, describes the possible faults the electronic control unit cannot identify directly. These faults are mainly of a mechanical nature.

SECTION I

ECAS system troubleshooting can be performed with the Cluster or with the diagnosis instruments Modus, IWT, IT 2000 and E.A.SY..

Diagnosis with the cluster makes it possible to estimate the situation of faults in the system in advance, while the diagnosis instruments are essential to perform thorough diagnosis and operate on the single faults correctly.

Each single instrument displays the diagnosis and repair help.

### Diagnosis Instruments

MODUS (Maintenance and Diagnostic System)

A computerized fault-diagnosis station dedicated to diagnosing the brake systems, air suspensions, engines and systems controlled electronically.

The station is equipped with auxiliary functions, such as: programming electronic control units, consulting the spare parts catalogue and service time schedules.

The vehicle has a 30-pin diagnosis socket to interface with the instrument.

IT 2000 (IVECO Electronic Tester)

This makes it possible to take immediate action on the vehicle, identifying it with the chassis number.

It saves the results of diagnostics actions performed.

It can be used as a portable Personal Computer, too, being fitted for remote diagnosis.

By using MODUS as the mother station it is possible to update and configure the IT 2000.

IT 2000 interfaces with the vehicle via a 30-pin diagnosis socket.

E.A.SY.

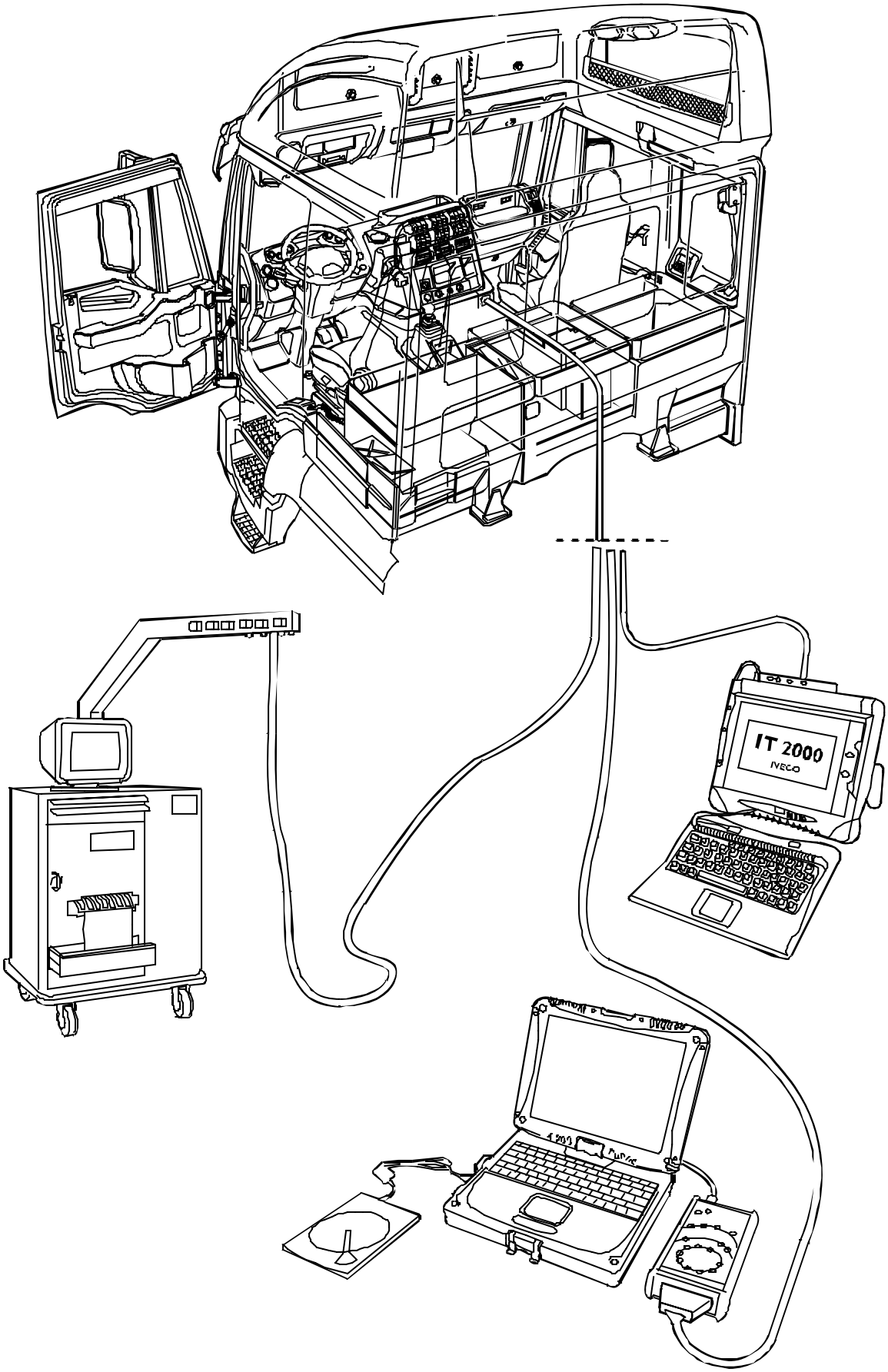
E.A.SY. system allows to simply make the diagnosis and programming of the various electronic central units aboard the vehicle.

E.A.SY. system is made up of ECI module communicating with the electronic central units and of a Panasonic PC.

ECI module, exploiting the Panasonic PC, also allows easy on the road interventions: in particular, thanks to Panasonic PC wireless technologies (e.g. GPRS), diagnostic interventions can be assisted by a remote expert centre.

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Figure 24

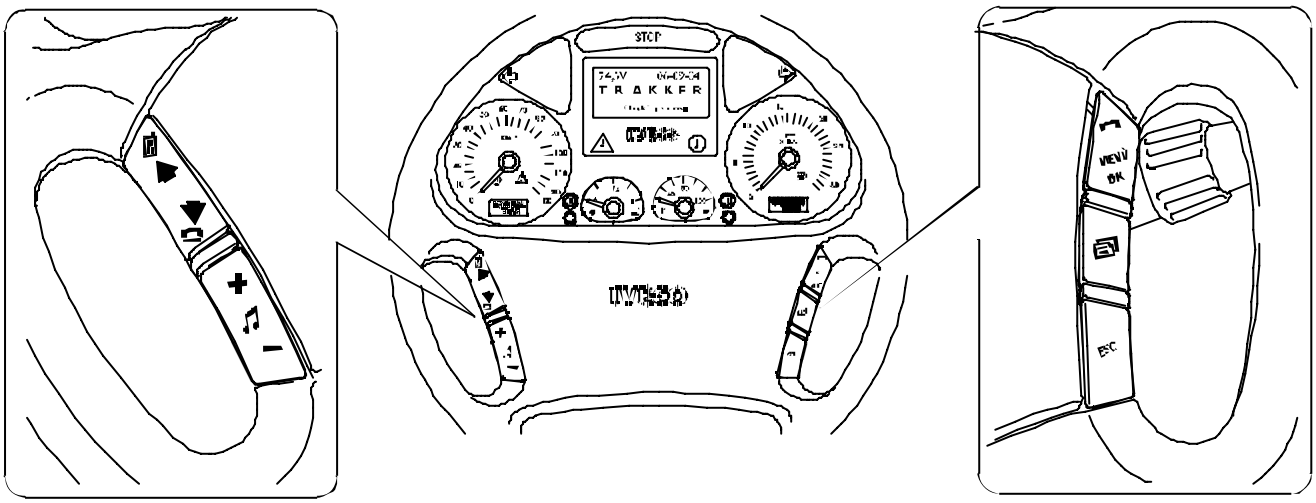


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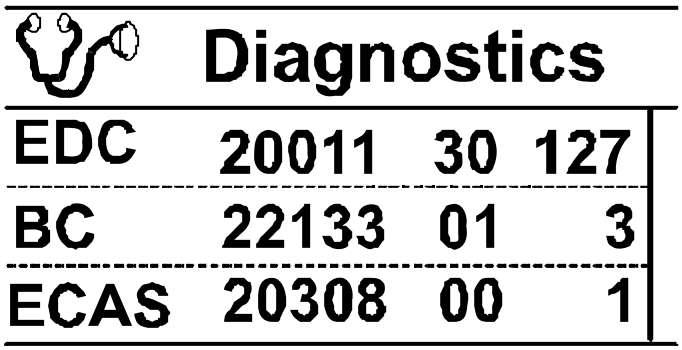
## Diagnosis on Cluster

Access to diagnostic screen is possible through "page" or " y " and " b " keys.

Figure 25




98888




98885

Diagnosis information on the cluster is split into 4 columns:

- First column = central unit.
- Second column = central unit address plus fault order number.
- Third column = failure type.
- Fourth column = failure frequency.

The screen shows three error messages at most, but can store up to eight error messages. For displaying any further messages, just operate " y " and " b " keys.

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## DTC-FMI error codes

| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | SOLENOID VALVES - ADDITIONAL AXLE LIFTING | SHORT CIRCUIT TO POSITIVE | Additional axle control deactivated. | Additional axle lifting solenoid valve locked closed. | Check wiring and connectors on additional axle control solenoid valve.<br>Check: Check isolation from - battery pin 1 - X3 / 7 - 10 - X1<br>Measuring conditions: Connectors connected to control unit.<br>Key on START.<br>Comparable values: 22 - 26 V | | | | |
| | | SOLENOID VALVES - ADDITIONAL AXLE LIFTING | OPEN CIRCUIT | Additional axle control deactivated. | Additional axle lifting solenoid valve locked closed. | Check wiring and connectors on additional axle control solenoid valve.<br>Check: Check continuity between pins 4 - X2 / 1 - X3<br>Measuring conditions: Connectors connected to control unit.<br>Key on STOP.<br>Comparable values: 70 - 90 Ohm | | | | |
| | | SOLENOID VALVES - ADDITIONAL AXLE LIFTING | SHORT CIRCUIT TO GROUND | Additional axle automatically lowered. | Additional axle lifting solenoid valve locked open. | Check wiring and connectors on additional axle control solenoid valve.<br>Check: Check isolation from - battery pin 1 X3 / 12 - X1<br>Measuring conditions: Connectors connected to control unit.<br>Key on STOP.<br>Comparable values: > 1 Mohm | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 03 | SOLENOID VALVES - FRONT SOLENOID VALVE | SHORT CIRCUIT TO POSITIVE | Front and rear axles automatic controls deactivated. Front axle manual controls deactivated. | Front axle solenoid valve locked closed. | Check wiring and connectors on front frame control solenoid valve. Check: Check isolation from + battery pin 15 - X2 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V | | | | |
| 01 | 05 | SOLENOID VALVES - FRONT SOLENOID VALVE | OPEN CIRCUIT | Front and rear axles automatic controls deactivated. Front axle manual controls deactivated. | Front axle solenoid valve locked closed. | Check wiring and connectors on front frame control solenoid valve. Check: Check continuity pins 4 - 15 / X2 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 70 - 90 Ohm | | | | |
| 01 | 06 | SOLENOID VALVES - FRONT SOLENOID VALVE | SHORT CIRCUIT TO GROUND | Front axle automatically lowered. | Front axle solenoid valve locked open. | Check wiring and connectors on front frame control solenoid valve. Check: Check isolation from - battery pin 15 - X2 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: > 1 Mohm | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 03 | 03 | SOLE-NOID VALVES - REAR RIGHT | SHORT CIRCUIT TO POSI-TIVE | Rear axles auto-matic controls deactivated. | RH engine axle solenoid valve locked closed. | Check wiring and con-nectors on RH engine axle frame control solenoid valve.<br>Check: Check isolation from - battery pin 13 - X2 / 7 -10 - X1<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on START.<br>Comparable values: 22 - 26 V | | | | |
| 03 | 05 | SOLE-NOID VALVES - REAR RIGHT | OPEN CIR-CUIT | Rear axles auto-matic controls deactivated. | RH engine axle solenoid valve locked closed. | Check wiring and con-nectors on RH engine axle frame control solenoid valve.<br>Check: Check continu-ity pins 4 - 13 / X2<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on STOP.<br>Comparable values: 70 - 90 Ohm | | | | |
| 03 | 06 | SOLE-NOID VALVES - REAR RIGHT | SHORT CIRCUIT TO GROUND | RH side engine axle automatically lowered. | RH engine axle solenoid valve locked open. | Check wiring and con-nectors on RH engine axle frame control solenoid valve.<br>Check: Check isolation from - battery pin 13 - X2 / 12 - X1<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on STOP.<br>Comparable values: > 1 Mohm | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 04 | 03 | SOLE-NOID VALVES - REAR LEFT | SHORT CIRCUIT TO POSI-TIVE | Rear axles auto-matic controls deactivated. | LH engine axle solenoid valve locked closed. | Check wiring and con-nectors on LH engine axle frame control solenoid valve.<br>Check: Check isolation from - battery pin 10 - X2 /7 - 10 X1<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on START.<br>Comparable values: 22 - 26 V | | | | |
| 04 | 05 | SOLE-NOID VALVES - REAR LEFT | OPEN CIR-CUIT | Rear axles auto-matic controls deactivated. | LH engine axle solenoid valve locked closed. | Check wiring and con-nectors on LH engine axle frame control solenoid valve.<br>Check: Check continu-ity between pins 4 - 10 / X2<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on STOP.<br>Comparable values: 70 - 90 Ohm | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 04 | 06 | SOLE-NOID VALVES - REAR LEFT | SHORT CIRCUIT TO GROUND | LH side engine axle automatically lowered. | LH engine axle solenoid valve locked open. | Check wiring and connectors on LH engine axle frame control solenoid valve.<br>Check: Check isolation from - battery pin 10 - X2 /12 - X1<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on STOP.<br>Comparable values: > 1 Mohm | | | | |
| 05 | 03 | SOLE-NOID VALVES - REAR RIGHT (THIRD AXLE) | SHORT CIRCUIT TO POSI-TIVE | Rear axles auto-matic controls deactivated.<br>Raise and auxili-ary deactivated at additional axle peak. | RH additional axle solenoid valve locked closed. | Check wiring and connectors on RH addi-tional axle frame con-trol solenoid valve.<br>Check: Check isolation from + battery pin 12 - X2 /7 - 10 - X1<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on START.<br>Comparable values: 22 - 26 V | | | | |
| 05 | 05 | SOLE-NOID VALVES - REAR RIGHT (THIRD AXLE) | OPEN CIR-CUIT | Rear axles auto-matic controls deactivated.<br>Raise and auxili-ary deactivated at additional axle peak. | RH additional axle solenoid valve locked closed. | Check wiring and connectors on RH addi-tional axle frame con-trol solenoid valve.<br>Check: Check continu-ity between pins 4 - 12 / X2<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on STOP.<br>Comparable values: 70 - 90 Ohm | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 05 | 06 | SOLENOID VALVES - REAR RIGHT (THIRD AXLE) | SHORT CIRCUIT TO GROUND | RH side additional axle automatically lowered. | RH additional axle solenoid valve locked open. | Check wiring and connectors on RH additional axle frame control solenoid valve.<br>Check: Check isolation from - battery pin 12 - X2 / 12 - X1<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on STOP.<br>Comparable values: > 1 Mohm | | | | |
| 06 | 03 | SOLENOID VALVES - REAR LEFT (THIRD AXLE) | SHORT CIRCUIT TO POSITIVE | Rear axles automatic controls deactivated.<br>Raise and auxiliary deactivated at additional axle peak. | LH additional axle solenoid valve locked closed. | Check wiring and connectors on LH additional axle frame control solenoid valve.<br>Check: Check isolation from - battery pin 14 - X2 / 7 - 10 - X1<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on START.<br>Comparable values: 22 - 26 V | | | | |
| 06 | 05 | SOLENOID VALVES - REAR LEFT (THIRD AXLE) | OPEN CIRCUIT | Rear axles automatic controls deactivated.<br>Raise and auxiliary deactivated at additional axle peak. | LH additional axle solenoid valve locked closed. | Check wiring and connectors on LH additional axle frame control solenoid valve.<br>Check: Check continuity between pins 4 - 14 / X2<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on STOP.<br>Comparable values: 70 - 90 Ohm | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 06 | 06 | SOLENOID VALVES - REAR LEFT (THIRD AXLE) | SHORT CIRCUIT TO GROUND | LH side additional axle automatically lowered. | LH additional axle solenoid valve locked open. | Check wiring and connectors on LH additional axle frame control solenoid valve.<br>Check: Check isolation from - battery pin 14 - X2 / 12 - X1<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on STOP.<br>Comparable values: > 1 Mohm | | | | |
| 07 | 03 | SOLENOID VALVES - AIR INLET/ OUTLET VALVE | SHORT CIRCUIT TO POSITIVE | Front and rear axles automatic controls deactivated.<br>Raise and auxiliary deactivated at additional axle peak. | Power supply solenoid valve locked closed. | Check wiring and connectors on power supply solenoid valve.<br>Check: Check isolation from - battery pin 11 - X2 / 7 - 10 - X1<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on START.<br>Comparable values: 22 - 26 V | | | | |
| 07 | 05 | SOLENOID VALVES - AIR INLET/ OUTLET VALVE | OPEN CIRCUIT | Front and rear axles automatic controls deactivated.<br>Raise and auxiliary deactivated at additional axle peak. | Power supply solenoid valve locked closed. | Check wiring and connectors on power supply solenoid valve.<br>Check: Check continuity between pins 4 - 11 / X2<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on STOP.<br>Comparable values: 70 - 90 Ohm | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 07 | 06 | SOLENOID VALVES - AIR INLET/ OUTLET VALVE | SHORT CIRCUIT TO GROUND | Front and rear axles automatic controls deactivated.<br>Raise and auxiliary deactivated at additional axle peak. | Power supply solenoid valve locked open. | Check wiring and connectors on power supply solenoid valve.<br>Check: Check isolation from - battery pin 11 - X2 / 12 - X1<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on STOP.<br>Comparable values: > 1 Mohm | | | | |
| 10 | 02 | SENSORS - FRONT LEVEL SENSOR | INCORRECT PARAMETERS | No front axle leveling. | Front axle level automatic controls disabled. | Electronic control unit configuration check.<br>Check calibration levels.<br>Check sensor installation and eventual mechanical connection faults. | | | | |
| 10 | 03 | SENSORS - FRONT LEVEL SENSOR | SHORT CIRCUIT TO POSITIVE | No front axle leveling. | Front axle level automatic controls disabled. | Check sensor wiring and connectors.<br>Check: Check isolation from - battery pin 9 - X2 / 7 - 10 - X1<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on START.<br>Comparable values: 22 - 26 V | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 05 | SENSORS - FRONT LEVEL SENSOR | OPEN CIRCUIT | No front axle leveling. | Front axle level automatic controls disabled. | Check sensor wiring and connectors.<br>Check: Check continuity between pins 7 - 9 / X2<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on STOP.<br>Comparable values: 4 - 5 Kohm | | | | |
| 10 | 06 | SENSORS - FRONT LEVEL SENSOR | SHORT CIRCUIT TO GROUND | No front axle leveling. | Front axle level automatic controls disabled. | Check sensor wiring and connectors.<br>Check: Check isolation from - battery pin 9 - X2 / 12 - X1<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on STOP.<br>Comparable values: > 1 Mohm | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 02 | SENSORS - REAR RIGHT LEVEL SENSOR | INCORRECT PARAMETERS | On "4x2 Tractor" - No rear axle leveling. On "6x2 Truck or Tractor" - Yellow fault light ON. On "6x2 Truck or Tractor" with simultaneous LH sensor fault - No rear axle leveling and auxiliary function deactivated at peak. | 1 sensor axle "4x2 Tractors" Deactivation of rear axle level automatic controls. 2 sensor axle "6x2 Truck or Tractor" no functional fault. 2 sensor axle "6x2 Truck or Tractor" with simultaneous LH sensor fault. Deactivation of rear axle level automatic controls and auxiliary at peak. | Electronic control unit configuration check. Check calibration levels. Check sensor installation and eventual mechanical connection faults. | | | | |
| 12 | 03 | SENSORS - REAR RIGHT LEVEL SENSOR | SHORT CIRCUIT TO POSITIVE | On "4x2 Tractor" - No rear axle leveling. On "6x2 Truck or Tractor" - Yellow fault light ON. On "6x2 Truck or Tractor" with simultaneous LH sensor fault - No rear axle leveling and auxiliary function deactivated at peak. | 1 sensor axle "4x2 Tractors" Deactivation of rear axle level automatic controls. 2 sensor axle "6x2 Truck or Tractor" no functional fault. 2 sensor axle "6x2 Truck or Tractor" with simultaneous LH sensor fault. Deactivation of rear axle level automatic controls and auxiliary at peak. | Check sensor wiring and connectors. Check: Check isolation from + battery pin 8 - X2 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 05 | SENSORS - REAR RIGHT LEVEL SENSOR | OPEN CIRCUIT | On "4x2 Tractor" - No rear axle leveling. On "6x2 Truck or Tractor" - Yellow fault light ON. On "6x2 Truck or Tractor" with simultaneous LH sensor fault - No rear axle leveling and auxiliary function deactivated at peak. | 1 sensor axle "4x2 Tractors" Deactivation of rear axle level automatic controls. 2 sensor axle "6x2 Truck or Tractor" no functional fault. 2 sensor axle "6x2 Truck or Tractor" with simultaneous LH sensor fault. Deactivation of rear axle level automatic controls and auxiliary at peak. | Check sensor wiring and connectors. Check: Check continuity between pins 7 - 8 / X2 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 80 - 90 Ohm | | | | |
| 12 | 06 | SENSORS - REAR RIGHT LEVEL SENSOR | SHORT CIRCUIT TO GROUND | On "4x2 Tractor" - No rear axle leveling. On "6x2 Truck or Tractor" - Yellow fault light ON. On "6x2 Truck or Tractor" with simultaneous LH sensor fault - No rear axle leveling and auxiliary function deactivated at peak. | 1 sensor axle "4x2 Tractors" Deactivation of rear axle level automatic controls. 2 sensor axle "6x2 Truck or Tractor" no functional fault. 2 sensor axle "6x2 Truck or Tractor" with simultaneous LH sensor fault. Deactivation of rear axle level automatic controls and auxiliary at peak. | Check sensor wiring and connectors. Check: Check isolation from + battery pin 8 - X2 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: > 1 Mohm | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 02 | SENSORS - REAR LEFT LEVEL SENSOR | INCORRECT PARAMETERS | On "6x2 Truck or Tractor" - Yellow fault light ON. On "6x2 Truck or Tractor" with simultaneous RH sensor fault - No rear axle leveling and auxiliary function deactivated at peak. | 2 sensor axle "6x2 Truck or Tractor" no functional fault. 2 sensor axle "6x2 Truck or Tractor" with simultaneous RH sensor fault. Deactivation of rear axle level automatic controls and auxiliary at peak. | Electronic control unit configuration check. Check calibration levels. Check sensor installation and eventual mechanical connection faults. | | | | |
| 13 | 03 | SENSORS - REAR LEFT LEVEL SENSOR | SHORT CIRCUIT TO POSITIVE | On "6x2 Truck or Tractor" - Yellow fault light ON. On "6x2 Truck or Tractor" with simultaneous RH sensor fault - No rear axle leveling and auxiliary function deactivated at peak. | 2 sensor axle "6x2 Truck or Tractor" no functional fault. 2 sensor axle "6x2 Truck or Tractor" with simultaneous RH sensor fault. Deactivation of rear axle level automatic controls and auxiliary at peak. | Check sensor wiring and connectors. Check: Check isolation from + battery pin 5 - X2 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 05 | SENSORS - REAR LEFT LEVEL SENSOR | OPEN CIRCUIT | On "6x2 Truck or Tractor" - Yellow fault light ON. On "6x2 Truck or Tractor" with simultaneous RH sensor fault - No rear axle leveling and auxiliary function deactivated at peak. | 2 sensor axle "6x2 Truck or Tractor" no functional fault. 2 sensor axle "6x2 Truck or Tractor" with simultaneous RH sensor fault. Deactivation of rear axle level automatic controls and auxiliary at peak. | Check sensor wiring and connectors. Check: Check continuity between pins 7 - 5 / X2 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 80 - 90 Ohm | | | | |
| 13 | 06 | SENSORS - REAR LEFT LEVEL SENSOR | SHORT CIRCUIT TO GROUND | On "6x2 Truck or Tractor" - Yellow fault light ON. On "6x2 Truck or Tractor" with simultaneous RH sensor fault - No rear axle leveling and auxiliary function deactivated at peak. | 2 sensor axle "6x2 Truck or Tractor" no functional fault. 2 sensor axle "6x2 Truck or Tractor" with simultaneous RH sensor fault. Deactivation of rear axle level automatic controls and auxiliary at peak. | Check sensor wiring and connectors. Check: Check isolation from - battery pin 5 - X2 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: > 1 Mohm | | | | |
| 16 | 03 | SENSORS - FRONT PRESSURE SENSOR | SHORT CIRCUIT TO POSITIVE | Possible front axle overload. | FAILURE INDICATOR TURNS ON.LOAD INDICATION IS MISSING OR DOES NOT RESULT. | Check connector wiring and components. | Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 10 Measure point 2: Connector X2 Pin: 3 | Key +15 ON; | Typical Value: 22-26 V; | INSERT ADAPTER BETWEEN THE UNIT AND CABLING |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 05 | SENSORS - FRONT PRESSURE SENSOR | OPEN CIRCUIT | Possible front axle overload. | FAILURE INDICATOR TURNS ON.LOAD INDICATION IS MISSING OR DOES NOT RESULT. | Check connector wiring and components. | Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 1 Measure point 2: Connector X2 Pin: 3 | Key +15 OFF; | Typical Value: 41 KOhm; | INSERT ADAPTER BETWEEN THE UNIT AND CABLING |
| 16 | 06 | SENSORS - FRONT PRESSURE SENSOR | SHORT CIRCUIT TO GROUND | Possible front axle overload. | FAILURE INDICATOR TURNS ON.LOAD INDICATION IS MISSING OR DOES NOT RESULT. | CHECK INSULATION FROM BATTERY.CHECK COMPONENT AND CONNECTOR CABLING INTEGRITY. | Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 3 Measure point 2: Connector X1 Pin: 12 | Key +15 OFF; | Typical Value: 1-1.5 KOhm; | INSERT ADAPTER BETWEEN THE UNIT AND CABLING |
| 18 | 03 | SENSORS - RIGHT PRESSURE SENSOR (AXLE) | SHORT CIRCUIT TO POSITIVE | Fault light ON. Axle load signal missing or incorrect. | Possible engine axle overload. | Check connector wiring and components. Check: Check isolation from + battery pin 2 - X2 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 18 | 05 | SENSORS - RIGHT PRESSURE SENSOR (AXLE) | OPEN CIRCUIT | Fault light ON. Axle load signal missing or incorrect. | Possible engine axle overload. | Check connector wiring and components. Check: Check continuity between pins 1 - 2 / X2 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 35 - 45 Kohm | | | | |
| 18 | 06 | SENSORS - RIGHT PRESSURE SENSOR (AXLE) | SHORT CIRCUIT TO GROUND | Fault light ON. Axle load signal missing or incorrect. | Possible engine axle overload. | Check connector wiring and components. Check: Check isolation from - battery pin 2 - X2 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 1 - 1.5 Kohm | | | | |
| 19 | 03 | SENSORS - LEFT PRESSURE SENSOR (AXLE) | SHORT CIRCUIT TO POSITIVE | Fault light ON. Axle load signal missing or incorrect. | Possible engine axle overload. | Check connector wiring and components. Check: Check isolation from + battery pin 6 - X2 /7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 19 | 05 | SENSORS - LEFT PRESSURE SENSOR (AXLE) | OPEN CIRCUIT | Fault light ON. Axle load signal missing or incorrect. | Possible engine axle overload. | Check connector wiring and components. Check: Check continuity between pins 1 - 6 / X2 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 35 - 45 Kohm | | | | |
| 19 | 06 | SENSORS - LEFT PRESSURE SENSOR (AXLE) | SHORT CIRCUIT TO GROUND | Fault light ON. Axle load signal missing or incorrect. | Possible engine axle overload. | Check connector wiring and components. Check: Check isolation from - battery pin 6 - X2 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 1 - 1.5 Kohm | | | | |
| 1A | 03 | SENSORS - RIGHT PRESSURE SENSOR 3RD AXLE | SHORT CIRCUIT TO POSITIVE | Fault light ON. Axle load signal missing or incorrect. | Possible additional axle overload. | Check connector wiring and components. Check: Check isolation from + battery pin 4 - X3 /7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 05 | SENSORS - RIGHT PRESSURE SENSOR 3RD AXLE | OPEN CIRCUIT | Fault light ON. Axle load signal missing or incorrect. | Possible additional axle overload. | Check connector wiring and components. Check: Check continuity between pins 1 - X2 / 4 - X3 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 35 - 45 Kohm | | | | |
| 1A | 06 | SENSORS - RIGHT PRESSURE SENSOR 3RD AXLE | SHORT CIRCUIT TO GROUND | Fault light ON. Axle load signal missing or incorrect. | Possible additional axle overload. | Check connector wiring and components. Check: Check isolation from - battery pin 4 - X3 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 1 - 1.5 Kohm | | | | |
| 1B | 03 | SENSORS - LEFT PRESSURE SENSOR 3RD AXLE | SHORT CIRCUIT TO POSITIVE | Fault light ON. Axle load signal missing or incorrect. | Possible additional axle overload. | Check connector wiring and components. Check: Check isolation from + battery pin 3 - X3 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V | | | | |



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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1B | 05 | SENSORS - LEFT PRESSURE SENSOR 3RD AXLE | OPEN CIRCUIT | Fault light ON. Axle load signal missing or incorrect. | Possible additional axle overload. | Check connector wiring and components. Check: Check continuity between pins 1 - X2 / 3 - X3 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 35 - 45 Kohm | | | | |
| 1B | 06 | SENSORS - LEFT PRESSURE SENSOR 3RD AXLE | SHORT CIRCUIT TO GROUND | Fault light ON. Axle load signal missing or incorrect. | Possible additional axle overload. | Check connector wiring and components. Check: Check isolation from - battery pin 3 - X3 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 1 - 1.5 Kohm | | | | |
| 1C | 03 | SENSORS - PRESSURE SENSOR RAISER | SHORT CIRCUIT TO POSITIVE | Additional axle cannot be raised. Auxiliary function deactivated at peak. | Additional axle control disabled. | Check connector wiring and components. Check: Check isolation from + battery pin 5 - X3 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1C | 05 | SENSORS - PRESSURE SENSOR RAISER | OPEN CIR-CUIT | Additional axle cannot be raised. Auxiliary function deactivated at peak. | Additional axle control disabled. | Check connector wir-ing and components. Check: Check continu-ity between pins 1 - X2 / 5 - X3 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 35 - 45 Kohm | | | | |
| 1C | 06 | SENSORS - PRESSURE SENSOR RAISER | SHORT CIRCUIT TO GROUND | Additional axle cannot be raised. Auxiliary function deactivated at peak. | Additional axle control disabled. | Check connector wir-ing and components. Check: Check isolation from - battery pin 5 - X3 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 1 - 1.5 Kohm | | | | |
| 21 | 0B | REMOTE CON-TROL - REMOTE CON-TROL 1 | IT IS NOT POSSIBLE TO DE-TECT THE FAULT | Deactivation re-mote control 1. | Level manual controls dis-abled. | Check correct oper-ation of remote con-trol on Modus instru-ment status para-meters. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 22 | 03 | POWER SUPPLY - SUPPLY VOLTAGE FOR ELECTRO-VALVES | SHORT CIRCUIT TO POSITIVE | Fault light ON. | Load distribution on axles control disabled. | Check wiring and connectors on frame control solenoid valves.<br>Check: Check isolation from + battery pin 4 - X2 / 7 - 10 - X1<br>Measuring conditions: Connectors connected to control unit.<br>Key on START.<br>Comparable values: 22 - 26 V | | | | |
| 22 | 05 | POWER SUPPLY - SUPPLY VOLTAGE FOR ELECTRO-VALVES | OPEN CIRCUIT | Pneumatic suspension locked. Manual trim variations cannot be carried out. Auxiliary function deactivated at peak. | ECAS totally disabled. | Check wiring and connectors on frame control solenoid valves.<br>Check: Check continuity between pins 4 - X2 / 6.1 or 61.1 solenoids<br>Measuring conditions: Connectors connected to control unit.<br>Key on STOP.<br>Comparable values: 70 - 90 Ohm | | | | |
| 22 | 06 | POWER SUPPLY - SUPPLY VOLTAGE FOR ELECTRO-VALVES | SHORT CIRCUIT TO GROUND | Pneumatic suspension locked. Manual trim variations cannot be carried out. Auxiliary function deactivated at peak. | ECAS totally disabled. | Check wiring and connectors on frame control solenoid valves.<br>Check: Check isolation from - battery pin 4 - X2 / 12 - X1<br>Measuring conditions: Connectors connected to control unit.<br>Key on STOP.<br>Comparable values: > 1 Mohm | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 26 | 02 | ELEC-TRONIC CON-TROL UNIT - MEMORY CHECK-SUM | SPECIFIC DATA NOT CORRECT | No frame auto-matic adjustment. Additional axle cannot be raised. Auxiliary function deactivated at peak. | Additional axle control and level automatic controls dis-abled. | Electronic control unit configuration check. Check calibration le-vels. Check: Reprogram Electronic control unit. Recalibrate frame level. Measuring conditions: Comparable values: | | | | |
| 27 | 02 | ELEC-TRONIC CON-TROL UNIT - PARA-METER CHECK-SUM | INCOR-RECT PARA-METERS | No frame auto-matic adjustment. Additional axle cannot be raised. Auxiliary function deactivated at peak. | Additional axle control and level automatic controls dis-abled. | Electronic control unit configuration check. Check calibration le-vels. Check: Reprogram Electronic control unit. Recalibrate frame level. Measuring conditions: Comparable values: | | | | |
| 28 | 02 | ELEC-TRONIC CON-TROL UNIT - HEIGHT SENSOR CALIBRA-TION DATA CHECK-SUM FAULT | INCOR-RECT PARA-METERS | No frame auto-matic adjustment. Additional axle cannot be raised. Auxiliary function deactivated at peak. | Additional axle control and level automatic controls dis-abled. | Electronic control unit configuration check. Check calibration le-vels. Check: Reprogram Electronic control unit. Recalibrate frame level. Measuring conditions: Comparable values: | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 2E | 03 | POWER SUPPLY - PRESSURE SENSORS VOLTAGE SUPPLY | SHORT CIRCUIT TO POSI-TIVE | Fault light ON. Axles load signal missing or incor-rect. | Possible axles overload. | Check connector wiring and components.<br>Check: Check isolation from + battery pin 1 - X2 / 7 - 10 - X1<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on START.<br>Comparable values: 0.5 - 4.5 V | | | | |
| 2E | 06 | POWER SUPPLY - PRESSURE SENSORS VOLTAGE SUPPLY | SHORT CIRCUIT TO GROUND | Fault light ON. Axles load signal missing or incor-rect. Additional axle cannot be raised. Auxiliary function deacti-vated at peak. | Possible axles overload. Addi-tional axle con-trol disabled. | Check connector wiring and components.<br>Check: Check isolation from - battery pin 1 - X2 / 7 - 12 - X1<br>Measuring conditions:<br>Connectors connected to control unit.<br>Key on STOP.<br>Comparable values: 30 - 50 Kohm | | | | |
| 2E | 0B | POWER SUPPLY - PRESSURE SENSORS VOLTAGE SUPPLY | IT IS NOT POSSIBLE TO DE-TECT THE FAULT | Fault light ON. Axles load signal missing or incor-rect. Additional axle cannot be raised. Auxiliary function deacti-vated at peak. | Possible axles overload. Addi-tional axle con-trol disabled. | Check connector wiring and components.<br>Check:<br>A) Check isolation from + battery pin 1 - X2 / 7 - 10 - X1<br>B) Check isolation from - battery pin 1 - X2 / 12 - X1<br>Measuring conditions:<br>A) Connectors con-nected to control unit.<br>Key on START.<br>B) Connectors con-nected to control unit.<br><br>Key on STOP.<br>Comparable values:<br>A) 0.5 - 4.5 V<br>B) 30 - 50 Kohm | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 2F | 03 | POWER SUPPLY - SUPPLY VOLTAGE FOR ECAS REMOTE CON-TROL | SHORT CIRCUIT TO POSI-TIVE | Remote controls deactivated. | Level manual controls dis-abled. | Check connector wir-ing and components. Check: Check isolation from + battery pin 13 - X1 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 1 - 1.5 V | | | | |
| 2F | 06 | POWER SUPPLY - SUPPLY VOLTAGE FOR ECAS REMOTE CON-TROL | SHORT CIRCUIT TO GROUND | Remote controls deactivated. | Level manual controls dis-abled. | Check connector wir-ing and components. Check: Check isolation from - battery pin 13 - X1 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 30 - 40 Kohm | | | | |
| 30 | 03 | REMOTE CON-TROL - REMOTE CON-TROL 1 | SHORT CIRCUIT TO POSI-TIVE - DATA LINE | Deactivation re-mote control 1. | Level manual controls dis-abled. | Check connectors wir-ing and components. Check: Check isolation from + battery pin 11 - X1 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 22 - 26 V | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 30 | 06 | REMOTE CONTROL - REMOTE CONTROL 1 | SHORT CIRCUIT TO GROUND - DATA LINE | Deactivation remote control 1. | Level manual controls disabled. | Check connectors wiring and components. Check: Check isolation from - battery pin 11 - X1 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 6 - 7 Kohm | | | | |
| 31 | 03 | REMOTE CONTROL - REMOTE CONTROL 1 | SHORT CIRCUIT TO POSITIVE - CLOCK LEITUNG | Deactivation remote control 1. | Level manual controls disabled. | Check connectors wiring and components. Check: Check isolation from + battery pin 8 - X1 / 7 - 10 - X1 Measuring conditions: Connectors connected to control unit. Key on START. Comparable values: 4 - 4.5 V | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 31 | 06 | REMOTE CON-TROL - REMOTE CON-TROL 1 | SHORT CIRCUIT TO GROUND - CLOCK LINE | Deactivation re-mote control 1. | Level manual controls dis-abled. | Check connectors wir-ing and components. Check: Check isolation from - battery pin 8 - X1 / 12 - X1 Measuring conditions: Connectors connected to control unit. Key on STOP. Comparable values: 8.5 - 9.5 Kohm | | | | |
| 3C | 09 | CAN LINE - CAN COM-MUNICA-TION ERROR | ABNOR-MAL UP-DATE RATE | Level adjustment delayed or ad-vanced. | Delayed level adjustment time. Incorrect braking adjust-ment. | Check vehicle CAN line and relative con-nections on the rel-evant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connec-tor.Measuring condi-tions: Connectors con-nected to control unit. Key on STOP.Compar-able values: 60 ohm | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 3D | 09 | CAN LINE - MESSAGE VSC1 (CCVS) FROM ENGINE | FAULTY SIGNAL | Level adjustment delayed or advanced. | Delayed level adjustment time. Incorrect braking adjustment. | Check vehicle CAN line and relative connections on the relevant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connector.Measuring conditions: Connectors connected to control unit. Key on STOP.Comparable values: 60 ohm | | | | |
| 3E | 09 | CAN LINE - MESSAGE EEC1 FROM ENGINE | FAULTY SIGNAL | Level adjustment delayed or advanced. | Delayed level adjustment time. Incorrect braking adjustment. | Check vehicle CAN line and relative connections on the relevant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connector.Measuring conditions: Connectors connected to control unit. Key on STOP.Comparable values: 60 ohm | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 44 | 09 | CAN LINE - MESSAGE TCO1 FROM TACHO-GRAPH | FAULTY SIGNAL | Level adjustment delayed or advanced. | Delayed level adjustment time. Incorrect braking adjustment. | Check vehicle CAN line and relative connections on the relevant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connector.Measuring conditions: Connectors connected to control unit. Key on STOP.Comparable values: 60 ohm | | | | |
| 45 | 09 | CAN LINE - MESSAGE TIME AND DATE FROM TACHO-GRAPH | FAULTY SIGNAL | Level adjustment delayed or advanced. | Delayed level adjustment time. Incorrect braking adjustment. | Check vehicle CAN line and relative connections on the relevant control units.Check: Check condition between pin 15 and 16 on 30-pole diagnosis connector.Measuring conditions: Connectors connected to control unit. Key on STOP.Comparable values: 60 ohm | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| E7 | 09 | CAN LINE - DATA UPDATING FREQUENCY | FAULTY SIGNAL | Level adjustment delayed or advanced. | Delayed level adjustment time. Incorrect braking adjustment. | Check vehicle CAN line and relative connections on the relevant control units. | | | | |
| FE | 02 | ELECTRONIC CONTROL UNIT - ELECTRONIC CONTROL UNIT | SPECIFIC DATA NOT CORRECT | Pneumatic suspension locked. Manual trim variations cannot be carried out. Auxiliary function deactivated at peak. | ECAS totally disabled. | Electronic control unit configuration check. Check: Reprogram Electronic control unit, if fault persists, replace. Measuring conditions: Comparable values: | | | | |

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SECTION 2

| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Noisy suspension | Insufficient lubrication. | Lubricate thoroughly. |
| | Shock absorbers noisy or inefficient. | Check and if necessary replace shock absorbers. |
| | Wheel bearings worn with excessive play. | Renew bearings or adjust play. |
| | Leaf spring hangers loose. | Check hanger fixings and if necessary replace any loose pins or bolts. |
| | Leaf spring pack loose due to broken centre bolt. | Overhaul the leaf springs and renew the centre bolt and self-locking nut. |
| | Leaf spring pack loose due to breakage of pins securing the spring clamps. | Check leaf spring clamps and renew the pins. |
| Vehicle pulls to one side | Tyre pressures incorrect. | Check and inflate to specified pressure. |
| | Front wheel alignment incorrect. | Check and adjust front wheel alignment. |
| | Hydraulic shock absorbers inefficient. | Fit new shock absorbers. |
| | Broken leaf spring. | Overhaul leaf spring and renew components as required. |
| | Incorrect load distribution. | Distribute load evenly over loading deck. |
| Excessive flexibility of suspension | Leaf spring centre bolt broken. | Fit new bolt. |
| | Spring leaves over-stressed or broken. | Overhaul the leaf spring and renew damaged parts or the complete spring as necessary. |
| Squeaking, knocking, excessive noise in general | Leaf spring mountings loose. | Check mountings and if necessary renew loose shackle pins. |
| | Leaf spring pack loose due to broken centre bolt. | Overhaul the leaf springs and renew the centre bolt and self-locking nut. |
| | Leaf spring pack loose due to breakage of pins securing the spring clamps. | Check leaf spring clamps and renew the pins.. |
| | Wheel bearings worn.<br>Excessive play of bearings. | Renew bearings, if necessary.<br>Adjust axial clearances of bearings. |
| | Excessive wear or play of bearings at central pivot of cantilever suspension. | Renew bearings and/or adjust axial clearances of bearings. |

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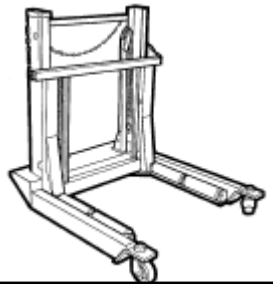
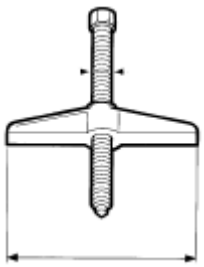
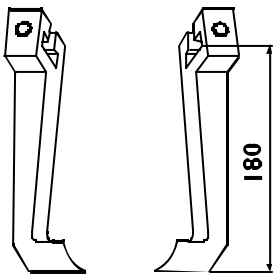
## TIGHTENING TORQUES

| DESCRIPTION | TORQUE | |
|---|---|---|
| | Nm | (kgm) |
| FRONT SUSPENSION | | |
| Collared nut for leaf spring U-bolts | 460 ± 50 | (46 ± 5) |
| Flanged nut for front and rear shackle pins | 710 ± 70 | (71 ± 7) |
| M14 flanged nut for bolt securing front spring hanger to chassis frame and for securing central pivot on 8x4 | 180 ± 20 | (18 ± 2) |
| M16 nut for securing front spring hanger | 275 ± 25 | (27.5 ± 2.5) |
| M20 flanged nut for anti-roll bar retaining pin * | 437.5 ± 42.5 | (43.7 ± 4.2) |
| Anti-roll bar retaining pin * | 437.5 ± 42.5 | (43.7 ± 4.2) |
| M16 nut for lower shock absorber mounting | 150 ± 15 | (15 ± 1,5) |
| M14 nut for upper shock absorber mounting | 63.5 ± 6.5 | (6.3 ± 0.6) |
| M20 bolt for shock absorber-axle mounting | 259 ± 26 | (25.9 ± 2.6) |
| Fork-securing M20 nut | 400 ± 40 | (40 ± 4) |
| M12 nut for anti-roll bar bushing support * * | 182.5 ± 17.5 | (18.2 ± 1.7) |
| M20 flanged nut for anti-roll bar retaining pin * * | 756.5 ± 20.5 | (75.6 ± 2) |
| REAR SUSPENSION | | |
| Collared nut for leaf spring U-bolts | 460 ± 50 | (46 ± 5) |
| Flanged nut for front and rear shackle pins | 710 ± 70 | (71 ± 7) |
| M20 flanged nut for anti-roll bar retaining pin | 437.5 ± 42.5 | (43.7 ± 4.2) |
| Anti-roll bar retaining pin * | 437.5 ± 42.5 | (43.7 ± 4.2) |
| U-bolt retaining bolt for front spring pivot | 192 ± 17 | (19.2 ± 1.7) |
| M14 bolt securing U-bolt for central pivot pin (8x4 - 8x8 vehicles) | 205 ± 20 | (20.5 ± 2) |
| M14 nut for upper and lower shock absorber mounting | 63.5 ± 6.5 | (6.3 ± 0.6) |
| M24 nut securing shock absorber to hanger and axle | 400 ± 40 | (40 ± 4) |
| M24x110 bolt securing shock absorber to chassis frame | 400 ± 40 | (40 ± 4) |
| M20 nut or bolt securing shock absorber to axle or hanger | 380 ± 40 | (38 ± 4) |
| M20 bolt securing bar and shock absorber springs support * * | 700 ± 15 | (70 ± 1.5) |
| M20 nut securing shock absorber to hanger and to air spring support beam | 230 ± 20 | (23 ± 2) |
| REAR CANTILEVER SUSPENSION | | |
| Nut for leaf spring clamping U-bolt | 825 ± 75 | (82.5 ± 7.5) |
| Flanged hex head bolt securing upper hanger bracket to chassis frame | 270 ± 55 | (27 ± 5.5) |
| Flanged hex head bolt securing lower hanger bracket to upper hanger bracket | 492.5 ± 96.5 | (49 ± 9.6) |
| Retaining bolt for longitudinal bar to leaf spring slipper block | 420 | (42) |
| Hex retaining nut for reaction bar | 390 ± 40 | (39 ± 4) |
| M20 flanged nut for anti-roll bar retaining pin | 437.5 ± 42.5 | (43.7 ± 4.2) |
| M18 hex nut securing longitudinal bars | 385 ± 35 | (38.5 ± 3.5) |
| M18 hex nut securing longitudinal bars * * | 417.5 ± 57.5 | (41.7 ± 5.7) |
| M18 hex head bolt securing triangular bar to hanger bracket * * | 352.5 ± 32.5 | (35.2 ± 3.2) |
| 16x1.5 hex bolt securing triangular bar pivot mounting to axle * * | 277.5 ± 27.5 | (27.7 ± 2.7) |
| Hex socket screw securing plate to axle casing * * | 430 ± 30 | (43 ± 3) |

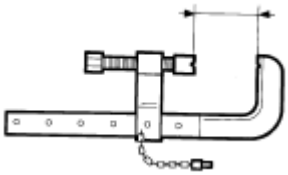
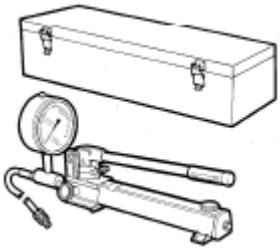
* Excluding vehicles with pneumatic suspension
* * Only for vehicles with pneumatic suspension

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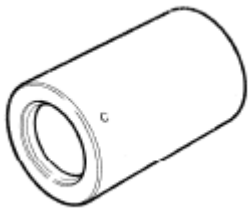
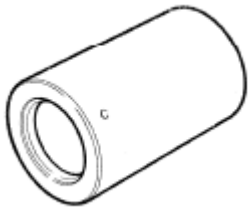
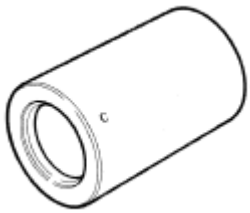
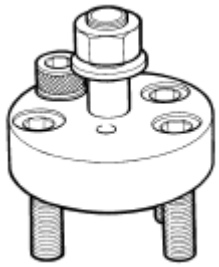
## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99305117** |  | Pneumatic circuit check instruments |
| **99321024** |  | Hydraulic jack for wheel removal and refitting |
| **99327030** |  | E.A.SY. |
| **99331016** |  | Unitester case fitted with multimeter and amperometric device |
| **99341003** |  | Single-acting lift |
| **99341011** |   | Pair of brackets |

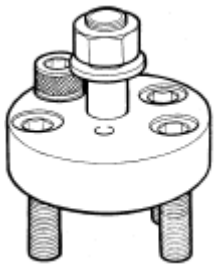
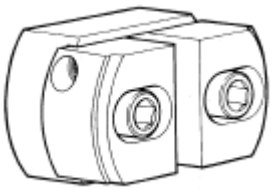
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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99341015** |  | Clamp |
| **99341035** |  | High pressure pump for assembly of suspension pivots and hangers |
| **99345055** |  | Adapter plate for use with pullers |
| **99346001** |  | Standard installer (use with specific bushes) |
| **99346004** |  | Threaded bush (for use with 99346001and 99363245) |
| **99346049** |  | Tool for disassembling and assembling flexible blocks on stabilizer bar and leaf spring. |

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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99346238** ♦ |  | Sleeve for installing inner race of angular contact bearing (use with specific bushes) |
| **99346242** ♦♦ |  | Sleeve for installing inner race of angular contact bearing (use with specific bushes) |
| **99346243** |  | Sleeve for installing inner race of angular contact bearing (use with specific bushes) |
| **99346247** |  | Reference spacers for ECAS suspension adjustment |
| **99363245** |  | Threaded bush (for use with 99346001 and 99346004) |
| **99363296** ♦ |  | Tool to be fitted to bearing spindle for installing inner race of angular contact bearing (use with 99346001 - 99346004 - 99346238 - 99346243 - 99363245) |

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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99363309** ♦♦ |  | Tool to be fitted to bearing spindle for installing inner race of angular contact bearing (use with 99346001 - 99346004 - 99346242 - 99346243 - 99363245) |
| **99370007** |  | Interchangeable driver handle for bearing installers |
| **99374094** |  | Installer for outer bearing races (134 to 215) (for use with 99370007) |
| **99374119** ♦ |  | Installer for spring mounting oil seal |
| **99374131** ♦♦ |  | Installer for spring mounting oil seal |

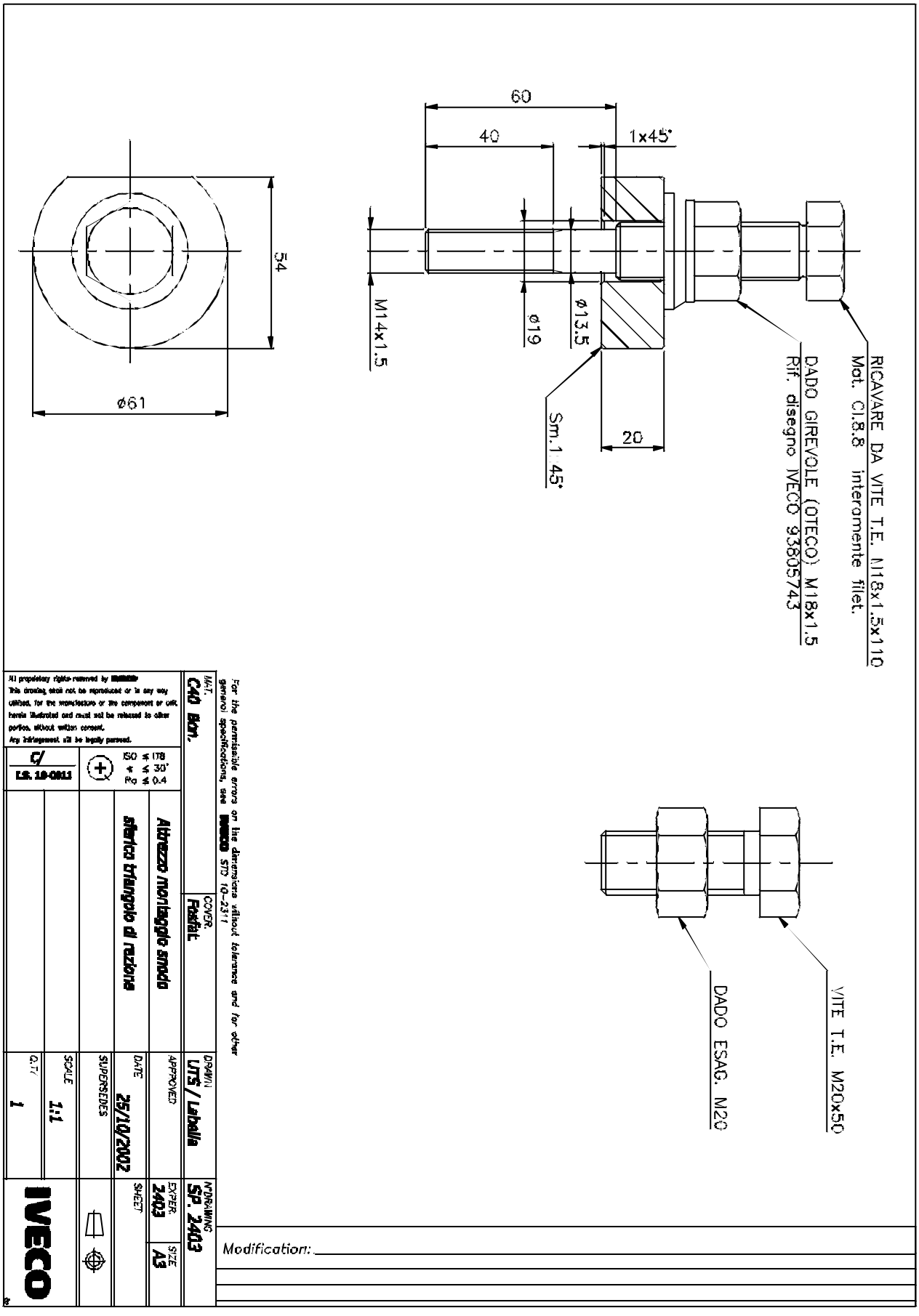
♦ Vehicles with 21 tons suspensions (outside diameter of central pivot shaft 88 mm)
♦♦ Vehicles with 32 tons suspensions (outside diameter of central pivot shaft 120 mm)

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## EXPERIMENTAL TOOLS

This chapter shows technical construction drawings of the special purpose tool (S.P. 2403), used in servicing the suspension described in this section. This may be built by the repair workshops.



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## 500410 FRONT LEAF SPRING REMOVAL-REFITTING

### Removal

Figure 26

Arrange vehicle on flat ground and lock rear wheels.

Loosen front wheels securing nuts.

By a hydraulic jack, lift the vehicle from front side and rest it on two support stands.

Unscrew wheels securing nuts and disconnect wheels with hydraulic truck 99321024.

Position a hydraulic jack suitable to support front axle when the leaf spring will be disconnected.

Then, lower the hydraulic jack that is prearranged under front axle until leaf spring tension is released.

Remove board (5) operating as follows:

- remove screws (4), operating from under the vehicle and remove board complete assembly;
- remove screw (10) of rear shackle (11);

**NOTE** If screw (10) is oriented with its head towards the external side of the vehicle, it is necessary for dismounting the vehicle to partially disconnect the air filter as described below:

- disconnect lower cover (2);
- remove container (15);
- disconnect filtering cartridge (14) operating on nut (1);

- remove the nut with screw (3) securing leaf spring to front support;
- unscrew nuts (6) and unthread U bolts (7);
- disengage shock absorber (13) from suspension operating on fastener (8);
- remove leaf spring (9).

### Refitting

For reconnection, invert operations performed for disconnection observing following warnings.

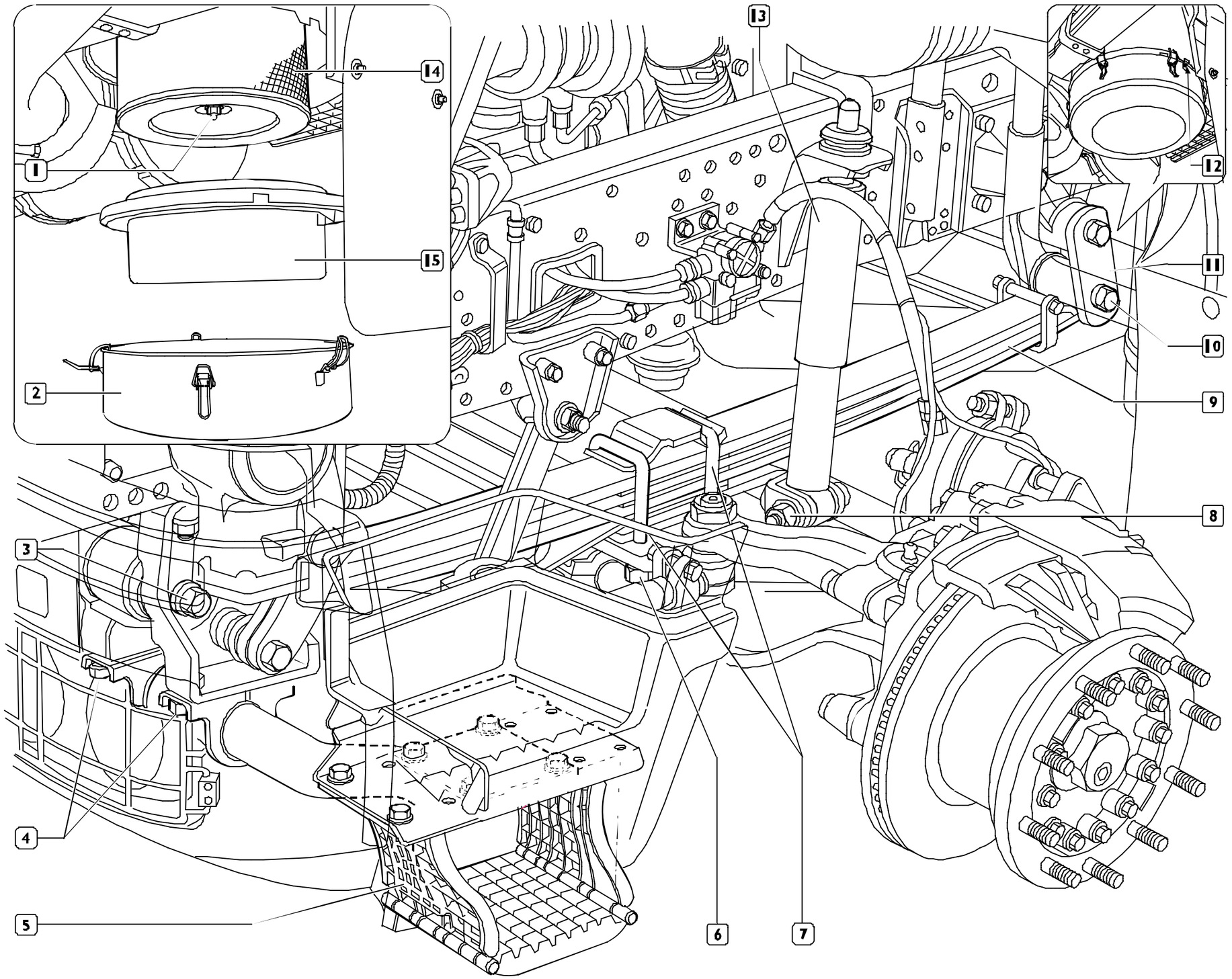
Check the thread of the brackets joining leaf springs to front axle; if faults are found, rectify thread (operation 500412), or replace brackets.

**NOTE** For correct cover (2) springs clamping, align to mark (12).

Tighten screws (10) with their head oriented inwards.

Check stop spring buffers conditions; if stop spring buffers are found to be worn out, replace them (operation 500417).

Tighten nuts at prescribed torque.



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## 500420 REMOVAL-REFITTING OF INTERMEDIATE AXLE LEAF SPRING (8x4 VEHICLES)

### Removal

Park the vehicle on level ground and chock the rear wheels.
Loosen the wheel nuts on the 2nd axle.
Using a hydraulic jack, raise the front of the vehicle and support it on two stands.
Unscrew the wheel nuts and, using hydraulic trolley 99321024, remove the wheels.

Position a hydraulic jack to support the axle when the leaf spring is detached.
Lower the hydraulic jack supporting the axle to relieve the tension on the leaf spring (2).

- Detach the front leaf spring from the mounting (1) before proceeding with the removal of the second steering axle;
- remove the rear shackle pin (7);
- undo the front mounting (1) to detach the leaf spring from the vehicle;
- unscrew the four nuts (4) and withdraw the U-bolts (3);
- remove the nut and bolt (5) and detach the shock absorber (20) from the suspension;
- remove the complete leaf spring (2).

### Refitting

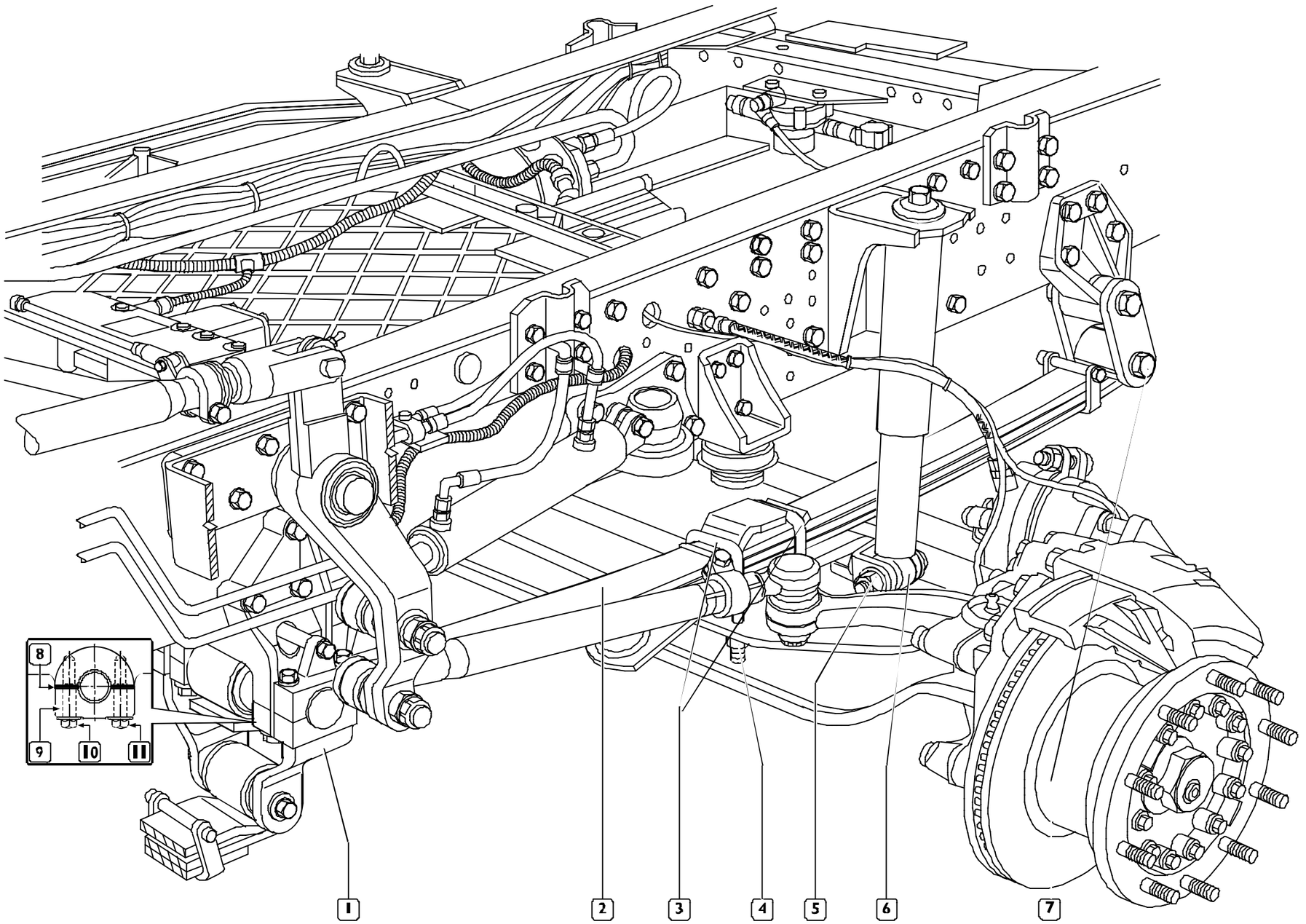
Carry out the removal operations in reverse order, observing the following instructions:

**NOTE** Before the leaf spring can be attached to the two mountings, the spring must be loaded (using suitable equipment including hydraulic jacks and by loading the vehicle itself), thereby causing it to extend and bringing the holes for the shackle pins into alignment.

Inspect the threads on the U-bolts the secure the leaf spring to the axle; if damaged, re-cut the threads (operation 500412) or renew the U-bolts.
Check the condition of the rubber bump stops and renew them if deteriorated (operation 500417).

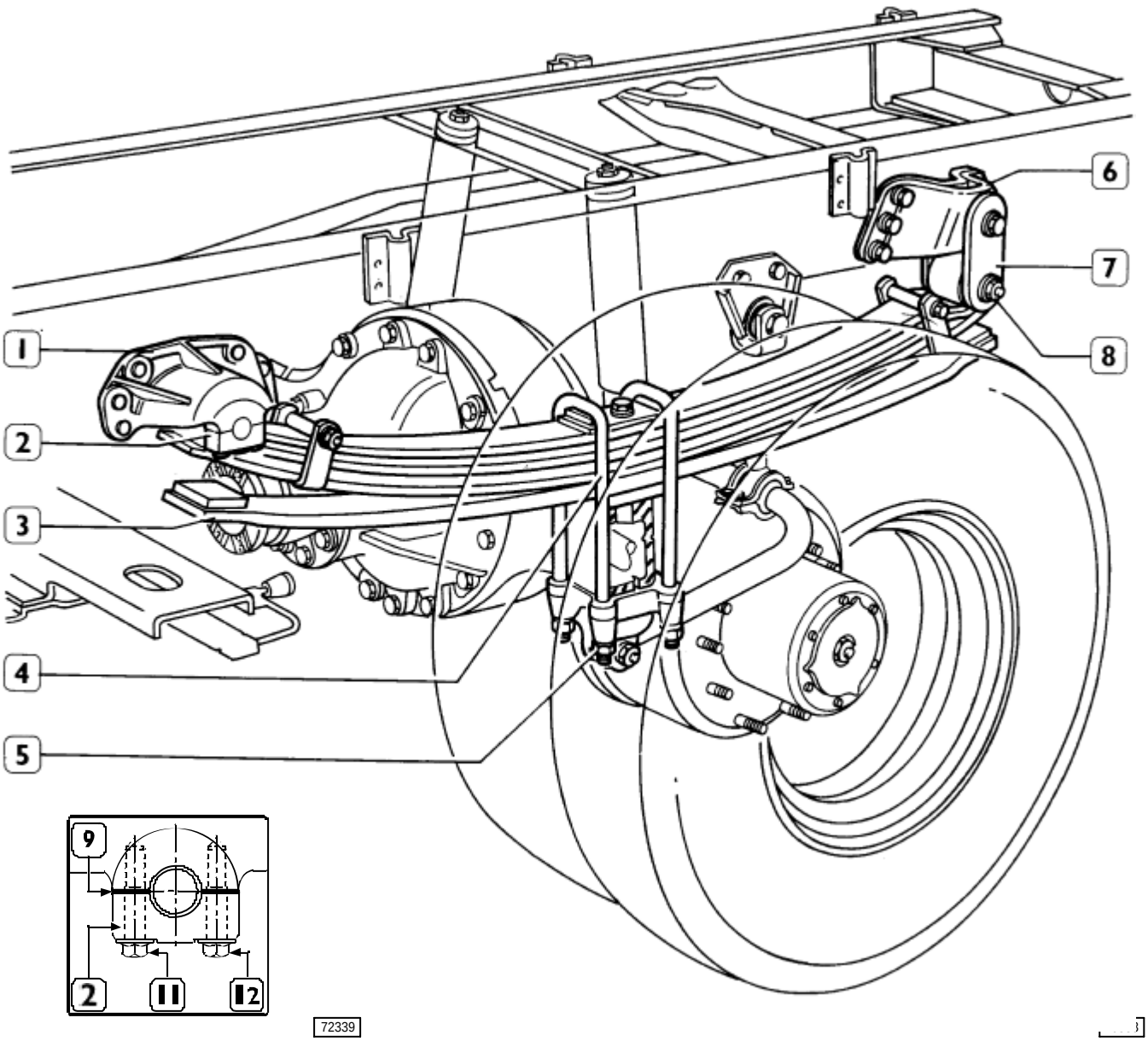
Tighten all nuts to the prescribed torque settings.
To tighten down the cap (9), first tighten bolt (10) to the prescribed torque, interposing spacer (8), and then tighten bolt (11) without a spacer.

Figure 27



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# 500410 REMOVAL-REFITTING OF REAR LEAF SPRING (4x2 - 4x4 VEHICLES)




REAR SUSPENSION WITH PARABOLIC LEAF SPRING

## Removal

Park the vehicle on level ground and chock the front wheels.
Using a hydraulic jack, raise the vehicle and support the chassis on two stands.
Remove the wheels using hydraulic trolley 99321024.
Remove the nuts (5) and withdraw the U-bolts securing the leaf spring (3) to the axle.
Position trolley 99306064 under the leaf spring and attach the latter to the trolley with the specific brackets.
Remove bolts (11 and 12) and remove the cap (2) along with the spacer (9) that secures the spring shackle pin to the front hanger (1); unscrew nut (8) and withdraw the shackle pin securing the shackle plate (7) to the rear hanger (6).
Operate the jack to lower the axle so that the leaf spring centre bolt can be withdrawn.

## Refitting

Carry out the removal operations in reverse order, observing the following instructions:

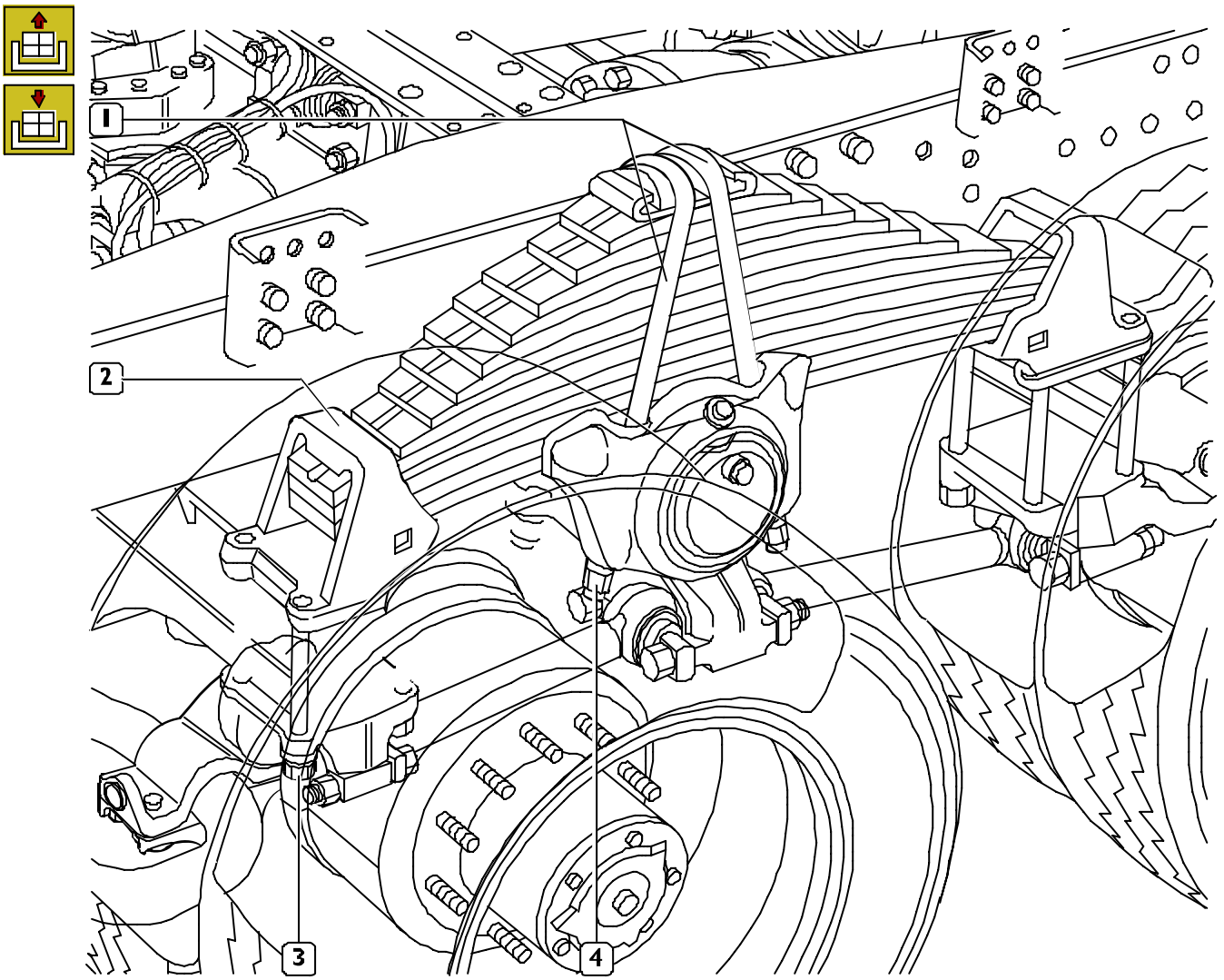
Inspect the threads on the U-bolts the secure the leaf spring to the axle; if damaged, restore the threads (operation 500412) or renew the U-bolts.
Check the condition of the rubber bump stops and renew them if deteriorated (operation 500417).

Tighten all nuts to the prescribed torque settings.
To tighten down the cap (9), first tighten bolt (10) to the prescribed torque, interposing spacer (8), and then tighten bolt (11) without a spacer.

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# 500430 REMOVAL-REFITTING OF REAR LEAF SPRING ON CANTILEVER TYPE SUSPENSIONS (6x4 - 6x6 - 8x4 - 8x8 VEHICLES)

Figure 29




## Removal

Park the vehicle on level ground, chock the front wheels and loosen the rear wheel nuts.
Position the bracket 99370617 on a hydraulic jack, place the jack under the axle and raise the rear of the vehicle. Support the chassis frame and the intermediate and rear axles on stands, while ensuring that the bracket maintains contact with the axle.
Remove the wheel nuts and remove the wheels using hydraulic trolley 99321024.
Remove the nuts (5) of the U-bolts (1) securing the leaf spring (6) to the central pivot.
Remove the bolts (3) and detach the longitudinal bar mounting bracket (4) and the slipper block (2) from the axle casing.
Proceed with the removal of the complete leaf spring from the vehicle using a suitable jack.

## Refitting

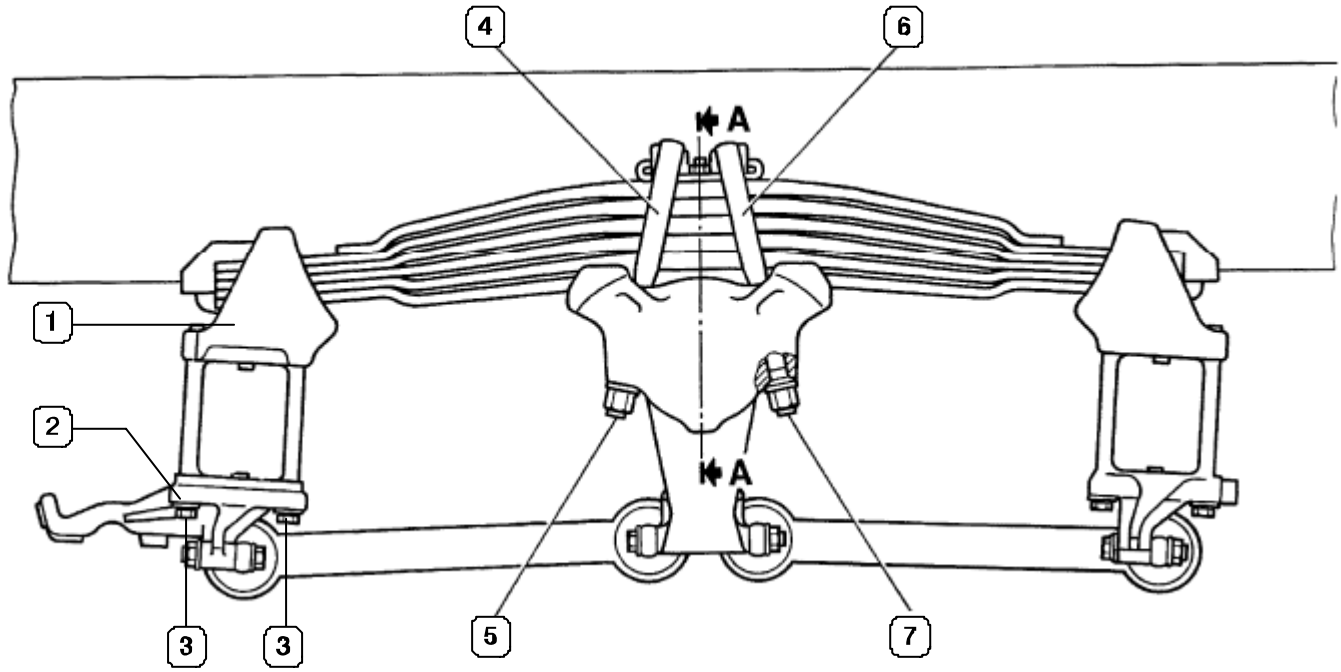
Carry out the removal operations in reverse order, observing the following instructions.

Inspect the threads on the U-bolts the secure the leaf spring to the axle; if damaged, re-cut the threads (operation 500452) or renew the U-bolts.
Fit the slipper block and the longitudinal bar mounting bracket as described on page 79.

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## Procedure for assembly of the slipper block and mounting brackets for the longitudinal bars

Figure 30




36836

- Apply MODILAC grease to the threads of the slipper block (1);
- apply resin for box frames to bolt contact surfaces and holes in the bracket (2);
- after having aligned the parts, pre-tighten bolts (3) in cross-wise sequence to a torque of 100 Nm;
- finally tighten bolts (3) to a torque of 420 Nm.

### Tightening the U-bolts clamping the leaf spring to the central pivot

Tighten the leaf spring (4 and 6) clamping nuts (5 and 7) as follows:

- tighten nuts (5) to a torque of 300 to 500 Nm
- tighten nuts (7) to a torque of 750 to 900 Nm
- tighten nuts (5) to a torque of 750 to 900 Nm

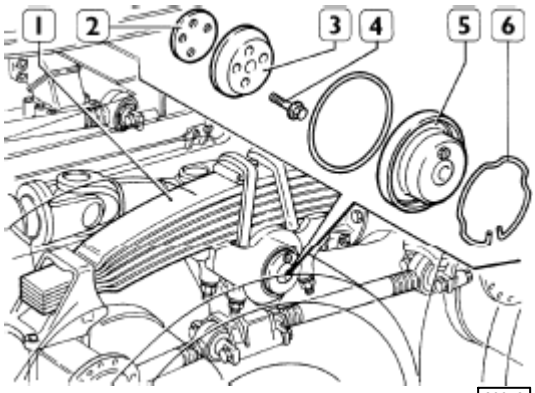
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# REAR CANTILEVER SUSPENSION (6x4 - 6x6 - 8x4 - 8x8 vehicles)

**500440 Removal-refitting of central pivot**
**500442 Removal-refitting of central pivot shaft**
**500443 Renewal of bearings**
**500449 Removal-refitting of hanger bracket**

## Removal of the central pivot

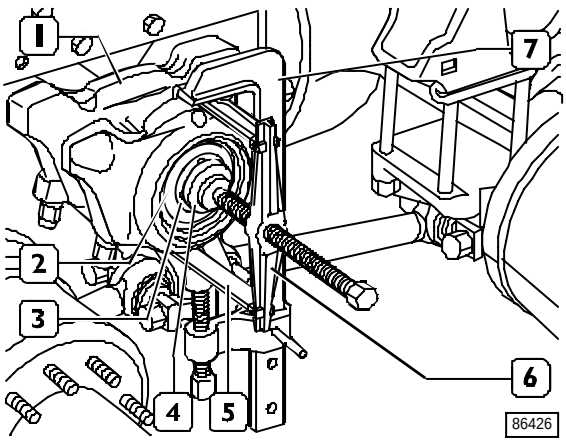
Figure 31




Remove the leaf spring (1) as described in the relative chapter (operation 500430).

Raise the front of the vehicle and support it on stands so that the chassis frame is level.
Remove the spring clip (6) and remove the cap (5). Unscrew the bolts (4) and remove plate and the underlying adjustment shims (2).

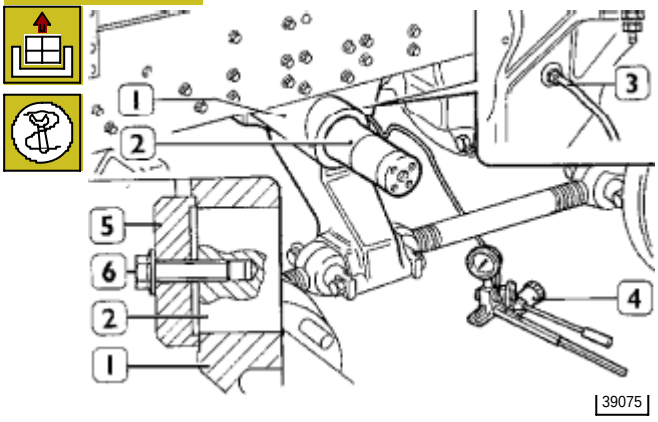
Figure 32




With tools 99341011 (5), 99341003 (6), 99341015 (7) and reaction block 99345055 (4), withdraw from shaft (3) the central support (1) completed with external half-bearing (2).

## Removal of the central pivot shaft

Figure 33



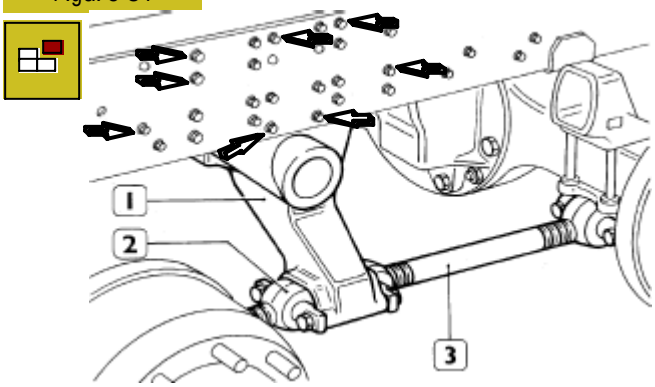

Loosen bolt (6) by one full turn.

Do not remove the bolt (6) and plate (5) as these will prevent the shaft (2) from being violently expelled from the bracket during the subsequent operation.

## Removal of the hanger bracket

Fit the pipe (3) of hydraulic pump 99341035 (4) to the hole in the hanger bracket (1); operate the pump to separate the shaft (2) from the bracket (1).
Remove bolt (6) and plate (5) and withdraw the shaft (2) from the bracket (1).

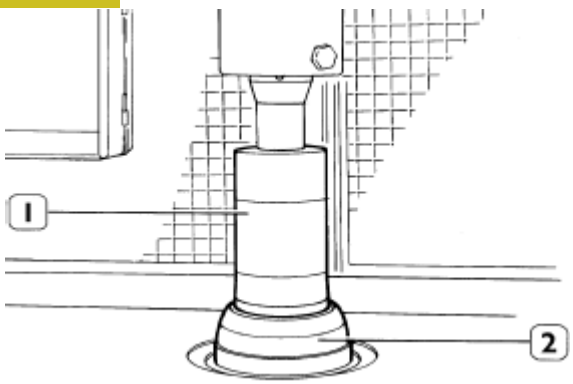
Figure 34




Detach the longitudinal tie-rods (2 and 3) and detach the bracket (1). If the upper bracket (1, Figure 38) is to be replaced, remove the retaining bolts (⇒) and detach it from the chassis side members.

## Renewal of the bearings

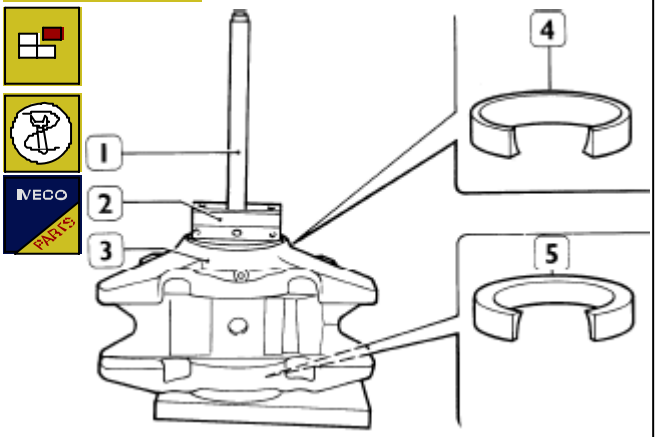
Figure 35




Using a hydraulic press, withdraw the inner bearing race (2) of the central pivot shaft (1).

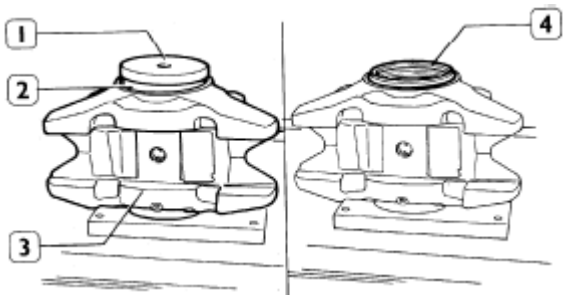
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Figure 36




The outer races of the bearings (4 and 5) are to be removed from the central pivot with the aid of a suitable bearing extraction tool.
To refit the bearings, use tool 99374094 (2) with a press and partially insert the bearings in the central pivot (3).
Complete the installation using a mallet and driver handle 99370007 (1).

Figure 37

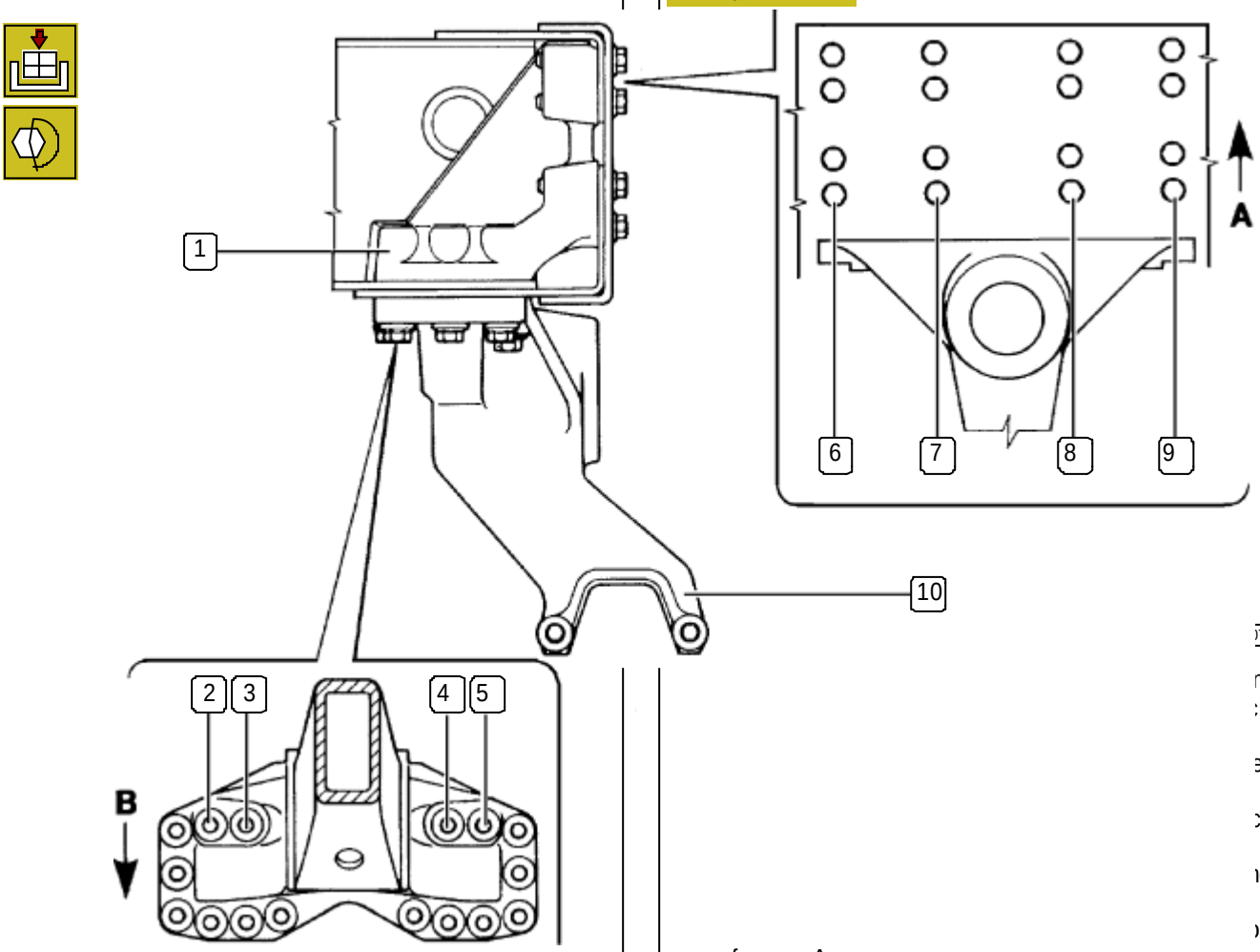



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Using installer (1) 99374119 or 99374131, install the seal (2) in the central pivot (3).
Then fit ring (4).

## Refitting the hanger bracket

Figure 38




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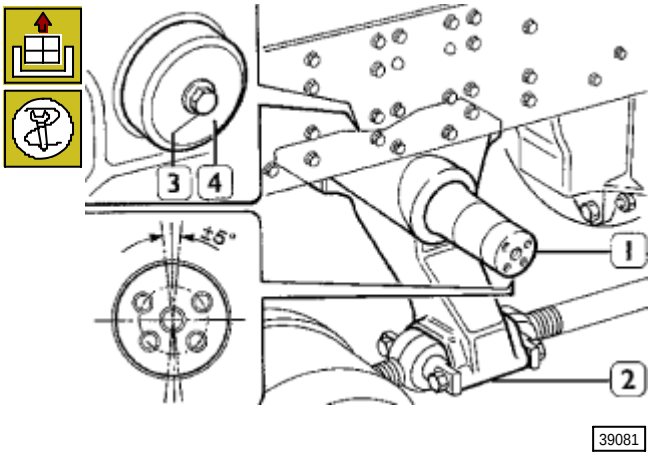
of arrow A.

- Tightening torque for bolts securing lower bracket (10) to upper bracket (1): 395 to 590 Nm;
- Tightening torque for bolts securing upper bracket (1) to chassis side member: 215 to 325 Nm;

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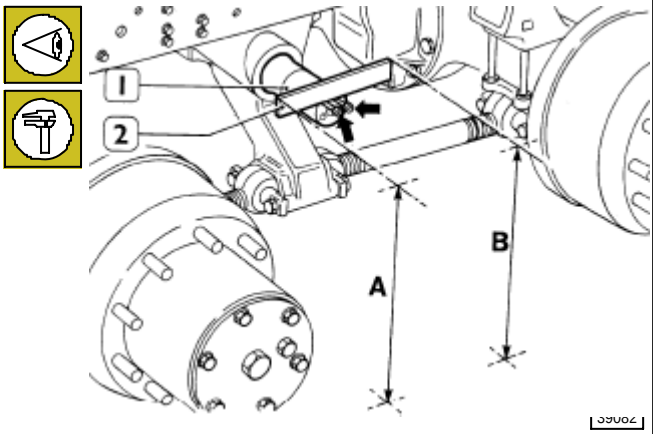
## Refitting the central pivot shaft

Figure 39



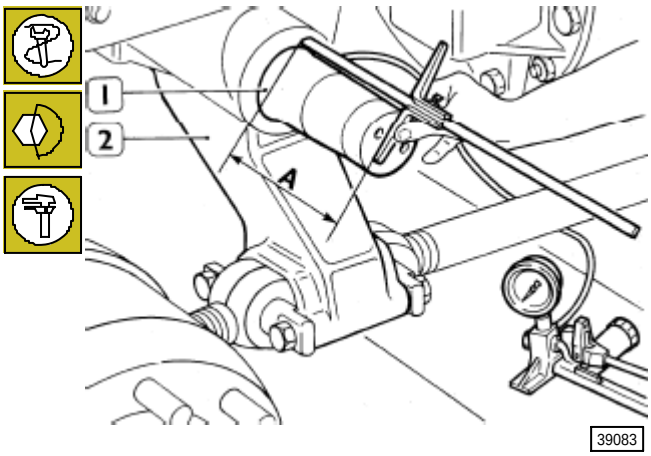

Insert the shaft (1) in the hanger bracket (2) with the holes oriented as shown in the figure; position the plate (4) on the bracket (2) and secure it to the shaft (1) with the bolt (3).

Figure 40



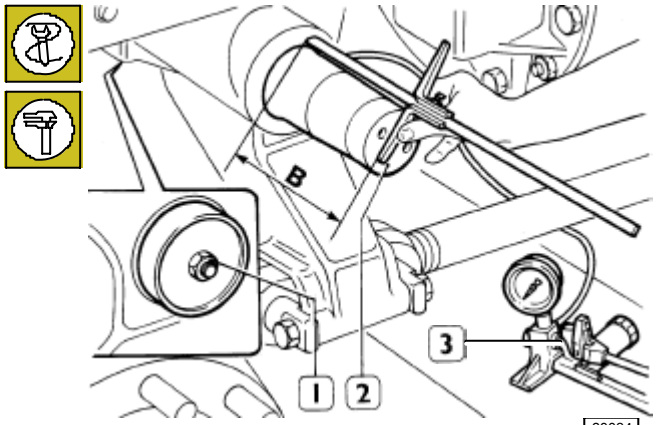

Screw the bolts (⇒) into the holes in the shaft (1); place a straight edge (2) along the top of the bolts and check that the ends A and B are equidistant from the ground; if not, adjust by turning the shaft (1).

Figure 41




Hold the shaft (1) against rotation and tighten the bolts (3, Figure 37) to a torque of 50 Nm. Measure the distance A between the end of the shaft (1) and the hanger bracket (2). The distance measured must be within the range indicated in the table in Figure 42.

Figure 42




While holding the shaft (2) against rotation, operate the hydraulic pump 99341035 (3) and simultaneously screw in bolt (1) until the end of the shaft (2) is positioned at distance B from the bracket.
The distance B must be equal to A-C, where A is the distance previously measured and C is the value indicated in the table. The distance B must be within the range indicated in the table.

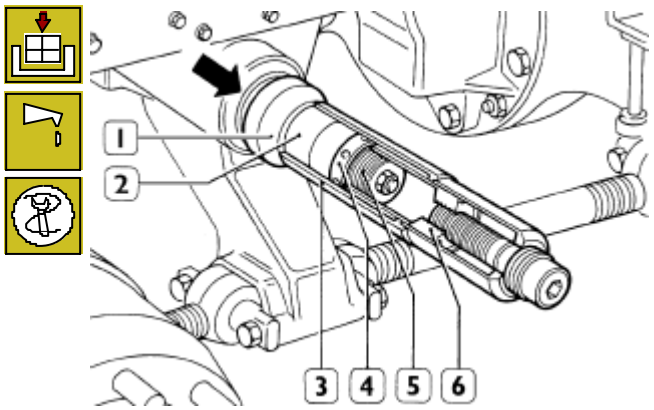
| Measurement | Outside diameter of shaft end (2) | |
|---|---|---|
| | 88 mm | 120 mm |
| A | 217.5 ÷ 220.5 | 211.5 ÷ 215 |
| B | 213.5 ÷ 216.5 | 205 ÷ 208.5 |
| C | 4.5 $^{+0.5}$ | 6.5 $^{+0.5}$ |

Towards the end of the shaft fitting procedure, the oil reaches a pressure between 800 and 1300 bar.

Having obtained distance B, open the discharge valve on the hydraulic pump 99341035 and wait at least 10 minutes before finally tightening the bolt (1) to a torque of 830 to 665 Nm ( 83 to 66.5 kgm). Disconnect the pump tube from the hanger bracket and refit the plug to the oil inlet hole.

## Refitting the central pivot

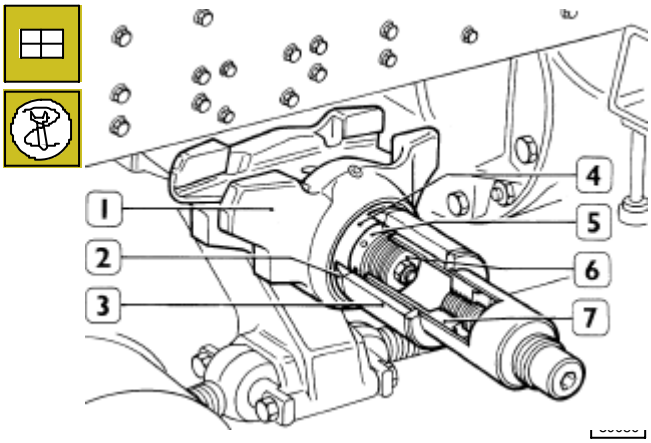
Figure 43




Lubricate the oil seal (⇒) with TUTELA MR3 grease and fit it to the shaft (2). Using tools 99346238 or 99346242 (3), 99363296 or 9936330 (4), 99363245 (5), and 99346004 (6), which are to be fitted to the shaft (2) as shown, install the inner bearing (1).

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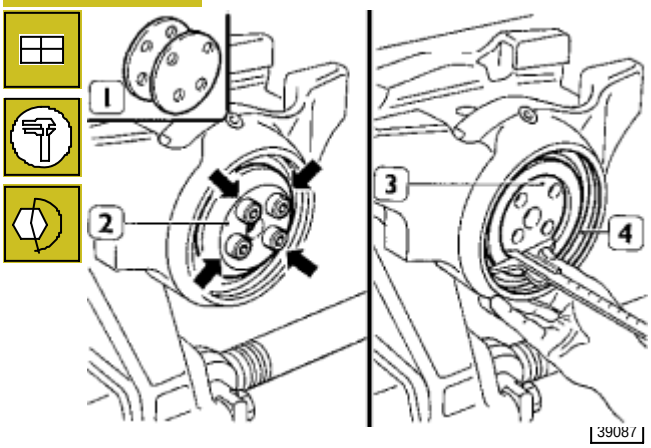
Figure 44




Fit the central pivot (1) to the shaft (4) and, using tools 99346243 (3), 99363296 (5), 99363245 (6), 99346004 (7) and 99346001 (8), fitted to the shaft (4) as shown, install the inner race of the outer bearing (2).

**NOTE** Towards the end of the installation operation, it will be necessary to tap the central pivot (1) with a mallet to ensure that the inner races of the bearings seat correctly in their respective housings.
Remove the installation tools from the shaft.

Figure 45

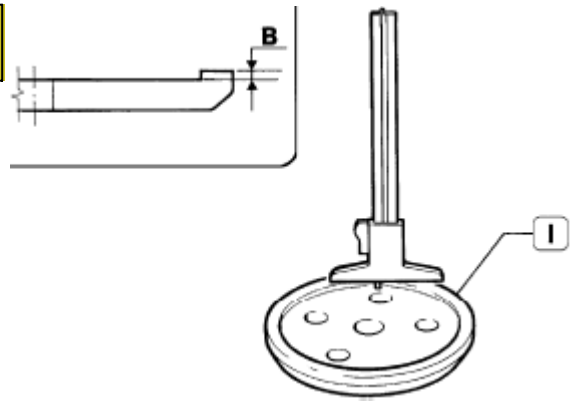



Determine the thickness S of the bearing axial play adjustment shims (1) as follows:

- apply the plate (2) and tighten the retaining bolts (⇒) to a torque of 30 Nm;
- Remove the bolts (⇒), remove the plate and measure the distance between the end of the shaft (3) and the inner race (4) of the bearing:
  distance A shaft protrusion
  distance -A shaft stand-in
- measure the stand-in of the plate surface (1) as shown in Figure 35: distance B.

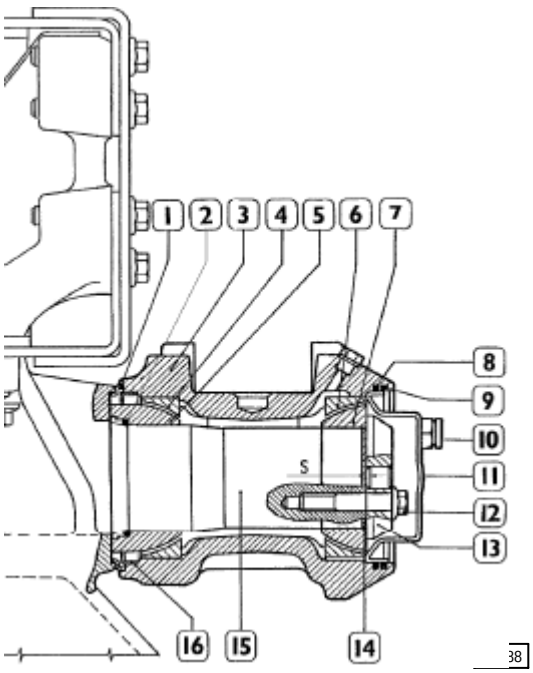
The thickness S of the adjustment shin is given by:
S = B + C - (± A).
A and B are the measured distances and C is the axial play of the bearings (0.1 to 0.3 mm). Then fit: adjustment shim/s of the calculated thickness and the plate (2) and tighten the retaining bolts (⇒) to a torque of 240 Nm. Fit the leaf spring and tighten the u-bolt nuts in the manner described on page 79.

Figure 46




Tap the central pivot a few times in the direction of the shaft axis, then check that the pivot can freely rotate through 180°; if not, increase the thickness of the adjustment shim by 0.1 mm.

Figure 47




CENTRAL PIVOT COMPONENTS
1. Oil seal - 2. Oil seal - 3. Central pivot - 4. Outer race of inner bearing - 5. Inner race of inner bearing - 6. Outer race of outer bearing - 7. Inner race of outer bearing - 8. Oil seal - 9. Spring clip - 10. Plug - 11. Cap - 12. Bolt - 13. Plate - 14. Adjustment shims - 15. Shaft - 16. Seal.

Fit: oil seal (8) lubricated with TUTELA MR3 grease and cap (11) with plug (10) positioned at the top. Secure the cap (11) to the central pivot (3) with spring clip (9). Remove the plug (10) and pour in TUTELA GI/A oil until it flows out of the hole (quantity ~ 0,5 l).
Inject Tutela MR2 grease into the grease nipple located on the hanger bracket: complete the suspension refitting procedure as described on page 78.

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# 528913 REMOVAL-REFITTING OF REAR AXLE LONGITUDINAL ARM
# 528914 REMOVAL-REFITTING OF INTERMEDIATE AXLE LONGITUDINAL ARM
# 528918 REMOVAL-REFITTING OF REAR AXLE TRIANGULAR ARM FOR VEHICLES WITH AIR SUSPENSION

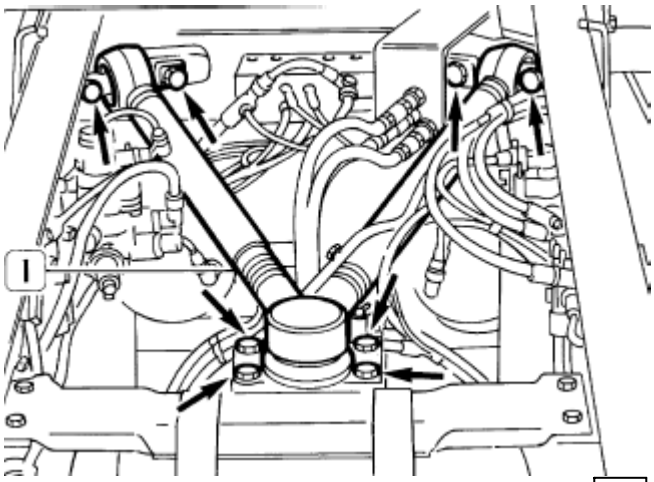
## Removal

Remove the retaining nuts or bolts (⇒) of the longitudinal arms (1, Figure 49) or triangular arms (1, Figure 48), and remove the arms.

## Refitting

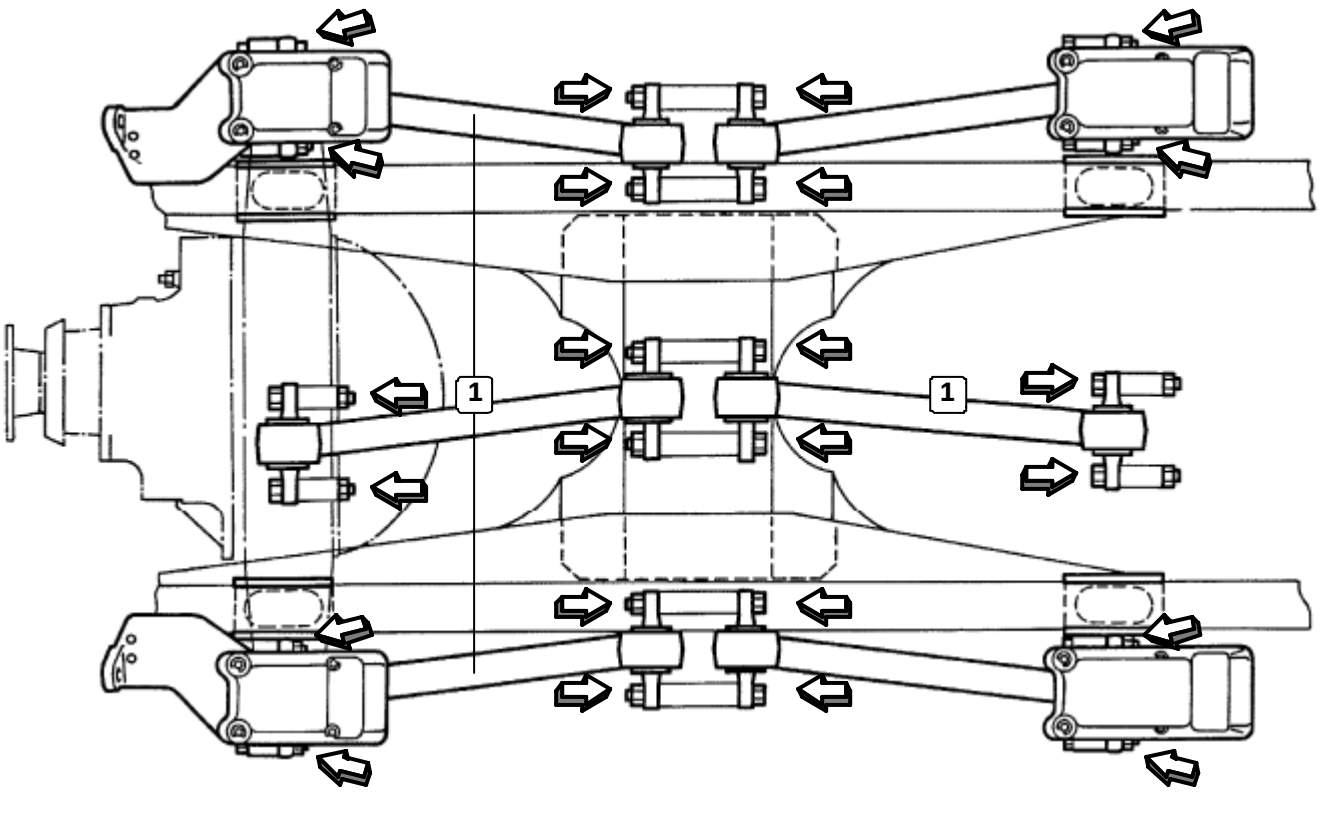
Refitting is the reverse of removal. Tighten nuts/bolts to the specified torque.

Figure 48




TRIANGULAR ARM FITTED TO VEHICLES WITH AIR SUSPENSION 4x4 - 6x4 - 8x4

Figure 49

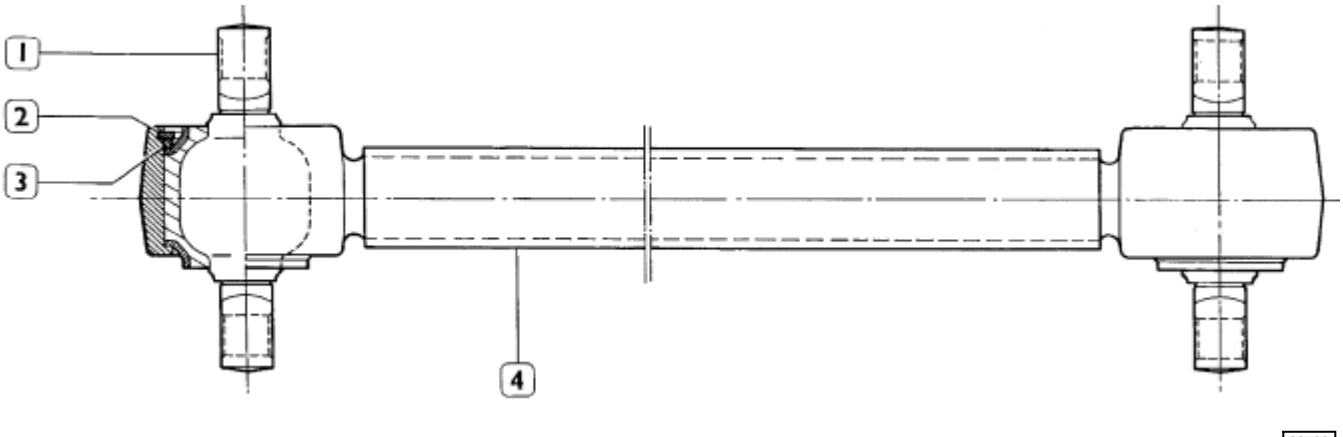



LONGITUDINAL ARMS FITTED TO 6x4 - 8x4 - 8x8 VEHICLES

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## REPLACING THE SUSPENSION ARM FLEXIBLE PIN

Figure 50




LONGITUDINAL SUSPENSION ARM

### Dismounting

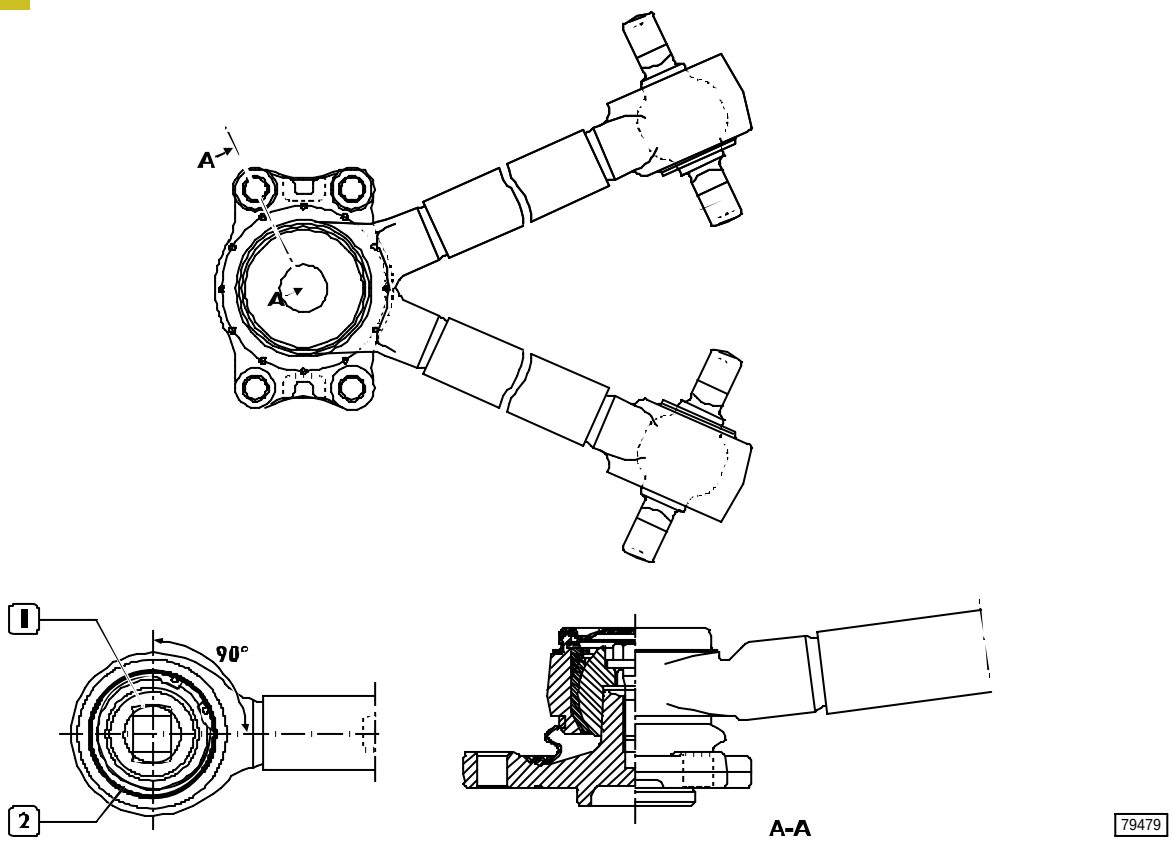
Using a suitable press and drift, compress the flexible part of the pin (1) in order to remove the circlip (2) and the underlying ring (3) with pincers.
Withdraw the pin (1) from the suspension arm (4).

### Mounting

Carry out the removal operations in reverse order, bearing in mind that the pin mounting face must be positioned at 90_ to the longitudinal axis of the suspension arm. The circlip opening must be oriented as shown in the detail in the figure.

## REPLACING TRIANGULAR SWINGING ARM BALL ARTICULATED JOINT

Figure 51




TRIANGULAR SUSPENSION ARM

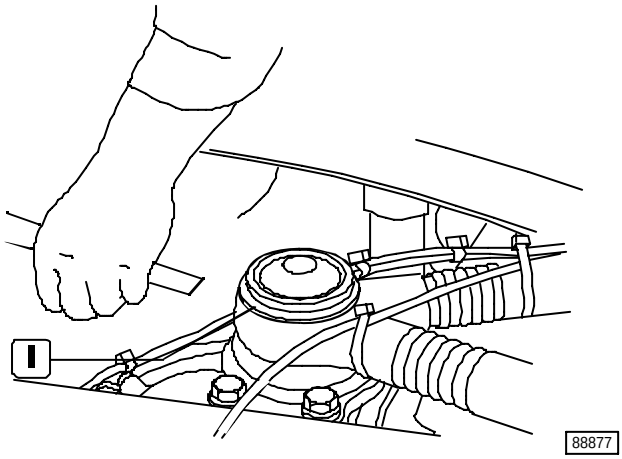
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## Dismounting

Replacing the ball articulated joint directly on the vehicle can only be performed on tractors. For boxed trucks, the operation is carried out at the bench after detaching the reaction triangle (see procedure described at page 84).

Before replacing the articulated joint, a stand has to be arranged under the axle in order to avoid dangerous oscillations of it once dismounting has been performed.

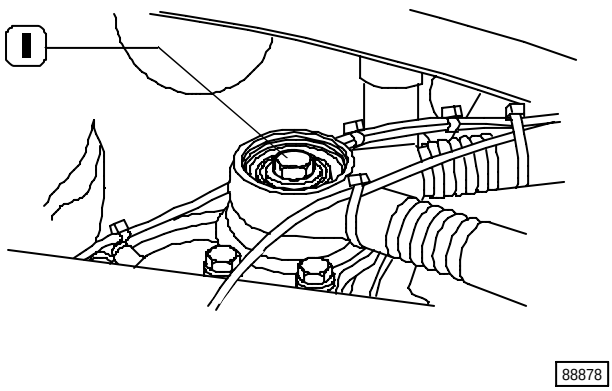
Figure 52




Dismount cover (1).

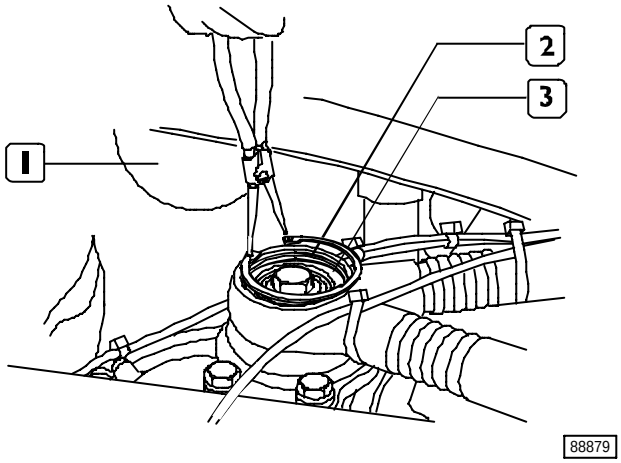
**NOTE** Once it has been removed, the cover is to be replaced by a new one.

Figure 53




Unscrew screw (1).

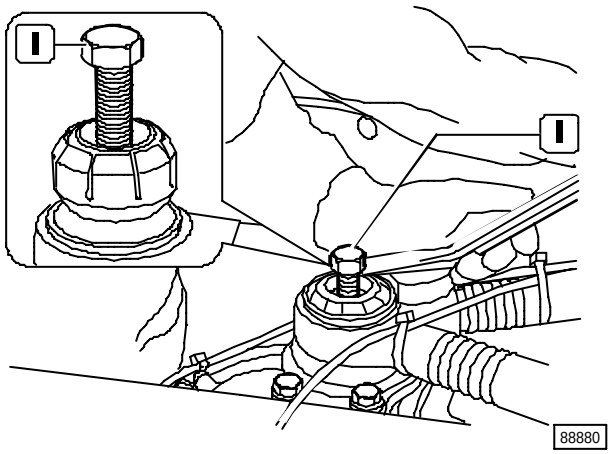
Figure 54




Remove spring ring (1) by pliers.

Remove underlying check rings (2, 3).

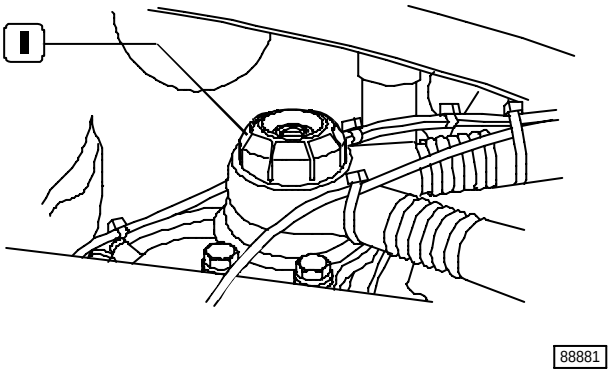
Figure 55




Dismount the ball articulated joint with M20 X 1,5 screw (1) and suitable tools.

## Mounting

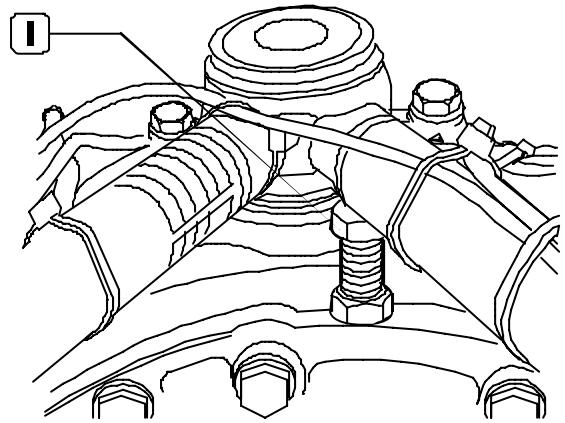
Figure 56




Mount ball articulated joint (1) into seat by provided beater

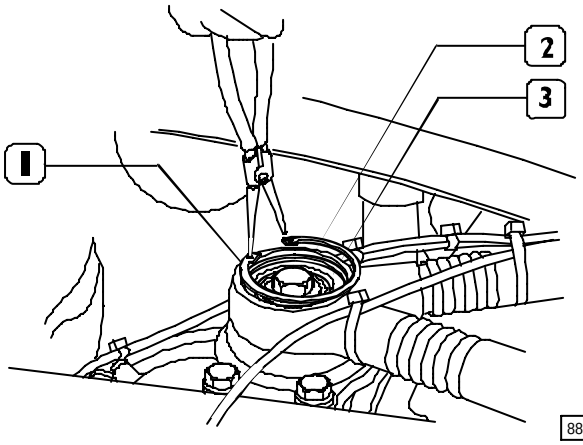
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Figure 57




Arrange part (1) of the tool of Sp. 2403 under one of reaction triangle arms to the purpose of making upper seal ring mounting easier.

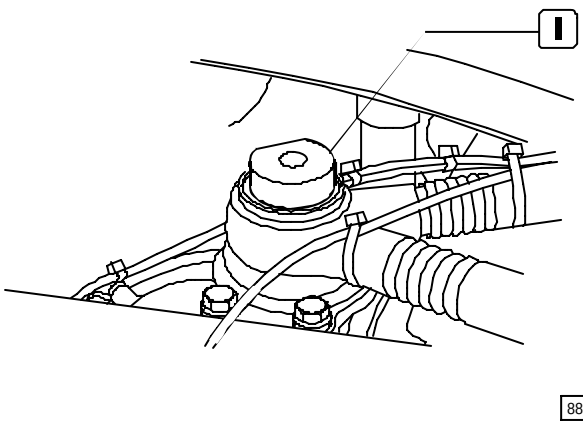
Figure 58




Mount seal rings (1, 2, 3).

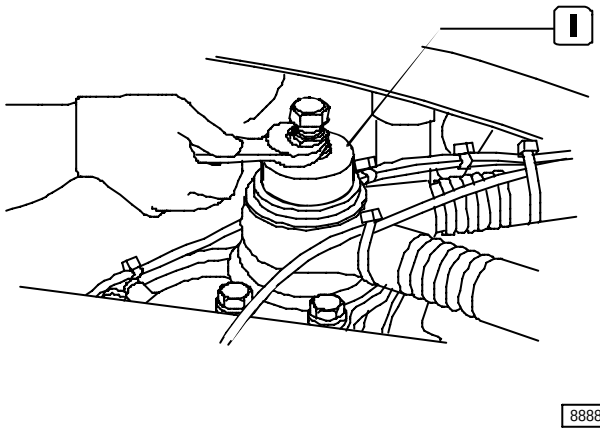
Remove the part of tool (1) of Sp. 2403 (see previous figure).

Figure 59



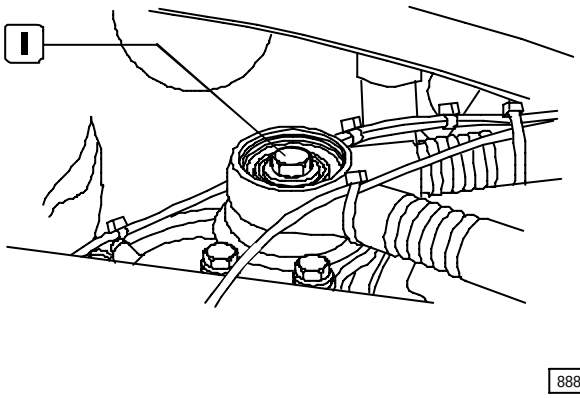

Position spacer (1) of the tool of Sp. 2403 as in figure.

Figure 60



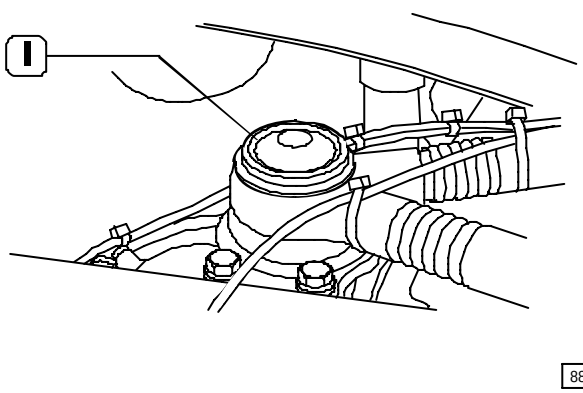

By tool (1) of Sp. 2403, draw the ball articulated joint and seal ring.

Figure 61




Tighten screw (1) with a proper torque (135 Nm).

Figure 62

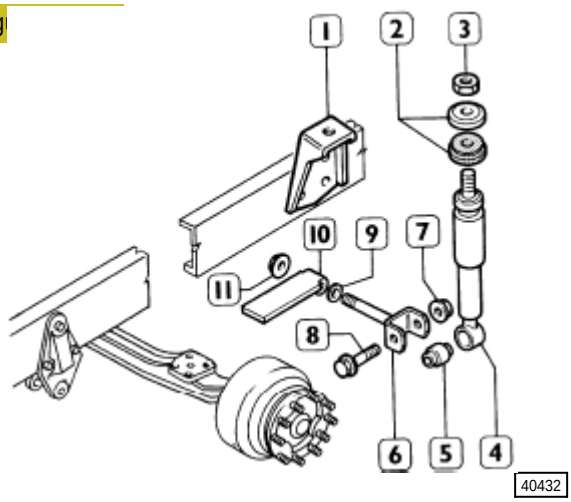



Mount cover (1).

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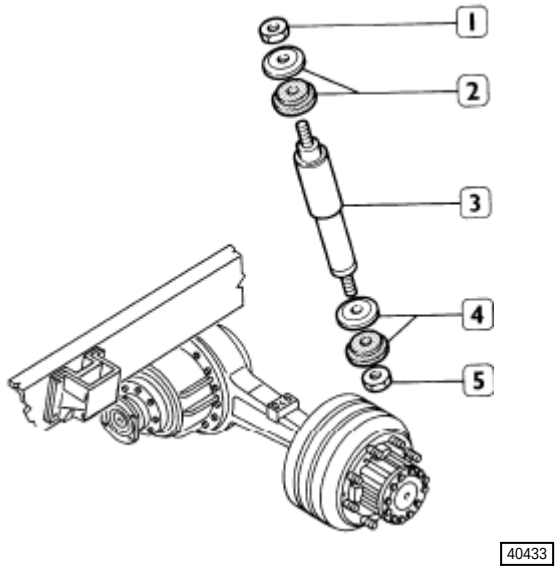
## 5009 SHOCK ABSORBERS

Figure 63




1. Hanger bracket - 2. Bushes - 3. Nut - 4. Shock absorber - 5. Bush - 6. Lower mounting bracket - 7. Nut - 8. Bolt - 9. Washer - 10. Bracket - 11. Nut.

Figure 64




1. Hanger bracket - 2. Bushes - 3. Nut - 4. Shock absorber - 5. Bush - 6. Lower mounting bracket - 7. Nut - 8. Bolt - 9. Washer - 10. Bracket - 11. Nut.

### Removal

Remove the shock absorber by removing the upper and lower mounting bolts/nuts.

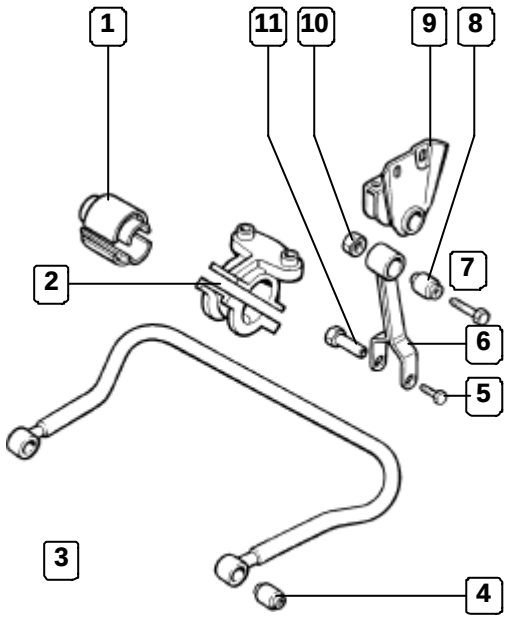
**NOTE** Inspect the rubber bushes; if worn or deteriorated, renew them. Check shock absorber efficiency using suitable test equipment.

### Refitting

Carry out the removal operations in reverse order; tighten bolts and nuts to specified torques.

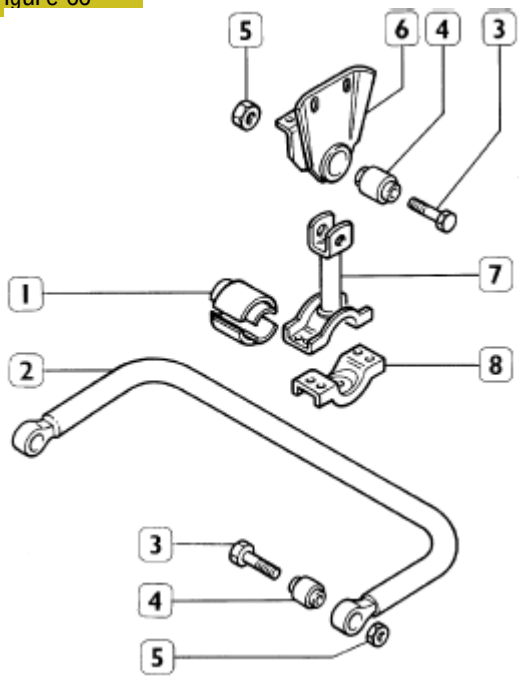
## 5289 ANTI-ROLL BARS

Figure 65




FRONT ANTI-ROLL BAR COMPONENTS
1. Bush - 2. Bush support - 3. Anti-roll bar - 4. Rubber bush - 5. Bolt - 6. Link rod - 7. Bolt - 8. Rubber bush - 9. Bracket - 10. Nut - 11. Bolt

Figure 66




REAR ANTI-ROLL BAR COMPONENTS
1. Bush - 2. Anti-roll bar - 3. Bolt - 4. Rubber bush - 5. Nut - 6. Bracket - 7. Link rod - 8. Cap

To renew the rubber bushes (4-8, Figure 65) and (4, Figure 66), use a press with tool 99346049 to remove and install the bushes.

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# 5289 ANTI-ROLL BAR
# 528930 FRONT ANTI-ROLL BAR
# 528940 AUXILIARY AXLE ANTI-ROLL BAR (8x4 VEHICLES)
# 528960 REAR ANTI-ROLL BAR
# 528950 INTERMEDIATE AXLE ANTI-ROLL BAR (6x4 - 6x6 - 8x4 - 8x8 VEHICLES)

## Removal

Remove the anti-roll bar by removing the nuts/bolts securing the pivot mountings and the cap retaining bolts.

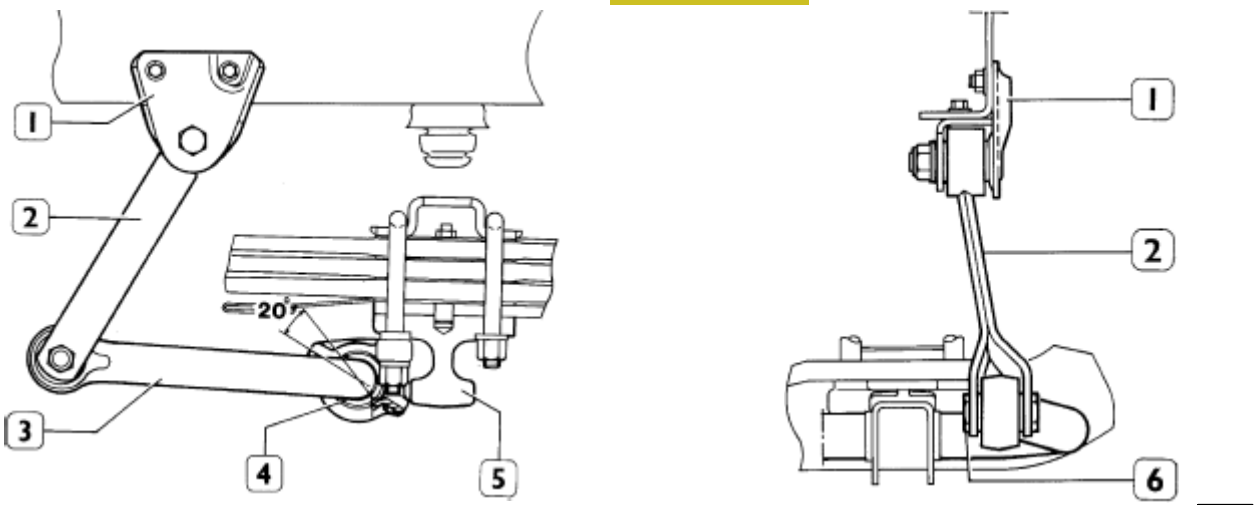
Check the bushes and/or rubber mountings and renew them if they show signs of wear or deterioration.

## Refitting

Refit by carrying out the removal operations in reverse order; tighten nuts/bolts to the specified torques.

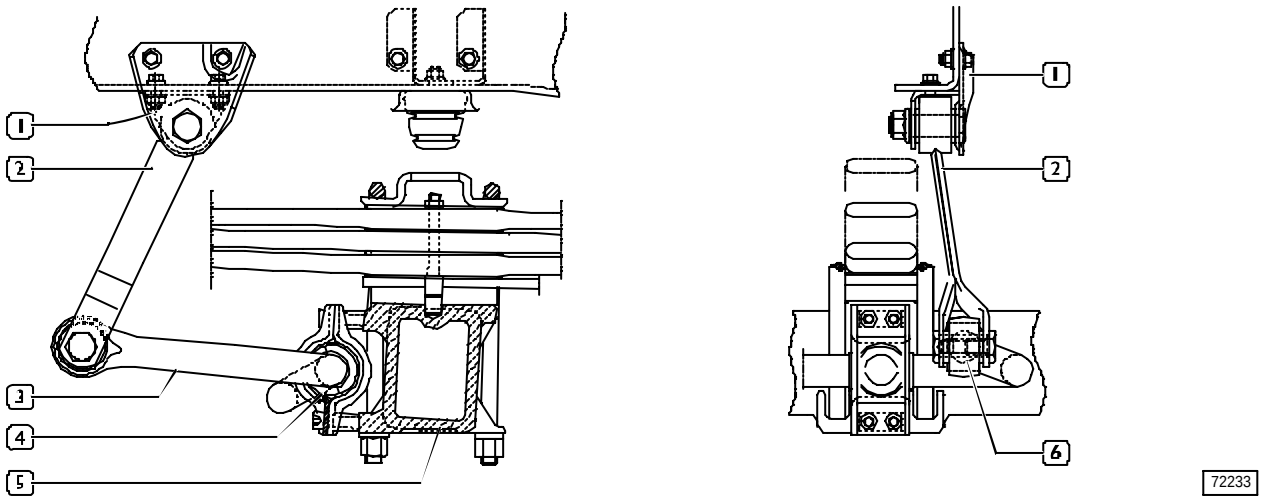
**NOTE** Position the half bushes (4) so that the joint is located as shown in the figure.

Figure 67




ASSEMBLY DRAWING FOR FRONT ANTI-ROLL BAR: 4x2 - 6x4 - 8x4 VEHICLES
1. Upper hanger bracket - 2. Link rod - 3. Anti-roll bar - 4. Rubber bush (in two halves) - 5. Front axle - 6. Cap.

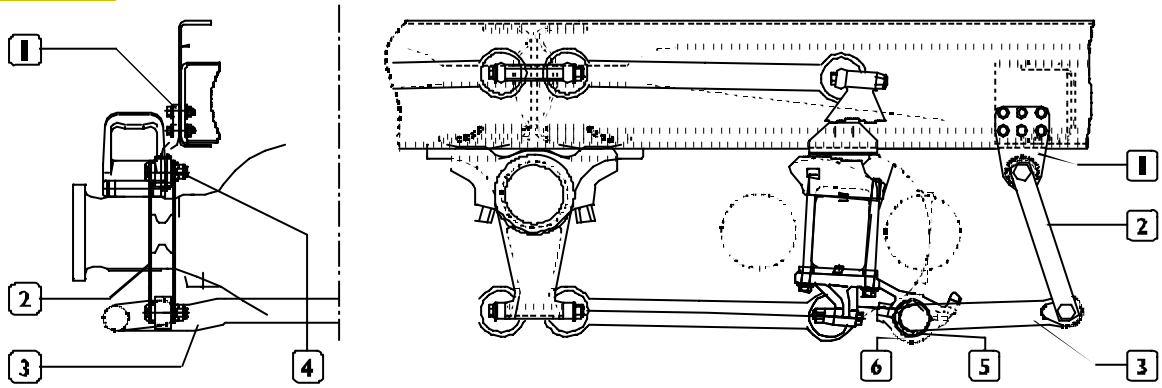
Figure 68




ASSEMBLY DRAWING FOR REAR ANTI-ROLL BAR: 4x4 - 6x6 - 8x8 VEHICLES
1. Upper hanger bracket - 2. Link rod - 3. Anti-roll bar - 4. Rubber bush (in two halves) - 5. Axle - 6. Cap.

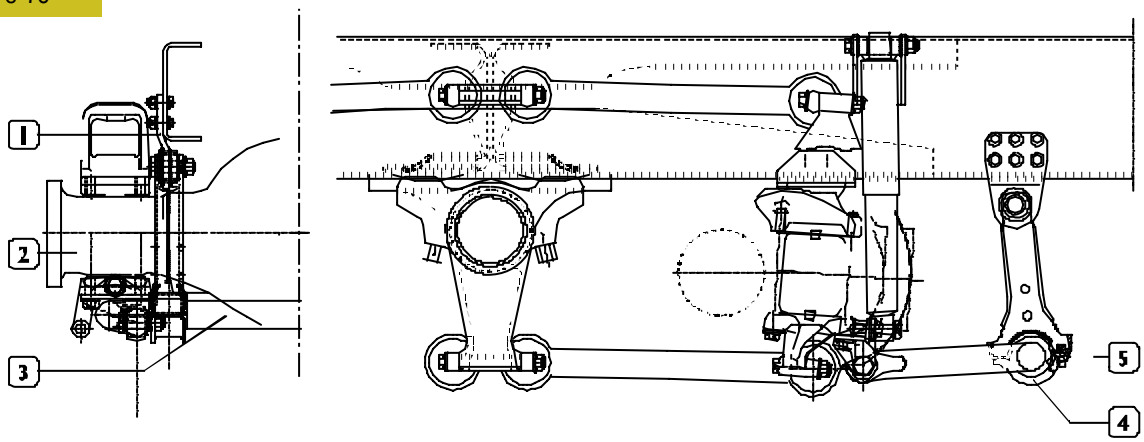
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Figure 69



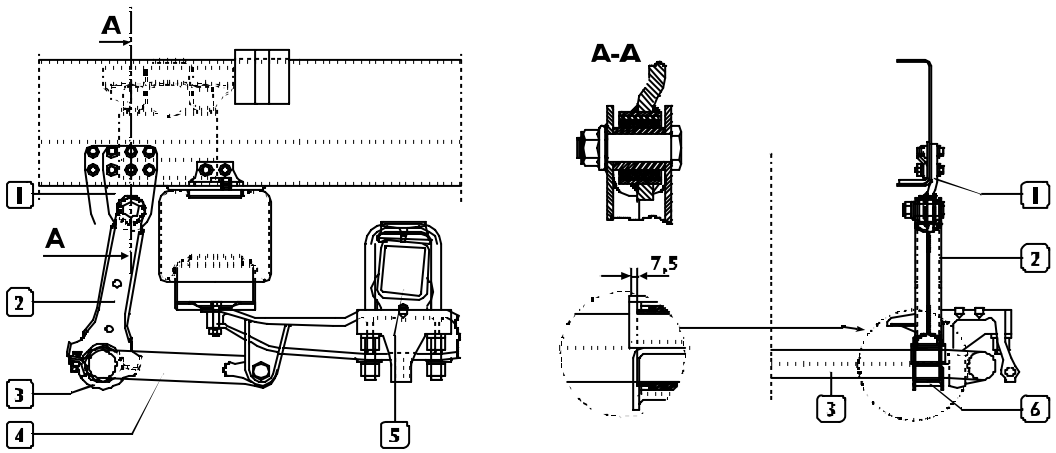

ASSEMBLY DRAWING FOR REAR ANTI-ROLL BAR: 6x4 - 8x4 VEHICLES
1. Upper hanger bracket - 2. Link rod - 3. Anti-roll bar - 4. Rear axle - 5. Rubber bush (in two halves) - 6. Cap.

Figure 70




ASSEMBLY DRAWING FOR REAR ANTI-ROLL BAR: 6x4 - 8x4 VEHICLES
1. Upper hanger bracket - 2. Link rod - 3. Anti-roll bar - 4. Rubber bush (in two halves) - 4. Rear axle - 5. Cap.

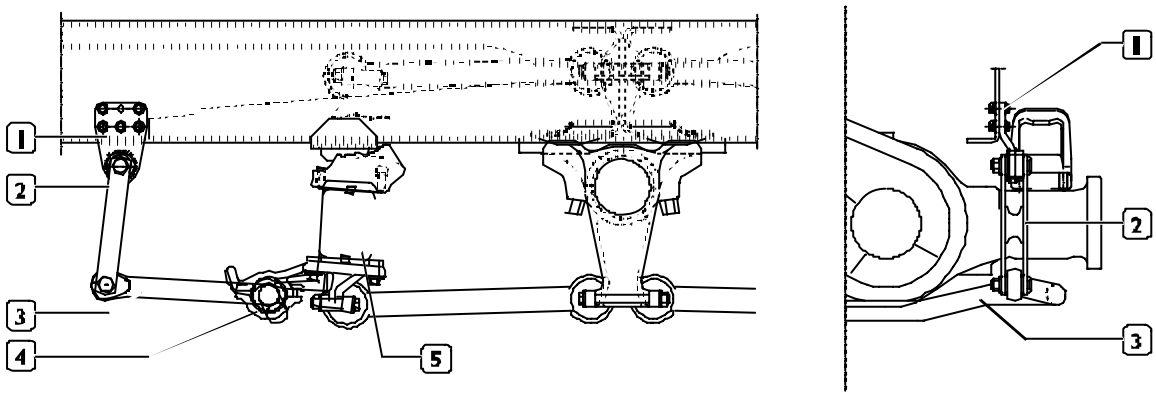
Figure 71




ASSEMBLY DRAWING FOR REAR ANTI-ROLL BAR: 6x4 - 8x4 VEHICLES WITH AIR SUSPENSION
1. Upper hanger bracket - 2. Link rod - 3. Rubber bush (in two halves) - 4. Anti-roll bar - 5. Rear axle - 6. Cap.

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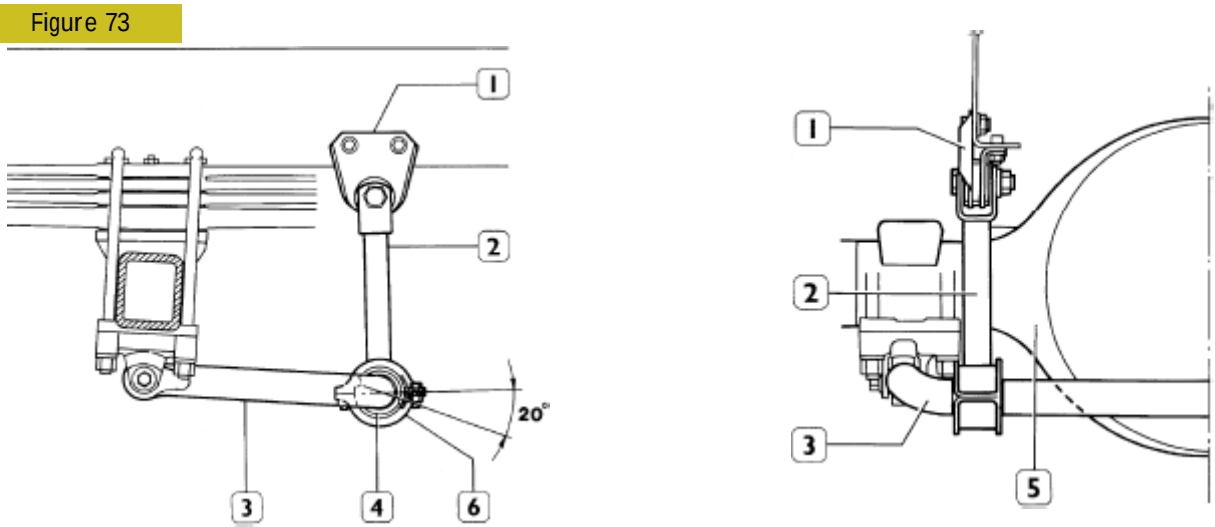
Figure 72




72237

ASSEMBLY DRAWING FOR INTERMEDIATE AXLE ANTI-ROLL BAR: 6x4 - 6x6 - 8x4 - 8x8 VEHICLES
1. Upper hanger bracket - 2. Link rod - 3. Anti-roll bar - 4. Rubber bush (in two halves) - 5. Front axle.

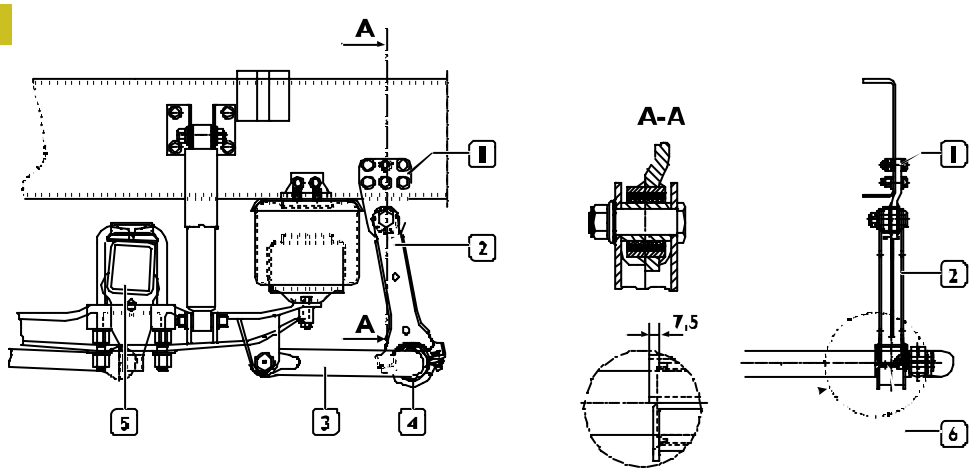
Figure 73




38695

ASSEMBLY DRAWING FOR REAR ANTI-ROLL BAR: 4x2 VEHICLES
1. Upper hanger bracket - 2. Link rod - 3. Anti-roll bar - 4. Rubber bush (in two halves) - 5. Rear axle - 6. Cap.

Figure 74




72238

ASSEMBLY DRAWING FOR REAR ANTI-ROLL BAR: 4x2 - 4x4 VEHICLES WITH AIR SUSPENSION
ASSEMBLING DIAGRAM FOR ADDITIONAL AXLE STABILISING BAR FOR 8x4 VEHICLES
WITH PNEUMATIC SUSPENSION
1. Upper hanger bracket - 2. Link rod - 3. Anti-roll bar - 4. Rubber bush (in two halves) - 5. Rear axle - 6. Cap.

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SECTION 11

# 5025 Wheels and tyres

Page

DESCRIPTION . . . . . 3

MAIN DATA . . . . . 3

- Tire pressure values . . . . . 3

TOOLS . . . . . 4

TROUBLESHOOTING . . . . . 4

- Main operating faults . . . . . 4

STATIC WHEEL BALANCING . . . . . 6

CORRECTION OF RESIDUAL STATIC IMBALANCE 7

TYRE INFLATION PRESSURES . . . . . 7

HOW TYRE BEHAVIOUR DEPENDS ON PRESSURE . . . . . 8

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## DESCRIPTION

The wheel rim is the structure that confers rigidity to the wheel and is identified by the following dimensions:

- rim diameter, measured across centre of the wheel from one bead seat to the other
- rim width, (distance between the inside of the bead flanges across the rim)

The tyre performs the following functions:

- to cushion the wheel against shocks transmitted from uneven road surfaces using the elasticity of air;
- to transmit the driving force delivered by the engine to the road surface to move the vehicle;
- to confer the maximum grip and stability of contact between the tyre and the road, while affording satisfactory durability;
- to withstand the forces created by sudden braking, hard acceleration and the centrifugal forces generated when cornering;
- to ensure the stability of the vehicle at high speed; to ensure that steering effort is converted into directional movement.

## MAIN DATA

| WHEELS | | Wheel rims | Tyres |
|---|---|---|---|
|  | Disc with specific continuous rims | 22.5x9.00<br>22.5x9.00<br>22.5x8.25 | 13 R 22,5<br>315/80 R 22.5<br>12 R 22.5 |

### Tire pressure values

**NOTE** When checking tyre pressures refer to the values indicated in the specific "Use and Maintenance" handbook.

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## TOOLS

| TOOL No. | DESCRIPTION |
|---|---|
| **99305037** | Electronic on-vehicle balancer for front wheel balancing |

## TROUBLESHOOTING
### Main operating faults

| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Excessive wear | Excessive speed over rough surfaces. | Reduce speed. |
| | Sudden variations in speed due to violent acceleration or harsh braking. | Avoid all unnecessary acceleration and braking. |
| | Excessive speed with tyres under-inflated. | Check tyre pressures with tyres cold. |
| | Tyres over-inflated. | Reduce tyre pressures. |
| | Vehicle overloaded. | Consult permissible load specifications. |
| Uneven wear | Difference in tyre pressures between different pairs of wheels. | Check tyre pressures. |
| | Tyres under-inflated: wear concentrated on outer edges of the tread rather than in the centre. | Inflate tyres to correct pressure. |
| | Tyres over-inflated: wear concentrated in the centre of the tread. | Reduce tyre pressures. |
| | Insufficient front wheel toe-in: excessive wear on inner edges of tyre treads. | Check and adjust toe-in. |
| | Front wheels set to incorrect wheel geometry. | Restore correct wheel geometry. |
| | Wheel rims deformed causing imbalance. | Repair wheel rims, if possible, or replace them; then balance the wheels. |
| | Tyres incorrectly fitted to rims. | Fit the tyre correctly and balance the wheel. |
| | Rear axle out of parallel due to breakage on leaf spring centre bolt, springs of different lengths or buckled springs. | Overhaul the suspension. |
| | Excessive front wheel toe-in; excessive wear on outer edges of tread. | Check and adjust front wheel toe-in. |

*(Continued)*

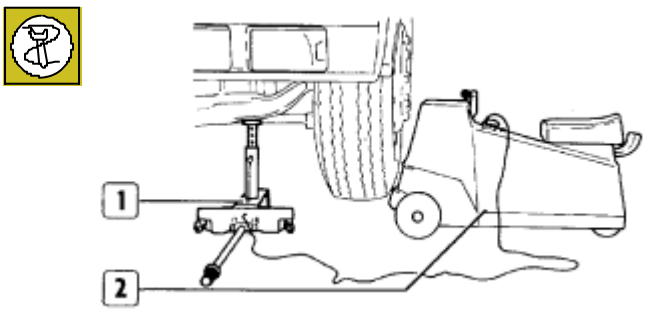
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| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Vehicle pulls to one side | Front wheels out of balance. | Balance the wheels. |
| | Front tyres inflated to different pressures. | Check that both tyres are inflated to correct pressure. |
| | Excessively uneven wear between tyres of the same wheel pair. | Renew the tyre that is excessively worn. |

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## 502511 STATIC WHEEL BALANCING

Figure 1

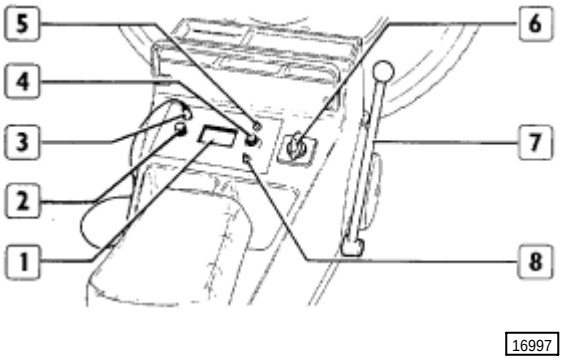



The front wheels can be balanced while on the vehicle using the electronic balancer 99305037; this method has the advantage of balancing the wheel along with the other rotating masses.

The operation must be carried out as follows:

- Jack up the front of the vehicle and check that the wheels can rotate freely.
- Position the pickup unit (1) under the axle near to the wheel, setting the height so that the wheel spinner of unit 99305037 (2) is in contact with the tyre; position an axle stand under the opposite end of the axle and lower the jack.

Figure 2

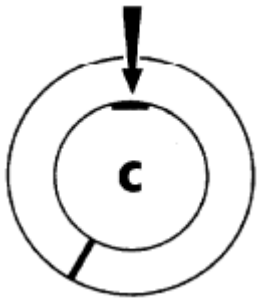



- Connect the lead (3) of the pickup unit to the balancer 99305037.
- Make a radial reference mark on tyre, using chalk or a strip of adhesive tape.
- Turn switch (2) to the static balancing position and sensitivity switch (4) to notch nº 5 on the graduated scale.
- Turn on switch (5) for the meter light (1) and turn on the strobe lamp (8).
- Turn the wheel spinner switch (6) to the first speed position in order to rotate the wheel.

Turn the wheel spinner switch (6) to the second speed position and push the balancer against the tyre.
As the wheel is spinning, the stroboscopic effect will make the reference mark appear static; the needle on the meter (1) will move from zero to a maximum value and then return to zero.
Once the needle has started to fall, withdraw the balancer, switch off the wheel spinner completely (6) and brake the spinner motor by means of the brake lever (7).
The wheel will continue to revolve due to inertia and the new position of the reference mark should be noted.
Read the value shown by the needle on the weight indication meter (1). Multiply this value by ten to obtain the correction weight to be fitted to the rim.

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Figure 3



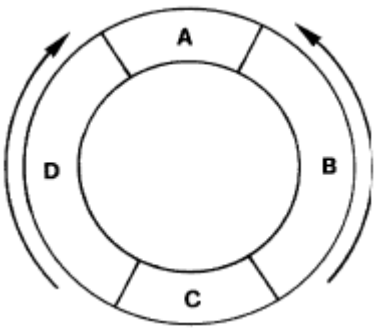

16998

Fit the calculated correction weight as shown in the figure.
If the meter needle remains in the green section during testing, the wheel is already balanced.

**NOTE** If the weight required to balance the wheel exceeds 100 grams, divide the weight in half and attach one of the two parts thus formed to the inside of the rim and the other to the outside, making sure that they are in the same position.

## CORRECTION OF RESIDUAL STATIC IMBALANCE

Figure 4




23885

To correct residual imbalance, repeat the operations described above, and, referring to the diagram in Figure 4 and the weight indication on the meter (1, Figure 2), adjust as follows:

- If the weight is in zone A, this means that it is too light and therefore it must be increased by the amount shown on the weight indication meter (1, Figure 2).
- If the weight is in the bottom zone C, this means that it is too heavy and therefore must be reduced by the amount shown on the weight indication meter.
- If the weight is zones B or D, do not increase or reduce the weight, but move it upwards 5 cm in the direction shown by the arrows in figure 4.

## 502510 TYRE INFLATION PRESSURES

Tyre pressures must be checked with the tyres cold. Take care to obtain an accurate reading: too high a pressure will result in a harsh ride and excessive wear of the centre part of the tread, while if the pressure is too low, the load will not be distributed evenly over the entire tread but concentrated on the edges, causing premature wear of these areas and damage to the internal structure of the tyre.
Unequal tyre pressures will affect the stability of the vehicle and impair driving safety.
Abnormal tyre wear can occur in different parts of the tread.

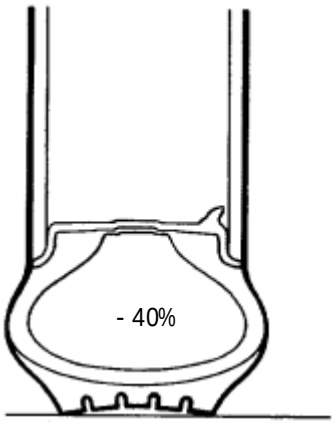
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## HOW TYRE BEHAVIOUR DEPENDS ON PRESSURE

The diagrams illustrate how different inflation pressures affect tyre behaviour and performance.

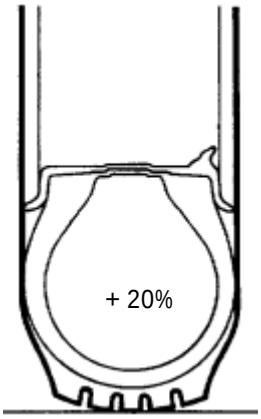
**NOTE** (The percentage values given inside the tyres indicate the inflation pressure levels, while the performance value refers to the life of the tyre).

Figure 5



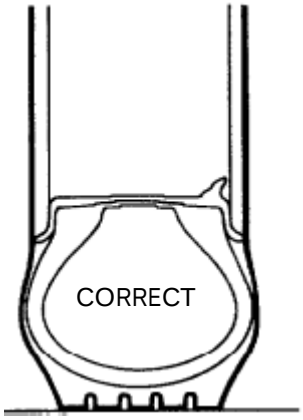

PERFORMANCE 40%

Figure 6




PERFORMANCE 90%

Figure 7




PERFORMANCE 100%

**NOTE** If anomalous wear of front tyres is found (either inside or outside the tread), have front wheel toe-in checked. Never exceed the maximum weight per axle (the vehicle's gross weight being unchanged).
It is advisable to change the tyre pair fitted to one axle when bands - due to block wear - are visible over the entire tread width (see dotted areas on pictures).
Tyres are provided with wear indicators. Replacement is compulsory when such indicators are reached.

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SECTION 12

# 5014 Steering system


| | Page |
|---|---|
| DESCRIPTION | 3 |
| MAIN DATA | 4 |
| TROUBLESHOOTING | 5 |
| - Main operating faults of a mechanical nature | 5 |
| TIGHTENING TORQUES | 7 |
| TOOLS | 8 |
| - Steering control diagram for 4x2 - 6x4 vehicles (ZF 8098 power steering) | 10 |
| - Steering control diagram for 4x4 - 6x6 vehicles (ZF 8098 power steering) | 11 |
| - Steering control diagram for 8x4x4 vehicles (ZF 8099 power steering) | 12 |
| - Steering control diagram for 8x8 vehicles (ZF 8099 power steering) | 13 |
| - Steering hydraulic control circuit diagram for 8x4x4 - 8x8 vehicles | 14 |
| STEERING CONTROL | 15 |
| HYDRAULIC STEERING | 16 |
| - Mounting steering wheel lever | 16 |
| REMOVING-REFITTING THE STEERING CONTROL ASSEMBLY | 17 |
| - Removal | 17 |
| - Refitting | 19 |
| - Replacing the pneumatic cylinder | 19 |
| - Removal | 19 |
| - Mounting | 20 |
| - Replacing blinker switch | 22 |
| - Removal | 22 |

https://truckmanualshub.com/
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Page

- Mounting . . . . . 23

MAIN OPERATIONS . . . . . 23

BLEEDING THE POWER STEERING SYSTEM . . . . . 23

MEASURING STEERING BOX PLAY AT THE STEERING WHEEL . . . . . 23

CHECKING THE MAXIMUM PRESSURE OF THE POWER STEERING SYSTEM . . . . . 24

- Setting the automatic hydraulic steering limit . . 24

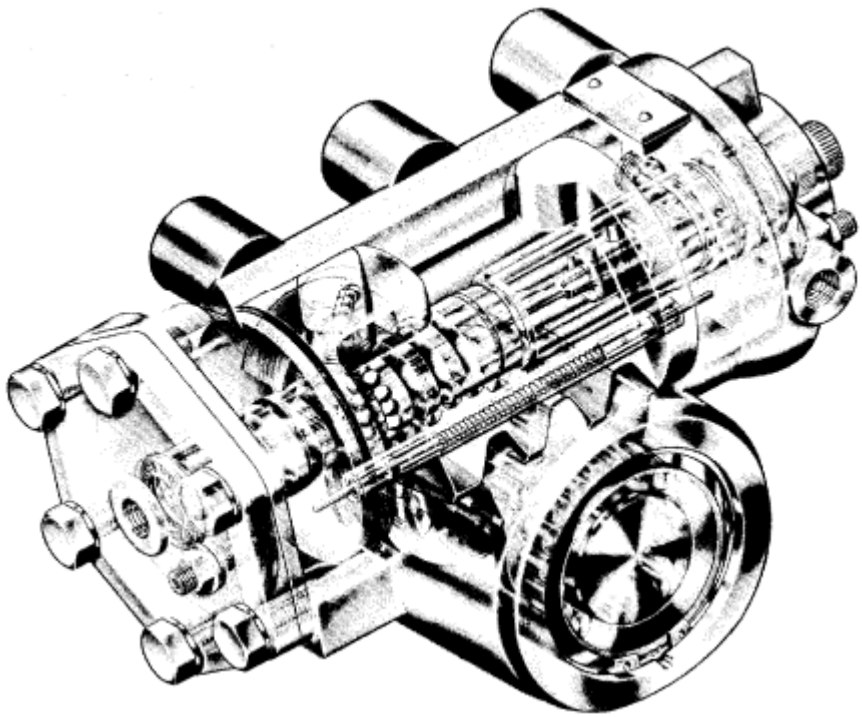
- Check . . . . . 24

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## DESCRIPTION

ZF 8098 power steering unit is a continuous ball-type steering unit; it essentially consists of: housing and steering built-in mechanical part, control valve and operating cylinder.

Figure 1



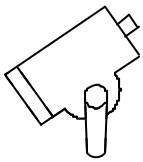
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ZF 8098 POWER STEERING UNIT

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## MAIN DATA

### Vehicles: 4x2 - 4x4 - 6x4 - 6x6

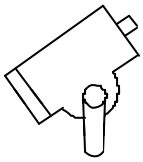


| | | |
|---|---|---|
| Power steering unit | ZF 8098 ball circulation with built-in pressure relief valve (the hydraulic guide can be provided with a hydraulic device to automatically regulate steering angle limit) | |
| Variable working pressure | 170 + 10 bar | |
| Variable reduction ratio: | | |
| - drive centre | 22.2:1 | |
| - steering lock | 26.2:1 | |



| | | | |
|---|---|---|---|
| Power steering pump | | ZF | |
| Min. rpm | rpm | 500 | 500 |
| Max. rpm | rpm | 4700 | 3500 |
| Max. pressure (without pressure relief valve) | bar | 180 | 180 |
| Delivery | dm $^3$/min | 22 | 16 |

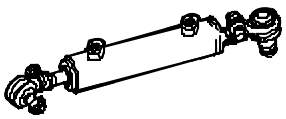
### Vehicles: 8x4x4 - 8x8



| | |
|---|---|
| Power steering unit | ZF 8099 ball circulation, dual circuit, with pressure relief valve in circuits 1 and 2; and check valve in circuit 1 Hydraulic device to automatically regulate steering angle limit |
| Variable working pressure | 140 + 14 bar |
| Variable reduction ratio: | |
| - drive centre | 22.2:1 |
| - steering lock | 26.2:1 |



| Assembling | | on compressor | ancillary on gearbox |
|---|---|---|---|
| Power steering pump | | ZF | ZF |
| Min. rpm | rpm | 500 | - |
| Max. rpm | rpm | 3000 | 4500 |
| Max. pressure (without pressure relief valve)* | bar | 165* | 180 |
| Controlled delivery | dm $^3$/min | 22.5 ÷ 30 | 16 |



| | | |
|---|---|---|
| Drive cylinder for hydraulic guide | | ZF 8099 |
| Length between wheel bases: | | |
| - start of stroke | mm | 578 |
| - end of stroke | mm | 828 |
| - straight-line ride position | mm | 702 |

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## TROUBLESHOOTING

### Main operating faults of a mechanical nature

| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Steering stiff when turning right and left | Insufficient oil in circuit. | Check oil level with engine running; top up to dip stick upper notch and bleed the circuit. |
| | Air in the hydraulic circuit. | Check the seal of the intake pipe and the pump shaft gasket and top up the oil. Bleed the circuit. |
| | Locked or clogged modulating valve. | Remove the valve, wash and check the throttle hole to ensure it is not clogged. |
| | Oil pump flow rate is insufficient. | Overhaul or replace the pump. |
| | Spider not sliding well. | Move the union in both directions so that it slopes under its own weight. |
| | Poor lubrication of transmission lever bearings (on vehicles with second steering). | Grease the transmission lever bearings. |
| | Worn transmission lever bearings (on vehicles with second steering axle). | Overhaul the transmission levers and replace worn parts. |
| | Hydraulic cylinders not working (on vehicles with second steering axle). | Replace the faulty cylinders. |
| | A hydraulic pump is not working (6x6 - 8x4x4 vehicles). | Overhaul or replace the hydraulic pump. |
| Steering is only hard to the left or the right | Inefficient internal gaskets. | Send the power steering to a ZF station. |
| | Hydraulic centre position is not correct (when the steering wheel is released it returns to an end position). | Have the power steering adjusted by a ZF station. |
| Steering is hard when the steering wheel isturned quickly | Clogged modulating valve. | Remove the valve, wash and clean. |
| | Hydraulic pump flow rate is inadequate (wear on gears). | Overhaul or replace the hydraulic pump. |
| | Air in the steering system. | Check the seal of the intake pump and the pump shaft gasket. Top up the oil. Bleed the circuit. |

*(Continued)*

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| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Hard knocks on the steering wheel when steering | Universal joint is slack. | Replace the universal joint. |
| | Power steering internal breakdown. | Send the power steering to a ZF station. |
| | System oil level too low. | Top up oil and bleed the circuit. |
| | Bad wheel attitude. | Make checks and adjustments. |
| | Unbalanced wheels. | Carry out the balancing operations following the instructions in the "Wheels and Tyres" section. |
| | Drag link king pins loose. | Replace any worn parts. |
| | Hydraulic pump not functioning properly. | Replace the pump. |
| | Oil seepage from power steering circuit fittings. | Check the efficiency of the gaskets on the fittings and replace any that are worn. |
| Steering wheel torsional vibration | Unbalanced wheels. | Carry out the balancing operations following the instructions in the "Wheels and Tyres" section. |
| | Incorrect front wheel attitude. | Make the checks and adjustments according to the specification data given in the "AXLES" section. |
| | Air in the hydraulic system. | Check the seal of the intake pump and the pump shaft gasket. Top up the oil. Bleed the circuit. |
| Excessive steering wheel play | Backlash in ball joints and/or flexible mountings are slack. | Replace the kingpins. |
| | Universal joint is slack. | Replace the universal joint. |
| | Power steering internal breakdown. | Send the power steering to a ZF station. |
| Loss of fluid | Tank cover not secured. | Secure cover. |
| | Deterioration of gaskets and seals. | Replace, top up fluid and bleed. |
| | In every case it is necessary to establish where and why hydraulic fluid is being lost, eliminate the cause and, with the engine running, top up fluid to upper mark on dipstick. | |
| Insufficient pressure in the circuit | Pump not operating correctly. | Replace pump. |
| | Fluid leaking from couplings in power steering circuit. | Check coupling seals for serviceability, replacing any which are worn. |
| | Insufficient fluid level in the tank. | Top up level and bleed circuit. |
| | Fluid leaking from couplings in power steering circuit (8x4x4). | Check coupling seals for serviceability, replacing any which are worn. |

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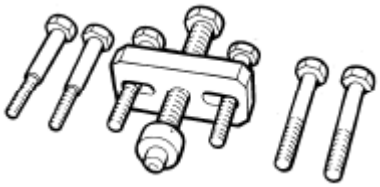
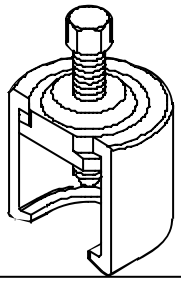
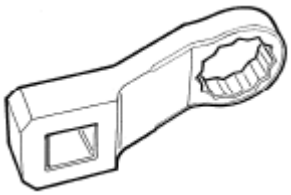
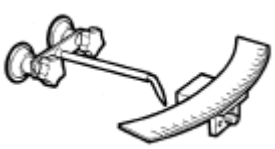
## TIGHTENING TORQUES

| DESCRIPTION | TORQUE | |
|---|---|---|
| | Nm | (kgm) |
| Hexagonal nut with collar for steering support and idler arm | 226.5 ± 22.5 | (22.6 ± 2.2) |
| Flanged hexagonal head screw for fixing steering stand | 278 ± 28 | (27.8 ± 2.8) |
| Hexagonal head screw for steering box | 527.5 ± 52.5 | (52.7 ± 5.3) |
| Calibrated hexagonal head screw for steering box | 527.5 ± 52.5 | (52.7 ± 5.3) |
| Castle nut for steering linkage and hydraulic cylinder (*) | 300 | (30) |
| Self-locking nut for universal joint | 55 ± 5 | (5.5 ± 0.5) |
| Calibrated screw for universal joint | 55 ± 5 | (5.5 ± 0.5) |
| Fastening collar for drag link and track rod | 80 ± 10 | (8 ± 1) |
| Hexagonal nut for steering box lever | 575 ± 55 | (57.5 ± 5.5) |
| Self-locking flanged nut for steering stand | 226.5 ± 22.5 | (22.6 ± 2.2) |
| Y Flanged hexagonal head screw for idler arm | 278 ± 28 | (27.8 ± 2.8) |
| (*) If at the prescribed torque, the slot does not match the hole, continue to tighten until it becomes possible to insert the split pin. | | |

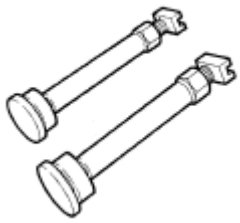
Y 8x4 -8x8 Vehicles

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## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99347042** |  | Steering wheel puller |
| **99347045** |  | Steering drop arm puller |
| **99347068** |  | Steering ball joint remover |
| **99355032** |  | Wrench for power steering gear retaining bolts |
| **99374393** |  | Pressure gauges for testing power steering system pressure |
| **99374398** |  | Calibrated scale and pointer for measuring steering play (to be used with 99374393) |

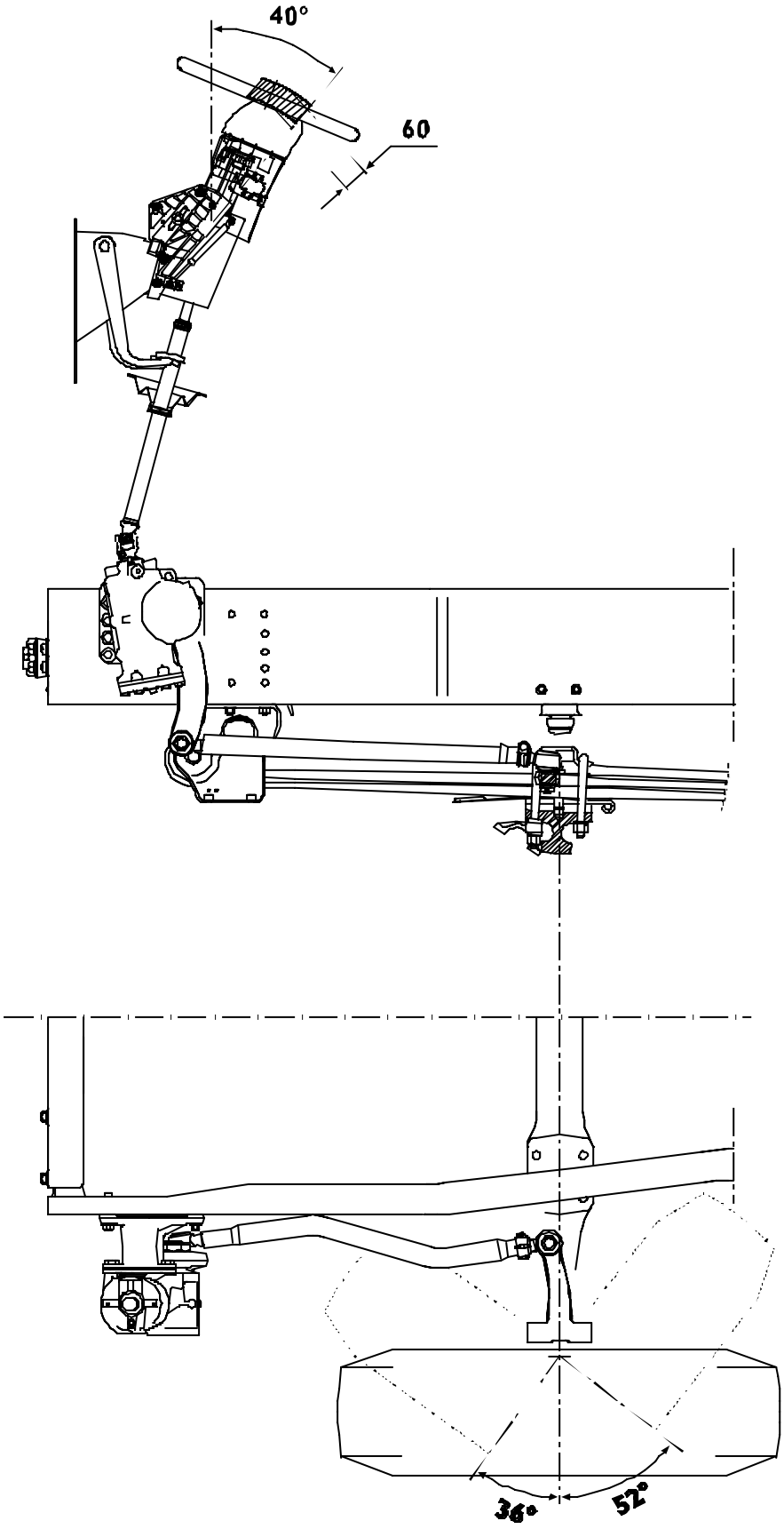
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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99374399** |  | Pair of expanders to lock wheels (to be used with 99374393 and 99374398) |

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**Steering control diagram for 4x2 - 6x4 vehicles (ZF 8098 power steering)**

Figure 2

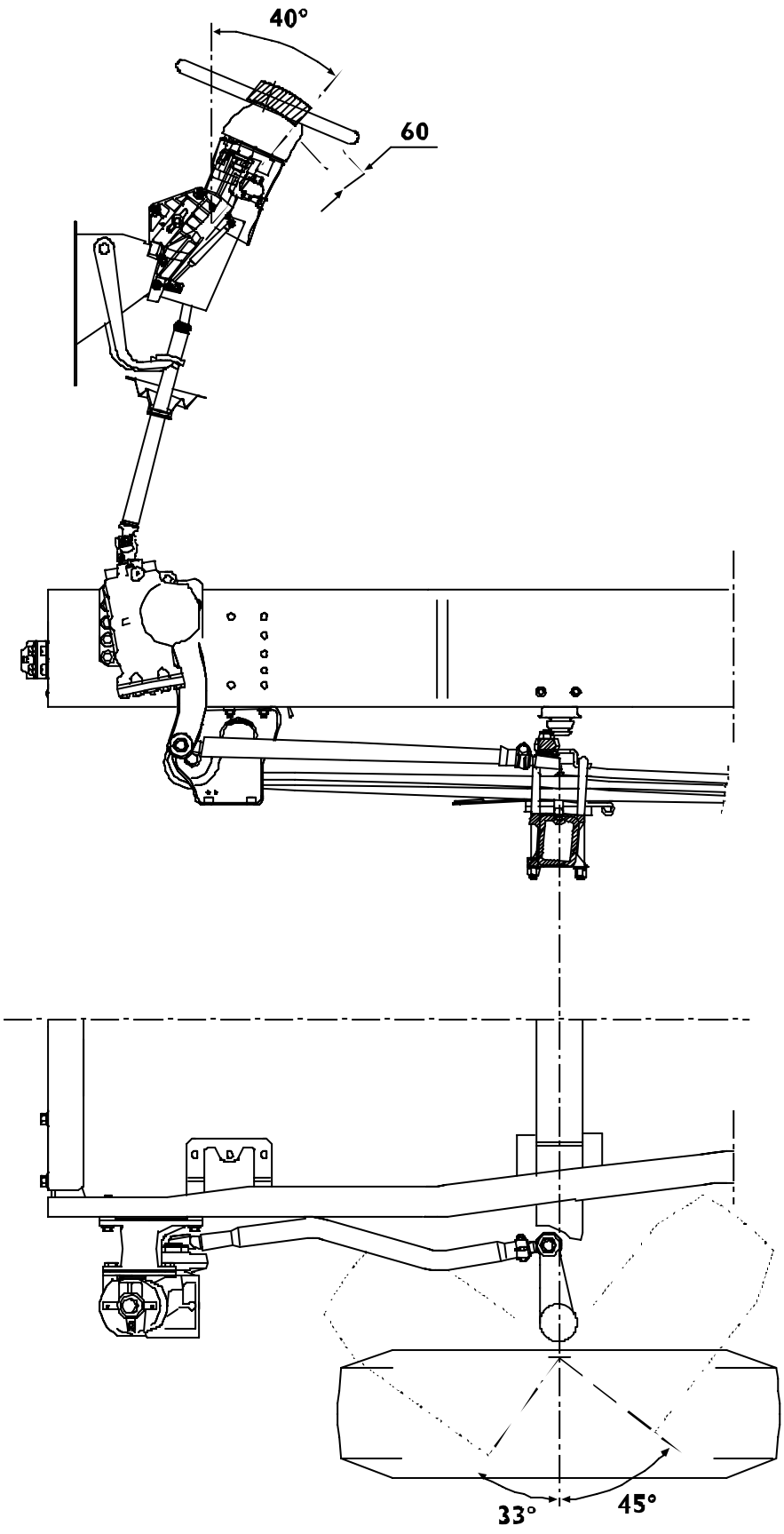



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**Steering control diagram for 4x4 - 6x6 vehicles (ZF 8098 power steering)**

Figure 3

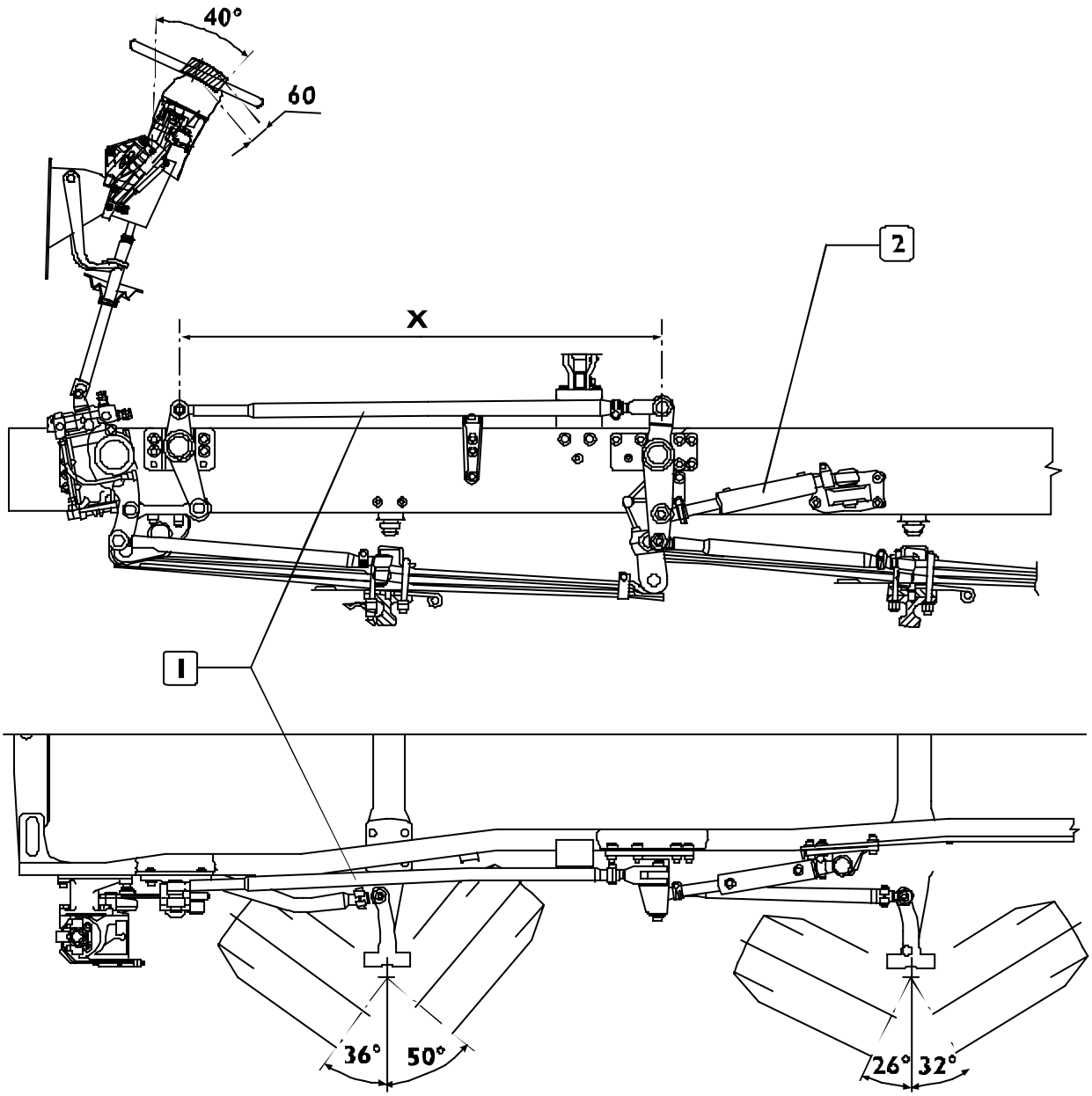



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## Steering control diagram for 8x4x4 vehicles (ZF 8099 power steering)

Figure 4



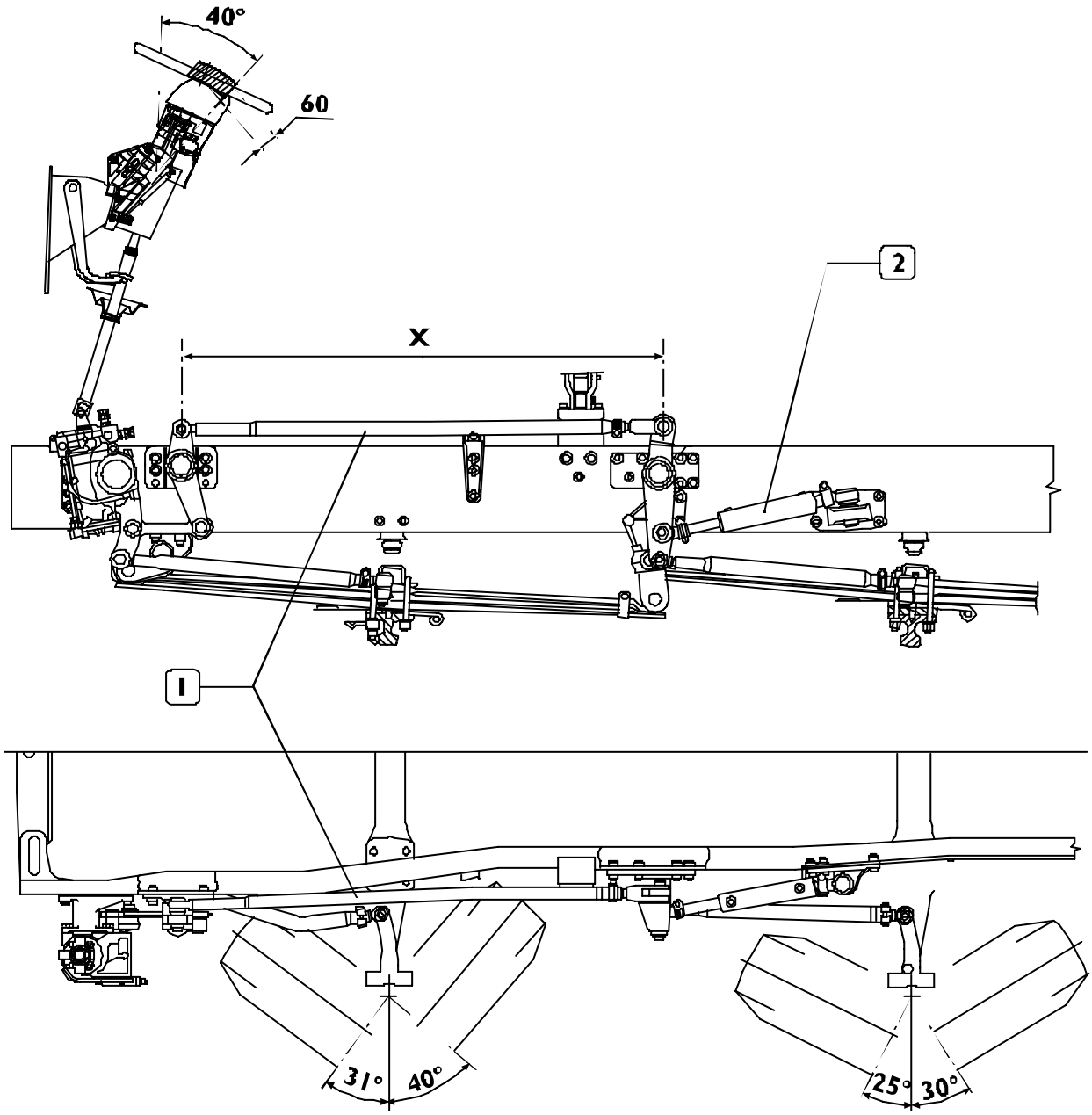

The intermediate rod (1) length x measured at the distance between centres of kingpins and fork shall be always restored when replacing one of the above mentioned parts and/or checked before inspecting the wheel alignment.
- vehicles with wheel base 1500 mm : x = 1540 ± 2
- vehicles with wheel base 1875 mm : x = 1735 ± 2

Drive cylinder length measured at kingpin distance between centres shall be 578 mm at stroke start and 828 mm at the end of stroke.

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## Steering control diagram for 8x8 vehicles (ZF 8099 power steering)

Figure 5



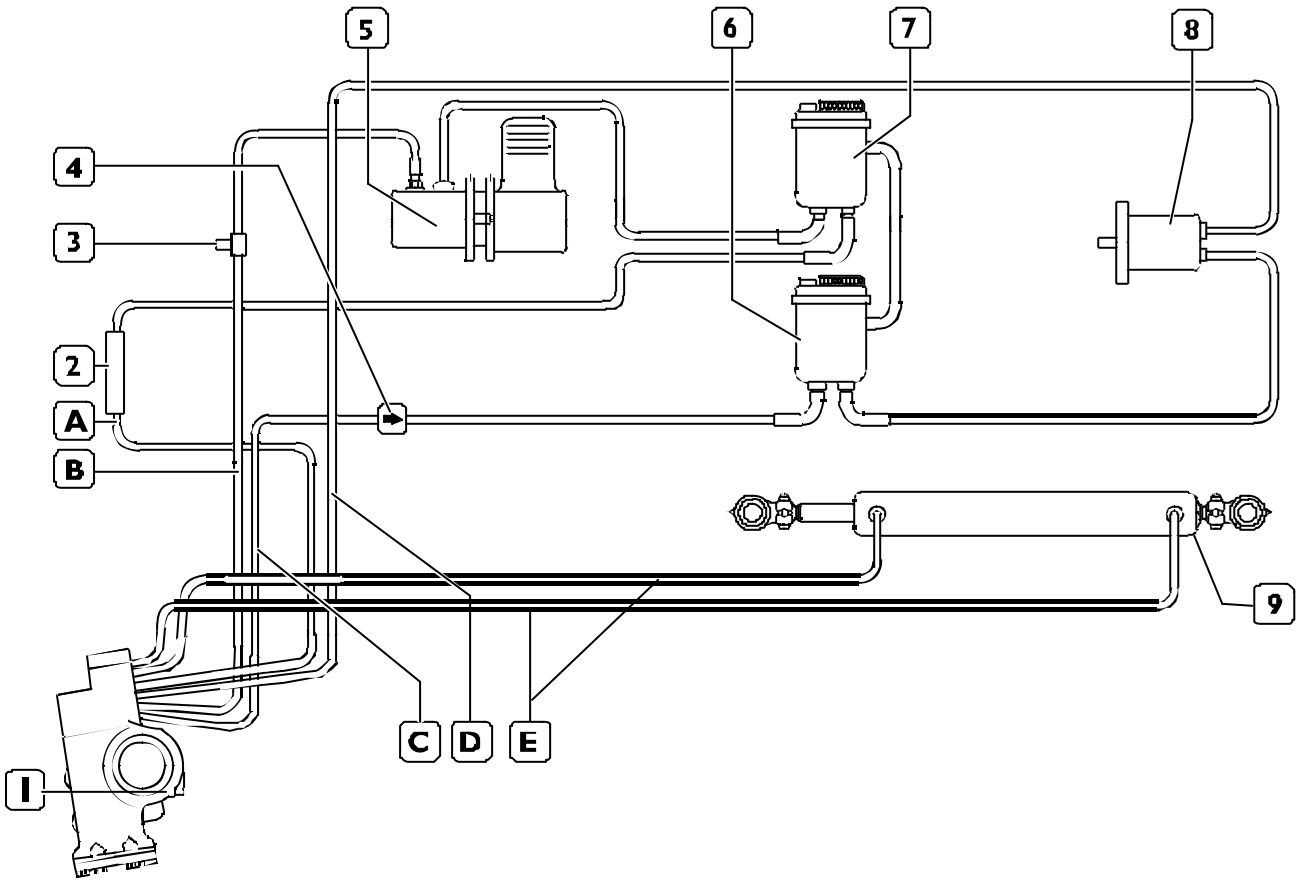

The intermediate rod (1) length x measured at the distance between centres of kingpins and fork shall be always restored when replacing one of the above mentioned parts and/or checked before inspecting the wheel alignment.
- vehicles with wheel base 1500 mm : x = 1540 ± 2
- vehicles with wheel base 1875 mm : x = 1735 ± 2

Drive cylinder length measured at kingpin distance between centres shall be 578 mm at stroke start and 828 mm at the end of stroke.

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## Steering hydraulic control circuit diagram for 8x4x4 - 8x8 vehicles

Figure 6

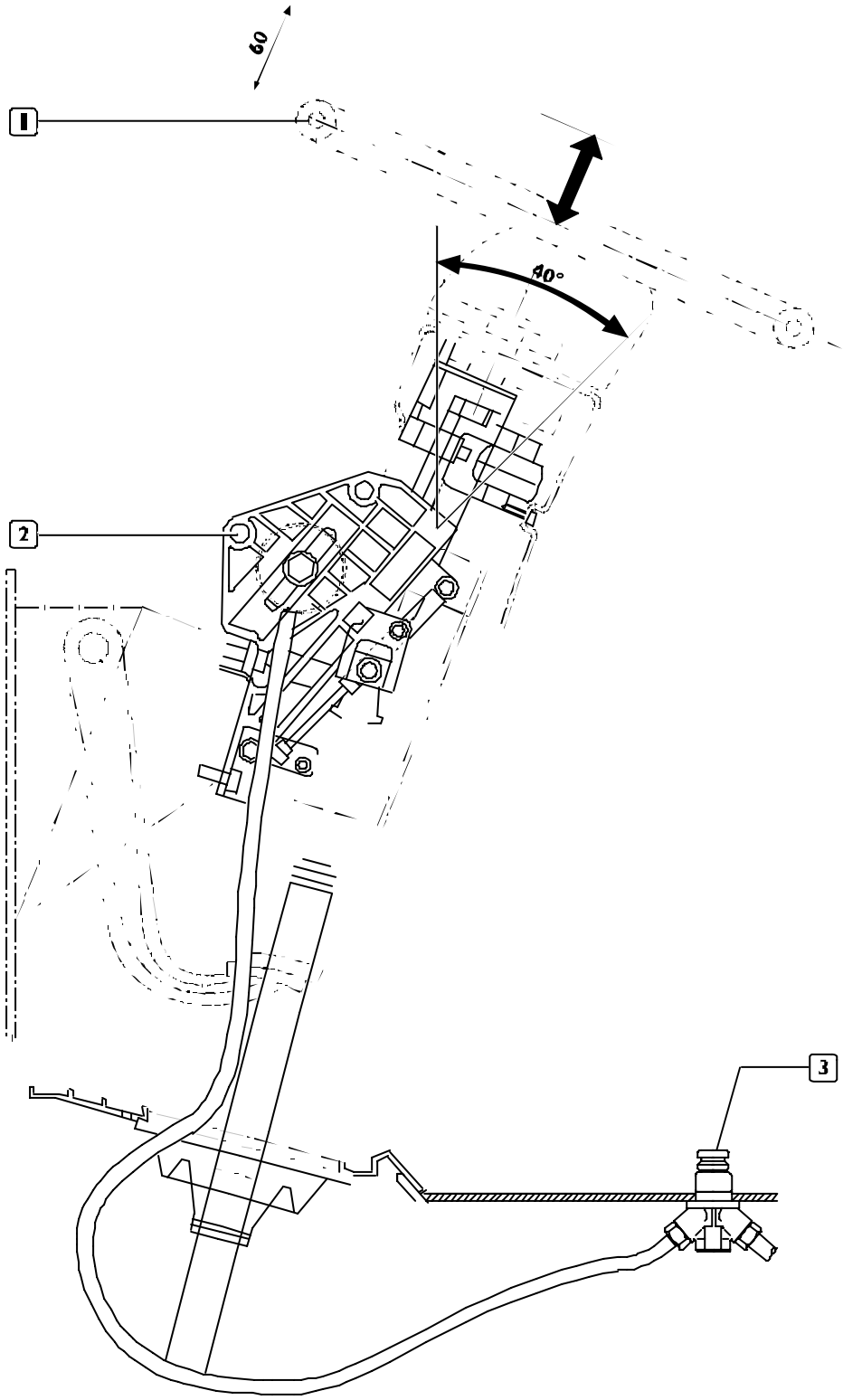



1. Steering box - 2. Oil cooler - 3. Pressure test fitting - 4. Flow indicator - 5. Compressor - 6. Circuit 2 reservoir - 7. Circuit 1 reservoir - 8. Pump on gearbox - 9 - Power cylinder - A. Circuit 1 return pipe - B. Circuit 2 delivery pipe - C. Circuit 2 delivery pipe - D. Circuit 1 return pipe - E. Power cylinder pipe.

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## 50140 STEERING CONTROL

Figure 7




The steering control is equipped with a pneumatic device to adjust the angle and height of the steering wheel.
The position of the steering wheel is adjusted by pressing the push-button on the floor of the cab:

- Press the button (3) on the floor: the pressurized air of the services system is sent to the steering wheel adjustment assembly (2) releasing it.
- Manoeuvre the steering wheel (1) into the required position (longitudinal travel along the axis of the steering column 60 mm, angular travel to the vertical 40°).
- Release the button on the floor.

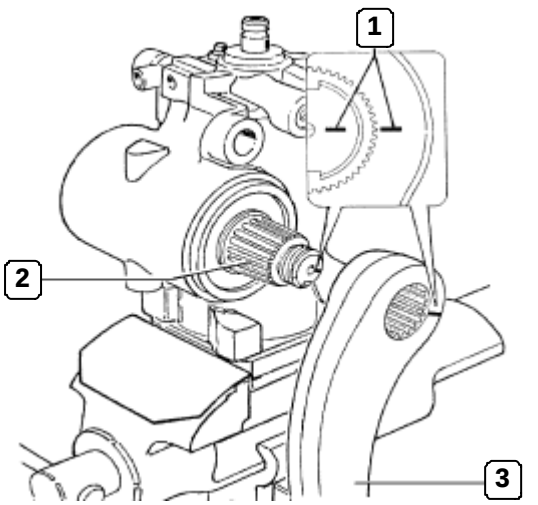
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## HYDRAULIC STEERING

**NOTE** If the hydraulic steering has to be replaced, before reconnecting the new hydraulic guide to the support, the steering wheel lever is to be mounted on the new hydraulic guide as described in following chapter.
If the hydraulic guide is provided with a steering limit automatic regulation, the automatic regulation is to be set as described in relevant chapter after reconnecting the hydraulic guide.

### Mounting steering wheel lever

Figure 8

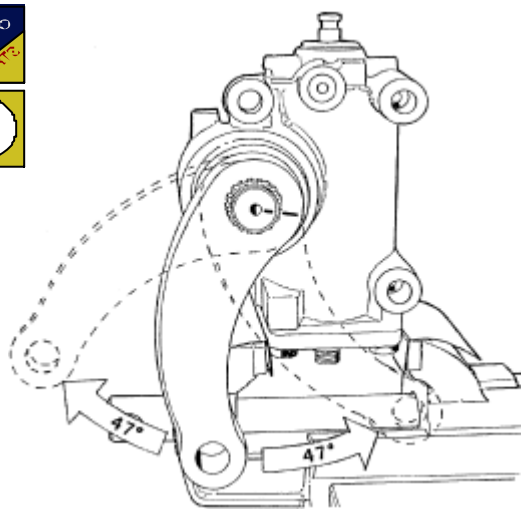



33690

Secure the power steering box in a vice.
Fit the steering lever (3), making the reference marks (1) cut on the driving shaft (2) and on the lever (3) tally.

So as not to change the setting of the automatic hydraulic steering limit (if present), do not turn the shaft (2) of the power steering box with a torque greater than 25 Nm.

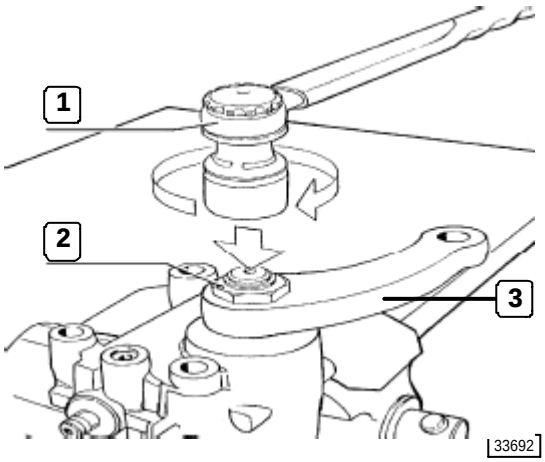
Figure 9




33691

Check the angular travel of the lever that has to be 47° in both directions.

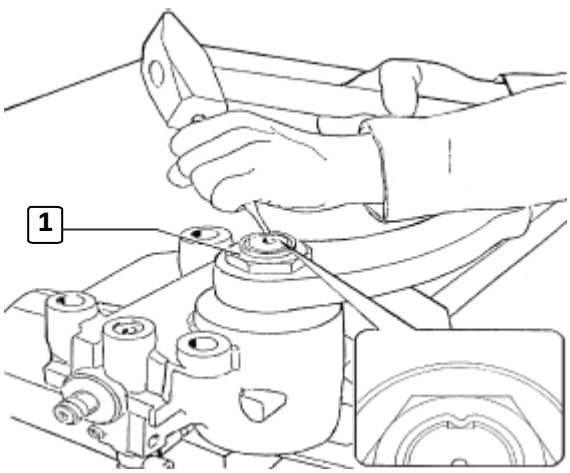
Figure 10




33692

Keeping the lever (3) stationary to prevent turning the power steering shaft, lock the nut (2) fixing the lever with a torque wrench (1) to a torque of 575 Nm.

Figure 11




33693

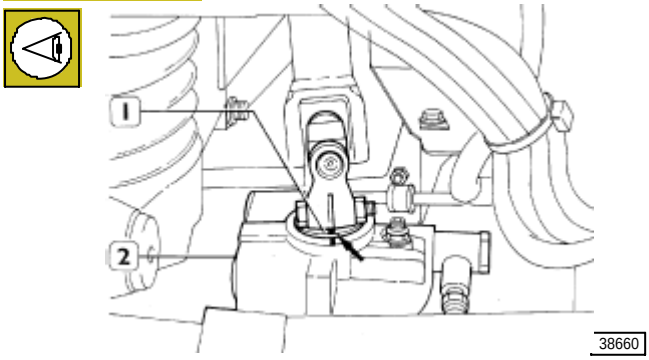
Using a suitable punch, notch the collar of the nut (1).

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## 501410 REMOVING-REFITTING THE STEERING CONTROL ASSEMBLY

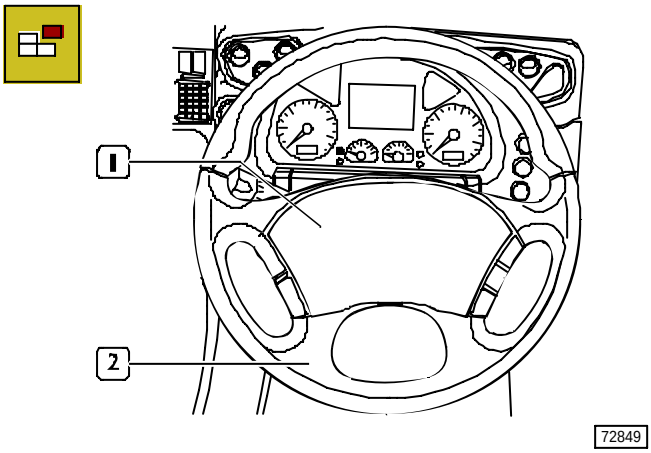
### Removal

Figure 12



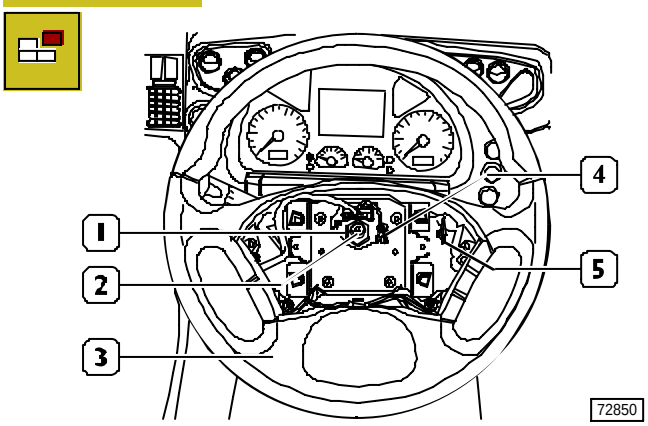

Lift the cowling of the cab. Set the wheels straight and check that the steering box is in the "straight ahead" position, so the reference mark ⇐ of the shaft (1) coincides with the reference mark ⇒ of the steering box (2).

Figure 13



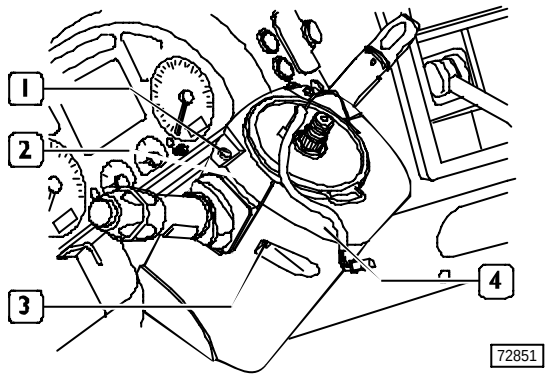

Engage the steering lock by taking the ignition key out.
Take the cover (1) off the steering wheel (2).

Figure 14



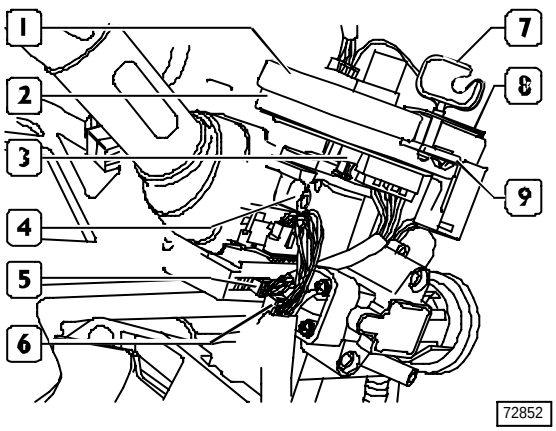

Disconnect the connection (4) of the earth cable.
Remove the nut (1), mark the assembly position of the steering wheel (3) on the shaft (2) and remove the steering wheel (3).

Figure 15




Take out the screws (1 and 3) and take off the side guards (2.4).

Figure 16

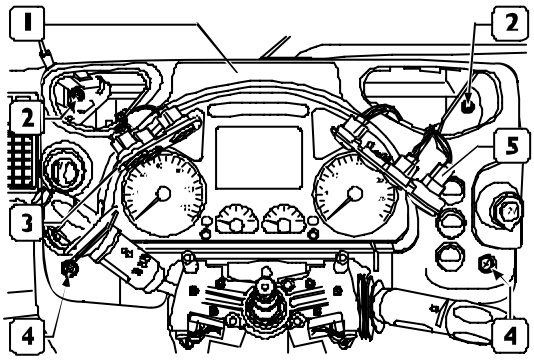



Remove the interconnecting box (2) from the steering control mounting (4), keeping strictly to the procedures described hereunder. This is to prevent damaging the spiralled cable in the box, during assembly, and to avoid a wrong reading of the steering wheel angle.

Disconnect the electric connections (5 and 6). Take the key (5, Figure 14) out of the steering wheel (3, Figure 14). Fasten the cover (1) of the interconnecting box (2) to the box by inserting the key (7) in the slots (8 and 9). This prevents the cover (1) and the box (2) from turning on each during disassembly and this condition is maintained until assembly. If there is no key (7), use a screw and nut of suitable length and diameter.
Take hold of the interconnecting box (2), lift it carefully so that the retaining spring pins (3) come out of the mounting (4) and put it aside.

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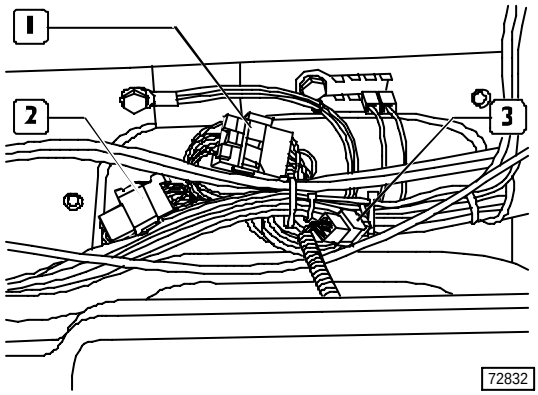
Figure 17




72831

Remove the push-button panels (3 and 5) and the caps for the screws (4) from the instrument panel (1).
Take out the screws (2 and 4), remove the instrument panel (1) and put it aside.

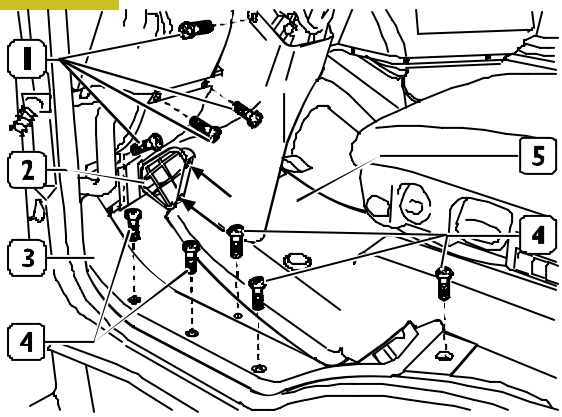
Figure 18




72832

Disconnect the connections (1) of the windscreen wiper, (2) of the drive control system, (3) of the immobilizer.

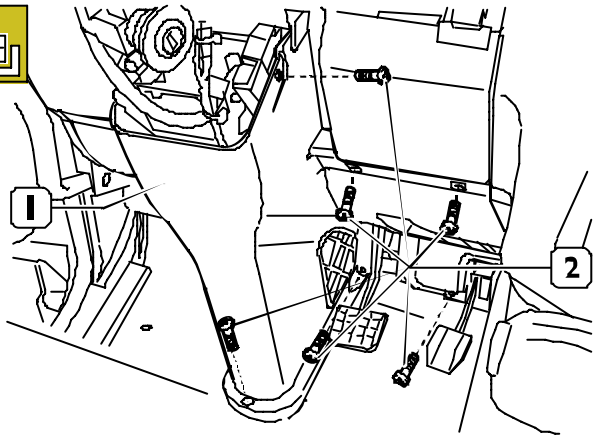
Figure 19




77108

- Remove mat (5).
- Unscrew securing screws (4) of the sill (3).
- Detach the sill (3) from the vehicle.
- Undo the fasteners (⇐) and take out the air opening (2) in the floor.
- Unscrew the side screws (1) fixing the steering column guard.

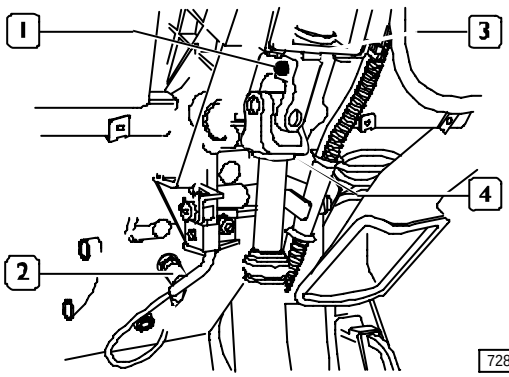
Figure 20




90002

- Unscrew the screws (2) fixing the steering column guard in the area of the pedal board.
- Detach the steering column guard (1) from the vehicle.

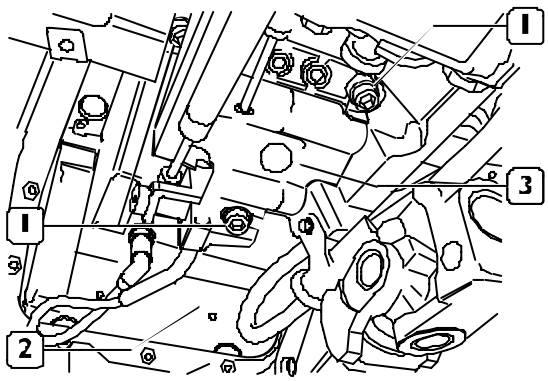
Figure 21




72854

Mark the assembly position of the shaft (2, Figure 14) on the mounting (3) and on the universal joint (4). Loosen the screw (1) and extract the universal joint (4) from the top shaft.
Disconnect the pipe (2).

Figure 22

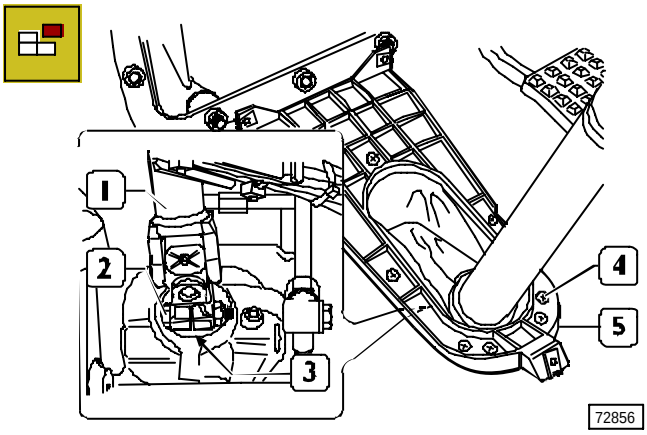



72855

Take out the 3 screws (1) and remove the steering control mounting (3) from the pedal board (2).

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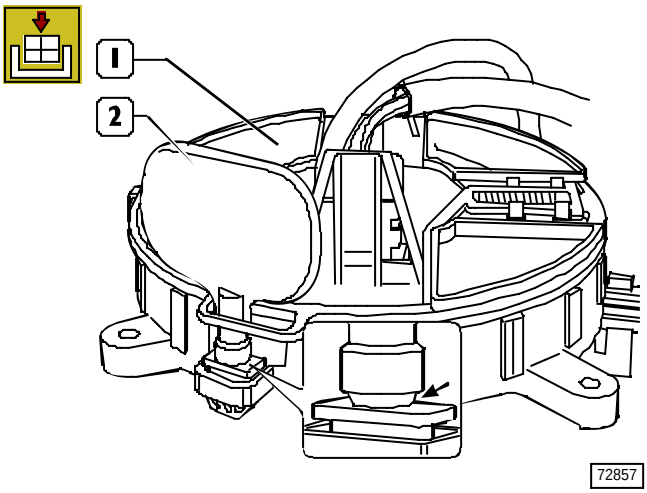
Figure 23




From outside the cab, loosen the screw (2) and disconnect the bottom shaft (1) from the power steering (3) shaft. Take out the screws (4) and remove the bottom shaft (1) together with the guard (5).

## Refitting

Figure 24

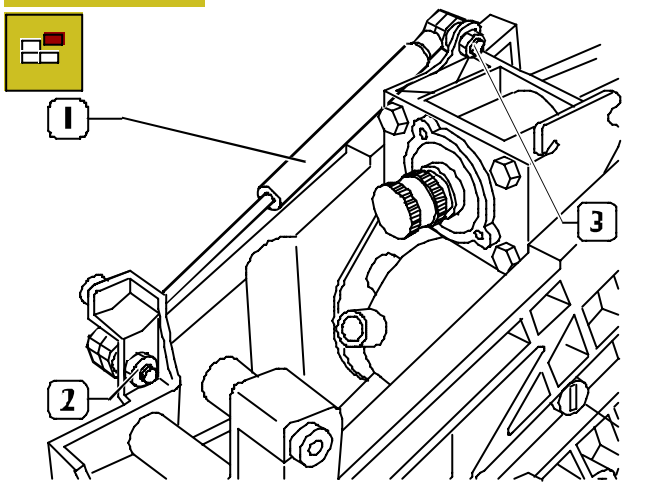



To refit, carry out the operations described for removal in reverse order, tightening the screws and/or nuts to the required torque.

The interconnecting box (1) is supplied as a spare with the stop key assembled as illustrated in the figure. After fitting it on the steering control mounting, it is necessary to turn the key (2) so as to cause it to break at the point shown by the arrow and put the key in the steering wheel housing, see Figure 14.

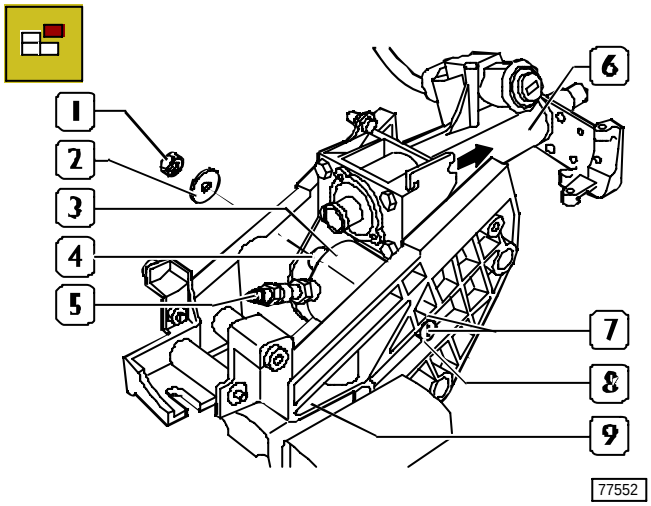
## Replacing the pneumatic cylinder
## Removal

Figure 25




Remove the steering gear assembly as described under the relevant heading (operation 501410).
Remove the damper (1) by taking out the fixing nuts (2 and 3).

Figure 26




Screw a suitable coupling (5) into the air supply hole of the cylinder (3) and introduce air at a pressure of 8 ÷ 12 bars.

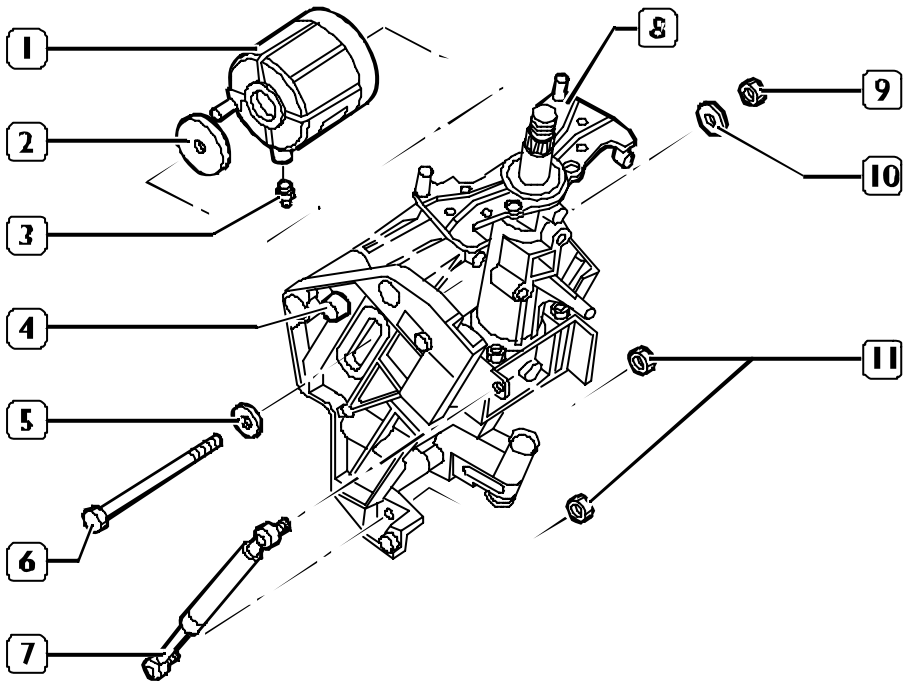
The air pressure must be maintained throughout removal: this is a necessary condition to make sure the pneumatic cylinder (3) gets released.

Shift the steering gear shaft-assembly (6) completely outwards (→).
Mark the assembly position of the screw (7) on the mount (9).
Remove the nut (1), extract the screw (7) with the washers (2 and 8) and remove from the mount (9) the pneumatic cylinder (3) the adjustment washer (4) and the steering gear shaft assembly (6).

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## Mounting

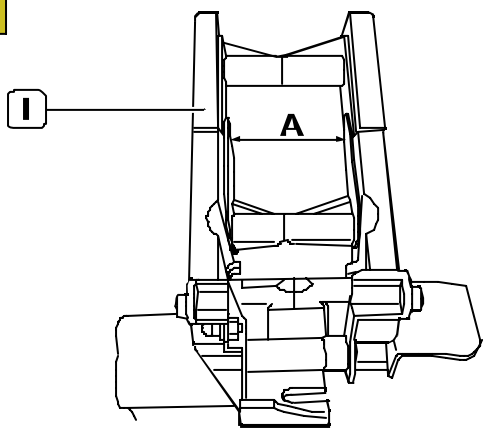
Figure 27




77554

PARTS COMPRISING THE STEERING GEAR ASSEMBLY
1. Pneumatic cylinder - 2. Adjustment washer - 3. Coupling - 4. Mount - 5. Washer - 6. Screw - 7. Damper - 8. Steering gear shaft assembly - 9. Nut - 10. Washer - 11. Nut.

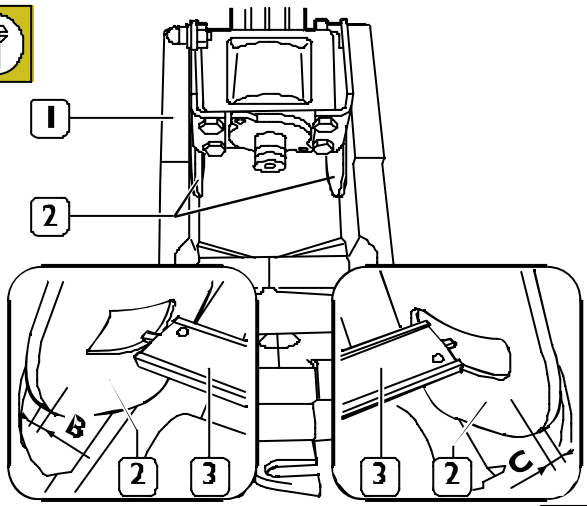
Figure 28




77553

Determine the thickness of the adjustment washer (2, Figure 27) as follows.
Measure the distance A between the sliding surfaces of the mount (1) with a suitable instrument (precision class 0.05 mm).

Figure 29

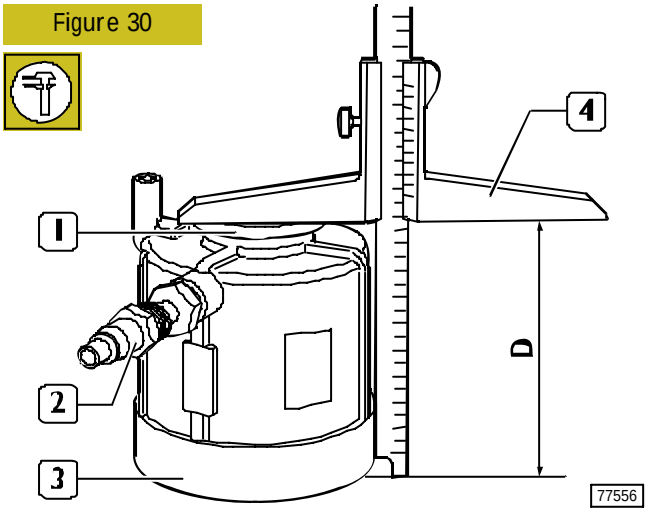



77555

Position the steering gear shaft mount (2) in the mount (1).
Measure the distances B and C between the internal surface of the mount (2) and the sliding surface (of the above) of the mount (1) with a suitable instrument (3) (precision class 0.05 mm).

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Figure 30



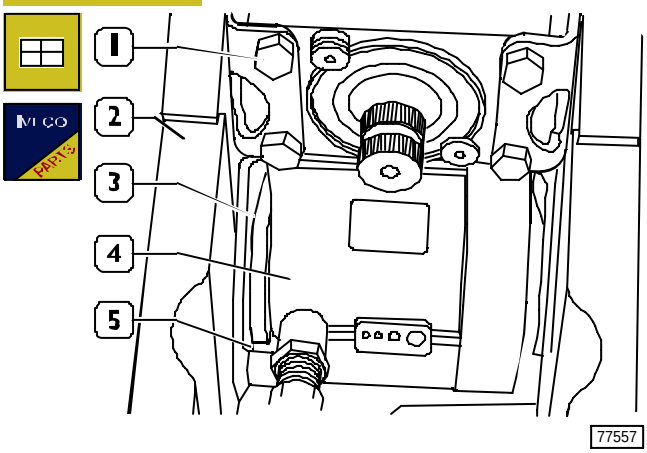

Screw a suitable coupling (2) into the air supply hole of the new cylinder (3) and introduce air at a pressure of 8 ÷ 12 bars.

The air pressure must be maintained throughout the measurement and following assembly.

Place the pneumatic cylinder (3) on the plane and put the adjustment washer (1) on its piston; measure the distance (D) with a suitable instrument (4, precision class 0.05 mm).

S = A - (B + C + D + 0.2), where A - B - C - D are the distances measured and 0.2 is the clearance.

Figure 31

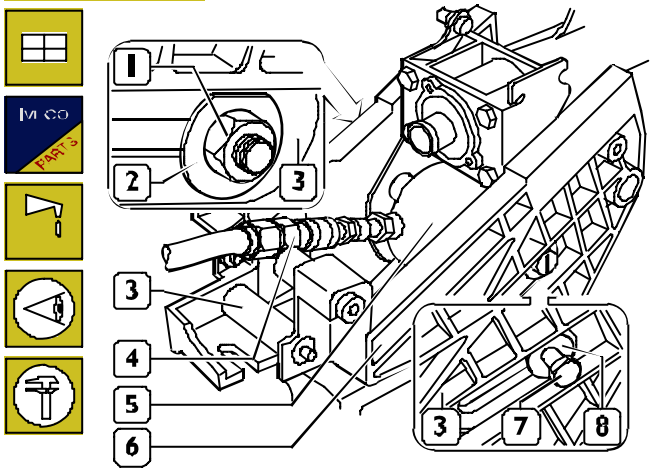



Put mount (2) in mount (1) and fit on the cylinder (4 supplied with air at a pressure of 8 ÷ 12 bars) positioning it with the pin (5) in the guiding groove of the mount (2).
Choose the adjustment washer (3) from the ones supplied as spares, with the thickness calculated in the preceding measurement.

**NOTE** Washer thickness: 4.6 – 4.7 – 4.8 – 4.9 - 5-5 – 5.2 – 5.4 mm.

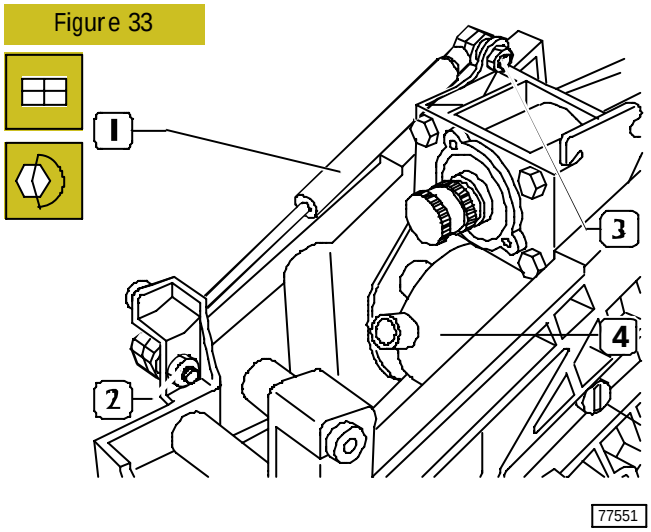
Lubricate the washer (3) with grease and insert it between the cylinder (4) and the mount (1).

Figure 32




Fit on a new screw (7) with the washer (8) positioning it at the point marked during removal.
From the opposite side, fit on the washer (2). Apply Loctite 270 on the thread of the new nut (1) and screw it onto the screw (3) to determine a clearance of 0.1 ÷ 0.2 mm between the washer (2) and the mount (3).
Check the travel of the mount (8) of the steering gear shaft on the mount (3) in all directions.
Set the steering gear shaft mount (6) in the position of the start of travel (minimum height of the steering wheel).
Remove the air coupling (4) from the pneumatic cylinder (5).

Figure 33



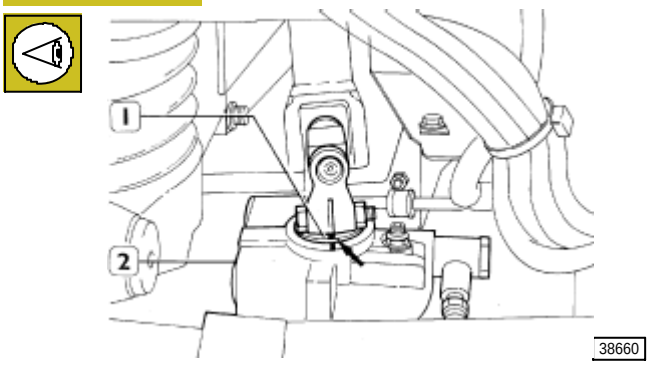

Fit on the damper (1), screw down the fixing nuts (2 and 3) tightening them to a torque of 23 Nm.
Check the locking of the cylinder (4): applying a tractive force of 300 N (30 kg) to the steering gear shaft, in the direction of the driver, this must not move in relation to the mount (3).
Then refit the steering gear assembly to the vehicle as described under the relevant heading.

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## Replacing blinker switch

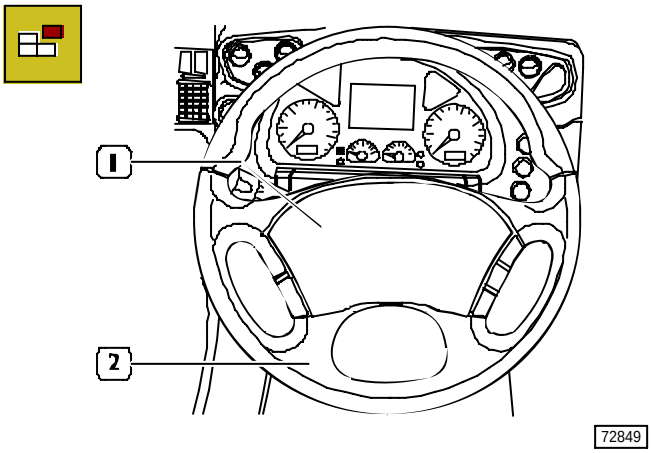
### Removal

Figure 34



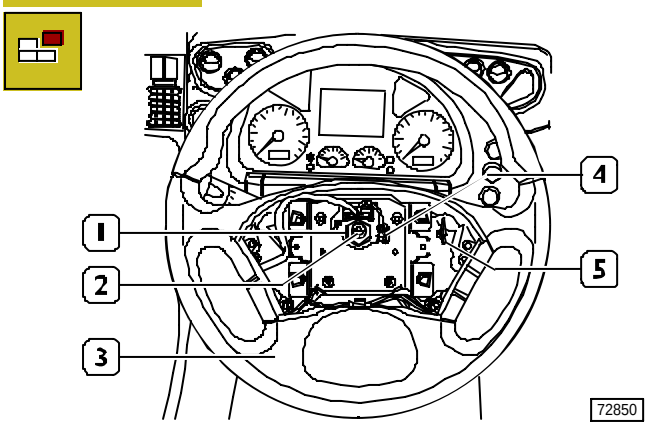

Lift the cowling of the cab. Set the wheels straight and check that the steering box is in the "straight ahead" position, so the reference mark ⇐ of the shaft (1) coincides with the reference mark ⇒ of the steering box (2).

Figure 35



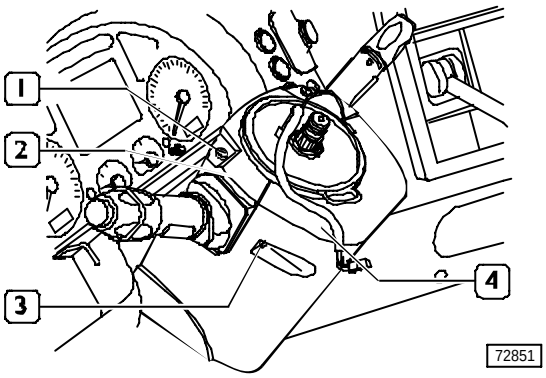

Engage the steering lock by taking the ignition key out.
Take the cover (1) off the steering wheel (2).

Figure 36



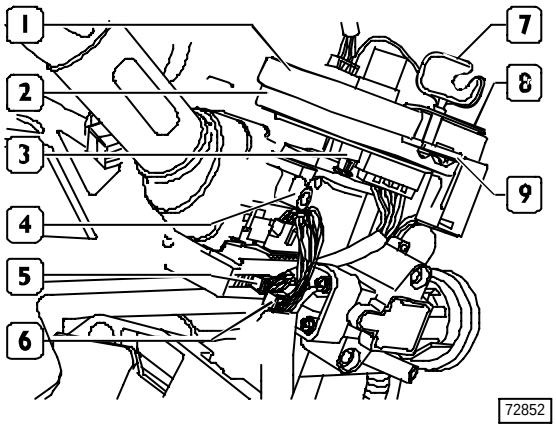

Disconnect the connection (4) of the earth cable.
Remove the nut (1), mark the assembly position of the steering wheel (3) on the shaft (2) and remove the steering wheel (3).

Figure 37




Take out the screws (1 and 3) and take off the side guards (2.4).

Figure 38

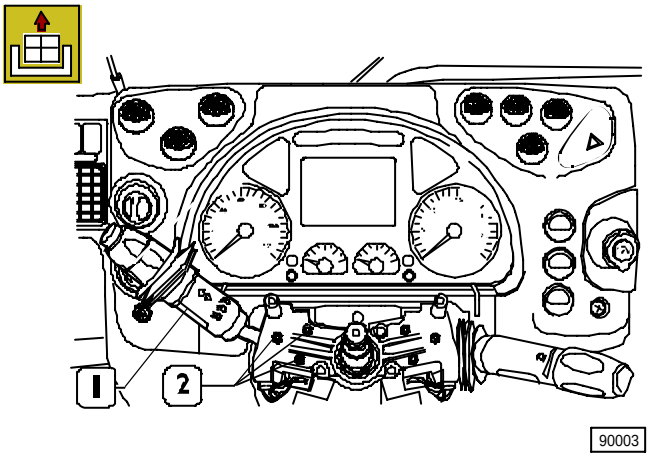



Remove the interconnecting box (2) from the steering control mounting (4), keeping strictly to the procedures described hereunder. This is to prevent damaging the spiralled cable in the box, during assembly, and to avoid a wrong reading of the steering wheel angle.

Disconnect the electric connections (5 and 6). Take the key (5, Figure 36) out of the steering wheel (3, Figure 36). Fasten the cover (1) of the interconnecting box (2) to the box by inserting the key (7) in the slots (8 and 9). This prevents the cover (1) and the box (2) from turning on each during disassembly and this condition is maintained until assembly. If there is no key (7), use a screw and nut of suitable length and diameter.
Take hold of the interconnecting box (2), lift it carefully so that the retaining spring pins (3) come out of the mounting (4) and put it aside.

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Figure 39




Disconnect securing screws (2) of steering column stalk (1). Remove electric connection and disconnect steering column stalk (1).

### Mounting

For mounting, invert operations described for dismounting, tightening the screws and/or nuts at prescribed torque.

The steering column stalks that are supplied as spares have no thread on securing plate. Never thread holes because you might damage the components inside steering column stalk. As the plate is made of aluminium, it allows self-threading on securing it through screws.

## MAIN OPERATIONS

### 501430 BLEEDING THE POWER STEERING SYSTEM

For vehicles 4x2 - 4x4 - 6x4 - 6x6

To bleed the power steering system, proceed as follows.

Fill the power steering fluid reservoir with the prescribed fluid (Tutela GI/A)

Turn the engine over with the starter motor and top up the fluid continually to prevent air being drawn into the pump.

Top up the fluid until the level remains constant above the minimum mark on the dipstick.

Start the engine and run it idling, checking that the level of the fluid does not fall under the minimum level marked on the dipstick.

Turn the steering wheel from lock to lock several times to force any air out of the power steering cylinder until no more bubbles appear in the fluid in the reservoir.

Accelerate to maximum rpm, then stop the engine and check that the fluid level does not rise more than 1 to 3 cm.

For vehicles 8x4 - 8x8

Fill the hydraulic power steering case through the oil reservoir of Circuit 1.

Fill the oil reservoir of circuit 1 with the prescribed oil, start the engine and keep it idling.

Top up the oil continuously to prevent the pump from sucking air.

Fill the emergency pump through the oil reservoir of the emergency circuit.

Fill the oil reservoir with the prescribed oil, lift the engine axles from the ground, start the engine and keep it idling, then engage a gear.

Top up the oil continuously to prevent the pump from sucking air.

When the two circuits are full, i.e. when the oil level in the two reservoirs cannot fall below the top mark, start the engine and, with the axles lifted from the ground, keep it idling for 2-3 minutes with the gear engaged.

Turn the steering wheels several times from one limit switch to the other.

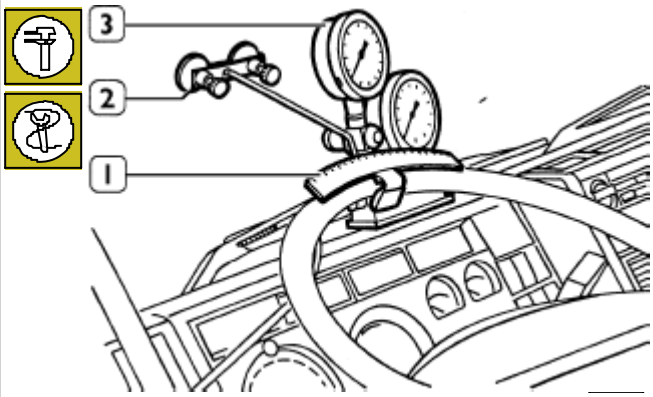
Check continuously and top up the oil in the reservoirs, if needed.

### 501430 MEASURING STEERING BOX PLAY AT THE STEERING WHEEL

Check there is no mechanical play in the steering linkage.

Lock the left-hand wheel in the straight-ahead position using the expanders 99374399; raise the axle.

Figure 40




Attach the fixed pointer (2) to the windscreen with suction cups, and attach the graduated scale 99374398 (1) to the steering wheel. Position the pressure tester 99374393 (3) (0 to 10 bar and 0 to 160 bar, pressure gauges connected by a shunt valve). Connect the pipe of the pressure tester to the fitting on the power steering delivery pipe. Top up the fluid level if necessary. Start the engine and run at idle speed. Record the pressure reading shown on the 0 to 10 bar gauge. Slowly turn the steering wheel to the left until the previous pressure reading is increased by 1 bar. Hold the steering wheel in this position and record the value in mm reached on the graduated scale 99374398. Now turn the steering wheel to the right until the pressure reading is again increased by 1 bar, and note the value in mm on the graduated scale 99374398. Add together the two values in mm obtained for left and right steering: the total should not exceed 40 mm. Lower the axle.

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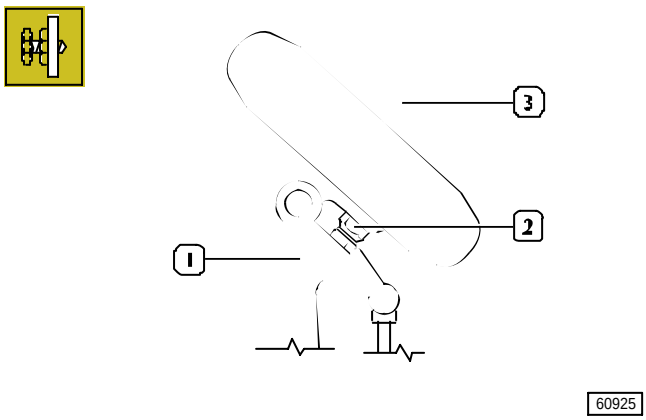
## CHECKING THE MAXIMUM PRESSURE OF THE POWER STEERING SYSTEM

Using the pressure tester 99374393, connected as described above, and the driver's side wheel locked, start the engine and run at idle. Apply a steering force of 10÷20 kg to the steering wheel and record the pressure reading on the 0÷160 bar gauge. Repeat the operation applying the same steering force in the opposite direction; if the readings obtained are lower than specified, locate the source of the problem.

**NOTE** The maximum pressure is given on the data plate attached to the ZF steering box.

### Setting the automatic hydraulic steering limit

Figure 41




This adjustment is made after fitting the power steering system on the vehicle, with the vehicle unloaded and the front wheels raised or set on revolving platforms. In addition, it is necessary to steer both right and left as follows.
Make sure the gearbox is in neutral.
Start the engine and run at a speed of ≤ 1500 rpm.
Turn the steering wheel in one direction to bring the stop screw (2) on the stub axle (3) into contact with the axle (1).

In this position, apply an additional force on the steering wheel to determine the automatic setting. Repeat this procedure steering in the opposite direction.

If there is a reduction in the travel of the steering control lever, it is necessary to replace the steering limiting screw concerned with a new one, or both screws if the trouble involves the opposite travel as well.

The screws are located on the top and bottom sides of the power steering box. Make the adjustment as described above.

### Check

Connect a pressure gauge (minimum full-scale value 200 bar) to the pressure test fitting on the delivery line from the pump to the power steering and apply a steering force at the steering wheel of 50 ± 20 Nm (corresponding to 200 ± 80 N on a 500 mm diameter steering wheel), turning the wheel to the full lock position. The pressure reading should be within the range of 35 to 70 bar. If the pressure is too high, replace the adjustment screws with new ones and repeat the adjustment procedure. If the pressure is too low, check that the hydraulic system is operating properly and that there are no leaks.

Aquila Trucks Centres

SECTION 13

# 79 Pneumatic system
# 52 Brakes


Page

SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (MISCELLANEOUS AND GENERATORS) . . . 5

SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES) . . . . . 6

SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (TANKS AND ACCUMULATORS) . . . 12

SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (CALIPERS AND CYLINDERS) . . . . . 13

SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (HALF-JOINTS AND COUPLING HEADS) . 15

SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (INDICATORS AND SWITCHES) . . . . 17

SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (BRAKES) . . . . . 18

PIPES AND COUPLINGS . . . . . 19

- General . . . . . 19

- Replacing flexible hoses with threaded couplings . . . . . 19

- Replacing flexible hoses with quick-connection couplings . . . . . 20

- Replace hoses with Raufoss type fittings . . . . . 21/1

BRAKING SYSTEMS WITH ABS - EBL DEVICE . . . . 22

- Main diagram for vehicles 4x2 - 4x4 used for haulage . . . . . 22

- Working diagram for 6x4 vehicles isolated with an ABS - EBL device . . . . . 23

- Working diagram for 6x4 - 6x6 vehicles designed for towing with ABS - EBL device . . . . . 24

- Working diagram for 8x4x4 - 8x8x4 vehicles isolated with an ABS - EBL device . . . . . 25

- Working diagram for 8x4x4 - 8x8x4 vehicles designed for towing with ABS - EBL device . . . . . 26

BRAKING SYSTEMS WITH ABS - EBL - ASR DEVICE . . . . . 27

https://truckmanualshub.com/

Aquila Trucks Centres


Page

- Working diagram for 4x2 - 4x4 vehicles designed for towing . . . . . 27
- Main diagram for vehicles 6x4 with ABS - EBL - ASR . . . . . 28
- Main diagram for vehicles 6x4 - 6X6 used for haulage fitted with ABS - EBL - ASR . 29
- Main diagram for vehicles 8x4x4 - 8x8x4 with ABS - EBL - ASR . . . . . 30
- Main diagram for vehicles 8x4x4 - 8x4x4 used for haulage fitted with ABS - EBL - ASR . 31
- Braking system main components layout on the vehicle . . . . . 32

DESCRIPTION . . . . . 33

- Service braking . . . . . 33
- Emergency braking . . . . . 33
- Retarding braking . . . . . 33
- Parking braking . . . . . 33

BRAKES . . . . . 33

- Front disc brakes SN7 type (for vehicles with partial traction) . . . . . 33
- Drum brakes . . . . . 33

FAULT DIAGNOSIS . . . . . 34

- Diagnosis Instruments . . . . . 34
- Diagnosis on Cluster . . . . . 36
- DTC - FMI error codes . . . . . 37

TIGHTENING TORQUES . . . . . 73

TOOLS . . . . . 74

MAIN DATA - PNEUMATIC SYSTEM . . . . . 82

MAIN DATA - BRAKES . . . . . 86

BRAKING SYSTEM MAIN COMPONENTS CHECK 89

BRAKING SYSTEM MAIN COMPONENTS . . . . 92

- Compressor . . . . . 92
- Troubleshooting . . . . . 92
- Head fastening screws tightening torque . . . . . 92
- A.P.U. (Air Processing Unit) . . . . . 93
- A.P.U. Troubleshooting (Drier + four-way protection valve) . . . . . 93

Page

- Duplex distributor . . . . . 94
- Troubleshooting . . . . . 94
- Pressure reducer . . . . . 95
- Troubleshooting . . . . . 95
- Triple control servo distributor . . . . . 95
- Setting at the bench . . . . . 95
- Predominance adjustment . . . . . 95
- KNORR BREMSE AC 597B . . . . . 96
- WABCO 973 009 013 . . . . . 96
- Troubleshooting . . . . . 96
- Coupling heads . . . . . 97
- Check valve (towing vehicles) . . . . . 97
- Parking brakes control hand distributor (for towing vehicles) . . . . . 97
- Troubleshooting . . . . . 97
- Parking brakes control hand distributor (stand-alone vehicles) . . . . . 98
- Troubleshooting . . . . . 98
- Relay valves . . . . . 99
- Troubleshooting . . . . . 99
- Diaphragm brake cylinder . . . . . 99
- Combined brake cylinder . . . . . 100
- Combined cylinder emergency relief device . . 100

REPAIR OPERATIONS . . . . . 100

- Troubleshooting . . . . . 100
- Troubleshooting . . . . . 101

ANTI-SKID SYSTEM . . . . . 101

- ABS (Anti-Lock Brake System) . . . . . 101
- ASR (Anti-Slip Regulator) system . . . . . 101
- EBL (Electronic Brakes Limiter) . . . . . 101
- Pressure sensor . . . . . 101
- Electronic control unit . . . . . 102

Aquila Trucks Centres

Page

- Brake anti-lock distributor . . . . . 102
- Electropneumatic valve for ASR . . . . . 102
- Rpm sensors . . . . . 102
- Phonic wheels . . . . . 102

FRONT DISC BRAKES SN7 TYPE . . . . . 103

- Operation (See previous figure) . . . . . 104

CHECKS . . . . . 104

- Checking the automatic play recovery system efficiency . . . . . 104
- SN7 brake caliper components . . . . . 105
- SN7 brake calliper braking gaskets thickness check . . . . . 106
- Replacing brake linings . . . . . 107
- Removing and refitting brake callipers . . . . . 109
- Removal . . . . . 109
- Refitting . . . . . 109
- Removing and refitting wheel hubs . . . . . 110

Page

- Removal . . . . . 110
- Refitting . . . . . 110

SN7 BRAKE CALIPER OVERHAUL . . . . . 112

- Disassembly . . . . . 112
- Component part cleaning and check . . . . . 113
- Assembly . . . . . 113

OVERHAULING BRAKE DISCS . . . . . 115

TURNING AND GRINDING BRAKE DISCS ON THE BENCH . . . . . 115

TURNING AND GRINDING BRAKE DISCS ON THE VEHICLE . . . . . 115

DRUM BRAKES . . . . . 116

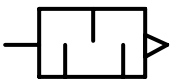
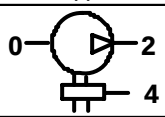
DUO DUPLEX DRUM FRONT/REAR BRAKES . . . . . 117

- Disassembly . . . . . 117
- Drum turning . . . . . 120
- Replacing brake linings . . . . . 120
- Turning brake linings . . . . . 121
- Assembly . . . . . 121

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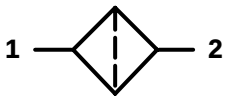
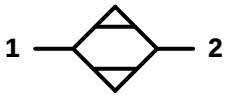
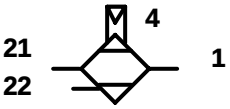
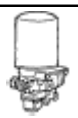
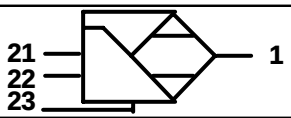
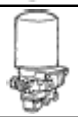
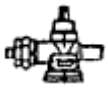
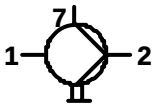
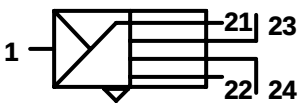
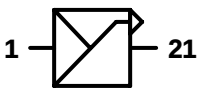
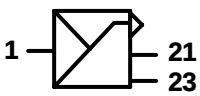
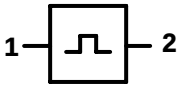
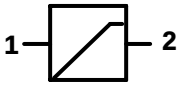
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## SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (MISCELLANEOUS AND GENERATORS)

| DESCRIPTION | SYMBOL | |
|---|---|---|
| HYDRAULIC FLOW |  | |
| AIR FLOW |  | |
| ELECTRICAL LINE |  | |
| ABLE TO ROTATE |  | |
| CROSSOVER OF CONNECTED LINES |  | |
| PRESSURE TEST POINT |  | |
| QUICK-CONNECTION COUPLING |  | |
| COCK |  |  |
| COCK WITH OUTLET |  |  |
| SILENCER |  | |
| COMPRESSOR |  |  |
| ENERGY SAVING COMPRESSOR |  |  |
| VACUUM PUMP |  |  |
| HYDRAULIC PUMP |  |  |
| HYDRAULIC HAND PUMP |  |  |

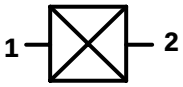
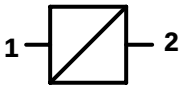
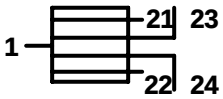
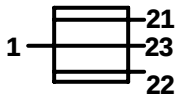
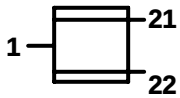
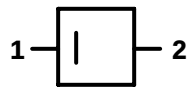
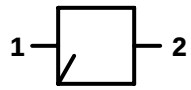
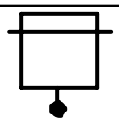
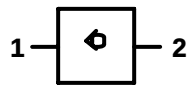
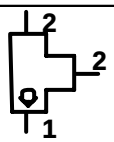
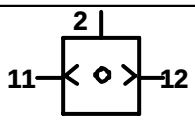
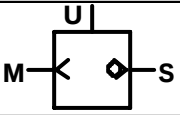
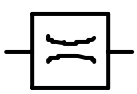
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## SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

| DESCRIPTION | SYMBOL | |
|---|---|---|
| CONDENSATE SEPARATOR |  |  |
| FILTER |   |  |
| DEHUMIDIFIER |   |  |
| DEHUMIDIFIER |   |  |
| DEHUMIDIFIER WITH BUILT-IN REGULATOR |   |  |
| AUTOMATIC CONDENSATION DRAIN VALVE |  |  |
| CONTROLLED CONDENSATION DRAIN VALVE |  |  |
| HAND CONDENSATE DRAIN VALVE |  |  |
| CONTROLLED ANTI-ICING UNIT |   |  |
| AUTOMATIC ANTI-ICING UNIT |   |  |
| PRESSURE REGULATOR WITH INDEPENDENT CIRCUIT |   |  |
| PRESSURE REGULATOR |   |  |
| PRESSURE CONTROLLER |   |  |
| PRESSURE CONTROLLER (GOVERNOR) |   |  |
| PRESSURE LIMITING VALVE |   |  |

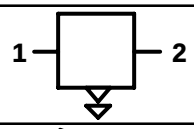
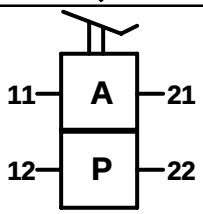
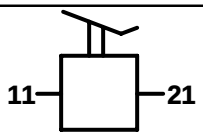
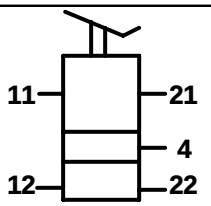
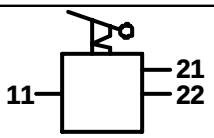
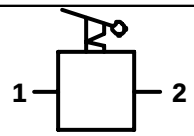
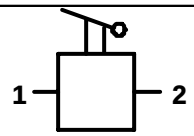
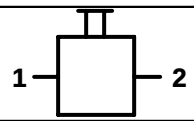
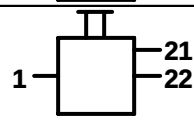
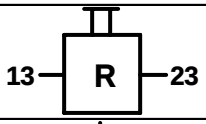
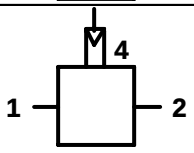
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## SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

| DESCRIPTION | SYMBOL | |
|---|---|---|
| PROPORTIONAL REDUCING VALVE |  |  |
| ADAPTER VALVE |  |  |
| FOUR CIRCUIT PROTECTION VALVE |  |  |
| THREE CIRCUIT PROTECTION VALVE |  |  |
| TWO CIRCUIT PROTECTION VALVE |  |  |
| NON-RETURN AIR INLET VALVE |  |  |
| LIMITED RETURN AIR INLET VALVE |  |  |
| SAFETY VALVE |  |  |
| CHECK VALVE |  |  |
| CHECK VALVE |  |  |
| DOUBLE SHUT-OF VALVE |  |  |
| DIFFERENTIAL DOUBLE SHUT-OFF VALVE |  |  |
| THROTTLE VALVE WITH QUICK RETURN |  |  |
| THROTTLE VALVE |  |  |

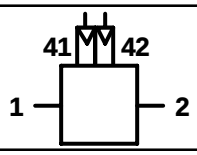
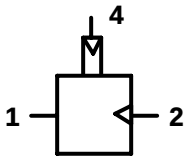
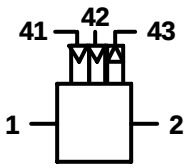
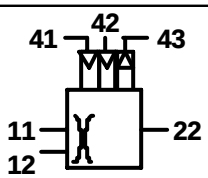
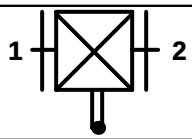
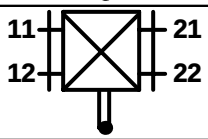
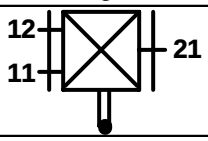
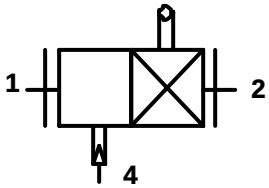
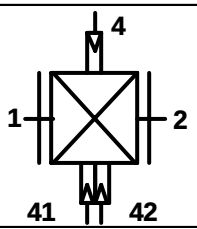
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## SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

| DESCRIPTION | SYMBOL | |
|---|---|---|
| QUICK DISCHARGE |  |  |
| BRAKE CONTROL VALVE |  |  |
| BRAKE CONTROL VALVE |  |  |
| BRAKE CONTROL VALVE |  |  |
| PARKING BRAKE CONTROL VALVE |  |  |
| PARKING BRAKE CONTROL VALVE |  |  |
| BRAKE VALVE |  |  |
| CONTROL VALVE |  |  |
| CONTROL VALVE |  |  |
| RETARDER CONTROL VALVE |  | |
| SERVO CONTROL VALVE |  |  |

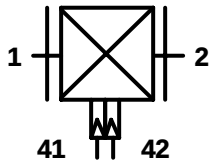
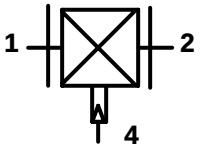
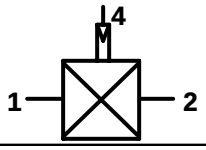
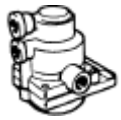
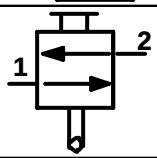
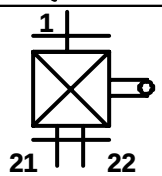
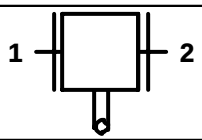
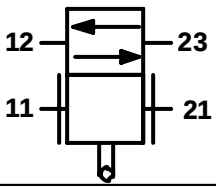
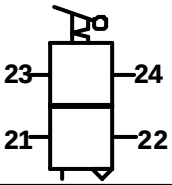
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## SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

| DESCRIPTION | SYMBOL | |
|---|---|---|
| SERVO CONTROL VALVE |  |  |
| SERVO CONTROL VALVE FOR SINGLE LINE |  |  |
| TRAILER BREAKING TRIPLE CONTROL VALVE |  |  |
| TRAILER BREAKING TRIPLE CONTROL VALVE WITH BUILT-IN SERVO SWITCHING |  |  |
| LOAD SENSING VALVE |  |  |
| DUAL LOAD SENSING VALVE |  |  |
| LOAD SENSING VALVE WITH BY-PASS |  |  |
| LOAD SENSING VALVE WITH BUILT-IN RELAY |  |  |
| LOAD SENSING VALVE WITH BUILT-IN RELAY WITH AIR CONTROL |  |  |

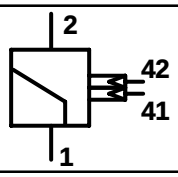
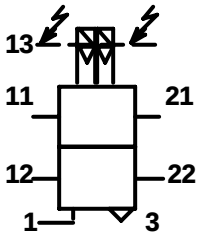
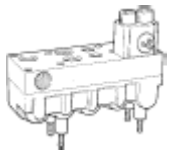
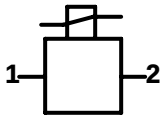
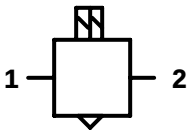
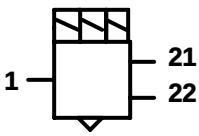
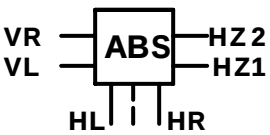
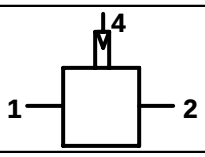
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## SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

| DESCRIPTION | SYMBOL | |
|---|---|---|
| LOAD SENSING VALVE WITH AIR CONTROL |  |  |
| LOAD SENSING VALVE WITH AIR CONTROL |  |  |
| PROPORTIONAL REDUCING VALVE |  |  |
| SLAVED PROPORTIONAL REDUCING VALVE |  |  |
| STROKE LIMITER VALVE |  |  |
| LEVELLING VALVE |  |  |
| LEVELLING VALVE |  |  |
| LEVELLING VALVE WITH BUILT-IN TRAVEL LIMITER |  |  |
| HAND OPERATED SUSPENSION RAISING CONTROL VALVE |  |  |

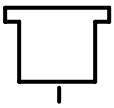
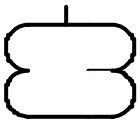
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## SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (VALVES)

| DESCRIPTION | SYMBOL | |
|---|---|---|
| PROPORTIONAL CONTROL VALVE |  |  |
| HAND OPERATED SUSPENSION CONTROL VALVE WITH ELECTRICAL MONITORING |  |  |
| ELECTROPNEUMATIC VALVE |  |  |
| ELECTROPNEUMATIC VALVE |  |  |
| ELECTROPNEUMATIC VALVE |  |  |
| HYDRAULIC MODULATOR FOR ABS |  |  |
| AUGMENTER VALVE |  |  |

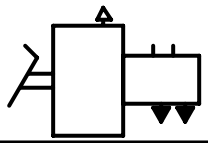
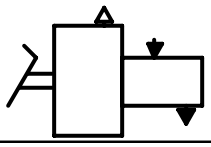
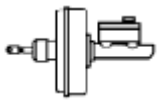
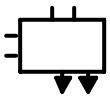
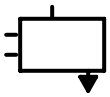
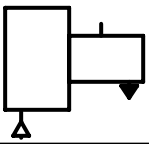
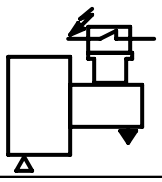
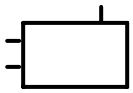
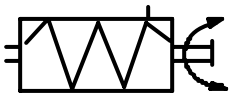
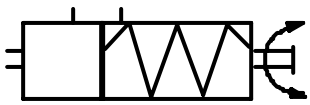
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## SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (TANKS AND ACCUMULATORS)

| DESCRIPTION | SYMBOL | |
|---|---|---|
| COMPRESSED AIR TANK |  |  |
| BRAKE FLUID RESERVOIR |  |  |
| AIR SPRING |  |  |

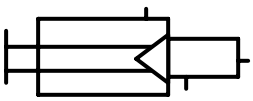
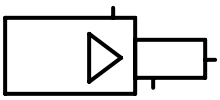
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## SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (CALIPERS AND CYLINDERS)

| DESCRIPTION | SYMBOL | |
|---|---|---|
| VACUUM BRAKE SERVO |  |  |
| VACUUM BRAKE SERVO |  |  |
| DUAL CIRCUIT MASTER CYLINDER |  |  |
| SINGLE CIRCUIT MASTER CYLINDER |  |  |
| AIR/HYDRAULIC CONVERTER |  |  |
| AIR/HYDRAULIC CONVERTER |  |  |
| HYDRAULIC BRAKE CYLINDER |  |  |
| OPERATOR CYLINDER |  |  |
| BRAKE CYLINDER |  |  |
| SPRING CYLINDER |  |  |
| COMBINED BRAKE CYLINDER |  |  |
| FIXED DISK BRAKE CALIPER |  |  |

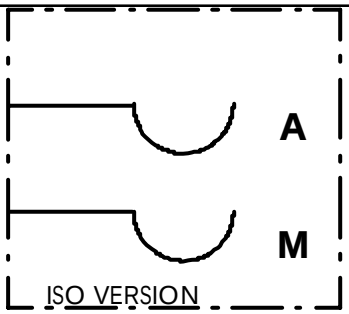
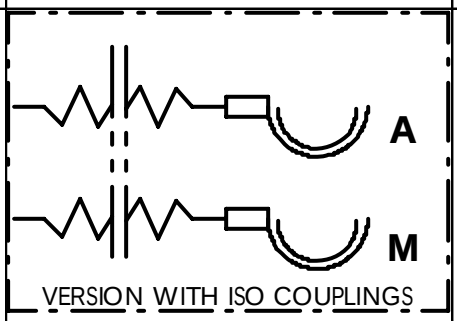
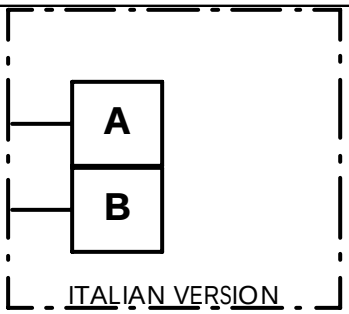
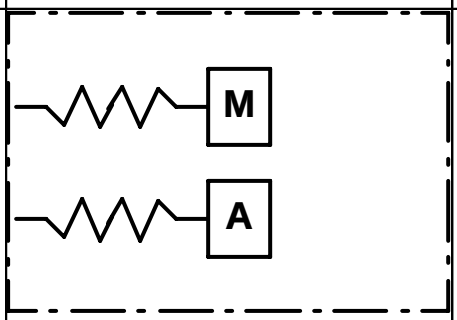
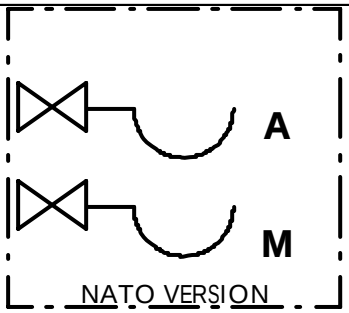
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## SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (CALLIPERS AND CYLINDERS)

| DESCRIPTION | SYMBOL | |
|---|---|---|
| FLOATING DISK BRAKE CALLIPER |  |  |
| FLOATING DISK BRAKE CALLIPER WITH PARKING |  |  |
| MECHANICAL FLOATING DISK BRAKE CALLIPER |  |  |
| SERVO CLUTCH |  |  |
| SERVO CLUTCH |  |  |

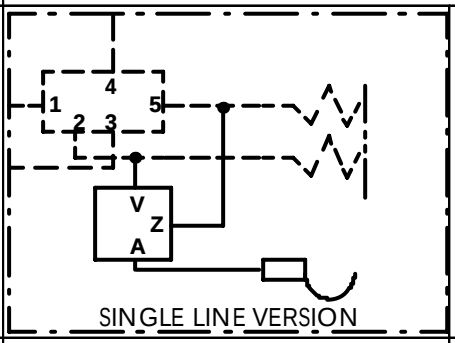
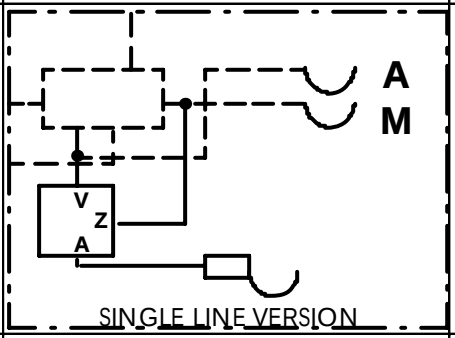
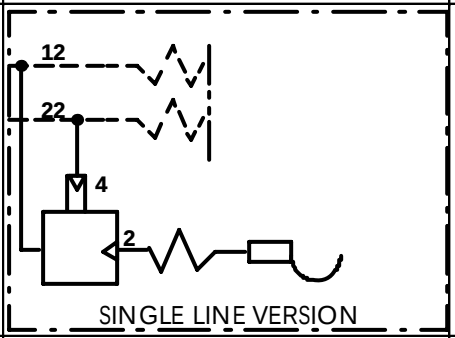
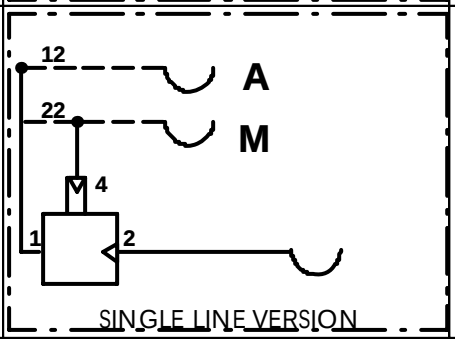
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## SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (HALF-JOINTS AND COUPLING HEADS)

| DESCRIPTION | SYMBOL | |
|---|---|---|
| "ISO" SEMICOUPLING |  |  |
| "ISO" SEMICOUPLING |  |  |
| "CUNA" SEMICOUPLING |  |  |
| "CUNA" SEMICOUPLING |  |  |
| "NATO" SEMICOUPLING |  |  |

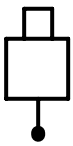
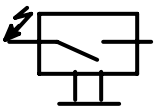
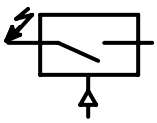
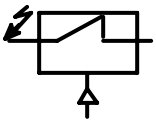
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## SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT (HALF-JOINTS AND COUPLING HEADS)

| DESCRIPTION | SYMBOL | |
|---|---|---|
| SEMI-COUPLING |  SINGLE LINE VERSION |  |
| SEMI-COUPLING |  SINGLE LINE VERSION |  |
| SEM-ICOUPLING |  SINGLE LINE VERSION |  |
| SEMI-COUPLING |  SINGLE LINE VERSION |  |

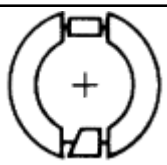
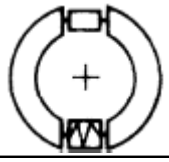
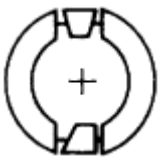
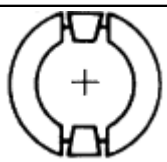
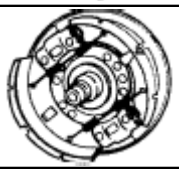
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## SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (INDICATORS AND SWITCHES)

| DESCRIPTION | SYMBOL | |
|---|---|---|
| PRESSURE GAUGE |  | |
| PRESSURE GAUGE |  | |
| PRESSURE TRANSMITTER |  | |
| LAMP |  | |
| MECHANICALLY CONTROLLED SWITCH |  | |
| PRESSURE SWITCH |  | |
| LOW PRESSURE SWITCH |  |  |
| AUDIBLE WARNING |  | |
| SENSOR |  |  |

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## SYMBOLS FOR AIR/HYDRAULIC SYSTEM CIRCUIT DIAGRAMS (BRAKES)

| DESCRIPTION | SYMBOL | |
|---|---|---|
| SINGLE CYLINDER HYDRAULIC BRAKE |  |  |
| TWIN CYLINDER HYDRAULIC BRAKE |  |  |
| DUAL SERVO HYDRAULIC BRAKE |  |  |
| DUAL SERVO HYDRAULIC BRAKE WITH PARKING BRAKE |  |  |
| SINGLE CAM OPERATED BRAKE |  |  |
| TWIN DUAL CAM OPERATED BRAKE |  |  |

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## 799512 PIPES AND COUPLINGS

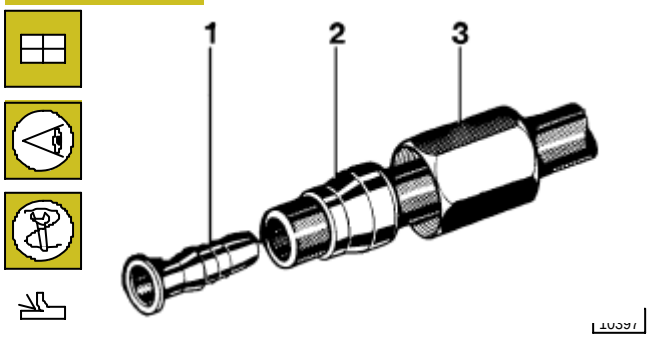
### General

Hydraulic system pipings for industrial vehicles are flexible ones made of polyamide with single-layered or double-layered structure and in the following diameters (⌀ 6-8-10-12-16 mm) equipped with spares in meters.

### Replacing flexible hoses with threaded couplings

Carefully follow the instructions below:

Figure 1

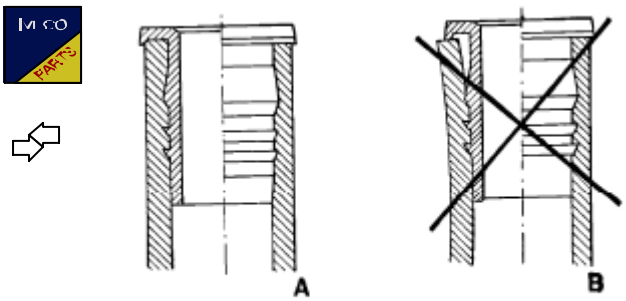



- Use only approved hose
- Check the condition of the replacement hose; there must be no cracks, cuts or incisions on it.
- Cut the pipe to the required length, cutting at 90– to the centreline using appropriate pipe cutting pliers 99387050.

Thread onto the pipe, in the order given:

- nut (3), compression ring (2) (larger thickness towards the nut (3)) and reinforcing bush (1);
- bush must be in perfect condition (it must not show any distortion or signs of hammering).

Figure 2




FITTIN
A = CORRECT METHOD OF FITTING
B = INCORRECT METHOD OF FITTING

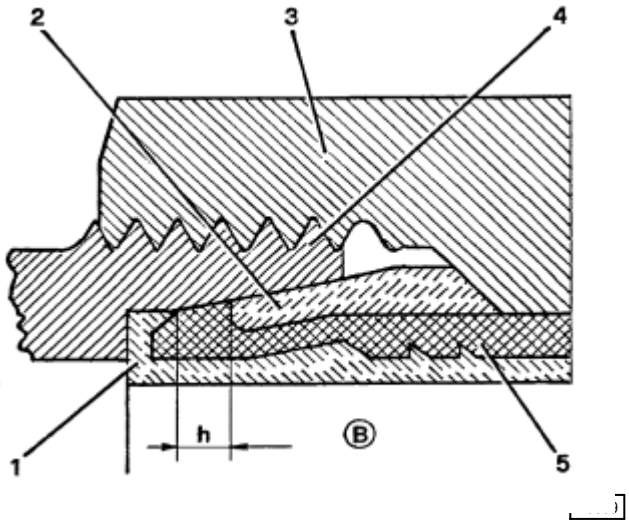
- Install reinforcing bush using tool 99372219, ensuring that there is contact between its flange and the end of the hose;
- make sure that the end of the hose fits into the raked groove in the flange.
- End-form the seating bush, on fitting to the vehicle or on the work bench, to a union.
- The pressure exerted and the final distance of the front edge of the compression ring from that of the reinforcing bush must be the value listed in the schedule as given in the table.

If the fittings are badly assembled, do not re-use the hose after extracting the bush and seating ring.

| | Pipe mm | Distance between edge of bush and ring mm (*) | Assembly pressure N/mm² |
|---|---|---|---|
| Double layer | 6 x 1 | from 1 to 1,5 | 0,040 |
| | 8 x 1 | from 2 to 2,5 | 0,050 |
| Single layer | 10 x 1,5 | from 2 to 2,5 | 0,050 |
| | 12 x 1,6 | from 2 to 2,5 | 0,060 |
| | 16 x 2,34 | from 3 to 3,5 | 0,060 |

(*) See reference h, Figure 3.

Figure 3




1. Reinforcing bush - 2. Pressure ring - 3. Nut - 4. Union
5. Hose - h. Distance between edge of bush and edge of ring (see table).

Insert the end of the hose prepared in this way into the union body until reinforcing bush flange bears against seating;

- To tighten nut onto union, first of all screw in by hand and then complete tightening using a polygon wrench fitted on the torque wrench, to be set according to the specified tightening torque.

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When fitting the hose to the vehicle, some important points requiring care should be borne in mind :

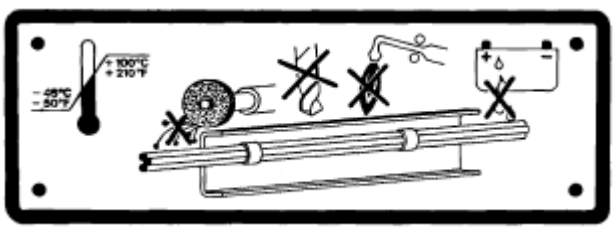
- Bends must comply with minimum radii, so as to avoid constrictions:

| Diameter of pipe mm | Minimum radius of curvature mm |
|---|---|
| 6 x 1 | ⌲ 40 |
| 8 x 1 | ⌲ 50 |
| 10 x 1,5 | ⌲ 60 |
| 12 x 1,6 | ⌲ 75 |
| 16 x 2,34 | ⌲ 100 |

Make sure that the hoses are not in contact with sharp edges or with sharp metal parts or sources of heat, but are at a minimum safety distance of 15 mm from these.

- When hoses run through chassis members or metal parts, make sure that the holes through which they pass are fitted with rubber grommets and that these are in good condition.
- Avoid sliding the hose along sharp edges which might cause cuts.
- Where the hose has to be attached to existing pipework, take account of the additional heat to which it may be subjected (power steering pipework); in this case, the hose must be protected with shields.
- When the hose has been connected, check that it is not under tension between the attachment points, instead leaving it slightly slack to take up the more substantial variations in temperature, especially for short lengths.
- Before fitting, thoroughly clean the hoses by blowing compressed air through them to safeguard operation of the system.

Figure 4



- Protect the hoses if grinding or welding operations are carried out on the vehicle; a notice is fitted in the cabin indicating the precautions to be observed carefully to avoid damage.

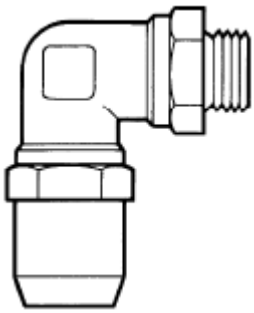
For greater safety and convenience in working, it is advisable to remove the hoses during these operations.

When fitting is finished, check that all seals (unions, couplings etc.) are completely free from leaks.

## Replacing flexible hoses with quick-connection couplings

Swivel couplings:

Figure 5

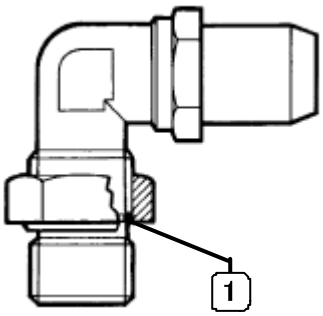


39306

Screw the coupling into the threaded seating provided on the air valve and tighten it to the tightening torque indicated in the table.

Banjo couplings:

Figure 6




39307

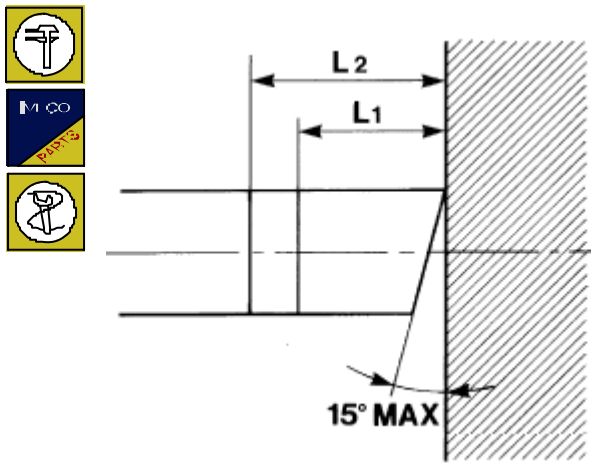
- Check that the seal ring (1) is in its seat;
- Tighten the coupling until the seal gasket contacts the valve;
- Direct the valve correctly and keeping the movable part still, lock the hexagonal nut to the torque indicated in the table.

Swivel and banjo couplings:

| COUPLING THREAD | TIGHTENIG TORQUE (Nm ± 10%) |
|---|---|
| M 10 x 1,0 mm | 22 |
| M 12 x 1,5 mm | 24 |
| M 14 x 1,5 mm | 28 |
| M 16 x 1,5 mm | 35 |
| M 22 x 1,5 mm | 40 |

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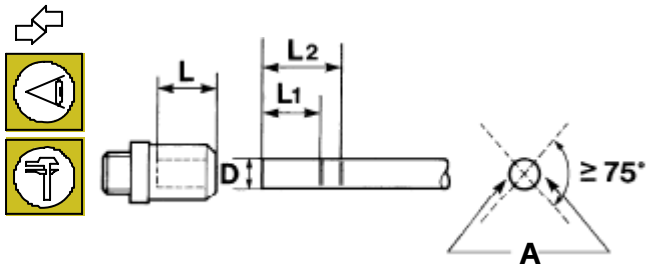
Figure 7




33977

- Only use approved type-tested hoses;
- Check the condition of the new hose to ensure it has no cracks, cuts or scores;
- Cut the hose at 90°, maximum error 15°, with reference to the axis. Use pipe-cutter pliers 99387050 to cut to the required length;

Figure 8




33976

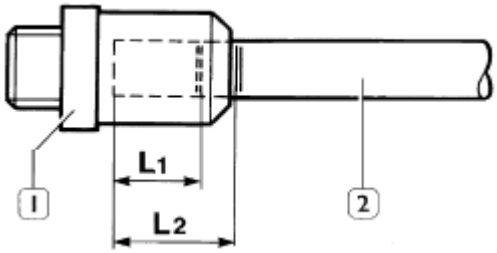
A = Mark to identify end of tube travel

- Use indelible ink to mark clearly two reference marks on both diametrically opposite faces of the pipe at an angle of ≥75°, set at distances $L_1$ and $L_2$ , to ensure correct fitting in place.

$L_1$ and $L_2$ vary according to the diameter of the hose and are to be measured at the longer part of the hose (see Figure 7).

| D (mm) | $L\ ^{0}_{+0,5}$ (mm) | $L_1\ ^{-0,5}_{+1}$ (mm) | $L_2\ ^{-0,5}_{+1}$ (mm) |
|---|---|---|---|
| 6 | 19.8 | 17 | 22 |
| 8 | 20.5 | 18 | 23 |
| 12 | 25 | 22 | 28 |
| 16 | 27.1 | 24 | 30 |

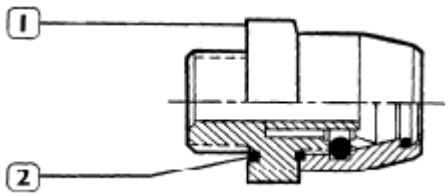
Figure 9




39308

- Insert the hose (2) by hand into the coupling (1), with a force between 30 and 20 Nm according to the hose diameter, so that reference mark $L_1$ is inside the hose whereas $L_2$ remains visible.

Figure 10




33978

When removing couplings (1) on pneumatic components, check the condition of the seal ring (2) and if necessary replace.

| COUPLING THREAD | SEAL RING DIMENSIONS |
|---|---|
| M 10 x 1.0 | 10.1 x 1.6 |
| M 12 x 1.5 | 11.0 x 2.0 |
| M 14 x 1.5 | - |
| M 16 x 1.5 | 15.0 x 2.0 |
| M 22 x 1.5 | - |

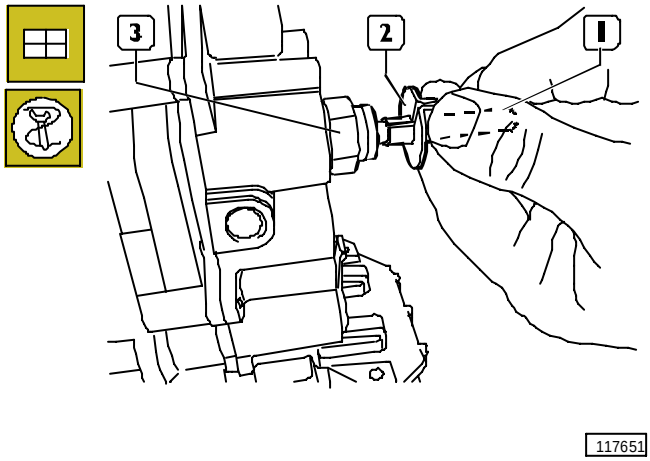
Whenever a hose is removed from a quick connection coupling, the coupling itself must be replaced. Spare quick connection couplings are supplied complete.

Quick release and threaded couplings are not interchangeable. This also applies to flexible hoses used with quick release couplings and flexible hoses used with threaded couplings.

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## Replace hoses with Raufoss type fittings

Figure 10/1




**NOTE** Operations for pipe change replacement with Raufoss type fittings are different from previously described ones only for what is mentioned below.

In order to remove pipe (1), fit tool 99387051 (2) on it through the opening. Push tool 99387051 (2) inside fitting (3) till release of polyamide pipe.
Remove pipe (1).

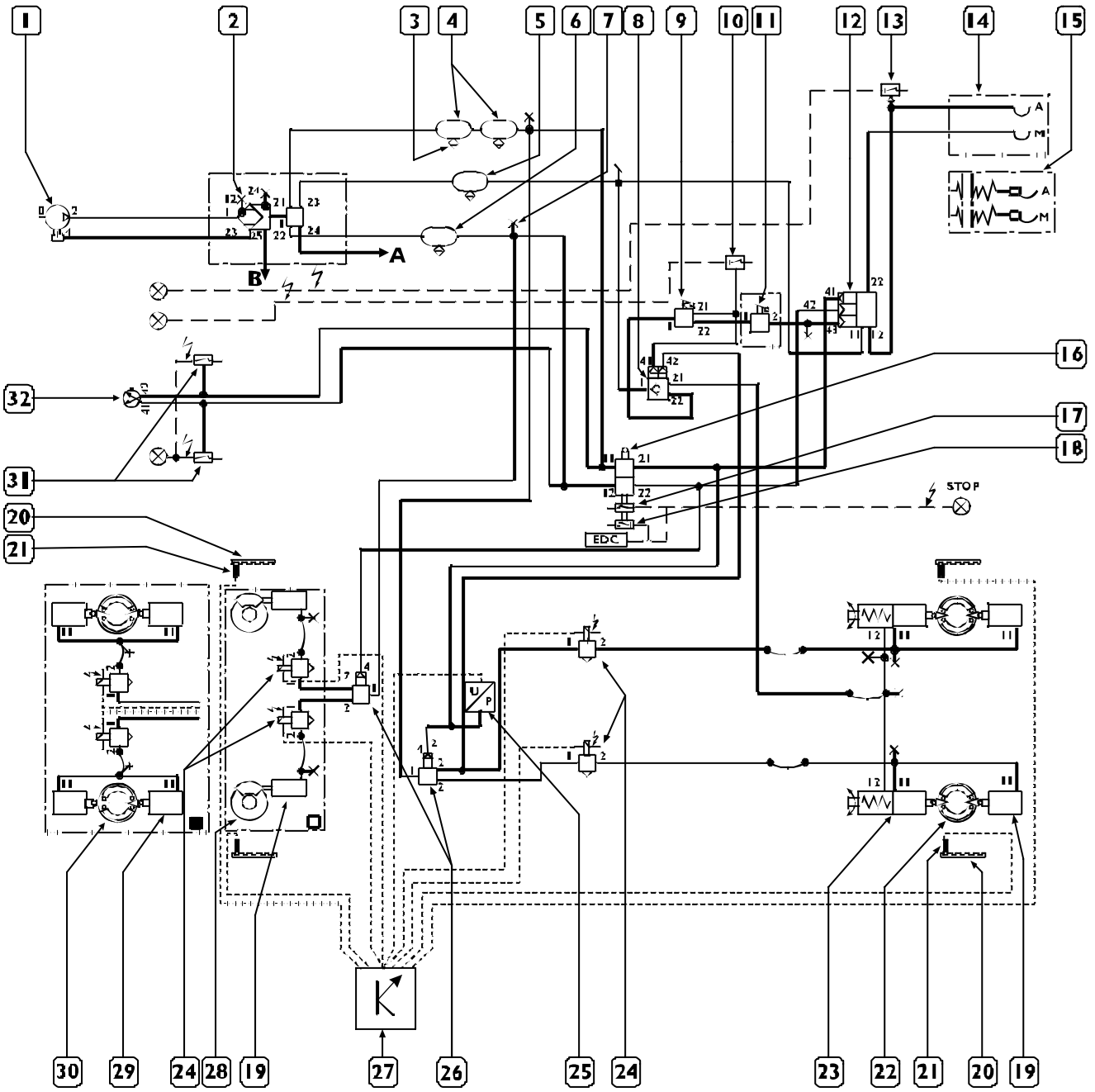
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## BRAKING SYSTEMS WITH ABS - EBL DEVICE

### Main diagram for vehicles 4x2 - 4x4 used for haulage

Figure 11



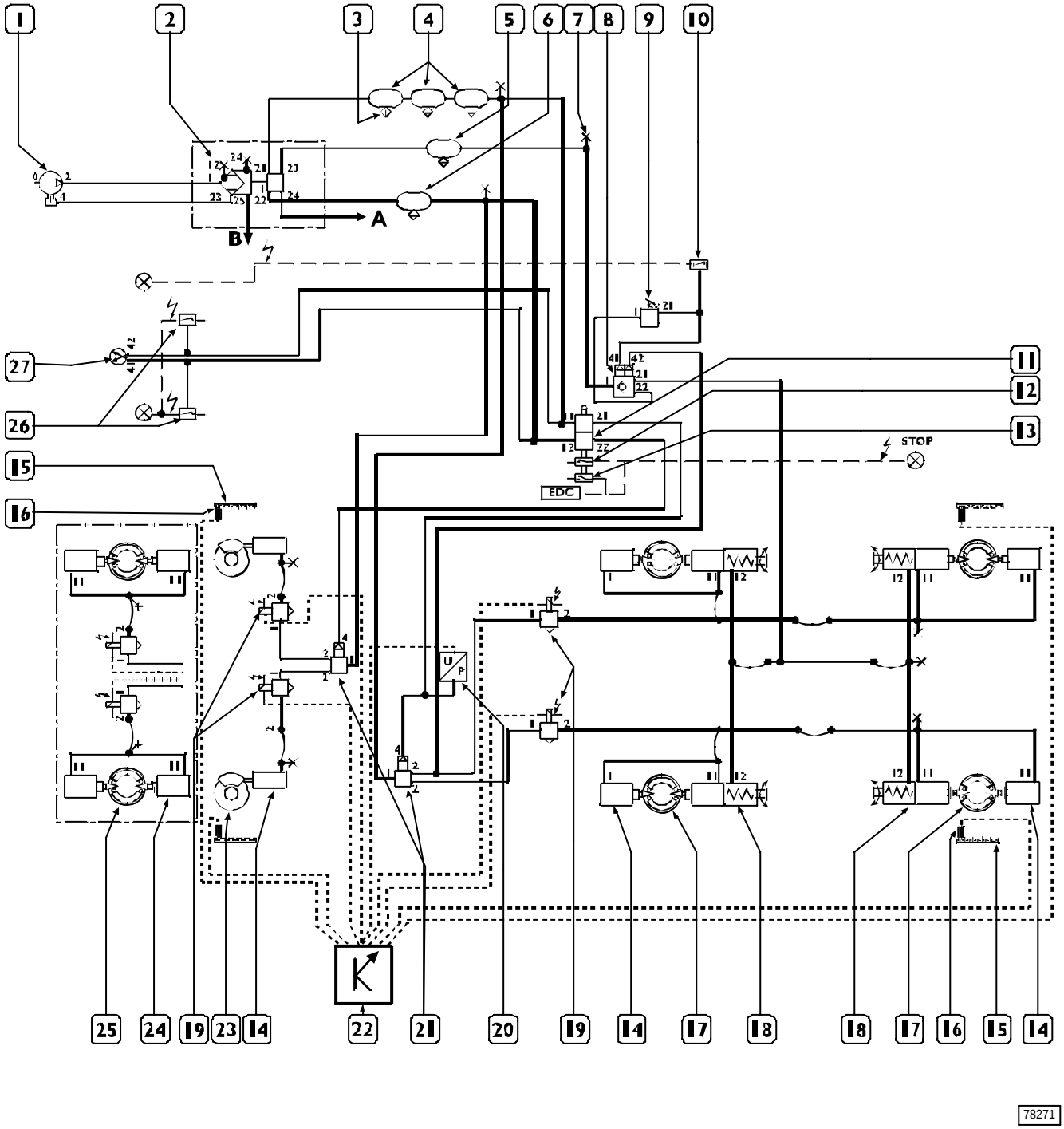

1. E.S. Compressor - 2. A.P.U. - 3. Manual condensate discharge valve - 4. Trailer air tank 20 l - 5. Rear axle air tank 20 l - 6. Front axle air tank 20 l - 7. Pressure test point - 8. Dual control relay valve - 9. Parking brake hand control valve - 10. Switch for parking brake on indicator - 11. Trailer slowing hand control valve (optional) - 12. Triple servo control valve for trailer braking - 13. Low pressure switch - 14. "ISO" half-coupling for truck - 15. "ISO" half-coupling for tractor - 16. Duplex distributor - 17. Brake light switch - 18. Engine brake control switch - 19. Diaphragm brake cylinder - 20. Phonic wheel - 21. Wheel speed sensor - 22. Duo Duplex drum brake assembly - 23. Combined brake cylinder - 24. ABS solenoid valve - 25. Pressure sensor - 26. Single-control relay valve - 27. Electronic control unit - 28. Disc brake assembly - 29. Diaphragm brake cylinder - 30. Drum brake assembly - 31. Low pressure switch - 32. Pressure gauge - A. Services - B. Services

V 4x2 vehicles
J 4x4 vehicles (optional for vehicles 4x2)

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## Working diagram for 6x4 vehicles isolated with an ABS - EBL device

Figure 12



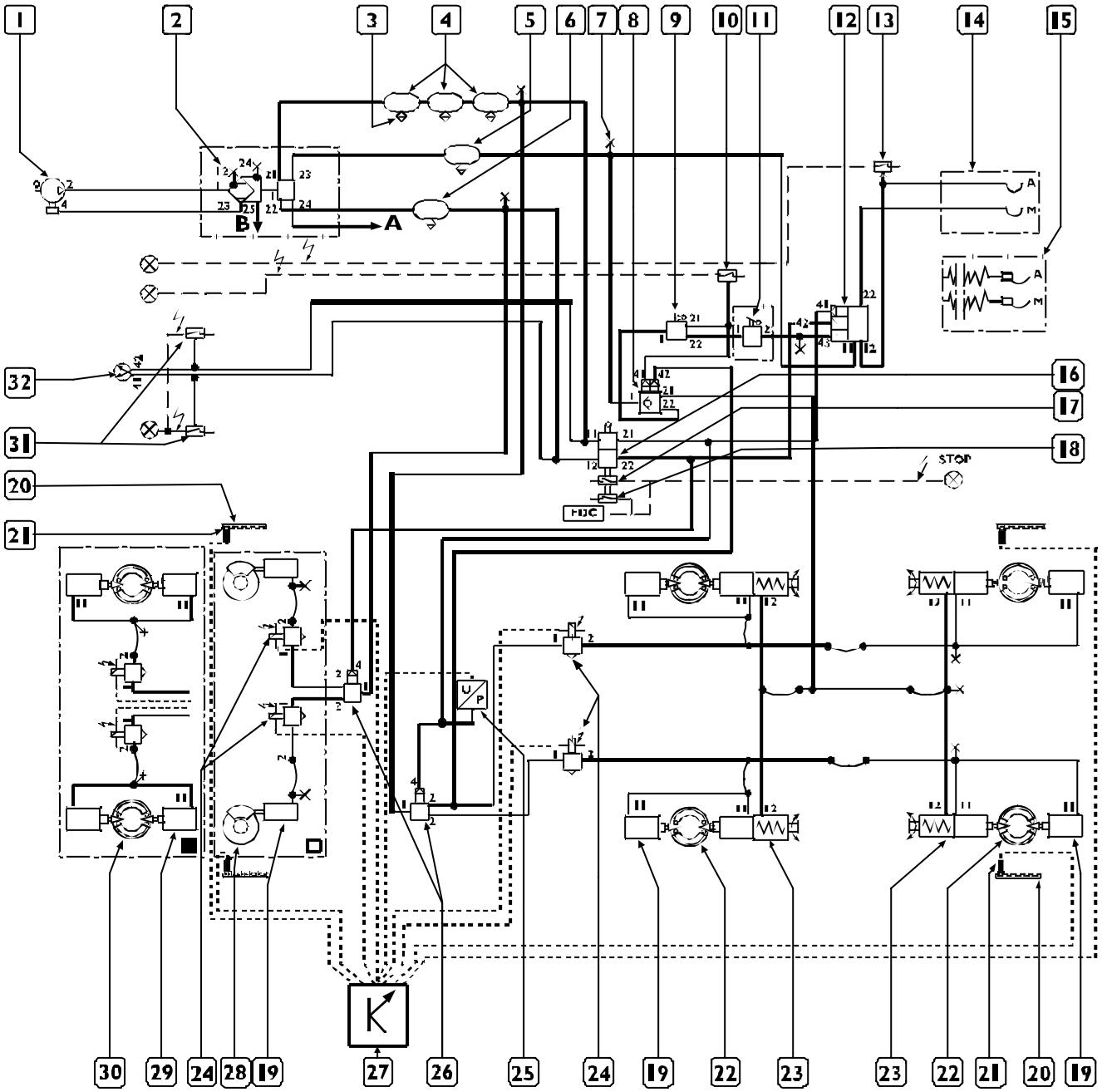

1. E.S. Compressor - 2. A.P.U. - 3. Manual condensate discharge valve - 4. Trailer air tank 20 l - 5. Rear axle air tank 20 l - 6. Front axle air tank 20 l - 7. Pressure test point - 8. Dual control relay valve - 9. Parking brake hand control valve - 10. Switch for parking brake on indicator - 11. Duplex distributor - 12. Brake light switch - 13. Engine brake control switch - 14. Diaphragm brake cylinder - 15. Phonic wheel - 16. Wheel speed sensor - 17. Duo Duplex drum brake assembly - 18. Combined brake cylinder - 19. ABS solenoid valve - 20. Pressure sensor - 21. Single-control relay valve - 22. Electronic control unit - 23. Disc brake assembly - 24. Diaphragm brake cylinder (*) - 25. Drum brake assembly (*) - 26. Low pressure switch - 27. Pressure gauge - A. Services - B. Services

(*) optional

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## Working diagram for 6x4 - 6x6 vehicles designed for towing with ABS - EBL device

Figure 13



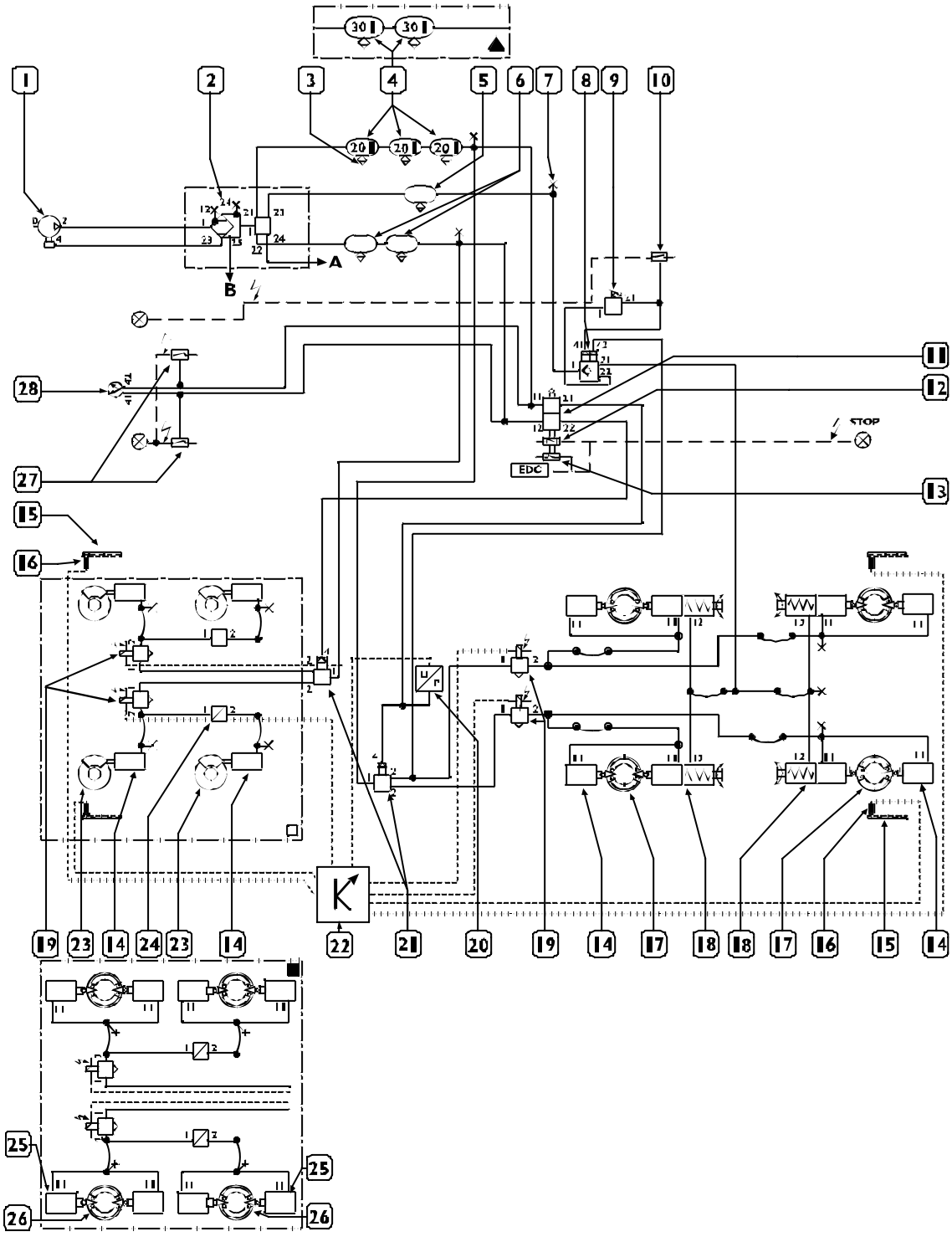

1. E.S. Compressor - 2. A.P.U. - 3. Manual condensate discharge valve - 4. Trailer air tank 20 l - 5. Rear axle air tank 20 l - 6. Front axle air tank 20 l - 7. Pressure test point - 8. Dual control relay valve - 9. Parking brake hand control valve - 10. Switch for parking brake on indicator - 11. Trailer slowing hand control valve (optional) - 12. Triple servo control valve for trailer braking - 13. Low pressure switch - 14. "ISO" half-coupling for truck - 15. "ISO" half-coupling for tractor - 16. Duplex distributor - 17. Brake light switch - 18. Engine brake control switch - 19. Diaphragm brake cylinder - 20. Phonic wheel - 21. Wheel speed sensor - 22. Double drum brake assembly - 23. Combined brake cylinder - 24. ABS solenoid valve - 25. Pressure sensor - 26. Single-control relay valve - 27. Electronic control unit - 28. Disc brake assembly - 29. Diaphragm brake cylinder - 30. Drum brake assembly - 31. Low pressure switch - 32. Pressure gauge - A. Services - B. Services

V 6x4 vehicles
J 6x6 vehicles (optional for 6x4 vehicles)

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## Working diagram for 8x4x4 - 8x8x4 vehicles isolated with an ABS - EBL device

Figure 14



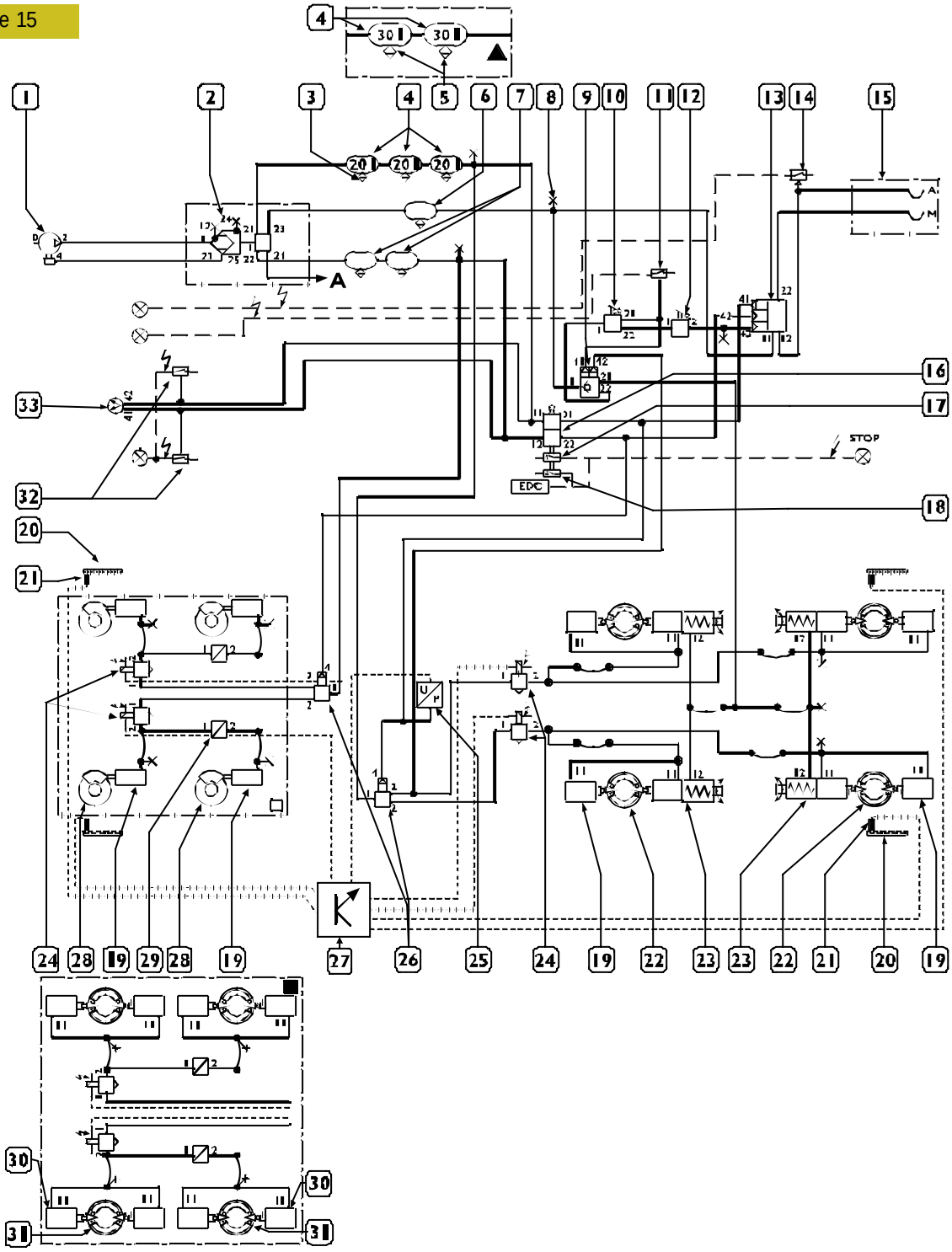

1. E.S. Compressor - 2. A.P.U. - 3. Manual condensate discharge valve - 4. Trailer air tank 20 l - 5. Rear axle air tank 20 l - 6. Front axle air tank 20 l - 7. Pressure test point - 8. Dual control relay valve - 9. Parking brake hand control valve - 10. Switch for parking brake on indicator - 11. Duplex distributor - 12. Brake light switch - 13. Engine brake control switch - 14. Diaphragm brake cylinder - 15. Phonic wheel - 16. Wheel speed sensor - 17. Duo Duplex drum brake assembly - 18. Combined brake cylinder - 19. ABS solenoid valve - 20. Pressure sensor - 21. Single-control relay valve - 22. Electronic control unit - 23. Disc brake assembly - 24. Proportional reducing valve - 25. Membrane brake cylinder - 26. Duo Duplex drum brake assembly - 27. Low pressure switch - 28. Manometer - A. Services

V 8x4x4 vehicles
J 8x8x4 vehicles (optional for vehicles 8x4x4)
Y Optional configuration depending on the type of air filter and the type of engine exhaust system.

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## Working diagram for 8x4x4 - 8x8x4 vehicles designed for towing with ABS - EBL device

Figure 15



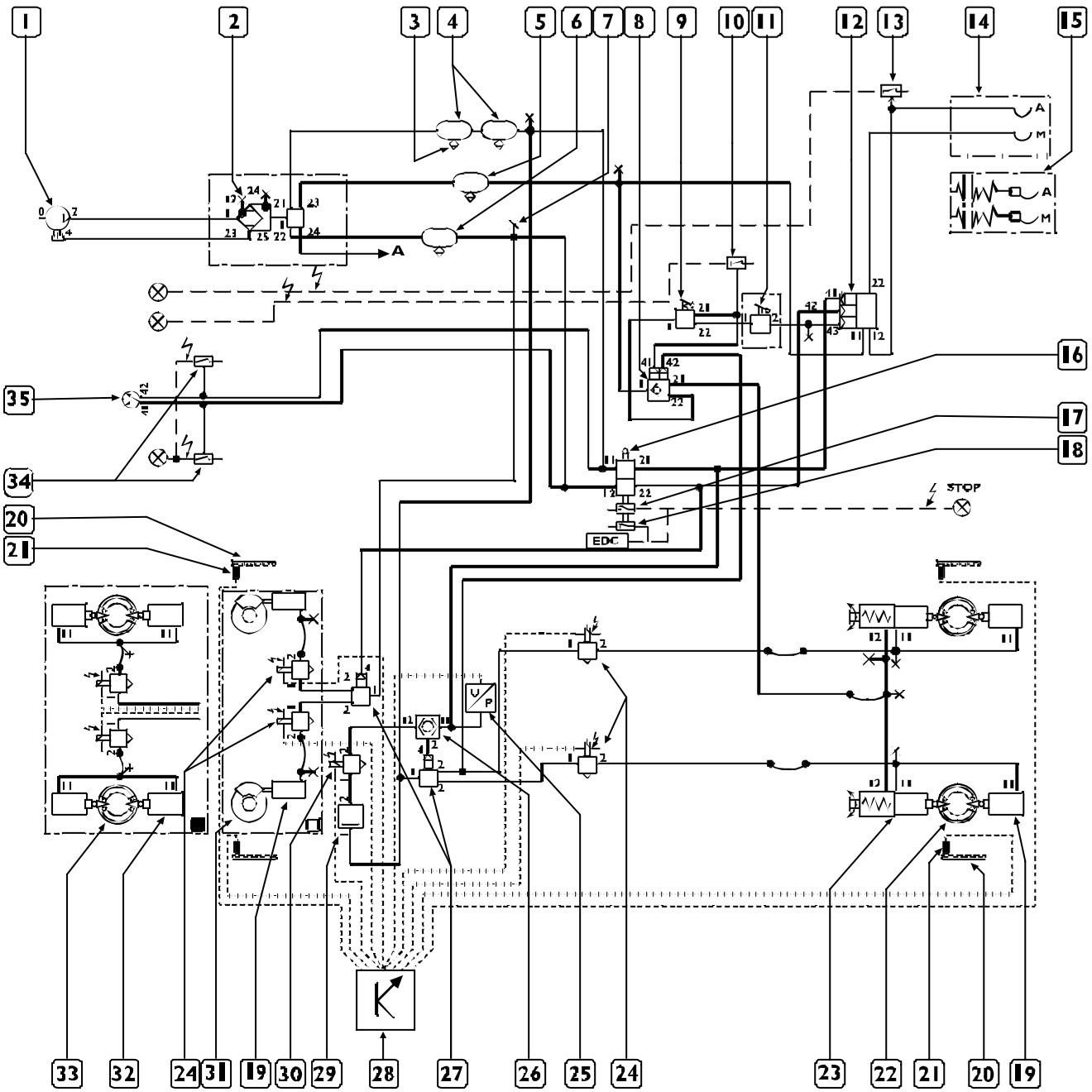

1. E.S. Compressor - 2. A.P.U. - 3. Manual condensate discharge valve - 4. Trailer air tank - 5. 20 liter trailer air tank - 6. Rear axle air tank 30 l - 7. Front axle air tank 20 l - 8. Pressure test point - 9. Dual control relay valve - 10. Parking brake hand control valve - 11. Switch for parking brake on indicator - 12. Trailer slowing hand control valve (optional) - 13. Triple servo control valve for trailer braking - 14. Low pressure switch - 15. "ISO" half-coupling for truck - 16. Duplex distributor - 17. Brake light switch - 18. Engine brake control switch - 19. Diaphragm brake cylinder - 20. Phonic wheel - 21. Wheel speed sensor - 22. Duo Duplex drum brake assembly - 23. Combined brake cylinder - 24. ABS solenoid valve - 25. Pressure sensor - 26. Single-control relay valve - 27. Electronic control unit - 28. Disc brake assembly - 29. Proportional reducing valve - 30. Diaphragm brake cylinder - 31. Duo Duplex drum brake assembly - 32. Low pressure switch - 33. Pressure gauge - A. Services

V 8x4x4 vehicles
J 8x8x4 vehicles (optional for vehicles 8x4x4)
Y Optional configuration depending on the type of air filter and the type of engine exhaust system.

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## BRAKING SYSTEMS WITH ABS - EBL - ASR DEVICE
### Working diagram for 4x2 - 4x4 vehicles designed for towing

Figure 16



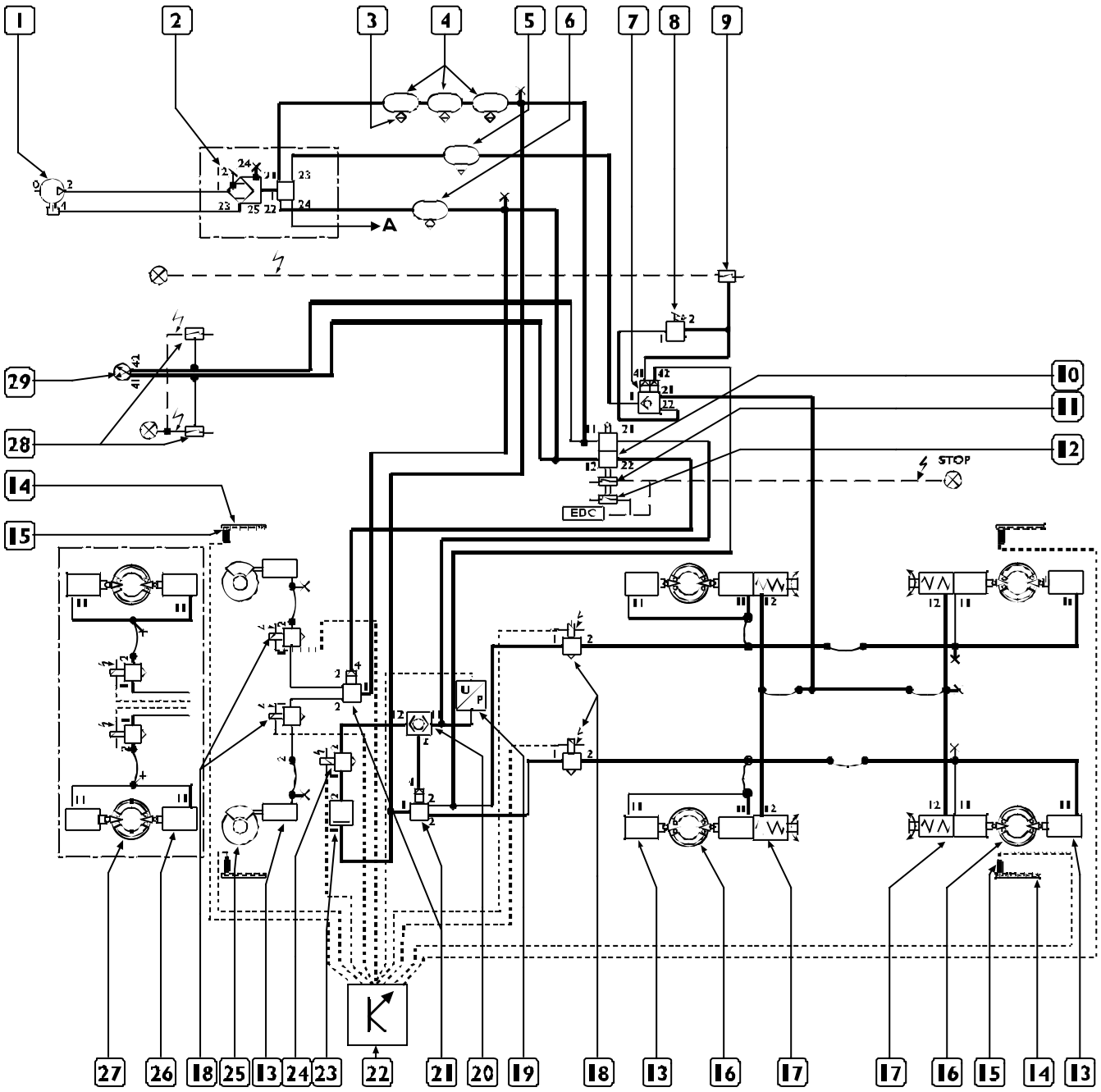

1. E.S. Compressor - 2. A.P.U. - 3. Manual condensate discharge valve - 4. Trailer air tank 20 l - 5. Rear axle air tank 20 l - 6. Front axle air tank 20 l - 7. Pressure test point - 8. Dual control relay valve - 9. Parking brake hand control valve - 10. Switch for parking brake on indicator - 11. Trailer slowing hand control valve (optional) - 12. Triple servo control valve for trailer braking - 13. Low pressure switch - 14. "ISO" half-coupling for truck - 15. "ISO" half-coupling for tractor - 16. Duplex distributor - 17. Brake light switch - 18. Engine brake control switch - 19. Diaphragm brake cylinder - 20. Phonic wheel - 21. Wheel speed sensor - 22. Duo Duplex drum brake assembly - 23. Combined brake cylinder - 24. ABS solenoid valve - 25. Pressure sensor - 26. Twin stop valve - 27. Single-control relay valve - 28. Electronic control unit - 29. Controlled pressure check valve - 30. A.S.R. solenoid valve - 31. Disc brake assembly - 32. Diaphragm brake cylinder - 33. Drum brake assembly - 34. Low pressure switch - 35. Pressure gauge -
A. Services

V 4x2 vehicles
J 4x4 vehicles (optional for 4x2 vehicles)

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## Main diagram for vehicles 6x4 with ABS - EBL - ASR

Figure 17



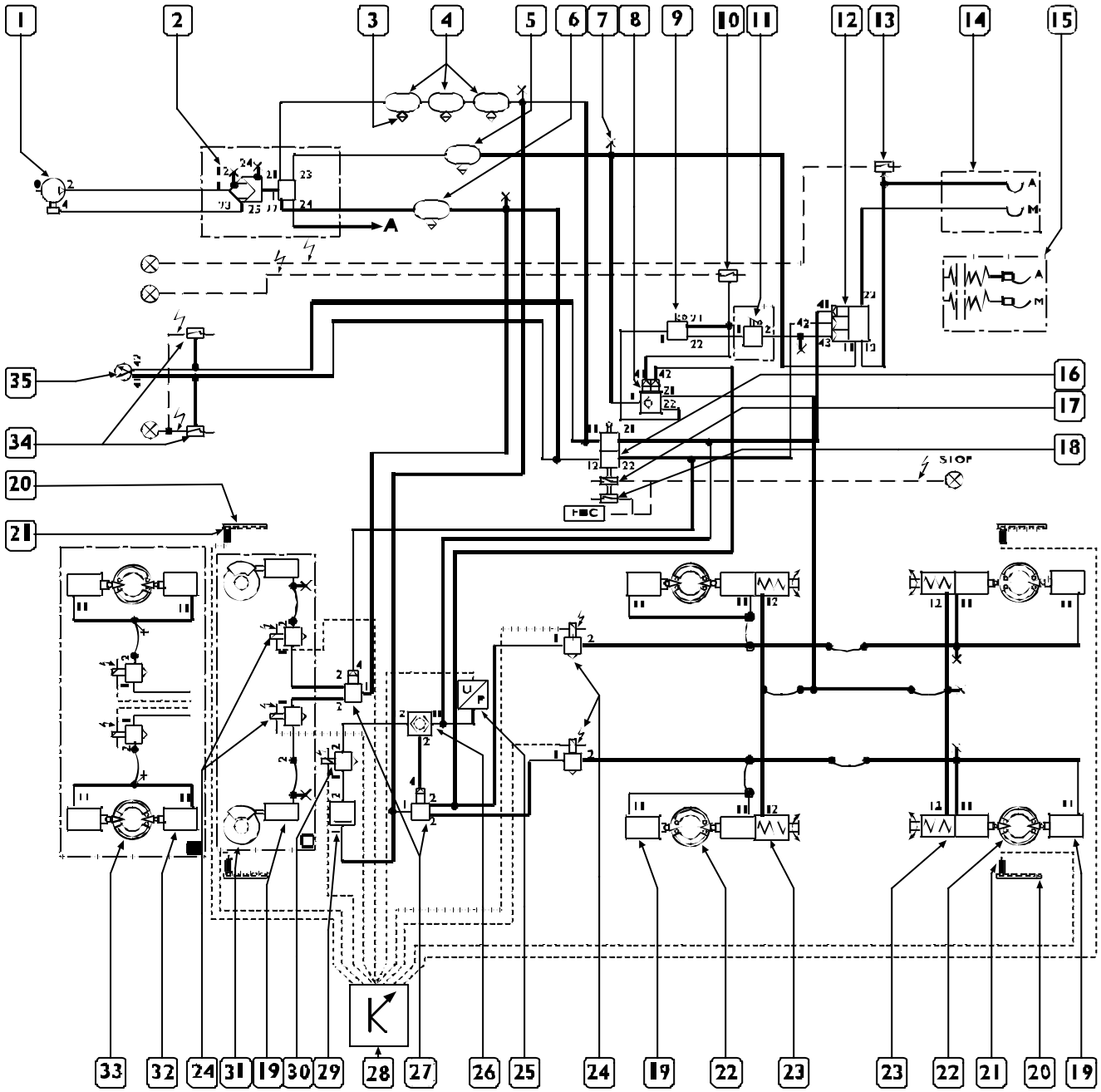

1. E.S. Compressor - 2. A.P.U. - 3. Manual condensate discharge valve - 4. Trailer air tank 20 l - 5. Rear axle air tank 20 l - 6. Front axle air tank 20 l - 7. Dual control relay valve - 8. Parking brake hand control valve - 9. Switch for parking brake on indicator - 10. Duplex distributor - 11. Brake light switch - 12. Engine brake control switch - 13. Diaphragm brake cylinder - 14. Phonic wheel - 15. Wheel speed sensor - 16. Duo Duplex drum brake assembly - 17. Combined brake cylinder - 18. ABS solenoid valve - 19. Pressure sensor - 20. Twin stop valve - 21. Single-control relay valve - 22. Electronic control unit 23. Controlled pressure check valve - 24. A.S.R. solenoid valve - 25. Disc brake assembly - 26. Diaphragm brake cylinder (*) - 27. Drum brake assembly (*) - 28. Low pressure switch - 29. Pressure gauge - A. Services

(*) optional

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## Main diagram for vehicles 6x4 - 6X6 used for haulage fitted with ABS - EBL - ASR

Figure 18



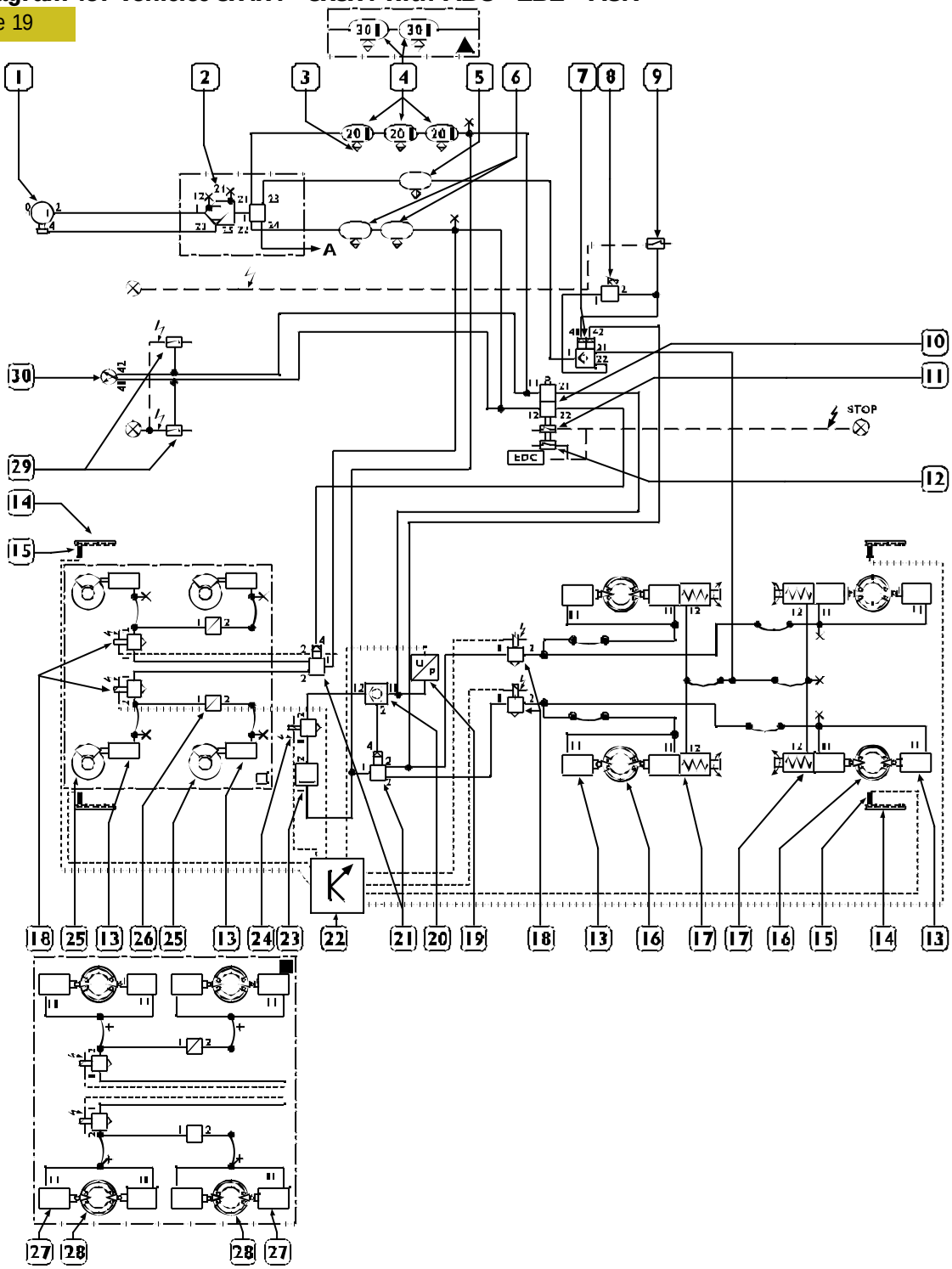

1. E.S. Compressor - 2. A.P.U. - 3. Manual condensate discharge valve - 4. Trailer air tank 20 l - 5. Rear axle air tank 20 l - 6. Front axle air tank 20 l - 7. Pressure test point - 8. Dual control relay valve - 9. Parking brake hand control valve - 10. Switch for parking brake on indicator 11. Trailer slowing hand control valve (optional) - 12. Triple servo control valve for trailer braking - 13. Low pressure switch - 14. "ISO" half-coupling for truck - 15. "ISO" half-coupling for tractor - 16. Duplex distributor - 17. Brake light switch - 18. Engine brake control switch - 19. Diaphragm brake cylinder - 20. Phonic wheel - 21. Wheel speed sensor - 22. Duo Duplex drum brake assembly - 23. Combined brake cylinder - 24. ABS solenoid valve - 25. Pressure sensor - 26. Twin stop valve - 27. Single-control relay valve - 28. Electronic control unit - 29. Controlled pressure check valve - 30. A.S.R. solenoid valve - 31. Disc brake assembly - 32. Diaphragm brake cylinder - 33. Drum brake assembly - 34. Low pressure switch - 35. Pressure gauge - A. Services

V 6x4 vehicles
J 6x6 vehicles (optional for 6x4 vehicles)

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## Main diagram for vehicles 8x4x4 - 8x8x4 with ABS - EBL - ASR

Figure 19



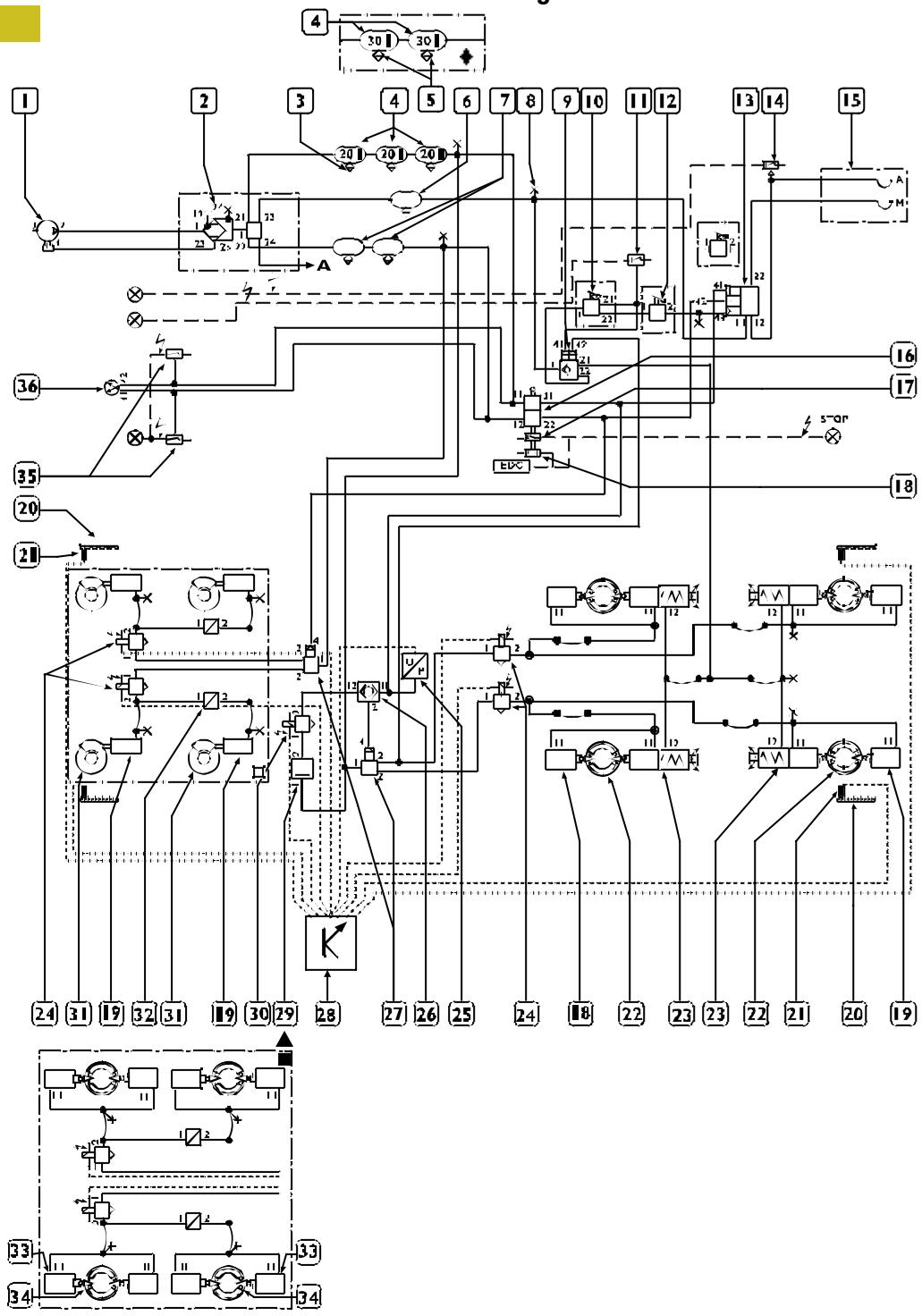

1. E.S. Compressor - 2. A.P.U. - 3. Manual condensate discharge valve - 4. Trailer air tank - 5. Rear axle air tank 20 l - 6. Front axle air tank 20 l - 7. Dual control relay valve - 8. Parking brake hand control valve - 9. Switch for parking brake on indicator - 10. Duplex distributor - 11. Brake light switch - 12. Engine brake control switch - 13. Diaphragm brake cylinder - 14. Phonic wheel - 15. Wheel speed sensor - 16. Duo Duplex drum brake assembly - 17. Combined brake cylinder - 18. ABS solenoid valve - 19. Pressure sensor - 20. Twin stop valve - 21. Single-control relay valve - 22. Electronic control unit 23. Controlled pressure check valve - 24. A.S.R. solenoid valve - 25. Disc brake assembly - 26. Proportional reducing valve - 27. Diaphragm brake cylinder - 28. Duo Duplex drum brake assembly - 29. Low pressure switch - 30. Pressure gauge - A. Services

V 8x4x4 vehicles
J 8x8x4 vehicles (optional for vehicles 8x4x4)
Y Optional configuration depending on the type of air filter and the type of engine exhaust system.

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## Main diagram for vehicles 8x4x4 - 8x8x4 used for haulage fitted with ABS - EBL - ASR

Figure 20




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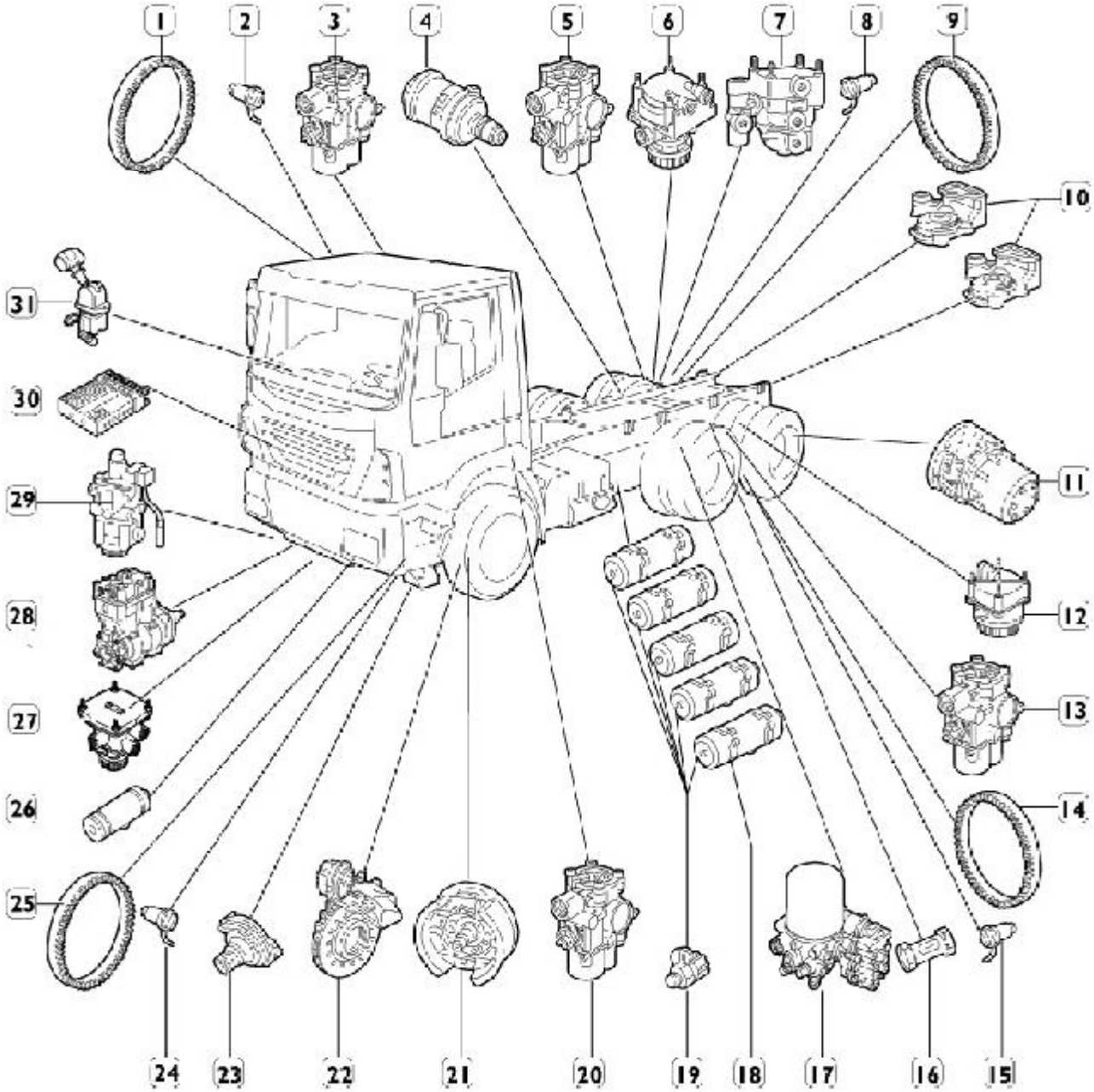
1. E.S. Compressor - 2. A.P.U. - 3. Manual condensate discharge valve - 4. Trailer air tank - 5. Manual condensate discharge valve - 6. Rear axle air tank 20 l - 7. Front axle air tank 20 l - 8. Pressure test point - 9. Dual control relay valve - 10. Parking brake hand control valve - 11. Switch for parking brake on indicator - 12. Trailer slowing hand control valve (optional) - 13. Triple servo control valve for trailer braking - 14. Low pressure switch - 15. "ISO" half-coupling for truck - 16. Duplex distributor - 17. Brake light switch - 18. Engine brake control switch - 19. Diaphragm brake cylinder - 20. Phonic wheel - 21. Wheel speed sensor - 22. Duo Duplex drum brake assembly - 23. Combined brake cylinder - 24. ABS solenoid valve - 25. Pressure sensor - 26. Twin stop valve - 27. Single-control relay valve - 28. Electronic control unit - 29. Controlled pressure check valve - 30. A.S.R. solenoid valve - 31. Disc brake assembly - 32. Proportional reducing valve - 33. Diaphragm brake cylinder - 34. Duo Duplex drum brake assembly - 35. Low pressure switch - 36. Pressure gauge - A. Services

V 8x4x4 vehicles
J 8x8x4 vehicles (optional for vehicles 8x4x4)
♦ Optional configuration depending on the type of air filter and the type of engine exhaust system.

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## Braking system main components layout on the vehicle

Figure 21




1. "Phonic" wheel- 2. Wheel turning sensor - 3. ABS electro-valve - 4. Combined brake cylinder - 5. ABS electro-valve - 6. Dual control relay valve - 7. Triple control servo-distributor - 8. Wheel turning sensor - 9. "Phonic" wheel - 10. Hose and coupling - 11. Duo Duplex bridge complex with drum control brake - 12. Relay valve- 13. ABS electro-valve - 14. "Phonic" wheel - 15. Wheel turning sensor - 16. Relief valve - 17. A.P.U. - 18. Air reservoir- 19. Manual condensed steam discharge valve - 20. ABS electro-valve - 21. Drum control brake Duo Duplex axle complex- 22. Disk brake axle complex - 23. Membrane brake cylinder axle (disk brakes) - 24. Wheel turning sensor - 25. "Phonic" wheel- 26. Air reservoir - 27. Relay valve with regulation of the predominance - 28. E.S Compressor. - 29. Duplex Distributor - 30. Electronic Power Unit - 31. Hand distributor parking brake control

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## DESCRIPTION

### Service braking

Pneumatically controlled pedal type, operating on all the wheels and the trailer.
It features two separate sections, one to activate the front axle braking components, the other for the rear axle components.
A third section, assisting the two distributor sections, brakes the trailer.
The duplex distributor controls the two separate sections and the triple control servo distributor that in its turn controls the third section.
Should a failure occur in one section, the pneumatic system sectioning enables the others to operate efficiently.

### Emergency braking

This is combined with the parking braking. The double circuit system enables the braking of one axle even when there is a failure in the braking of the other axle, by means of the service brake pedal and the parking hand lever.

### Retarding braking

The I.T.B. (Iveco Turbo Brake) engine brake used on Cursor engines is composed of a hydraulically controlled mechanism that cancels the exhaust valve clearance. By applying this mechanism, at the end of the compression phase, a few degrees before the T.D.C., the exhaust valves open slightly with a consequent reduction in the pressure formed in the cylinder. This takes advantage of the braking torque of the compression phase but without having the following return thrust on the piston.

### Parking braking

This is mechanical and actuated through the hand distributor set at the end of its stroke. It operates on the rear wheels of the tractor discharging the air from the spring section of the pneumatic cylinder and the servo distributor control section, thus locking the trailer or semi-trailer wheels.
From the driver's seat it is possible to check whether the trailer is able, with the trailer brakes released, to ensure the efficiency of the combined tractor-trailer parking brake.

## BRAKES

### Front disc brakes SN7 type (for vehicles with partial traction)

The discs are keyed onto the wheel hubs and equipped with ventilation fins that permit lowering the high temperature generated under the braking action.
A small electrical cable is embedded in the brake lining and is connected to the MET power unit which commando a warning light on the dashboard signal the wearing of the said brake linings.
The phonic wheels of the ABS device are keyed onto the wheel hubs.

### Drum brakes

S MERITOR DUO DUPLEX type 410 x 180 and 410 x 200

Each braking assembly is composed of a body housing the adjustment pins, control pins and wedge units.
The wedge units are operated by the stem of the cylinders that in their turn are operated by compressed air.
The wedge unit rollers, as they travel, cause the control pins to expand that, overcoming the resistance of the shoe return springs, bring the shoes up to the drum to actuate braking. The adjustment and control pins are made integral with the brake body by two pins that fit into a side slot. When the braking action ends, there is no air pressure in the diaphragm section of the combined brake cylinders and so the action of the wedge unit return and shoe return springs take the wedge units back into the starting position.
A sensor is screwed onto one of the two shoes forming the brake. This sensor indicates the state of wear of the brake linings. When the sensor wire comes into contact with the drum, the brake lining wear indicator light blinks in the cab.
When the sensor wire gets broken, due to further wear of the brake linings, the wear indicator light stays on, thereby indicating the linings have reached their maximum wear limit.

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## FAULT DIAGNOSIS

Fault diagnosis comprises two sections:

- The first one, organized by error codes (DTC-FMI), concerns faults that may be identified by the ABS control unit directly. These faults are mainly of an electric – electronic – pneumatic nature.
- The second one, organized by symptoms, describes the possible faults the electronic control unit cannot identify directly. These faults are mainly of a mechanical – pneumatic nature.

SECTION I

ABS system troubleshooting can be performed with the Cluster or with the diagnosis instruments Modus, IT 2000 and E.A.SY..

Diagnosis with the cluster makes it possible to estimate the situation of faults in the system in advance, while the diagnosis instruments are essential to perform thorough diagnosis and operate on the single faults correctly.

Each single instrument displays the diagnosis and repair help.

### Diagnosis Instruments

MODUS (Maintenance and Diagnostic System)

A computerized fault-diagnosis station dedicated to diagnosing the brake systems, air suspensions, engines and systems controlled electronically.

The station is equipped with auxiliary functions, such as: programming electronic control units, consulting the spare parts catalogue and service time schedules.

The vehicle has a 30-pin diagnosis socket to interface with the instrument.

IT 2000 (IVECO Electronic Tester)

This makes it possible to take immediate action on the vehicle, identifying it with the chassis number.

It saves the results of diagnostics actions performed.

It can be used as a portable Personal Computer, too, being fitted for remote diagnosis.

By using MODUS as the mother station it is possible to update and configure the IT 2000.

IT 2000 interfaces with the vehicle via a 30-pin diagnosis socket.

E.A.SY.

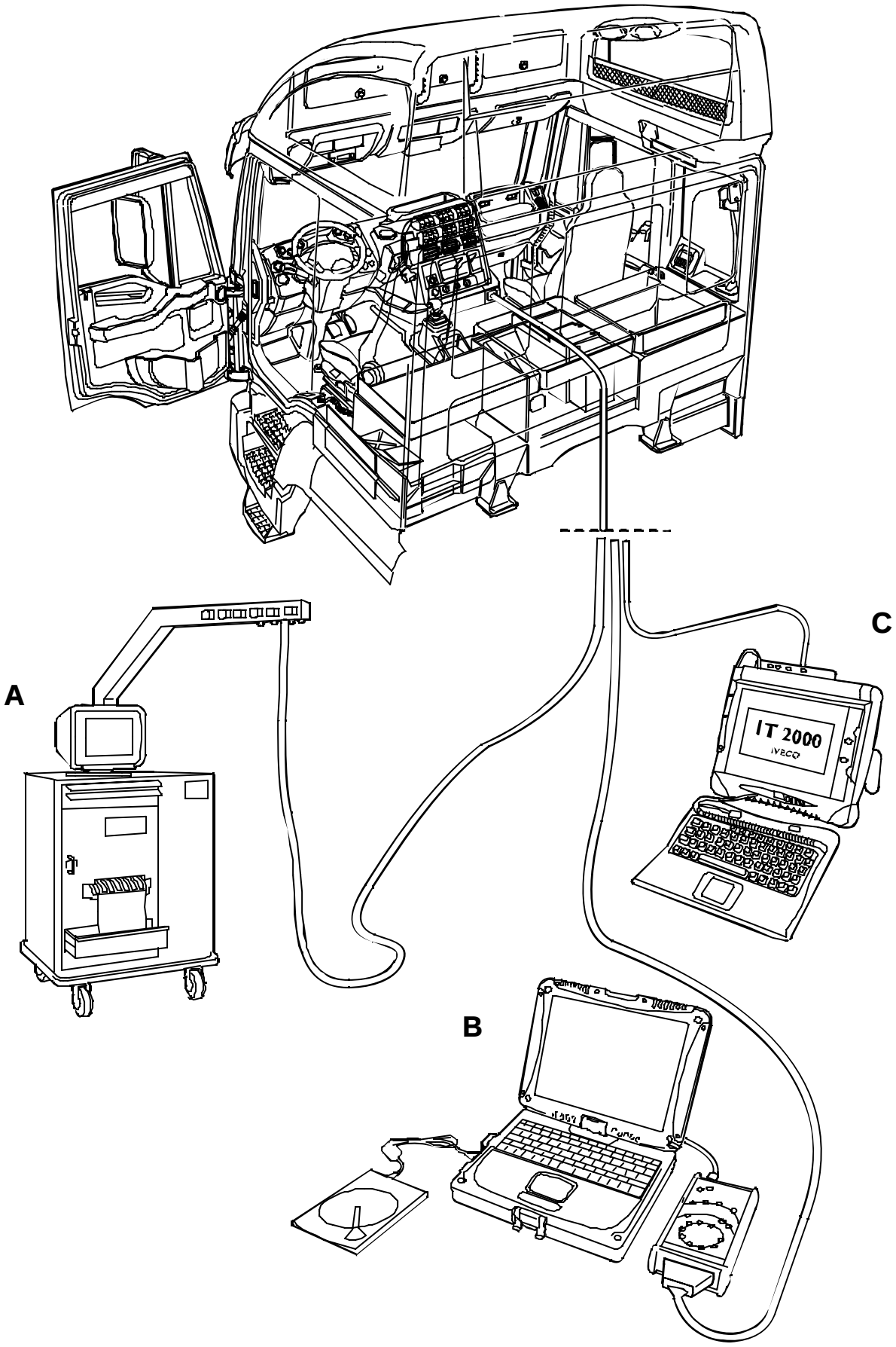
E.A.SY. system allows to simply make the diagnosis and programming of the various electronic central units aboard the vehicle.

E.A.SY. system is made up of ECI module communicating with the electronic central units and of a Panasonic PC.

ECI module, exploiting the Panasonic PC, also allows easy on the road interventions: in particular, thanks to Panasonic PC wireless technologies (e.g. GPRS), diagnostic interventions can be assisted by a remote expert centre.

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Figure 22




A. Modus - B. EASY - C. IT 2000

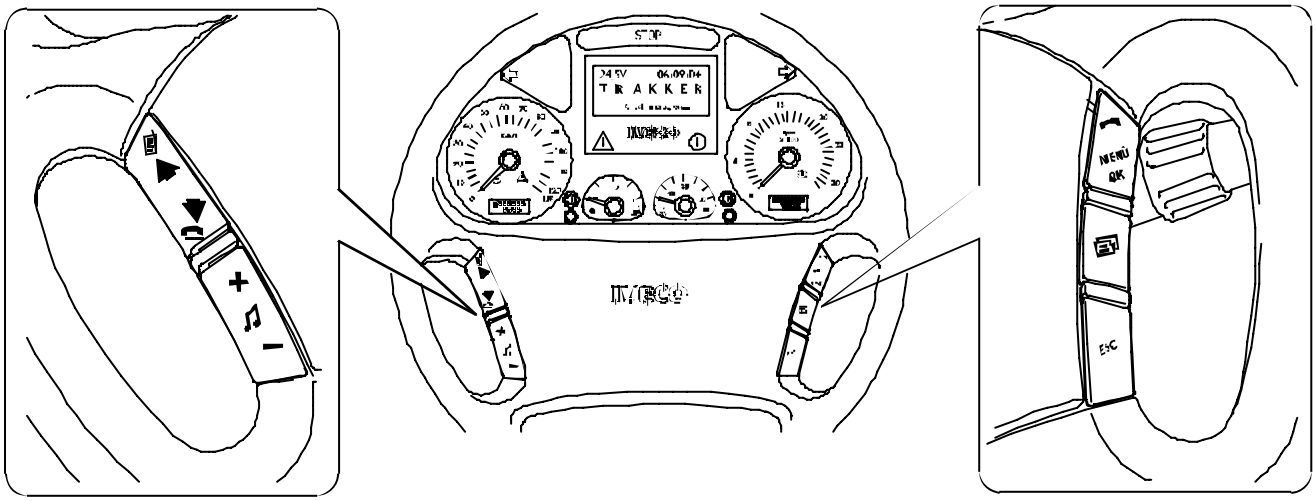
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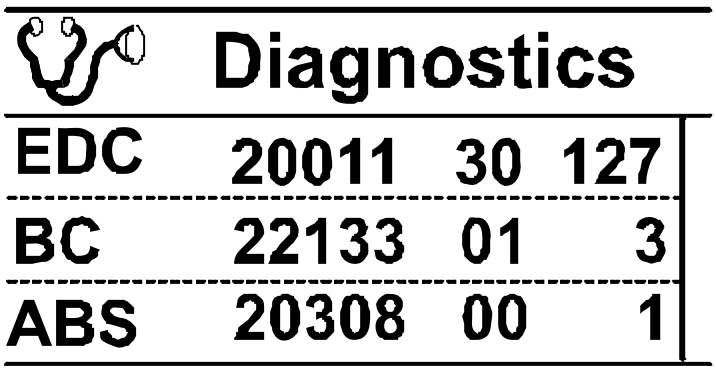
## Diagnosis on Cluster

Access to diagnostic screen is possible through "page" or " y " " b " keys.

Figure 23




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Diagnosis information on the cluster is split into 4 columns:

- First column = central unit.
- Second column = central unit address plus fault order number.
- Third column = failure type.
- Fourth column = failure frequency.

The screen shows three error messages at most, but can store up to eight error messages. For displaying any further messages, just operate " y " and " b " keys.

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 001 | 01 | SENSORS - FRONT LEFT SENSOR | EXCESSIVE AIR GAP | | | Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm | | | | |
| 001 | 02 | SENSORS - FRONT LEFT SENSOR | INCORRECT TYRE | | | Check that: - the phonic wheels are not faulty; - teeths are not damaged or missing; - the tyres have equal measure (measures released by constructor), tyres pressure . Verify the axle ratio. | | | | Check correct tyre circumference. |
| 001 | 03 | SENSORS - FRONT LEFT SENSOR | SHORT CIRCUIT TO POSITIVE | | Possible short circuit. | Check sensor wiring. Check sensor efficiency, replace it if damaged. | 1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X2 Pin: 12 2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X1 Pin: 4 3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 ON; | 1- Min. value: 0.9 KOhm; Max. value: 2 KOhm; 2- Min. value: 500 KOhm; 3- Max. value: 1 V; | Carry out the indicated measurements |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 001 | 04 | SENSORS - FRONT LEFT SENSOR | SHORT CIRCUIT TO GROUND | | Possible short circuit. | Check sensor wiring. Check sensor efficiency, replace it if damaged. | 1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X2 Pin: 12<br><br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X1 Pin: 4<br><br>3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF;<br>3- Connector Connected; Key +15 ON; | 1- Min. value: 0.9 KOhm; Max. value: 2 KOhm;<br>2- Min. value: 500 KOhm;<br>3- Max. value: 1 V; | Carry out the indicated measurements |
| 001 | 05 | SENSORS - FRONT LEFT SENSOR | OPEN CIRCUIT | | Possible open circuit or interrupted cable between. | Check sensor wiring. Check sensor efficiency, replace it if damaged. | 1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X2 Pin: 12<br><br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X1 Pin: 4<br><br>3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF;<br>3- Connector Connected; Key +15 ON; | 1- Min. value: 0.9 KOhm; Max. value: 2 KOhm;<br>2- Min. value: 500 KOhm;<br>3- Max. value: 1 V; | Carry out the indicated measurements |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 001 | 06 | SENSORS - FRONT LEFT SENSOR | SHORT CIRCUIT | | Possible short circuit. | Check sensor wiring. Check sensor efficiency, replace it if damaged. | 1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X2 Pin: 12<br><br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X1 Pin: 4<br><br>3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 15 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF;<br>3- Connector Connected; Key +15 ON; | 1- Min. value: 0.9 KOhm; Max. value: 2 KOhm;<br>2- Min. value: 500 KOhm;<br>3- Max. value: 1 V; | Carry out the indicated measurements |
| 001 | 07 | SENSORS - FRONT LEFT SENSOR | PHONIC WHEEL | | | Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel.<br>Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel.<br>Comparable values: 0,7 ± 0,05 mm | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 001 | 08 | SENSORS - FRONT LEFT SENSOR | SLIPPING | | Mechanical problems in the ASR -System (pneumatic pipes, the ASR electrovalve, ABS-electrovalves, ASR disabling switch). | Check that:<br>- the phonic wheels are not faulty;<br>- teeths are not damaged or missing. | | | | Check and restore clearance between sensor and phonic wheel.<br>Check:<br>Check the integrity and cleanliness of the phonic wheel.<br>Restore clearance between sensor and phonic wheel.<br>Comparable values: 0,7 ± 0,05 mm |
| 001 | 09 | SENSORS - FRONT LEFT SENSOR | INVERTED WIRING | | | Using the MEASURABLE PARAMETERS read the velocity of the wheel in question. | | | | |
| 001 | 0A | SENSORS - FRONT LEFT SENSOR | IRREGULAR SIGNAL | | | Position of the sensor incorrect; high air gap; false contacts in the connector. | | | | |
| 001 | 0B | SENSORS - FRONT LEFT SENSOR | SIGNAL NOT PLAUSIBLE | | | Position of the sensor incorrect; high air gap; false contacts in the connector. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 001 | 0C | SENSORS - FRONT LEFT SENSOR | WRONG SIGNAL | | | Position of the sensor incorrect; high air gap; false contacts in the connector. | | | | If necessary, replace the ECU. |
| 002 | 01 | SENSORS - FRONT RIGHT SENSOR | EXCESSIVE AIR GAP | | | Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel.<br>Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel.<br>Comparable values: 0,7 ± 0,05 mm | | | | |
| 002 | 02 | SENSORS - FRONT RIGHT SENSOR | INCORRECT TYRE | | | Check that:<br>- the phonic wheels are not faulty;<br>- teeths are not damaged or missing;<br>- the tyres have equal measure (measures released by constructor), tyres pressure .<br>Verify the axle ratio. | | | | Check correct tyre circumference. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 002 | 03 | SENSORS - FRONT RIGHT SENSOR | SHORT CIRCUIT TO POSITIVE | | Possible short circuit. | Check sensor wiring. Check sensor efficiency, replace it if damaged. | 1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 13 Measure point 2: Connector X2 Pin: 10<br><br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 13 Measure point 2: Connector X1 Pin: 8<br><br>3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 13 Measure point 2: Connector X1 Pin: 8 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF;<br>3- Connector Connected; Key +15 ON; | 1- Min. value: 0.9 KOhm; Max. value: 2 KOhm;<br>2- Min. value: 500 KOhm;<br>3- Max. value: 1 V; | Carry out the indicated measurements |
| 002 | 04 | SENSORS - FRONT RIGHT SENSOR | SHORT CIRCUIT TO GROUND | | Possible short circuit. | Check sensor wiring. Check sensor efficiency, replace it if damaged. | 1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 13 Measure point 2: Connector X2 Pin: 10<br><br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 10 Measure point 2: Connector X1 Pin: 4<br><br>3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 10 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF;<br>3- Connector Connected; Key +15 ON; | 1- Min. value: 0.9 KOhm; Max. value: 2 KOhm;<br>2- Min. value: 500 KOhm;<br>3- Max. value: 1 V; | Carry out the indicated measurements |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 002 | 05 | SENSORS - FRONT RIGHT SENSOR | OPEN CIRCUIT | | Possible open circuit or interrupted cable between. | Check sensor wiring. Check sensor efficiency, replace it if damaged. | 1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 13 Measure point 2: Connector X2 Pin: 10<br><br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 10 Measure point 2: Connector X1 Pin: 4<br><br>3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 10 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF;<br>3- Connector Connected; Key +15 ON; | 1- Min. value: 0.9 KOhm; Max. value: 2 KOhm;<br>2- Min. value: 500 KOhm;<br>3- Max. value: 1 V; | Carry out the indicated measurements |
| 002 | 06 | SENSORS - FRONT RIGHT SENSOR | SHORT CIRCUIT | | Possible short circuit. | Check sensor wiring. Check sensor efficiency, replace it if damaged. | 1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 13 Measure point 2: Connector X2 Pin: 10<br><br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 10 Measure point 2: Connector X1 Pin: 4<br><br>3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 10 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF;<br>3- Connector Connected; Key +15 ON; | 1- Min. value: 0.9 KOhm; Max. value: 2 KOhm;<br>2- Min. value: 500 KOhm;<br>3- Max. value: 1 V; | Carry out the indicated measurements |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 002 | 07 | SENSORS - FRONT RIGHT SENSOR | PHONIC WHEEL | | | Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm | | | | |
| 002 | 08 | SENSORS - FRONT RIGHT SENSOR | SLIPPING | | Mechanical problems in the ASR -System (pneumatic pipes, the ASR electrovalve, ABS-electrovalves, ASR disabling switch). | Check that: - the phonic wheels are not faulty; - teeths are not damaged or missing. | | | | Check and restore clearance between sensor and phonic wheel. Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel. Comparable values: 0,7 ± 0,05 mm |
| 002 | 09 | SENSORS - FRONT RIGHT SENSOR | INVERTED WIRING | | | Using the MEASURABLE PARAMETERS read the velocity of the wheel in question. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 002 | 0A | SENSORS - FRONT RIGHT SENSOR | IRREGULAR SIGNAL | | | Position of the sensor incorrect; high air gap; false contacts in the connector. | | | | |
| 002 | 0B | SENSORS - FRONT RIGHT SENSOR | SIGNAL NOT PLAUSIBLE | | | Position of the sensor incorrect; high air gap; false contacts in the connector. | | | | |
| 002 | 0C | SENSORS - FRONT RIGHT SENSOR | WRONG SIGNAL | | | Position of the sensor incorrect; high air gap; false contacts in the connector. | | | | If necessary, replace the ECU. |
| 003 | 01 | SENSORS - REAR LEFT SENSOR | EXCESSIVE AIR GAP | | | Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel.<br>Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel.<br>Comparable values: 0,7 ± 0,05 mm | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 003 | 02 | SENSORS - REAR LEFT SENSOR | INCORRECT TYRE | | | Check that:<br>- the phonic wheels are not faulty;<br>- teeths are not damaged or missing;<br>- the tyres have equal measure (measures released by constructor), tyres pressure .<br>Verify the axle ratio. | | | | Check correct tyre circumference. |
| 003 | 03 | SENSORS - REAR LEFT SENSOR | SHORT CIRCUIT TO POSITIVE | | Possible short circuit. | Check sensor wiring. Check sensor efficiency, replace it if damaged. | 1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 14 Measure point 2: Connector X2 Pin: 11<br><br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X1 Pin: 4<br><br>3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF;<br>3- Connector Connected; Key +15 ON; | 1- Min. value: 0.9 KOhm; Max. value: 2 KOhm;<br>2- Min. value: 500 KOhm;<br>3- Max. value: 1 V; | Carry out the indicated measurements |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 003 | 04 | SENSORS - REAR LEFT SENSOR | SHORT CIRCUIT TO GROUND | | Possible short circuit. | Check sensor wiring. Check sensor efficiency, replace it if damaged. | 1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 14 Measure point 2: Connector X2 Pin: 11<br><br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X1 Pin: 4<br><br>3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF;<br>3- Connector Connected; Key +15 ON; | 1- Min. value: 0.9 KOhm; Max. value: 2 KOhm;<br>2- Min. value: 500 KOhm;<br>3- Max. value: 1 V; | Carry out the indicated measurements |
| 003 | 05 | SENSORS - REAR LEFT SENSOR | OPEN CIRCUIT | | Possible open circuit or interrupted cable between. | Check sensor wiring. Check sensor efficiency, replace it if damaged. | 1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 14 Measure point 2: Connector X2 Pin: 11<br><br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X1 Pin: 4<br><br>3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF;<br>3- Connector Connected; Key +15 ON; | 1- Min. value: 0.9 KOhm; Max. value: 2 KOhm;<br>2- Min. value: 500 KOhm;<br>3- Max. value: 1 V; | Carry out the indicated measurements |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 003 | 06 | SENSORS - REAR LEFT SENSOR | SHORT CIRCUIT | | Possible short circuit. | Check sensor wiring. Check sensor efficiency, replace it if damaged. | 1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 14 Measure point 2: Connector X2 Pin: 11<br><br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X1 Pin: 4<br><br>3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 11 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF;<br>3- Connector Connected; Key +15 ON; | 1- Min. value: 0.9 KOhm; Max. value: 2 KOhm;<br>2- Min. value: 500 KOhm;<br>3- Max. value: 1 V; | Carry out the indicated measurements |
| 003 | 07 | SENSORS - REAR LEFT SENSOR | PHONIC WHEEL | | | Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel.<br>Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel.<br>Comparable values: 0,7 ± 0,05 mm | | | | |
| 003 | 08 | SENSORS - REAR LEFT SENSOR | INVERTED WIRING | | | Using the MEASURABLE PARAMETERS read the velocity of the wheel in question. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 003 | 09 | SENSORS - REAR LEFT SENSOR | SLIPPING | | Mechanical problems in the ASR -System (pneumatic pipes, the ASR electrovalve, ABS-electro-valves, ASR disabling switch). | Check that:<br>- the phonic wheels are not faulty;<br>- teeths are not damaged or missing. | | | | Check and restore clearance between sensor and phonic wheel.<br>Check:<br>Check the integrity and cleanliness of the phonic wheel.<br>Restore clearance between sensor and phonic wheel.<br>Comparable values: 0,7 ± 0,05 mm |
| 003 | 0A | SENSORS - REAR LEFT SENSOR | IRREGULAR SIGNAL | | | Position of the sensor incorrect; high air gap; false contacts in the connector. | | | | |
| 003 | 0B | SENSORS - REAR LEFT SENSOR | SIGNAL NOT PLAUSIBLE | | | Position of the sensor incorrect; high air gap; false contacts in the connector. | | | | |
| 003 | 0C | SENSORS - REAR LEFT SENSOR | WRONG SIGNAL | | | Position of the sensor incorrect; high air gap; false contacts in the connector. | | | | If necessary, replace the ECU. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 004 | 01 | SENSORS - REAR RIGHT SENSOR | EXCESSIVE AIR GAP | | | Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel.<br>Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel.<br>Comparable values: 0,7 ± 0,05 mm | | | | |
| 004 | 02 | SENSORS - REAR RIGHT SENSOR | INCORRECT TYRE | | | Check that:<br>- the phonic wheels are not faulty;<br>- teeths are not damaged or missing;<br>- the tyres have equal measure (measures released by constructor), tyres pressure .<br>Verify the axle ratio. | | | | Check correct tyre circumference. |
| 004 | 03 | SENSORS - REAR RIGHT SENSOR | SHORT CIRCUIT TO POSITIVE | | Possible short circuit. | Check sensor wiring. Check sensor efficiency, replace it if damaged. | 1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 18 Measure point 2: Connector X2 Pin: 17<br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 17 Measure point 2: Connector X1 Pin: 4<br>3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 17 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF;<br>3- Connector Connected; Key +15 ON; | 1- Min. value: 0.9 KOhm; Max. value: 2 KOhm;<br>2- Min. value: 500 KOhm;<br>3- Max. value: 1 V; | Carry out the indicated measurements |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 004 | 04 | SENSORS - REAR RIGHT SENSOR | SHORT CIRCUIT TO GROUND | | Possible short circuit. | Check sensor wiring. Check sensor efficiency, replace it if damaged. | 1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 18 Measure point 2: Connector X2 Pin: 17<br><br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 17 Measure point 2: Connector X1 Pin: 4<br><br>3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 17 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF;<br>3- Connector Connected; Key +15 ON; | 1- Min. value: 0.9 KOhm; Max. value: 2 KOhm;<br>2- Min. value: 500 KOhm;<br>3- Max. value: 1 V; | Carry out the indicated measurements |
| 004 | 05 | SENSORS - REAR RIGHT SENSOR | OPEN CIRCUIT | | Possible open circuit or interrupted cable between. | Check sensor wiring. Check sensor efficiency, replace it if damaged. | 1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 18 Measure point 2: Connector X2 Pin: 17<br><br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 17 Measure point 2: Connector X1 Pin: 4<br><br>3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 17 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF;<br>3- Connector Connected; Key +15 ON; | 1- Min. value: 0.9 KOhm; Max. value: 2 KOhm;<br>2- Min. value: 500 KOhm;<br>3- Max. value: 1 V; | Carry out the indicated measurements |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 004 | 06 | SENSORS - REAR RIGHT SENSOR | SHORT CIRCUIT | | Possible short circuit. | Check sensor wiring. Check sensor efficiency, replace it if damaged. | 1- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 18 Measure point 2: Connector X2 Pin: 17<br><br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X2 Pin: 17 Measure point 2: Connector X1 Pin: 4<br><br>3- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 17 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF;<br>3- Connector Connected; Key +15 ON; | 1- Min. value: 0.9 KOhm; Max. value: 2 KOhm;<br>2- Min. value: 500 KOhm;<br>3- Max. value: 1 V; | Carry out the indicated measurements |
| 004 | 07 | SENSORS - REAR RIGHT SENSOR | PHONIC WHEEL | | | Check phonic wheel and replace it if damaged. Check and restore clearance between sensor and phonic wheel.<br>Check: Check the integrity and cleanliness of the phonic wheel. Restore clearance between sensor and phonic wheel.<br>Comparable values: 0,7 ± 0,05 mm | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 004 | 08 | SENSORS - REAR RIGHT SENSOR | SLIPPING | | Mechanical problems in the ASR -System (pneumatic pipes, the ASR electrovalve, ABS-electro-valves, ASR disabling switch). | Check that:<br>- the phonic wheels are not faulty;<br>- teeths are not damaged or missing. | | | | Check and restore clearance between sensor and phonic wheel.<br>Check:<br>Check the integrity and cleanliness of the phonic wheel.<br>Restore clearance between sensor and phonic wheel.<br>Comparable values: 0,7 ± 0,05 mm |
| 004 | 09 | SENSORS - REAR RIGHT SENSOR | INVERTED WIRING | | | Using the MEASURABLE PARAMETERS read the velocity of the wheel in question. | | | | |
| 004 | 0A | SENSORS - REAR RIGHT SENSOR | IRREGULAR SIGNAL | | | Position of the sensor incorrect; high air gap; false contacts in the connector. | | | | |
| 004 | 0B | SENSORS - REAR RIGHT SENSOR | SIGNAL NOT PLAUSIBLE | | | Position of the sensor incorrect; high air gap; false contacts in the connector. | | | | |
| 004 | 0C | SENSORS - REAR RIGHT SENSOR | WRONG SIGNAL | | | Position of the sensor incorrect; high air gap; false contacts in the connector. | | | | If necessary, replace the ECU. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 007 | 03 | SOLENOID VALVES - FRONT LEFT ABS SOLENOID VALVE | SHORT CIRCUIT TO POSITIVE | | Possible short circuit. | Check wiring and connectors. | 1- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 3 Measure point 2: Connector X1 Pin: 4<br><br>2- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 6 Measure point 2: Connector X1 Pin: 4 | 1- Connector Connected; Key +15 ON;<br>2- Connector Connected; Key +15 ON; | 1- Max. value: 1 V;<br>2- Max. value: 1 V; | Carry out the recommended measurements. |
| 007 | 05 | SOLENOID VALVES - FRONT LEFT ABS SOLENOID VALVE | OPEN CIRCUIT | | Possible open circuit or interrupted cable between. | Check wiring and connectors. | 1- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 3 Measure point 2: Connector X1 Pin: 4<br><br>2- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 6 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF; | 1- Min. value: 14 Ohm; Max. value: 21 Ohm;<br>2- Min. value: 14 Ohm; Max. value: 21 Ohm; | Carry out the recommended measurements. |
| 007 | 06 | SOLENOID VALVES - FRONT LEFT ABS SOLENOID VALVE | SHORT CIRCUIT TO GROUND | | Possible short circuit. | Check wiring and connectors. | 1- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 3 Measure point 2: Connector X1 Pin: 4<br><br>2- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 6 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF; | 1- Min. value: 14 Ohm; Max. value: 21 Ohm;<br>2- Min. value: 14 Ohm; Max. value: 21 Ohm; | Carry out the recommended measurements. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 008 | 03 | SOLENOID VALVES - FRONT RIGHT ABS SOLENOID VALVE | SHORT CIRCUIT TO POSITIVE | | Possible short circuit. | Check wiring and connectors. | 1- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 1 Measure point 2: Connector X1 Pin: 4<br><br>2- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 4 Measure point 2: Connector X1 Pin: 4 | 1- Connector Connected; Key +15 ON;<br>2- Connector Connected; Key +15 ON; | 1- Max. value: 1 V;<br>2- Max. value: 1 V; | Carry out the recommended measurements. |
| 008 | 05 | SOLENOID VALVES - FRONT RIGHT ABS SOLENOID VALVE | OPEN CIRCUIT | | Possible open circuit or interrupted cable between. | Check wiring and connectors. | 1- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 1 Measure point 2: Connector X1 Pin: 4<br><br>2- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 4 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF; | 1- Min. value: 14 Ohm; Max. value: 21 Ohm;<br>2- Min. value: 14 Ohm; Max. value: 21 Ohm; | Carry out the recommended measurements. |
| 008 | 06 | SOLENOID VALVES - FRONT RIGHT ABS SOLENOID VALVE | SHORT CIRCUIT TO GROUND | | Possible short circuit. | Check wiring and connectors. | 1- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 1 Measure point 2: Connector X1 Pin: 4<br><br>2- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 4 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF; | 1- Min. value: 14 Ohm; Max. value: 21 Ohm;<br>2- Min. value: 14 Ohm; Max. value: 21 Ohm; | Carry out the recommended measurements. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 009 | 03 | SOLENOID VALVES - REAR LEFT ABS SOLENOID VALVE | SHORT CIRCUIT TO POSITIVE | | Possible short circuit. | Check wiring and connectors. | 1- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 2 Measure point 2: Connector X1 Pin: 4<br><br>2- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 5 Measure point 2: Connector X1 Pin: 4 | 1- Connector Connected; Key +15 ON;<br>2- Connector Connected; Key +15 ON; | 1- Max. value: 1 V;<br>2- Max. value: 1 V; | Carry out the recommended measurements. |
| 009 | 05 | SOLENOID VALVES - REAR LEFT ABS SOLENOID VALVE | OPEN CIRCUIT | | Possible open circuit or interrupted cable between. | Check wiring and connectors. | 1- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 2 Measure point 2: Connector X1 Pin: 4<br><br>2- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 5 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF; | 1- Min. value: 14 Ohm; Max. value: 21 Ohm;<br>2- Min. value: 14 Ohm; Max. value: 21 Ohm; | Carry out the recommended measurements. |
| 009 | 06 | SOLENOID VALVES - REAR LEFT ABS SOLENOID VALVE | SHORT CIRCUIT TO GROUND | | Possible short circuit. | Check wiring and connectors. | 1- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 2 Measure point 2: Connector X1 Pin: 4<br><br>2- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 5 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF; | 1- Min. value: 14 Ohm; Max. value: 21 Ohm;<br>2- Min. value: 14 Ohm; Max. value: 21 Ohm; | Carry out the recommended measurements. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 00A | 03 | SOLENOID VALVES - REAR RIGHT ABS SOLENOID VALVE | SHORT CIRCUIT TO POSITIVE | | Possible short circuit. | Check wiring and connectors. | 1- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 8 Measure point 2: Connector X1 Pin: 4<br><br>2- Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 9 Measure point 2: Connector X1 Pin: 4 | 1- Connector Connected; Key +15 ON;<br>2- Connector Connected; Key +15 ON; | 1- Max. value: 1 V;<br>2- Max. value: 1 V; | Carry out the recommended measurements. |
| 00A | 05 | SOLENOID VALVES - REAR RIGHT ABS SOLENOID VALVE | OPEN CIRCUIT | | Possible open circuit or interrupted cable between. | Check wiring and connectors. | 1- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 8 Measure point 2: Connector X1 Pin: 4<br><br>2- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 9 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF; | 1- Min. value: 14 Ohm; Max. value: 21 Ohm;<br>2- Min. value: 14 Ohm; Max. value: 21 Ohm; | Carry out the recommended measurements. |
| 00A | 06 | SOLENOID VALVES - REAR RIGHT ABS SOLENOID VALVE | SHORT CIRCUIT TO GROUND | | Possible short circuit. | Check wiring and connectors. | 1- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 8 Measure point 2: Connector X1 Pin: 4<br><br>2- Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 9 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF; | 1- Min. value: 14 Ohm; Max. value: 21 Ohm;<br>2- Min. value: 14 Ohm; Max. value: 21 Ohm; | Carry out the recommended measurements. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 00D | 03 | THIRD BRAKE RELAY - THIRD BRAKE RELAY | SHORT CIRCUIT TO POSITIVE | | Possible short circuit. | Check for a fault in the fuse 70601 / 5.<br>Check for a fault in the connector ST93<br>Check that the relay 25104 (E) is working correctly. | 1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 14 Measure point 2: Connector X1 Pin: 4<br>2- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 14 Measure point 2: Connector X1 Pin: 7 | 1- Connector Connected; Key +15 ON;<br>2- Connector Not connected; Key +15 OFF; | 1- Max. value: 1 V;<br>2- Min. value: 14 Ohm; Max. value: 21 Ohm; | Carry out the recommended measurements. |
| 00D | 05 | THIRD BRAKE RELAY - THIRD BRAKE RELAY | OPEN CIRCUIT | | Possible open circuit or interrupted cable between. | Check for a fault in the fuse 70601 / 5.<br>Check for a fault in the connector ST93 Check that the relay 25104 (E) is working correctly. Reset the ECU: 1- With ignition key on "ON" short-circuit Pin 13 (connector X1) to ground for a time between 3 and 6 sec.<br>2- Wait for 2 sec.<br>3- Short-circuir again the Pin 13 connector X1 to ground and repeat the procedure for three times; each short-circuit should last at least 0,5 sec. If the procedure has been correctly carried out the ASR indicator switches on (four short pulses). When the ignition key is switched ON again, it is possible to delete the faults memory. If the fault persists, replace the E.C.U. | 1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 14 Measure point 2: Connector X1 Pin: 4<br>2- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 14 Measure point 2: Connector X1 Pin: 7 | 1- Connector Connected; Key +15 ON;<br>2- Connector Not connected; Key +15 OFF; | 1- Max. value: 1 V;<br>2- Min. value: 14 Ohm; Max. value: 21 Ohm; | Carry out the recommended measurements. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 00D | 06 | THIRD BRAKE RELAY - THIRD BRAKE RELAY | SHORT CIRCUIT TO GROUND | | Possible short circuit. | Check for a fault in the fuse 70601 / 5.<br>Check for a fault in the connector ST93<br>Check that the relay 25104 (E) is working correctly. | 1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 14 Measure point 2: Connector X1 Pin: 4<br><br>2- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 14 Measure point 2: Connector X1 Pin: 7 | 1- Connector Connected; Key +15 ON;<br>2- Connector Not connected; Key +15 OFF; | 1- Max. value: 1 V;<br>2- Min. value: 14 Ohm; Max. value: 21 Ohm; | Carry out the recommended measurements. |
| 00E | 04 | VOLTAGE | LOW TENSION/ OPEN CIRCUIT | | Possible open circuit or interrupted cable between. | Check for a fault in the fuse 70601 / 4 (Stralis 70602 / 5).<br>Check for a fault in the fuse 70601 / 6 (Stralis 70602 / 6).<br>Check for a fault in the supply wiring.<br>Check the ignition key and voltage stability.<br>Check correct pin location on Electronic control unit, if fault persists, replace. | 1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 7 Measure point 2: Connector X1 Pin: 4<br><br>2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 8 Measure point 2: Connector X1 Pin: 4 | 1- Connector Connected; Key +15 ON;<br>2- Connector Connected; Key +15 ON; | 1- Min. value: 22 V; Max. value: 28 V;<br>2- Min. value: 22 V; Max. value: 28 V; | Carry out the recommended measurements. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 00E | 05 | VOLTAGE | GROUND FAULTY OR NOT PRESENT (pin 9 connector X1) | | Possible open circuit or interrupted cable between. | Check wiring and connectors.<br>Check: Check correct pin location on Electronic control unit, if fault persists, replace.<br>Comparable values: | 1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 4 Measure point 2: GND Pin: GND<br>2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 9 Measure point 2: GND Pin: GND<br>3- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 9 Measure point 2: GND Pin: GND<br>4- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 4 Measure point 2: GND Pin: GND | 1- Connector Connected; Key +15 ON;<br>2- Connector Connected; Key +15 ON;<br>3- Connector Not connected; Key +15 OFF;<br>4- Connector Not connected; Key +15 OFF; | 1- Max. value: 1 V;<br>2- Max. value: 1 V;<br>3- Max. value: 3 Ohm;<br>4- Max. value: 3 Ohm; | Carry out the recommended measurements. |
| 00E | 07 | THIRD BRAKE RELAY - SUPPLY RELAY (INSIDE THE ELECTRONIC CONTROL UNIT) | FAULT | | Ecu internal failure. | Before replacing the control unit make sure that the control unit is powered correctly. | (V) | | | Carry out the recommended measurements. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 010 | | PRESSURE SENSOR | SHORT CIRCUIT | | Short-circuit, faulty sensor. | Check sensor wiring. Replace sensor if damaged. | 1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 4<br>2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 7 Measure point 2: Connector X1 Pin: 4 | 1- Connector Connected; Key +15 ON;<br>2- Connector Connected; Key +15 ON; | 1- Min. value: 0.5 V; Max. value: 4.5 V;<br>2- Min. value: 22 V;<br>Max. value: 28 V; | Carry out the recommended measurements. |
| 010 | 03 | PRESSURE SENSOR | SHORT CIRCUIT TO POSITIVE | | Shorted to high source | Check sensor wiring. Replace sensor if damaged. | 1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 4<br>2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 7 Measure point 2: Connector X1 Pin: 4 | 1- Connector Connected; Key +15 ON;<br>2- Connector Connected; Key +15 ON; | 1- Min. value: 0.5 V; Max. value: 4.5 V;<br>2- Min. value: 22 V;<br>Max. value: 28 V; | Carry out the recommended measurements. |
| 010 | 05 | PRESSURE SENSOR | OPEN CIRCUIT OR SHORT CIRCUIT TO GROUND | | Open circuit or short-circuiting to negative. | Check sensor wiring. Replace sensor if damaged. | 1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 2 Measure point 2: Connector X1 Pin: 4<br>2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 7 Measure point 2: Connector X1 Pin: 4 | 1- Connector Connected; Key +15 ON;<br>2- Connector Connected; Key +15 ON; | 1- Min. value: 0.5 V; Max. value: 4.5 V;<br>2- Min. value: 22 V;<br>Max. value: 28 V; | Carry out the recommended measurements. |
| 012 | 03 | SOLENOID VALVES - ASR SOLENOID VALVE | SHORT CIRCUIT TO POSITIVE | | Possible short circuit. | Check wiring and connectors. | Measure type: Voltage (V) Measure point 1: Connector X2 Pin: 16 Measure point 2: Connector X1 Pin: 4 | Connector Connected; Key +15 ON; | Max. value: 1 V; | Carry out the recommended measurements. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 012 | 05 | SOLENOID VALVES - ASR SOLENOID VALVE | OPEN CIRCUIT | | Possible open circuit or interrupted cable between. | Check wiring and connectors.Check for a fault in the component. Reset the ECU: 1- With ignition key on "ON" short-circuit Pin 13 (connector X1) to ground for a time between 3 and 6 sec. 2- Wait for 2 seconds. 3-Short-circuir again the Pin 13 connector X1 to ground and repeat the procedure for three times; each short-circuit should last at least 0,5 sec. If the procedure has been correctly carried out the ASR indicator switches on (four short pulses). When the ignition key is switched ON again, it is possible to delete the faults memory. If the fault persists, replace the E.C.U. | Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 7 Measure point 2: Connector X2 Pin: 16 | Connector Not connected; Key +15 OFF; | Min. value: 30 Ohm; Max. value: 40 Ohm; | Carry out the recommended measurements. |
| 012 | 06 | SOLENOID VALVES - ASR SOLENOID VALVE | SHORT CIRCUIT TO GROUND | | Possible short circuit. | Check wiring and connectors. | Measure type: Resistance (Ohm) Measure point 1: Connector X2 Pin: 7 Measure point 2: Connector X2 Pin: 16 | Connector Not connected; Key +15 OFF; | Min. value: 30 Ohm; Max. value: 40 Ohm; | Carry out the recommended measurements. |
| 017 | 05 | ABS INDICATOR | SHORT CIRCUIT TO GROUND | | Possible causes: blink code activation > 16 sec. by means of switch (pin 15 ecu). | Check for a fault in the fuse 14 and connector ST18, pin 5. | Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 15 Measure point 2: Connector X1 Pin: 4 | Connector Connected; Key +15 ON; | Max. value: 1 V; | Carry out the recommended measurements. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 0E7 | 02 | CAN LINE | INPLAUSIBLE VEHICLE SPEED | | | Check that:<br>- the phonic wheels are not faulty;<br>- teeths are not damaged or missing;<br>- the tyres have equal measure (measures released by constructor), tyres pressure .<br>Verify the axle ratio. | | | | |
| 0E7 | 05 | CAN LINE | OPEN CIRCUIT OR SHORT CIRCUIT TO GROUND OR POSITIVE | | Possible open circuit or interrupted cable between. | Check wiring and connectors. Check for reversal of CAN line cables. | 1- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 1 (CAN H) Measure point 2: Connector X1 Pin: 3 (CAN L)<br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X1 ECU Pin: 1 (CAN H) Measure point 2: Connector X1 ECU Pin: 3 (CAN L) | 1- Connector Connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF; | 1- Typical Value: 60 Ohm;<br>2- Min. value: 29 KOhm; Max. value: 33 KOhm; | Carry out the recommended measurements. |
| 0E7 | 06 | CAN LINE | CONNECTION DISABLED | | Possible open circuit or interrupted cable between. | Check wiring and connectors. | 1- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 1 (CAN H) Measure point 2: Connector X1 Pin: 3 (CAN L)<br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X1 ECU Pin: 1 (CAN H) Measure point 2: Connector X1 ECU Pin: 3 (CAN L) | 1- Connector Connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF; | 1- Typical Value: 60 Ohm;<br>2- Min. value: 29 KOhm; Max. value: 33 KOhm; | Carry out the recommended measurements. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 0E7 | 07 | CAN LINE | TIMEOUT WITH THE RETARDER | | | Check for correct operation/connection of the control units that are interfaced with each other (e.g.: EDC, GEARBOXES, EBS, ABS, INTARDER, SUSPENSIONS, IMMOBILIZER, others...) | | | | |
| 0E7 | 08 | CAN LINE | DELAY IN THE COMMUNICATION WITH THE EDC E.C.U. (ENGINE BRAKE) | | | Check for correct operation/connection of the control units that are interfaced with each other (e.g.: EDC, GEARBOXES, EBS, ABS, INTARDER, SUSPENSIONS, IMMOBILIZER, others...) | | | | |
| 0E7 | 09 | CAN LINE | DELAY IN THE COMMUNICATION WITH THE EDC E.C.U. (TORQUE) | | | Check that the CAN LINE is correctly connected to the other control units. Check for CAN presence on the diagnostic connector. | 1- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 1 (CAN H) Measure point 2: Connector X1 Pin: 3 (CAN L)<br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X1 ECU Pin: 1 (CAN H) Measure point 2: Connector X1 ECU Pin: 3 (CAN L)<br>3- Measure type: Resistance (Ohm) Measure point 1: 30-pole connector Pin: 21 Measure point 2: 30-pole connector Pin: 22 | 1- Connector Connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF;<br>3- Connector Connected; Key +15 OFF; | 1- Typical Value: 60 Ohm;<br>2- Min. value: 29 KOhm; Max. value: 33 KOhm;<br>3- Typical Value: 60 Ohm; | Carry out the recommended measurements. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 0E7 | 0A | CAN LINE | DELAY IN THE COMMUNICATION WITH THE EDC E.C.U. (ENGINE BRAKE/RETARDER) | | | Check that the CAN LINE is correctly connected to the other control units. Check for CAN presence on the diagnostic connector. | 1- Measure type: Resistance (Ohm) Measure point 1: Connector X1 Pin: 1 (CAN H) Measure point 2: Connector X1 Pin: 3 (CAN L)<br>2- Measure type: Resistance (KOhm) Measure point 1: Connector X1 ECU Pin: 1 (CAN H) Measure point 2: Connector X1 ECU Pin: 3 (CAN L)<br>3- Measure type: Resistance (Ohm) Measure point 1: 30-pole connector Pin: 21 Measure point 2: 30-pole connector Pin: 22 | 1- Connector Connected; Key +15 OFF;<br>2- Connector Not connected; Key +15 OFF;<br>3- Connector Connected; Key +15 OFF; | 1- Typical Value: 60 Ohm;<br>2- Min. value: 29 KOhm; Max. value: 33 KOhm;<br>3- Typical Value: 60 Ohm; | Carry out the recommended measurements. |
| 0E7 | 0C | CAN LINE | INTERNAL FAULT | | Ecu internal failure. | Before replacing the control unit make sure that the control unit is powered correctly. | 1- Measure type: Resistance (KOhm) Measure point 1: Connector X1 ECU Pin: 1 (CAN H) Measure point 2: Connector X1 ECU Pin: 3 (CAN L)<br>2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 7 Measure point 2: Connector X1 Pin: 4<br>3- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 8 Measure point 2: Connector X1 Pin: 4 | 1- Connector Not connected; Key +15 OFF;<br>2- Connector Connected; Key +15 ON;<br>3- Connector Connected; Key +15 ON; | 1- Min. value: 29 KOhm; Max. value: 33 KOhm;<br>2- Min. value: 22 V; Max. value: 28 V;<br>3- Min. value: 22 V; Max. value: 28 V; | Carry out the recommended measurements. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 0FB | 03 | VOLTAGE | OVER-VOLTAGE | | The alternator charge may be excessive. | Check battery and alternator supply.<br>Check supply voltage. | | | | Check the Tension Regulator or any false contacts on the earth or positive points. |
| 0FD | 02 | ELEC-TRONIC CON-TROL UNIT | INCOR-RECT WHEEL PARAME-TERS | | | Reprogram ABS central unit with correct configuration. | | | | If the error persists to replace ECU. |
| 0FD | 0C | ELEC-TRONIC CON-TROL UNIT | EEPROM PARAME-TERS NOT CORRECT | | | Reprogram ABS central unit with correct configuration. | | | | If the error persists to replace ECU. |
| 0FE | 05 | ELEC-TRONIC CON-TROL UNIT | ASR FUNC-TION DIS-ABLED | Brake controlling ASR disabled. | ECU connector X2 not connected or absence of ground on PIN 2 of each ABS electrovalve. | Check compatibility between vehicle system and E.C.U. configuration. | | | | Check that the ABS ECU programming is convenient for the vehicle system.<br>Check the CAN line with EDC.<br>Check that the EDC ECU is properly programmed. |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 0FE | 05 | ELEC-TRONIC CON-TROL UNIT | ABS-ASR FUNC-TION DIS-ABLED | ABS / ASR dis-abled. | ECU connector X2 not con-nected or ab-sence of ground on PIN 2 of each ABS electro-valve. | Check compatibility be-tween vehicle system and E.C.U. configura-tion. | | | | Check that the ABS ECU pro-gramming is convenient for the ve-hicle system. Check the CAN line with EDC. Check that the EDC ECU is prop-erly pro-grammed. |
| 0FE | 08 | ELEC-TRONIC CON-TROL UNIT | EXCESSIVE SLIPPING | | Mechanical problems in the ASR -System (pneumatic pipes, the ASR electrovalve, ABS-electro-valves, ASR dis-abling switch). | Check phonic wheel and replace it if dam-aged. Check and re-store clearance be-tween sensor and pho-nic wheel. Check: Check the in-tegrity and cleanliness of the phonic wheel. Restore clearance be-tween sensor and pho-nic wheel. Comparable values: 0,7 ± 0,05 mm | | | | |
| 0FE | 09 | SOLE-NOID VALVES - ABS SOLE-NOID VALVES | ACTIVA-TION TIMES NOT CORRECT | | ABS valve enab-ling time incor-rect. | Check that the solenoid connectors in the elec-trical system and the pipes in the pneumatic system have not been inverted. | | | | |

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| DTC | FMI | Failing component | Type of Failure | Visible failure | Possible Cause | Repair action | Checks to be performed | Measuring conditions | Values to be detected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 0FE | 0C | ELEC-TRONIC CON-TROL UNIT | INTERNAL FAULT | | Ecu internal fail-ure. | Before replacing the control unit make sure that the control unit is powered correctly. | 1- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 7 Measure point 2: Connector X1 Pin: 4<br>2- Measure type: Voltage (V) Measure point 1: Connector X1 Pin: 8 Measure point 2: Connector X1 Pin: 4 | 1- Connector Connected; Key +15 ON;<br>2- Connector Connected; Key +15 ON; | 1- Min. value: 22 V; Max. value: 28 V;<br>2- Min. value: 22 V;<br>Max. value: 28 V; | Carry out the recom-mended measure-ments. |

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SECTION 2

| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Insufficient or irregular system charging | Pneumatic system pipes leaking or broken. | Tighten or replace loose or damaged fittings.<br>Replace broken or damaged pipes. |
| | Air compressor is faulty. | Overhaul or replace air compressor. |
| | Pressure regulator in drier is faulty. | Overhaul or replace drier. |
| | Four-way safety valve is faulty. | Overhaul or replace four-way safety valve. |
| Rear axle service braking is inefficient or irregular | Leaks or breakages in pneumatic system pipes. | Tighten or replace loose or damaged fittings.<br>Replace braoken or damaged pipes. |
| | Braking control is faulty. | Adjust, overhaul and if necessary replace the braking control. |
| | Worn or vitrified brake linings. | Overhaul or replace the brake linings. |
| | Rear brakes are faulty. | Overhaul the rear brakes. |
| | Duplex distributor is faulty. | Overhaul or replace Duplex distributor. |
| | Brake cylinders are faulty. | Overhaul or replace brake cylinders. |
| Front axle service braking is inefficient or irregular | Leaks or breakages in pneumatic system pipes. | Tighten or replace loose or damaged fittings<br>Replace broken or damaged pipes. |
| | Duplex distributor is faulty. | Overhaul or replace Duplex distributor. |
| | Worn and/or vitrified brake linings. | Overhaul or replace brake linings. |
| | Front brakes are faulty. | Overhaul front brakes. |
| | Diaphragm brake cylinders are faulty. | Overhaul or replace diaphragm brake cylinders. |

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| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Trailer service braking is inefficient or irregular | Leaks or breakages in pneumatic system pipes. | Tighten or replace loose or damaged fittings<br>Replace broken or damages pipes. |
| | Triple control servo distributor is faulty. | Overhaul or replace triple control servo distributor. |
| | Duplex distributor is faulty. | Overhaul or replace duplex control valve. |
| | Pressure reducer is faulty. | Overhaul or replace pressure reducer. |
| | Worn or vitrified brake linings. | Overhaul or replace brake linings. |
| | Trailer brakes is faulty. | Overhaul trailer brakes. |
| Inefficient or no parking braking | Leaks or breakages in pneumatic system pipes. | Tighten or replace loose or damaged couplings.<br>Replace broken or damaged pipes. |
| | Combined brake cylinders are faulty. | Overhaul or replace combined brake cylinders. |
| | Parking brake hand lever is faulty. | Overhaul or replace lever. |
| | Worn or vitrified brake linings. | Overhaul or replace brake linings. |
| | Relay valve is faulty. | Overhaul or replace relay valve. |
| Inefficient or no parking braking on trailer | Leaks or breakages in pneumatic system pipes. | Tighten or replace loose or damaged couplings.<br>Replace broken or damaged pipes. |
| | Triple control servo distributor is faulty. | Overhaul or replace triple action servo control valve. |
| | Parking brake hand lever is faulty. | Overhaul or replace hand lever. |
| | Worn or vitrified trailer brake linings. | Overhaul or replace trailer brake linings. |
| | Trailer brakes are faulty. | Overhaul trailer brakes. |

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| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Delayed parking brake release | Leaks or breakages in pneumatic system pipes. | Tighten or replace loose or damaged couplings.<br>Replace broken or damaged pipes. |
| | Relay valve is faulty. | Overhaul or replace relay valve. |
| | Combined brake cylinders are faulty. | Overhaul or replace combined brake cylinders. |
| | Parking brake hand lever is faulty. | Overhaul or replace lever. |
| | Rear brakes are faulty. | Overhaul rear brakes. |
| Delayed trailer parking brake release | Leaks or breakages in pneumatic system pipes. | Tighten or replace loose or damaged couplings.<br>Replace broken or damaged pipes. |
| | Triple control servo distributor is faulty. | Overhaul or replace triple action servo control valve. |
| | Parking brake hand lever is faulty. | Overhaul or replace hand lever. |
| | Trailer brakes are faulty. | Overhaul trailer brakes. |
| The vehicle pulls to one side when braking | Leaks or breakages in pneumatic system pipes. | Tighten or replace loose or damaged connections.<br>Replace broken or damaged pipes. |
| | Duplex distributor is faulty. | Overhaul or replace Duplex control valve. |
| | Braking control is faulty. | Adjust, overhaul and if necessary replace load proportioning valve. |
| | Front brakes are faulty. | Overhaul front brakes. |
| | Rear brakes are faulty. | Overhaul rear brakes. |
| | Triple control servo distributor is faulty. | Overhaul or replace triple action control valve. |
| Insufficient trailer slow-down braking | Leaks or breakages in pneumatic system pipes. | Tighten or replace loose or damaged couplings.<br>Replace broken or damaged pipes. |
| | Pressure reducer is faulty. | Overhaul or replace pressure reducer. |
| | Triple control servo distributor is faulty. | Overhaul or replace triple action control valve. |
| | Parking brake hand lever is faulty. | Overhaul or replace lever. |

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| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Brake linings become worn quickly | Duplex distributor is faulty. | Overhaul or replace duplex control valve. |
| | Braking control is faulty. | Adjust, overhaul and if necessary replace load proportioning valve. |
| | Brakes are faulty. | Overhaul brakes. |
| | Triple control servo distributor is faulty. | Overhaul or replace triple action control valve. |
| | Relay valve is faulty. | Overhaul or replace relay valve. |
| Brake system failure indicator light switched on | Leaks or breakages in pneumatic system pipes. | Tighten or replace loose or damaged couplings.<br>Replace broken or damaged pipes. |
| | Four-way safty valve is faulty. | Overhaul or replace four way protection valve. |
| | Light indicator electric circuit is badly wired. | Find wrong connection and rectify wiring. |
| Parking brake indicator light switched on with hand lever in running position | Light indicator electric circuit is badly wired. | Find wrong connection and rectify wiring. |
| | Parking hand lever is faulty. | Overhaul or replace lever. |
| | Pressure reducer operating normally. | Overhaul or replace pressure reducer. |
| Noisy brakes | Worn brake linings. | Replace brake linings. |
| | Shoe return springs are faulty. | Overhaul rear brakes. |
| | Brake drums are ovalized over prescribed tolerance range. | Face or, if necessary, replace drums. |

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## TIGHTENING TORQUES

| DESCRIPTION | TORQUE | |
|---|---|---|
| **Compressor** | **Nm** | **(kgm)** |
| Compressor, Knorr type - BREMSE 2 W 460 R, 464 $cm^3$ | | |
| Head fastening screws | 30 | (3) |
| Pulley fastening nut | 190 $^{+1}_{-0}$ | (19) |
| Combined brake cylinder | | |
| Brake cylinder ring nut | 300 + 30 | (30 ± 3) |
| Manual brake release screw | 15 + 20 | (1.5 ) |
| Diaphragm brake cylinder (for drum brakes) | | |
| Brake cylinder ring nut | 300 + 30 | (30±3) |
| Diaphragm brake cylinder (for disk brakes) | | |
| Nuts to secure cylinder to brake caliper | 180 ± 20 | (18±2) |
| Front disc brakes axle 5886/D | | |
| Ring nut fixing wheel bearings | 515.5 ± 24.5 | (51.5 ± 2.4) |
| Cylindrical head screws with hex socket to lock wheel bearing adjustment clamp | 27.5 ± 2.5 | (2.7 ± 0.2) |
| Self-locking hex screws to fix brake callipers to mount | 615.5 ± 61.5 | (61.5 ± 6.1) |
| Self-locking hex screw to fix brake calliper mount to stub axle | 312.5 ± 16.5 | (31.2 ± 1.6) |
| Hex screw fixing brake disc to wheel hub | 281.5 ± 13.5 | (28.1 ± 1.3) |
| Cover for wheel hub z | 130 ± 10 | (13 ± 1) |
| Tapered threaded plug for wheel hub cover | 50 ± 5 | (5 ± 0.5) |
| Rear drum brakes axle 5985/2D | | |
| Wheel securing nut | 600 $^{+50}_{-20}$ | ( 60 $^{+5}_{-2}$ ) |
| Brake support securing screw | 362.5 ± 33.5 | (36.2 ± 3.3) |
| Cover securing screw | 49 ± 5 | (4.9 ± 5) |
| Support securing screw | 25 ± 3 | (2.5 ± 3) |
| Axle drum brakes 452191/2D - 453291/2D - 452146/2D - 451391/2D | | |
| Screw fixing drum | 25 ± 3 | (2.5 ± 0.3) |
| Cover securing screw H | 50 ± 5 | (5 ± 0.3) |
| Flat-head screw | 50 ± 5 | (5 ± 0.5) |
| Wheel securing nut | 615 ± 35 | (61.5 ± 3.5) |
| Drum brakes on rear axle MT 23 - 155 | | |
| Wheel fastening nut | 665.5 ± 61.5 | (67.8 ± 6.2) |
| Drum fastening screw | 54.5 ± 12.5 | (29 ± 1.3) |
| Half-shaft fastening screw * | 262 ± 27 | (26.7 ± 2.7) |
| Wheel hub bearing ring nut | 932 ± 98 | (95 ± 10) |
| Nut for brake support fastening screw | 289.4 ± 14.5 | (29.5 ± 1.5) |
| Rev sensor support fastening screw D | 6 ± 1 | |

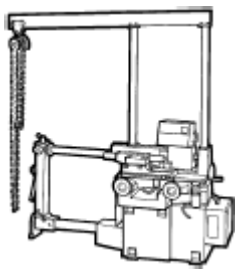
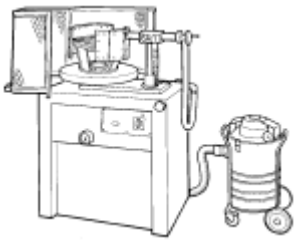
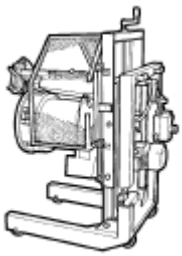
z Deposit a sealer bead only on hub cover ledge surface, using dedicated dispenser. Protect threaded portion. Use LOCTITE TYPE 574 as a sealer

* spread the flange/wheel hub mating surface with sealer IVECO 1905685 (LOCTITE 14780)

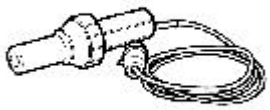
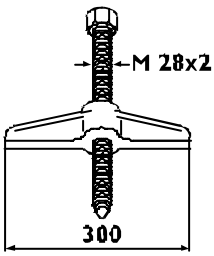
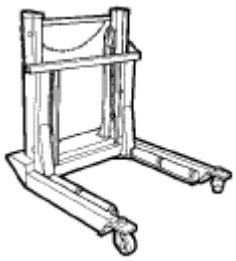
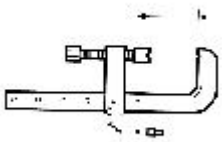
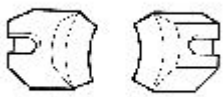
• apply LOCTITE 245 on the threading

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## TOOLS

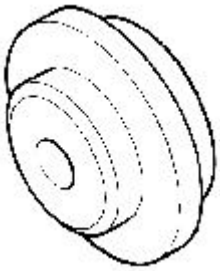
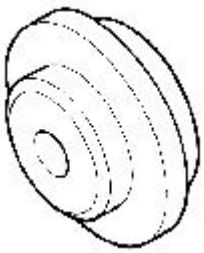
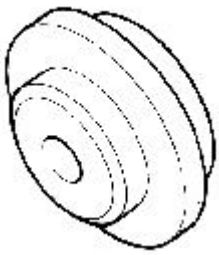
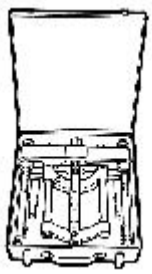
| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99301001** |  | Grinding and turning machine for brake discs and drums |
| **99301005** |  | Brake disc turning device |
| **99301006** |  | Brake shoe turning device |
| **99305079** |  | Brake shoe turning device |
| **99305087** |  | Rivet press |
| **99305117** |  | Instrument to check air circuits |

Aquila Trucks Centres

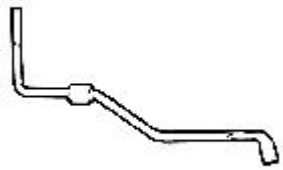
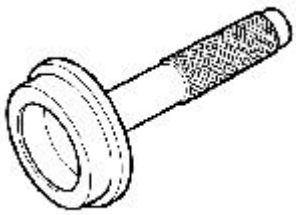
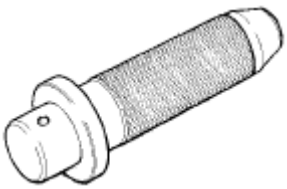
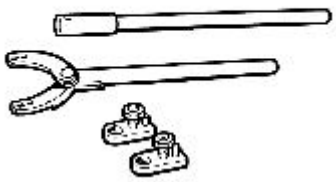
| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99305121** |  | Hot air device |
| **99341003** |  | Single-acting bridge (rear axles 452194/2D - 451391/2D - 453291/2D - 452191/D - 452146/2D) |
| **99321024** |  | Hydraulic trolley to remove and refit wheels |
| **99327030** |  | E.A.SY. |
| **99341015** |  | Clamp (rear axles 412191/2D - 451391/2D - 453291/2D - 452146/2D) |
| **99341023** |  | Grips (rear axles 452191/2D - 451391/2D - 453291/2D) |

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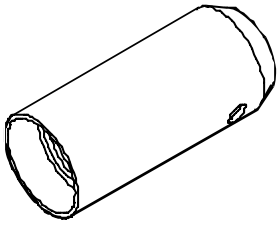
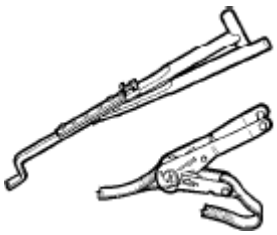
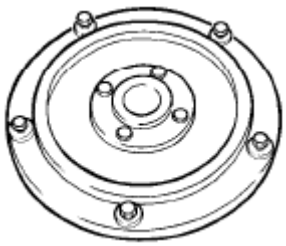
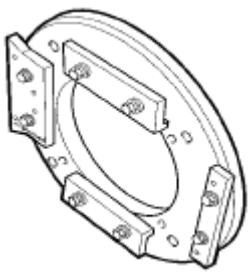
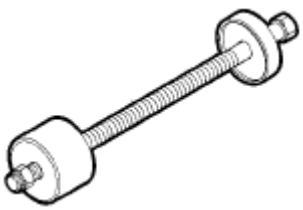
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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99345049** |  | Reaction block for extractors (drive axle 5985/2D) |
| **99345053** |  | Reaction block for extractors (drive axle 5985/2D, rear axle 452146/2D) |
| **99345055** |  | Reaction block for extractors (rear axles 452191/2D - 451391/2D - 453291/2D) |
| **99348001** |  | Extractor with locking device (drive axle 5985/2D, rear axles 452146/2D - 452191/2D - 451391/2D - 453291/2D) |
| **9938004** |  | Universal male extractor from 5 to 70 mm (drive axle 5985/2D) |
| **99354207** |  | Wrench for wheel hub caps (front axle 5886/D, drive axle 5985/2D, rear axles 452146/2D - SR145E/2D - 452191/2D - 451391/2D - 453291/2D) |

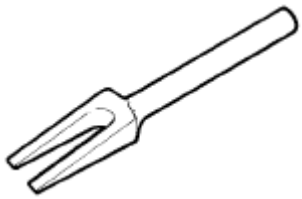
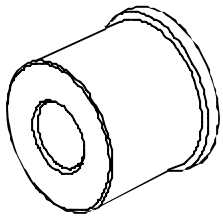
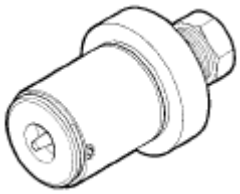
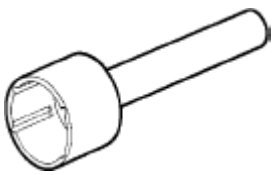
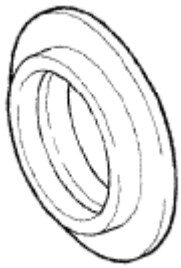
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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99356001** |  | Wheel brake shoe adjustment wrench (rear axles 452191/2D - 451391/2D - 453291/2D - 452146/2D) |
| **99356006** |  | Wrench for dismounting and remounting faired brake cylinder ring nut |
| **99370005** |  | Grip for interchangeable drifts (rear axles 452191/2D - 451391/2D - 453291/2D - 452146/2D) |
| **99370006** |  | Grip for interchangeable drifts (front axle 5886/D, drive axle 5985/2D, rear axles 452191/2D - 451391/2D - 453291/2D) |
| **99370007** |  | Grip for interchangeable drifts (front axle 5886/D, drive axle 5985/2D, rear axles 452191/2D - 451391/2D - 453291/2D - 452146/2D) |
| **99370317** |  | Reaction lever with extension to retain flanges (front axle 5886/D, drive axle 5985/2D, rear axles 452191/2D - 451391/2D - 453291/2D - 452146/2D) |

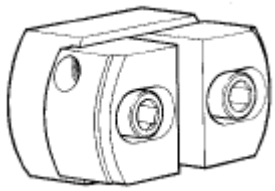
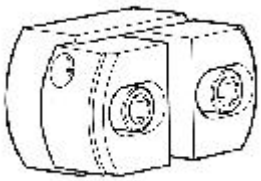
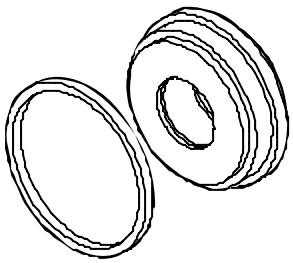
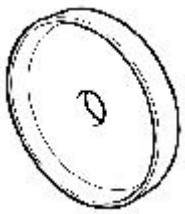
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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99370715** |  | Guide for fitting wheel hub (front axle 5886/D, rear axles 452191/2D - 451391/2D - 453291/2D |
| **99372211** |  | Tool to remove and refit brake shoe retainer springs |
| **99372213** |  | Tool for turning brake drum (use with 99301001) (drive axle 5985/2D, rear axles 452191/2D - 451391/2D - 453291/2D - 452146/2D, axle 5886/2D) |
| **99372228** |  | Hub for positioning dismantled floating shoe turning tools on lathe 99301001 |
| **99372230** |  | Tool for turning dismantled floating shoes (Rockwell 410) (use with 99301001 - 99372228) |
| **99372237** |  | Tool to mount brake calliper sliding bush guard (front axle 5886/D) |

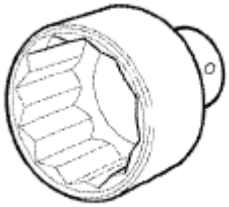
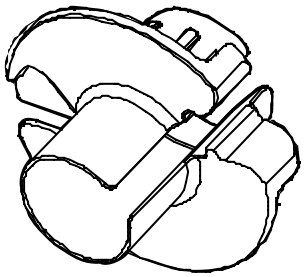
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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99372238** |  | Tool to extract brake calliper thrust units (front axle 5886/D) |
| **99372239** |  | Tool to mount thrust units with brake calliper guard (front axle 5886/D) |
| **99372240** |  | Tool to remove and refit brake calliper sliding bush guide bushings (use with 99372237 for assembly) (front axle 5886/D) |
| **99372241** |  | Tool for notching brake calliper sliding bush guide bushing (front axle 5886/D) |
| **99373004** |  | Key to remove brake cylinder gasket (Rockwell) (rear axles 452191/2D - 451391/2D - 453291/2D - 452146/2D, axle 5985/2D) |
| **99374025** |  | Installer, wheel hub inner seal (use with 99370005) |

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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99374093** |  | Drift to mount bearing outer races 91-134 mm (use with 99370007) (front axle - 5886/D, drive axle 5985/2D, rear axles 452191/2D - 451391/2D - 453291/2D - 452146/2D) |
| **99374094** |  | Drift to mount bearing outer races 134-215 mm (use with 99370007) (rear axles 452191/2D - 451391/2D - 453291/2D - 452146/2D, axle 5985/2D) |
| **99374132** |  | Key to mount wheel hub internal gasket (use with 99370006) (front axles 5886/D) |
| **99374161** |  | Key to mount wheel hub internal gasket (rear axles 452191/2D - 451391/2D - 453291/2D - 452146/2D) |
| **99374377** |  | Key to mount wheel hub internal gasket (drive axle 5985/2D) |
| **99374451** |  | Tool to remove and refit drive shafts (rear axles 452191/2D - 451391/2D - 453291/2D - 452146/2D) |

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| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99387050** |  | Cutting nippers for polyamide pipes |
| **99388001** |  | Wrench (80 mm) for front wheel hub bearing adjustment nut (front axle 5886/D, drive axle 5985/2D) |
| **99387051** |  | Toolkit to remove polyamide tubes (6-8-10-12 mm) from RAUFOSS joints |

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## MAIN DATA - PNEUMATIC SYSTEM

| DESIGNATION | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Compressor** | | | | | | | |
| - Type: WABCO 412 352 200 8 | | | | | | Single cylinder | |
| Displacement | | | | | | 352 $cm^3$ | |
| - Type: KNORR - BREMSE 2 W460 R | | | | | | Two cylinders | |
| Displacement | | | | | | 628 $cm^3$ | |
| **APU** | | | | | | | |
| - Type: KNORR Z 007035 | | | | | | | |
| Max. working pressure | bar | 13 bar | | | | | |
| Safety valve opening pressure | bar | 13 + 4 bar | | | | | |
| Circuit | | 1 | 2 | 3 | 4 | 3 | 4 |
| Fitting for second | | 21 | 22 | 23 | 24 | | 26 |
| Opening pressure (The circuit 1+2 are filled first) | bar | $7.5^{+0.2}_{0}$ | | $8.0^{-0}_{0.2}$ | | | |
| Opening pressure of the integrated safety valve | bar | | | > = 9.2 | | | |
| Static closing pressure. (Without compensation, with 0 bars in the circuit out of service) | bar | 6.5 ± 0.25 | | 6.5 ± 0.25 | | | |
| Working pressure | bar | | | $8.5_{-0.3}$ | | $8.5_{-0.5}$ | |
| Pressure limiter on/off pressure difference | bar | | | < = 0.65 | | | |
| **Air tanks** | | | | | | | |
| Front axle | | | | | | 20 Litres | |
| Rear axle | | | | | | 20 Litres | |
| Parking + trailer | | | | | | 20 Litres | |
| For regeneration | | | | | | 5 Litres | |
| Services | | | | | | 5 Litres | |
| **Engine brake control pedal valve** | | | | | | | |
| - Type: BOSCH A 481 110 125 - WABCO 463036019 - BENDIX CP6A | | | | | | | |
| Maximum working pressure | | | | | | 12 bar | |
| **Duplex distributor** | | | | | | | |
| - Type: KNORR - DX 60A | | | | | | | |
| Feed pressure | | | | | | 10.5 bar | |
| Working pressure | | | | | | 10.5 bar | |
| **Proportional reducing valve** | | | | | | | |
| - Type: KNORR DB 2116 | | | | | | | |
| Ratio | | | | | | 1.15:1 | |
| **Relay valve** | | | | | | | |
| - Type: KNORR - BREMSE - AC 574 AXY | | | | | | | |
| Max. working pressure | | | | | | 10.2 bar | |
| - Type: KNORR - BREMSE - RP2A | | | | | | | |
| Max. working pressure | | | | | | 10 bar | |

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| DESIGNATION | |
|---|---|
| **Double-acting relay valve** | |
| - Type: WABCO 973 011 208 0 | |
| Control maximum pressure | 10 bar |
| **Variable and automatic coupling heads** | |
| - Type: MARELLI - BOSCH - KNORR - BREMSE - WABCO - GRAU | |
| Working pressure | 8.5 bar |
| **Triple control servo distributor** | |
| - Type: KNORR - BREMSE AC 597 B - WABCO 973009013 | |
| Feed pressure | 8.5 bar |
| Predominance | 0.2 bar |
| Differential control pressure (ducts 41 and 22) | $2.5\ ^{-0,5}_{+0,3}$ bar |
| **Parking brake distributor (towing vehicles)** | |
| - Type: KNORR DPM 60EY | |
| Supply and working pressure | 8.5 bar |
| Travel of control lever (discharge) with start of emergency braking (point of resistance) | 67° |
| Parking braking | 73° |
| Test braking to check supply to triple control valve | 86° |
| **Parking brake distributor (stand-alone vehicles)** | |
| - Type: KNORR DPM 61EY | |
| Supply pressure | 8.5 bar |
| Travel of control lever (discharge) with start of emergency braking (point of resistance) | 67° |
| Parking braking | 73° |
| **Trailer retarder control valve (optional)** | |
| - KNORR DPM 96 DAX | |
| Supply pressure | 8.5 bar |
| Maximum angular travel of control lever | 73° |
| **Air pressure switch** | |
| - TDS F13043 - F13047 | |
| Working pressure | max 15 bar |
| Setting pressure | |
| with increasing pressure | 5.5 ± 0.5 bar |
| with decreasing pressure | 6.6 ± 0.3 bar |
| **Safety valve (for "Sweden" only)** | |
| - WABCO 434 205 061 0 | |
| Maximum operating pressure | 10 bar |
| **Controlled pressure valve** | |
| - WABCO 434 100 199 - KNORR - BREMSE 1B 435 47 - BENDIX VPC 4M | |
| Opening pressure | $7\ ^{+0.1}_{-0.3}$ bar |
| **ABS wheel anti-lock control valve** | |
| - Type: WABCO 472 195 055 0 | |
| Maximum operating pressure | 13 bar |
| - Type: KNORR - BREMSE IC 57664 | |
| Maximum operating pressure | 10,2 bar |

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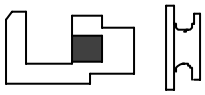
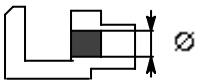
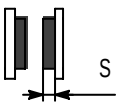
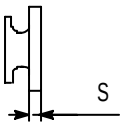
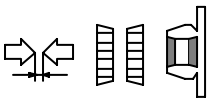
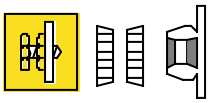
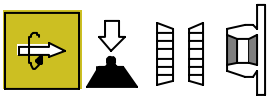
| DESIGNATION | |
|---|---|
| **Check valve** | |
| - Type: VOSS 02 68 91 42 00 | |
| Max. working pressure | 12 bar |
| Impedance pressure | 0.2 bar |
| **Twin stop valve** | |
| - WABCO 434 208 029 0 | |
| Supply pressure | max 10 bar |
| **Pressure test point valve** | |
| - Type: RAUFOSS | |
| Working pressure | max 12.5 bar |
| - Type: SIRIT | |
| Working pressure | max 12.5 bar |
| **Pressure sensor** | |
| - WABCO 441 040 015 0 | |
| Measuring principle | piezo-resistive |
| Permissible overpressure | 16 bar |
| **Solenoid valve normally closed ASR control** | |
| - WABCO 472 170 606 0 | |
| Working pressure | 5.5 ÷ 11 bar |
| Feed maximum pressure | 13 bar |
| Voltage | 24V |
| Current | 0.69 A |
| **Electronic control unit** | |
| - WABCO 446 004 320 0 | |
| Supply voltage | 24 V |
| **Membrane brake cylinder (for drum brakes)** | |
| - Type 14: BENDIX DFR 8944 B | |
| Maximum working pressure | 8.5 bar |
| Sleeve length | 187 mm |
| Stroke | min. 53 mm |
| - Type 14: KNORR EF 141 AY | |
| Maximum working pressure | 8.5 bar |
| Sleeve length | 152 mm |
| Stroke | 53 mm |
| - Type 16: BENDIX DFR 9023 B | |
| Maximum working pressure | 8.5 bar |
| Sleeve length | 187 mm |
| Stroke | min. 53 mm |
| - Type 16: KNORR EF 161 AY | |
| Maximum working pressure | 8.5 bar |
| Sleeve length | 152 mm |
| Stroke | min. 53 mm |
| - Type 18: BENDIX EF 180 BY | |
| Maximum working pressure | 8.5 bar |
| Sleeve length | 180 mm |
| Stroke | min. 53 mm |

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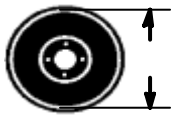
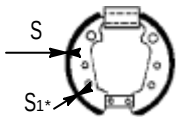
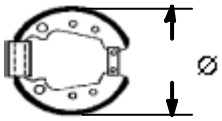
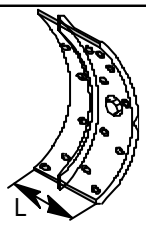
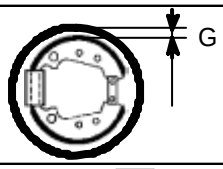
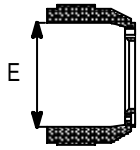
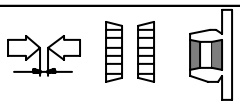
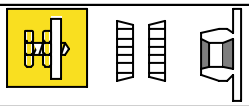
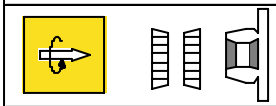
| DESIGNATION | |
|---|---|
| **Combined brake cylinder** | |
| - Type 16/24 HF: KNORR 1 C 56449 | |
| Maximum working pressure | 8.5 bar |
| Spring load | 7900 N |
| - Type 18/24 HF: KNORR 1 C 55976 | |
| Maximum working pressure | 8.5 bar |
| Spring load | 7900 N |
| - Type 14/24: HF KNORR - BREMSE BY 9276 (Z 005732) | |
| Maximum working pressure | 8.5 bar |
| Spring load | 10400 N |
| - Type 16/24: HF KNORR - BREMSE BY 9331 (Z 005733) | |
| Maximum working pressure | 8.5 bar |
| Spring load | 10400 N |
| **Membrane brake cylinder (for disk brakes)** | |
| - Type 22: KNORR - BREMSE Z 011553 | |
| Maximum working pressure | 10.7 bar |
| Sleeve length | 141 mm |
| Stroke | min 64 mm |
| - Type 24: KNORR - BREMSE Z 010464 | |
| Maximum working pressure | 10.7 bar |
| Sleeve length | 141 mm |
| Stroke | min 64 mm |
| **Membrane brake cylinder (for drum brakes)** | |
| - Type 16: KNORR EF 161 NYX | |
| Maximum working pressure | 8.5 bar |
| Sleeve length | 152 mm |
| Stroke | min 53 mm |
| - Type 16: KNORR EF 161 PYX | |
| Maximum working pressure | 8.5 bar |
| Sleeve length | 190 mm |
| Stroke | min 53 mm |
| - Type 18: KNORR EF 180 PYX | |
| Maximum working pressure | 8.5 bar |
| Sleeve length | 190 mm |
| Stroke | min 53 mm |
| **Combined brake cylinder** | |
| - Type 16/24 HF: KNORR - BREMSE Z 007616 | |
| Spring load | 7900N |
| Stroke | min 53 mm |
| - Type 18/24 HF: KNORR - BREMSE Z 007618 | |
| Spring load | 7900N |
| Stroke | min 53 mm |

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## MAIN DATA - BRAKES

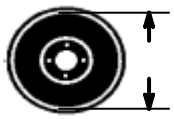
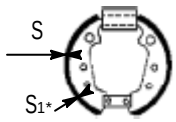
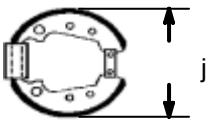
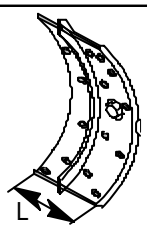
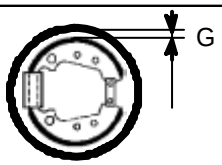
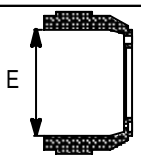
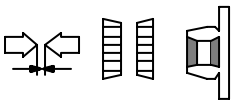
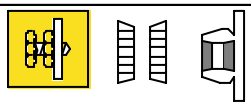
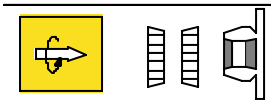
| | | |
|---|---|---|
|  | **KNORR FRONT DISC BRAKES:**<br>**FRONT AXLE**<br>**INTERMEDIATE ADDED AXLE** | 5886/D |
|  | Brake calliper cylinders:<br>- number<br>- diameter Ø mm | <br>2<br>68 |
|  | Brake lining thickness:<br>- standard S mm<br>- minimum permissible S mm | <br>21<br>2 |
|  | Brake disc diameter Ø mm | 432 |
|  | Brake disc thickness:<br>- normal S mm<br>- minimum permissible S mm | <br>45 ± 0.1<br>37 (4 mm per side) |
| | Operating clearance G mm | 0.5 ÷ 1 |
|  | **WHEEL HUBS** | |
|  | Wheel hub bearings | 2 with tapered rollers |
|  | Hub bearing end float mm | 0.16 max |
|  | Hub bearing end float adjustment | with ring nut |
|  | Rolling torque daNm | 0.50 max. |
|  | Oil for wheel hub bearings<br>Tutela W 140/M DA<br>Litres<br>Quantity of oil for each hub<br>Kg | <br><br>0.35<br><br>0.32 |

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| | MERITOR DUO-DUPLEX DRUM BRAKES | DRIVE AXLE 5985/2D |
|---|---|---|
|  | Drum diameter:<br>- Nominal Ø mm<br>- 1st uprating Ø mm<br>- 2nd uprating Ø mm | <br>410 ÷ 410.4<br>412 ÷ 412.4<br>414 ÷ 414.4 |
|  | Brake lining thickness:<br>- Nominal S mm<br>- 1st uprating S mm<br>- 2nd uprating S mm<br>- minimum permissible $S_{1*}$ mm | <br>22.95<br>23.95<br>24.95<br>6.95 |
|  | Diameter of brake linings:<br>- Nominal Ø mm<br>- 1st uprating Ø mm<br>- 2nd uprating Ø mm | <br>408 ÷ 409<br>410 ÷ 411<br>412 ÷ 413 |
|  | Width of brake linings:<br>L mm | <br>179 ÷ 180 |
|  | Clearance between brake linings and drum:<br>G mm | <br>0.5 ÷ 1.2 |
|  | Maximum error of concentricity in the drum diameter after turning<br>E mm | <br>0.04 |
|  | **WHEEL HUBS** | |
|  | Wheel hub bearings | Two with tapered rollers SET-RIGHT |
|  | Hub bearing end float<br>mm | Not adjustable |
|  | Hub bearing end float adjustment | Tightening to torque with ring nut |
|  | Wheel hub bearing rolling torque | 0.50 max<br>- |
|  | Oil for wheel hub bearings Tutela W 140/M DA<br>Litres<br>Quantity of oil for each hub<br>Kg | <br>-<br><br>- |

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| | MERITOR DUO-DUPLEX REAR DRUM BRAKES | H.R. REAR AXLE | | | | REAR AXLE |
|---|---|---|---|---|---|---|
| | | 451391/2D | 452146/2D | 452191/2D | 453291/2D | MT 23-155/2D |
|  | Drum diameter:<br>- Nominal Ø mm<br>- 1st uprating Ø mm<br>- 2nd uprating Ø mm | 410 ÷ 410.4<br>412 ÷ 412.4<br>414 ÷ 414.4 | | | | |
|  | Brake lining thickness:<br>- Nominal S mm<br>- 1st uprating S mm<br>- 2nd uprating S mm<br>- minimum permissible S1* mm | 22.95<br>23.95<br>24.95<br>6.95 | | | | |
|  | Diameter of brake linings:<br>- Nominal Ø mm<br>- 1st uprating Ø mm<br>- 2nd uprating Ø mm | 408 ÷ 409<br>410 ÷ 411<br>412 ÷ 413 | | | | |
|  | Width of brake linings:<br>L mm | 199 ÷ 200 | | | | |
|  | Clearance between brake linings and drum:<br>G mm | 1 ÷ 1.25 | | | | |
|  | Maximum error of concentricity in the drum diameter after turning<br>E mm | 0.04 | | | | |
|  | **WHEEL HUBS** | | | | | |
|  | Wheel hub bearings | SET-RIGHT | | | | Two with tapered rollers (Unit Bearing) |
|  | Hub bearing end float<br>mm | Not adjustable | | | | Not adjustable, tighten according to retaining ring nut torque |
|  | Hub bearing end float adjustment | - | | | | |
|  | Wheel hub bearing rolling torque | - | | | | |
|  | Oil for wheel hub bearings<br>Tutela W 140/M DA<br>Litres<br>Quantity of oil for each hub<br>Kg | -<br>- | | | | |

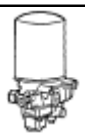
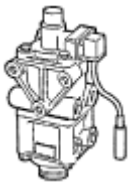
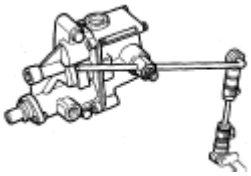
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## BRAKING SYSTEM MAIN COMPONENTS CHECK

Since the vehicle system is approved according to European road code standards, it is necessary that the efficiency and components are periodically checked using tool 99305117.
The checks are carried out with the vehicle at a standstill, using compressed air from the tanks, recharged, with the engine running, by the compressor.

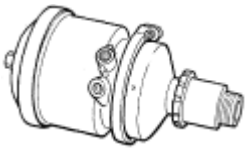
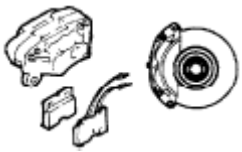
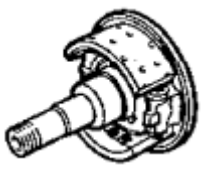


Always block the vehicle before starting any type of operation. Periodically check the gauges comparing them with a master gauge.

| DEVICE | DESIGNATION | CHECKS |
|---|---|---|
|  | Compressor | Check the tightness of fittings and that the compressor is securely fastened. Make sure the cooling fins are not dirty. |
|  | Drier (optional) | Operate on a bleeder valve or loosen a screwed plug (with integrated bleeder hole) to check that the air drier is operating correctly. The air should come from the tank with no signs of condensate water. |
|  | Air tanks for:<br>- Front axle<br>- Rear axle<br>- Parking+trailer<br>- Services<br>- Regeneration | Check the seal and anti-rust protection.<br>Discharge the condensate from the tanks through the bleeder valve |
|  | Four way safety valve | Check :<br>Maximum opening pressure 8 bar<br>Static closing pressure 6.5 $^{+0,5}_{-0}$ bar |
|  | Duplex distributor | Press the pedal to the end of its stroke, releasing the pedal it should return immediately to its home position.<br>Pressure restriction 7.6 ± 0.3 bar<br>Check that the pedal gasket is not worn, that the brake control rods are well secured and lubricated with no strain.<br>Check that the lever housings are not worn or oxidized. |
|  | Pneumatic pressure control socket | Ensure that the protection plugs are inserted |
|  | Parking brake distributor (with checking position) | Operate on the parking brake distributor until it triggers, the gauge on the control socket is to indicate the pressure discharge 0 bar in 1 second.<br><br>The automatic coupling joint pipe and the gauge are to indicate at the same time a pressure of 8.5 bar |
|  | Engine brake control pedal distributor | Check functioning and seal |
|  | Load sensing valve | The plate indicates all the set values to be compared to those found when checking and adjusting. |

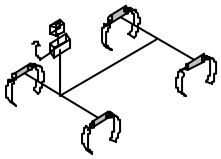
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| | | |
|---|---|---|
|  | Diaphragm cylinder | Check fastening, integrity and seal<br>The bleeder hole should be directed downwards and not clogged |
|  | Combined cylinder | Check fastening, integrity and seal.<br>The bleeder hole should be directed downwards and not clogged |
|  | Relay valve | Check operation and seal assessing the speed of brake cylinder activation |
|  | Engine brake control operator cylinder | Check operation and seal |
|  | Pressure reducer | Check set pressure (see specifications and data table)<br>Check operation |
|  | Triple control servo distributor for trailer braking, with incorporated modulated power steering | Fill the tank. Connect a gauge to the automatic coupling head and to a variable coupling head.<br>At a pressure of 1 bar, coming from the duplex distributor, the variable coupling head should have a pressure between 0.8 and 1.5 bar. Make a full braking (vehicle at a standstill).<br>Prescribed pressure must result at the coupling head, or a pressure that is 0.5 bar less. Activate the parking brake; at the variable coupling head the pressure should remain the same, or reduced by 0.5 bar. |
|  | Coupling heads | Check there is no dirt or damage on the coupling guides.<br>After coupling,operate the brake pedal and check the seal and stability between the coupling heads when delivering air at 7.5 bar.<br>Check there are no air leaks from the coupling gaskets. |
|  | Rear drum brakes | Releasing the pedal the shoes should return quickly and evenly to home position.<br>Check backlash between shoes and drum.<br>Check thickness of brake linings. |
|  | Disc brake calliper<br>Brake disc<br>Brake linings | Check the wear of the brake linings, scoring and wear of the brake disc, efficiency of the pistons, wear of the dust caps. |
|  | Drum brakes | When the pressure on the pedal stops, the shoes need to return to the rest position quickly and evenly on all the wheels.<br>Check the clearance between shoes and drum.<br>Check the thickness of the brake linings. |

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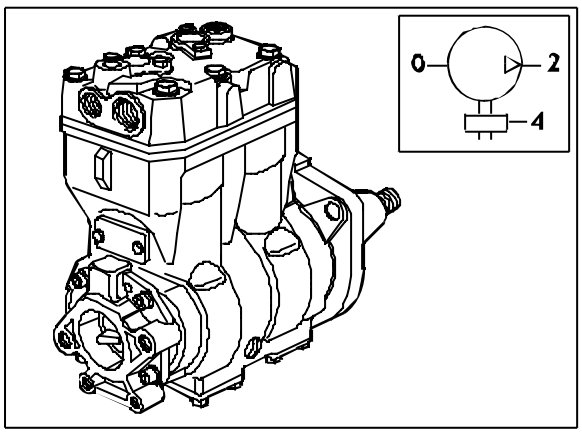
| | | |
|---|---|---|
|  | Pipes and fittings | Ensure that metal pipes are in perfect condition, with no dents or cracks. Polyamide hoses must have no cracks, cuts or scores. Also make sure that they are not near sharp edges of the bodywork or chassis that could damage them. Check that all the brackets fastening the pipes are securely fixed - loose fastenings cause vibrations that could give rise to breakages. Check that polyamide hoses are not in contact with oil or mineral grease, rubber solvents. Press hard on the brake pedal and check that the pipes are not blown. Check there are no leaks from fittings, otherwise tighten them fully, taking care when tightening not to cause irregular pipe torsion. In all the above cases the parts are to be replaced if there is a minimum of doubt as to their efficiency. Apart from their condition, it is recommended to replace hoses after considerable mileage, or after a period of long vehicle use. This will avoid sudden breakages due to age and fatigue. |
| | Pneumatic system seal with engine off below the starting pressure | This check is made on threaded couplings. Deliver air at a pressure of not less than 5 bar and spread quite thick soapy water on the joints and couplings using a soft brush, then observe carefully for signs of leaks. An air leak is within tolerance if it corresponds to a soap bubble with a diameter of 25 mm in 5 seconds, or a pressure drop within 10 minutes amounting to 2% of the disengagement pressure (0.22 ± 0.02 bar). |
| | Pneumatic system seal in partial braking range with 3 bar. | For 3 minutes the pressure must remain stabilized in the pneumatic system. The check is made with the parking brake deactivated. |

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# BRAKING SYSTEM MAIN COMPONENTS

## 790510 Compressor

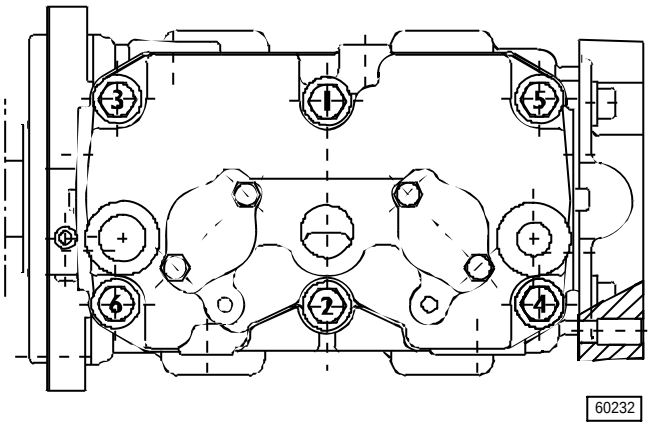
Figure 24




Produces sufficient compressed air to feed the braking system and ancillary services.

## Head fastening screws tightening torque

Figure 25




Tighten cylinder head fastening screws to the specified torque following the sequence shown in the figure.

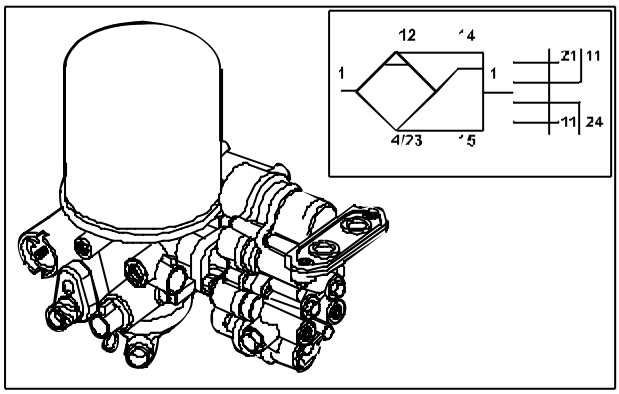
## Troubleshooting

| TROUBLE | POSSIBLE CAUSES | CURE |
|---|---|---|
| **Oil leakage from flange on outer side** | Incorrect driving torque | Tighten the screws to the prescribed values |
| | Flange body sealing surface not perfectly flat | Check the sealing surfaces, replace faulty parts or straighten them |
| | Broken gasket | Replace the gasket |
| | Shaft gasket damaged | Replace the gasket |
| **Oil leakage from head** | Damaged scraper ring (this can be seen because the whole seal seat is shiny) | Replace the entire piston |
| | Scraper ring is badly fitted | Fit in place with the TOP inscription turned towards the compressor head |
| | Scraper rings and piston rings are all on the same vertical line. | Fit in place at 120° with reference to each other |
| | Scored or ovalized cylinder | Grind the cylinder and fit a bigger piston |
| **No compression at all** | Deteriorated compression or intake valve | Replace the faulty parts |
| | Deteriorated compression or intake valve | Fit the rings at 120° with reference to each other |
| | Piston perforated or piston elements broken | Replace the entire piston |
| | Damaged gasket | Replace the gaskets |
| | Energy-saving device set on open during charging stage. | Replace the cylinder heads |
| **Poor efficiency** | Worn piston rings | Replace the piston (and piston rings) |
| | Air leakage between cylinder and head | Replace the gasket and tighten the screws to the prescribed torque |
| | Deteriorated energy saving unit, intake or compression valves | Replace the faulty parts |
| | Too much backlash between piston and cylinder | Grind the cylinder and fit a bigger piston |
| | Particles of carbonized oil between the intake and compression valves | Clean the valves |
| **Mechanical noises** | Too much backlash between small end and pin, between pin and piston hole, between shaft and big end, between shaft and bronze caps and between flanges and shaft. | Check the tolerances of the couplings involved |
| | Too much backlash between piston and cylinder | Grind the cylinder and fit a bigger piston |
| | Excessive deposits between piston and cylinder head caused by burnt oil. | Clean the incrustations and replace the valves |
| **Water seepage** | Head gasket or contact surfaces scored and uneven. | Replace the faulty parts |

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## A.P.U. (Air Processing Unit)

Figure 26




72019

Its function is to keep the air clean and at the right moisture level in the distribution system and keep the pressure needed for the operation of the connected systems at the outlet.
This component integrates the functions of 4-way pressure regulator, pressure reduction unit for parking, services and trailer.

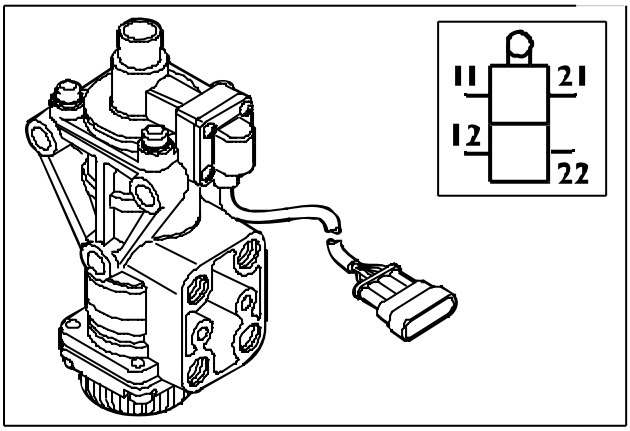
## A.P.U. Troubleshooting (Drier + four-way protection valve)

| PROBLEM | POSSIBLE CAUSE | REMEDY |
|---|---|---|
| **Too much condensate in the circuit** | Clogged filter cartridge | Replace the cartridge |
| **The set pressure is not reached in the tank** | Air leaking from safety valve | Overhaul the equipment and replace worn components |
| | Worn sealing gaskets | Overhaul the equipment and replace worn components |
| **Air loss at discharge** | Piston seal is insufficient | Overhaul the equipment and replace worn components |
| **Air leaks around the plugs** | Leakage from the valves in the four sections. | Overhaul the device, replacing the worn parts. |
| **Air leaks if a section breaks down** | Defective operation of the check valves. | Overhaul the device, replacing the worn parts if necessary or replace the device. |

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## 793110 Duplex distributor

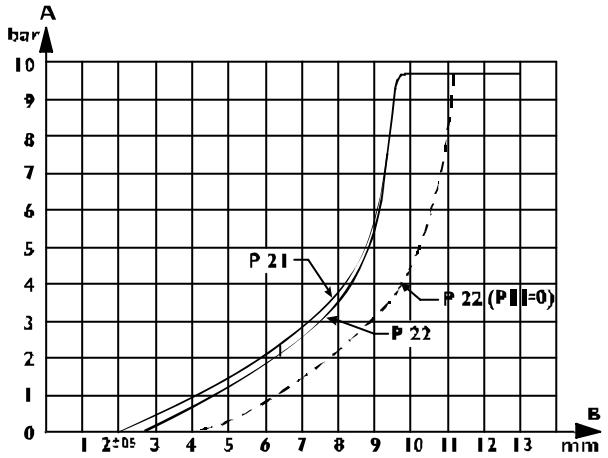
Figure 27




73914

Takes the air from the tank and distributes it to the braking elements. It is autorestrictive i.e. it limits the air output to an established maximum pressure and as a result there is a greater availability of energy and a maximum constant braking pressure regardless of the pressure variations in the tanks.
On vehicles fitted out as trucks duplex distributors are fitted to correct the braking force of the front axle elements according to the corrections made by the braking control (where present).

Figure 28




90639

PERFORMANCE DIAGRAM

A = Exit pressure p21/p22 [bar]

B = Shoe travel [mm]

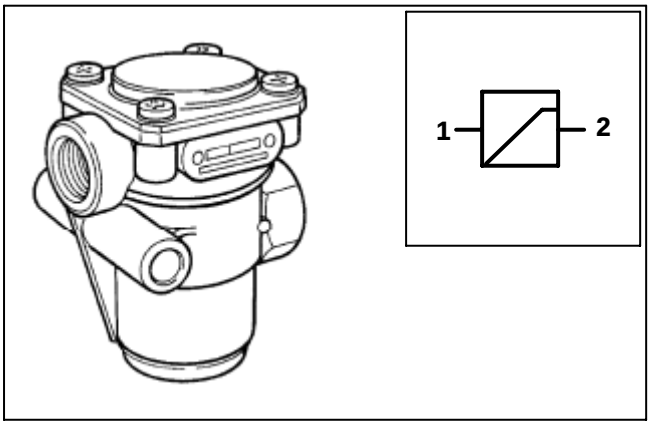
## Troubleshooting

| PROBLEM | POSSIBLE CAUSE | REMEDY |
|---|---|---|
| **Air escapes from the discharge hole** | Leaks from outlet ducts due to wear on seal gaskets | Overhaul the device and replace worn components |
| **Irregular autorestriction of distributor** | Auto restriction higher or lower than required | Adjust the device through the relevant screw |
| **Vibrations when braking** | Worn springs | Overhaul the device and replace faulty components |
| | Air leaks due to piston gasket seals in the two sections | Overhaul the device and replace faulty components |
| **Irregular operation of stop lamp control switch** | The electric circuit does not close | Replace the switch |
| | The electric circuit does not open | Replace the switch |

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## 793321 Pressure reducer

Figure 29




34953

Cuts off the compressed air flow to the user when the pressure in the latter reaches a determined value (set point).

### Setting at the bench

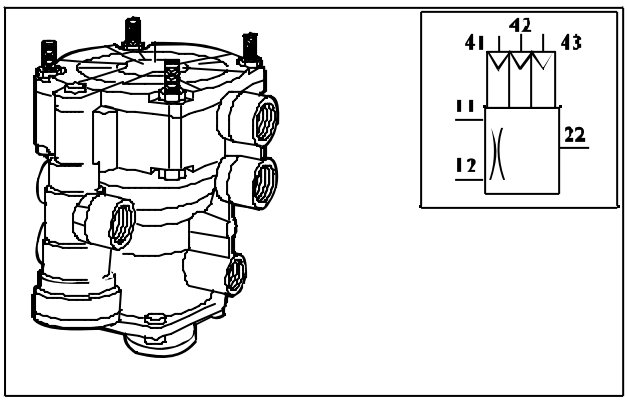
Set the element on the test bench and connect fittings 1 and 2 through the pipes to the gauge and the air supply.
Correct to the prescribed value through the adjusting screw and at the same time check the perfect seal of the unit.

### Troubleshooting

| PROBLEM | POSSIBLE CAUSE | REMEDY |
|---|---|---|
| **Pressure at the outlet fitting is different to the set value** | Valve not adjusted properly.<br>Leaks from the seal rings<br>Faulty piston and relevant seat | Adjust the unit<br>Overhaul the unit replacing damaged components<br>Replace the unit |

## 793332 Triple control servo distributor

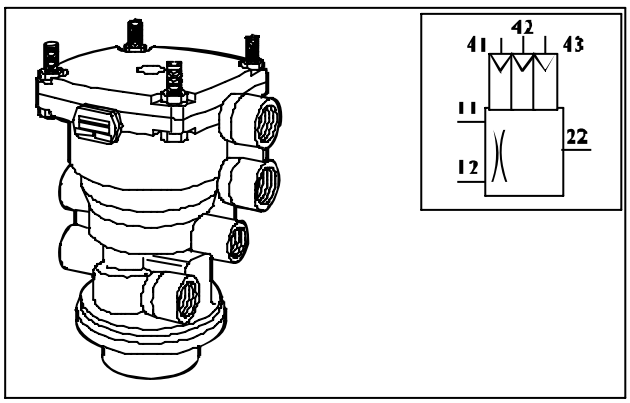
Figure 30




98886

KNORR - BREMSE AC 597B

Figure 31




98887

WABCO 973009013

The unit, controlled by two separate circuits of the duplex distributor and the tractor spring brake circuit, controls the trailer braking. It is also equipped with a predominance regulating device fitted on the lower external part.
The unit incorporates a device to actuate the trailer brake should there be a fault in the control pipe.

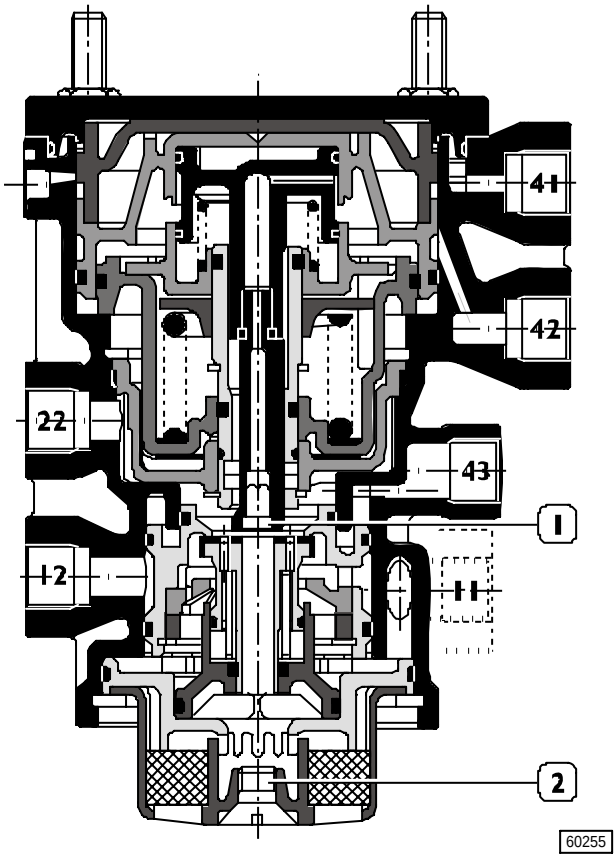
### Predominance adjustment

The unit is equipped with a predominance regulating device.

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## KNORR BREMSE AC 597B

Figure 32

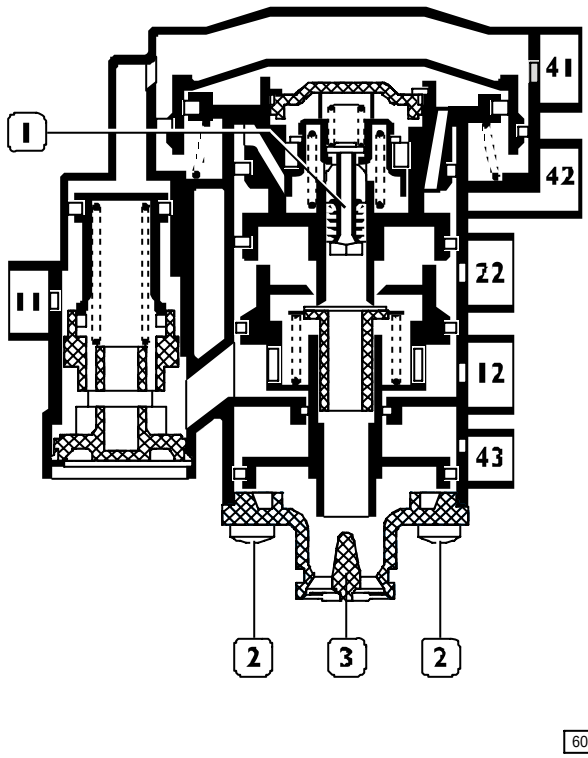



To adjust predominance for servo distributor KNORR - BREMSE AC 597 B, perform the following sequence of operations:

- Remove screw (2) from silencer body.
- Fit a setscrew wrench in the hole through the silencer body and operate on body hexagonal hole (1).
- Rotate CLOCKWISE to increase predominance.
- Rotate COUNTERCLOCKWISE to decrease predominance.

## WABCO 973 009 013

Figure 33




To adjust predominance for servo distributor WABCO 973 009013, perform the following sequence of operations:

- Remove screws (1) and then remove the cover (3).
- Operate on predominance adjusting screw (1).
- Rotate CLOCKWISE to decrease predominance.
- Rotate COUNTERCLOCKWISE to increase predominance.

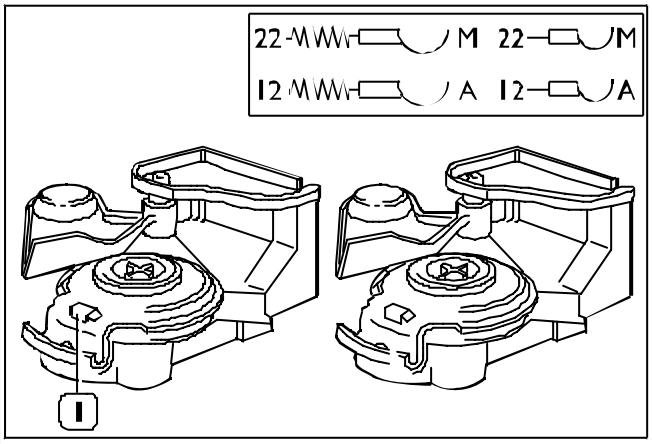
## Troubleshooting

| PROBLEM | POSSIBLE CAUSE | REMEDY |
|---|---|---|
| **Air leakage from exhaust when in resting condition** | Leaks from sealing gaskets.<br>Faulty exhaust valve and valve seat. | Overhaul the unit and replace faulty components<br>Overhaul the unit and replace faulty components |
| **Outlet pressures are different from the established values** | Wrong predominance value<br>Air leakage from sealing gaskets<br>Worn or faulty pistons and seats<br>Strained springs<br>Wrong predominance value. | Adjust predominance<br>Overhaul the unit and replace faulty components<br>Overhaul the unit and replace faulty components<br>Overhaul the unit and replace faulty components<br>Perform predominance adjustment. |

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## 798510 Coupling heads

Figure 34

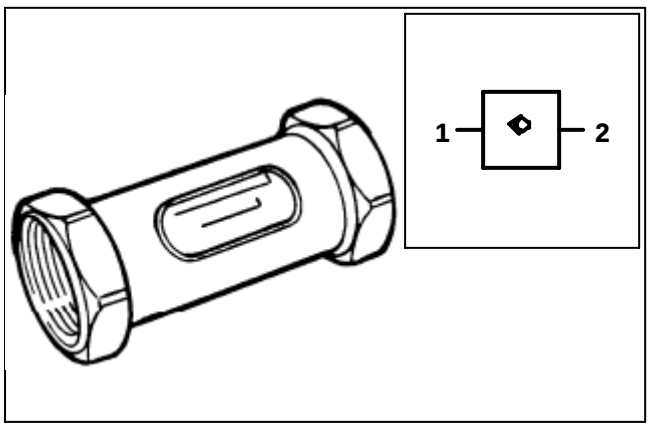



52871

The version for the "Variable" pipe has a yellow cover whereas the version for the "Automatic" pipe has a red cover and a side safety ridge (1). Safety ridges are used to prevent improper coupling.

## 793319 Check valve (towing vehicles)

Figure 35

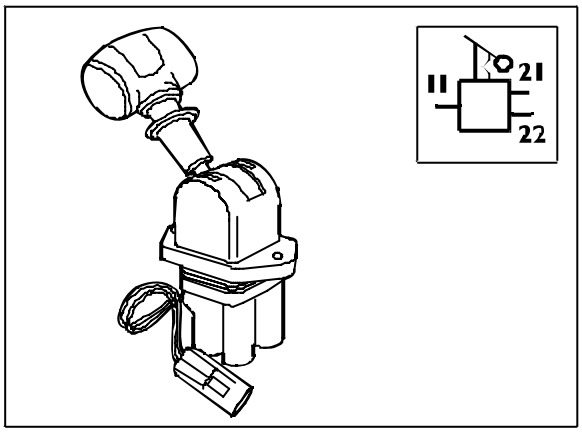



33987

Enables the compressed air to flow in the direction of the arrow marked on the housing and prevents reflux.

## 794310 Parking brakes control hand distributor (for towing vehicles)

Figure 36




79514

The device enables emergency and parking braking of the tractor and the trailer.
The device also enables the checking of the tractor braking effect. This operation is necessary when the vehicle is parked on very steep roads.

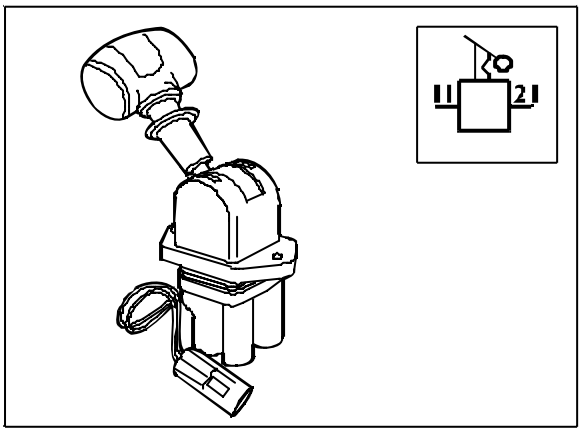
## Troubleshooting

| PROBLEM | POSSIBLE CAUSE | REMEDY |
|---|---|---|
| **Air escapes from the exhaust with control lever** | | |
| **In braking release position** | Faulty exhaust valve, relevant seat or seal ring | Check and overhaul the unit, replace faulty components. Carefully clean the components. |
| **In braking position** | Worn control valve, seal rings and component control valve | Check and overhaul the unit, replace faulty components. Carefully clean the components. |
| **It is difficult to turn the control lever** | Interference inside the distributor | Overhaul the unit and moisten all the sliding parts. |

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## 794310 Parking brakes control hand distributor (stand-alone vehicles)

Figure 37




The unit, inserted in the tractor parking brake circuit enables the actuation of the vehicle emergency and parking braking discharging the air contained in the spring cylinders.

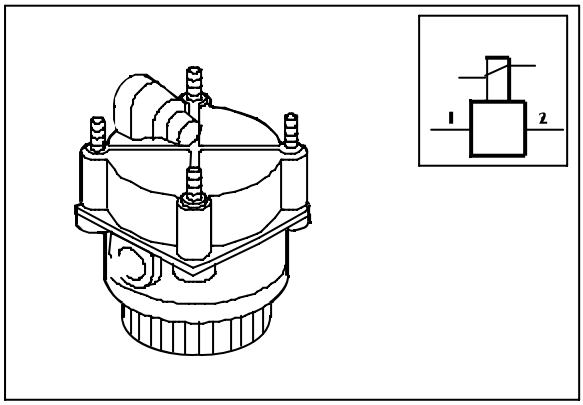
## Troubleshooting

| PROBLEM | POSSIBLE CAUSE | REMEDY |
|---|---|---|
| **Air leakage from the discharge with distributor lever in braking position** | Worn piston, exhaust valve, sealing rings. | Clean carefully, ensure that all the rubber components and relevant seats are in perfect condition.<br><br>Overhaul the unit and replace faulty components |
| **Air leakage from the discharge with distributor lever in emergency or parking braking position.** | Worn piston and relevant seal ring. | Clean carefully and check the components, overhaul the unit and replace faulty parts. |
| **Air leakage from distributor control lever cover.** | Worn plate, gaskets seal rings. | Clean the components carefully,check the seal and gasket surfaces.<br>Ensure that the rubber components and relevant seats are in perfect condition.<br>Overhaul the unit and replace faulty or worn components, if necessary restore contact surfaces. |
| **The distributor control lever is difficult to turn** | Interference inside the distributor. | Clean carefully and check all the components.<br>Overhaul the unit and replace faulty components<br>When fitting in place, slightly grease all sliding parts.<br><br>If faults or wear are found that could compromise the functioning, replace the complete unit |

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## 793331 Relay valves

Figure 38




90402

KNORR - BREMSE AC 574 AXY

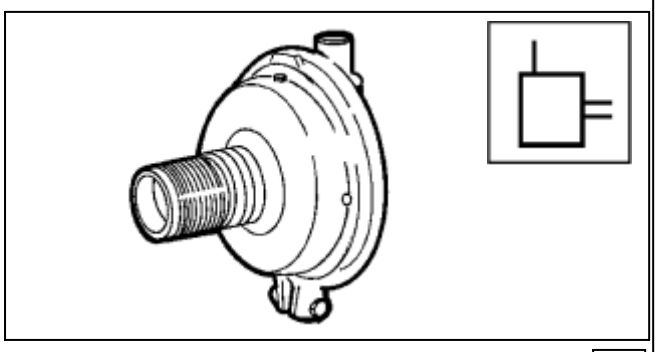
The apparatus allows for reducing braking system intervention time for front axis (valve of type KNORR BREMSE RP2A) or rear axis (valve of type KNORR - BREMSE AC 574 AXY).

### Troubleshooting

| PROBLEM | POSSIBLE CAUSE | REMEDY |
|---|---|---|
| **Air leakage from exhaust with control pipe in discharge condition** | Leakage from the delivery or from the seal rings | Overhaul the unit and replace faulty components |
| **Air escapes from the discharge with supply in the control pipe** | Leakage from the piston seal rings or from the exahust valve | Overhaul the unit and replace the faulty parts |

## 794911 Diaphragm brake cylinder

Figure 39



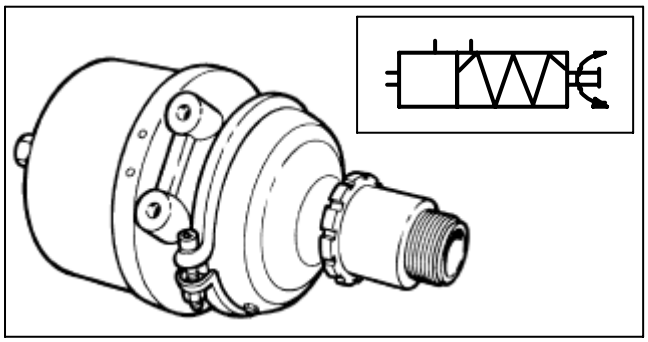
35798

The unit transmits the force impressed by the compressed air when the brake pedal is pressed to the mechanical service braking device. In case of failure, the complete cylinder is to be replaced (the figure shows the drum brakes version).

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## 794922 Combined brake cylinder

Figure 40

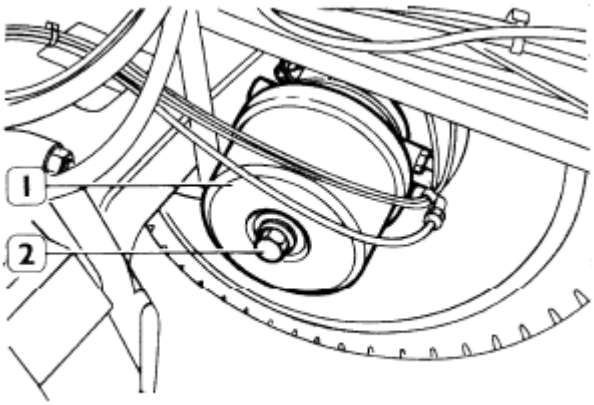


36744

This unit features two parts: one with diaphragm for service braking and one with spring for the parking and emergency braking in the case of failure in the brake system.

### Combined cylinder emergency relief device

Figure 41

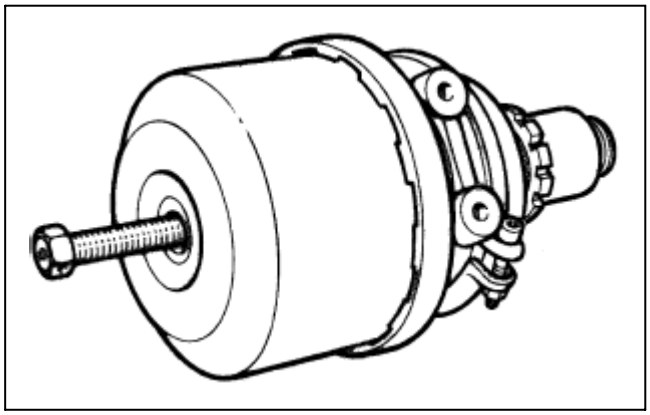



36745

If it is not possible to pneumatically feed the spring section of the combined cylinder (1) it is possible to manually relase the braking to permit towing. To release the brake loosen the screw (2) to the end of its stroke.

## REPAIR OPERATIONS

Figure 42



36476

Before removing the combined cylinder from the vehicle manually release the braking of the combined cylinder as described above.

It is recommended, before removal, to carefully clean mud or other impurities from external parts as these could damage the cylinder if they were to infiltrate into it.
If the cylinder spring section is faulty, do not remove this part since this operation could be dangerous for the operator.

## Troubleshooting

| PROBLEM | POSSIBLE CAUSE | REMEDY |
|---|---|---|
| **Air escapes from the exhaust or from the check ring.** | Perforated or broken diaphragm. | Replace the diaphragm |
| | Diaphragm lip broken. | |
| | Check ring fastening screws have be come loose. | Tighten the screws |
| **Air escapes from the diaphragm section feed** | Spring section components are stra ined. | Overhaul the unit and replace worn c omponents |

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## Troubleshooting

| FAULT | POSSIBLE CAUSE | REMEDY |
|---|---|---|
| **Air leak from outlet during braking** | Gasket on control piston<br>Faulty exhaust valve or relevant seat | Overhaul the unit and replace worn components |
| **Air leakage from couplings** | Not tightened to prescribed torque | Tighten couplings to specified torque |

## ANTI-SKID SYSTEM

### ABS (Anti-Lock Brake System)

The braking of a moving vehicle and the conseguent deceleration and stopping distances depend above all on the grip between the surfaces of the tyres and the road.

With a fully efficient braking system, a further improvement in braking can only be achieved by acting on the friction of the tyres or on the grade of the road surface.

When faced with especially tricky situations, such as poor grip due to a wet or icy road surface, the driver is forced to moderate use of the brakes in order to avoid partially locking one or more wheels, with the risk of skidding dangerously.

The function of the "ABS" is therefore to ensure vehicle stability (in all braking conditions), preventing the wheels from locking irrespective of the state of the road surface, so as to ensure the available grip is made full use of.

Even in the case of emergency braking, the system makes it possible to keep direction, that is to turn the steering wheel to avoid obstacles with no risk of skidding.

In short, the anti-lock brake system (ABS):

- Prevents the wheels locking when the vehicle is braking, no matter what grip is available on the road.
- Shortens stopping distances.
- Provides safety for the driver who can keep the vehicle's stability and direction.

### ASR (Anti-Slip Regulator) system

The driving wheels of an industrial vehicle slipping during acceleration has harmful consequences, such as a reduction in the force of traction, loss of grip between tyres and road surface with conseguent loss of control over the vehicle.
The function of the ASR is to prevent undesired wheel slip, both when accelerating and on bends, especially on icy or slippery roads, or for "off-road" use in mud and water.

In short, the ASR anti-slip regulator system:

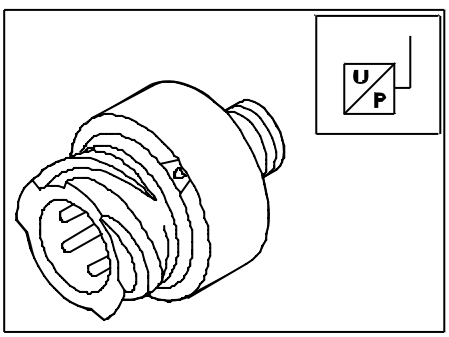
- Prevents the driving wheels slipping, both on starting and when travelling, with differential braking on the wheels and, if necessary, optimizing the engine torque.
- Keeps an optimal value of traction when the vehicle is on roads with a low grip coefficient.
- Improves stability especially on bends with a low grip coefficient.
- Limits tyre wear.

### EBL (Electronic Brakes Limiter)

The EBL function checks the rear axle wheel "slip", comparing it with the speed of the wheels of the front axle.
The control unit input data are the wheel speed and braking pressure measured by the pressure sensor installed upstream from the rear axle ABS modulators.
On the basis of these values, the control unit calculates the speed of the vehicle, the rear axle wheel "slip" and the minimum deceleration contemplated.
The EBL function is activated when the driver applies an excessive braking force for the conditions of load on the vehicle, thereby reducing the braking force on the rear axle.

### Pressure sensor

Figure 43



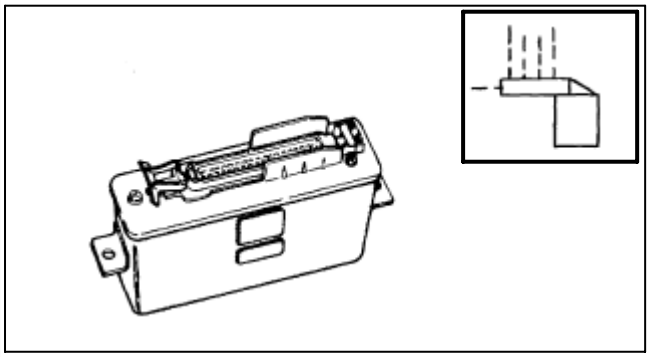

52722

In ABS/EBL systems, its job is to inform the electronic control unit of the extent of action required by the driver.
In EBS systems, this component is integrated in the front axle, rear axle and trailer control valves.

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## 526711 Electronic control unit

Figure 44

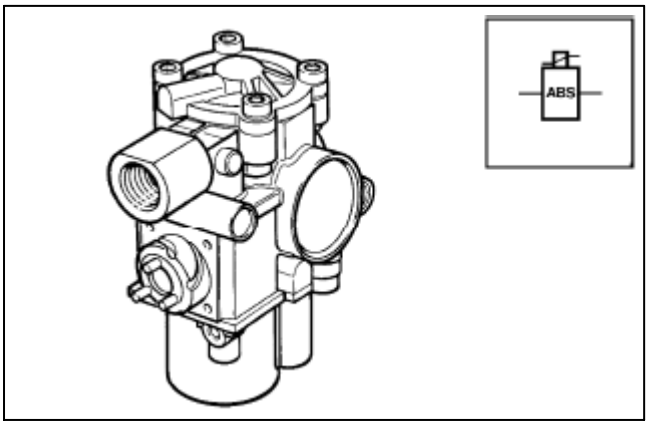


32370

The electronic control unit is the brain of the system.
It controls the system solenoid valve according to the signals received from the wheel revolutions sensor.
Each channel features four function circuits; the first is the input circuit that receives the analog signals from the sensor on the relevant wheel, they are debugged and converted to digital data through the measurement of the cycle duration. There is also a main circuit which has a microprocessor to process the information received from the input circuit.
The microprocessor contains a sophisticated program that enables it to determine the wheel acceleration and deceleration values, and to make the logic combinations of the various adjustment signals.
When necessary it sends out two command signals that are sent to the relevant anti-lock distributor through the third control unit circuit, to suitably adjust the braking pressure.
The fourth and last circuit is the safety circuit that checks the efficiency of the various system components.
In the case of a failure, it not only informs the driver by switching on the relevant warning indicator on the dashboard, but it also automatically disconnects the entire ABS system, leaving the conventional braking system fully efficient.

## 526714 Brake anti-lock distributor

Figure 45

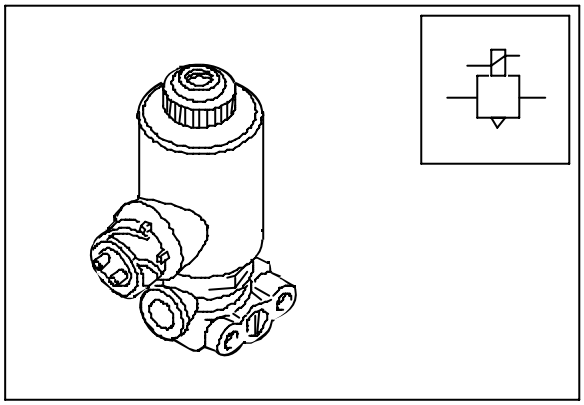



35805

This component modulates the air pressure in the brake circuit. When the electronic control unit detects a wheel with a tendency to lock, the valve intercepts the brake cylinder feed, thus preventing the wheel locking.

## 526724 Electropneumatic valve for ASR

Figure 46

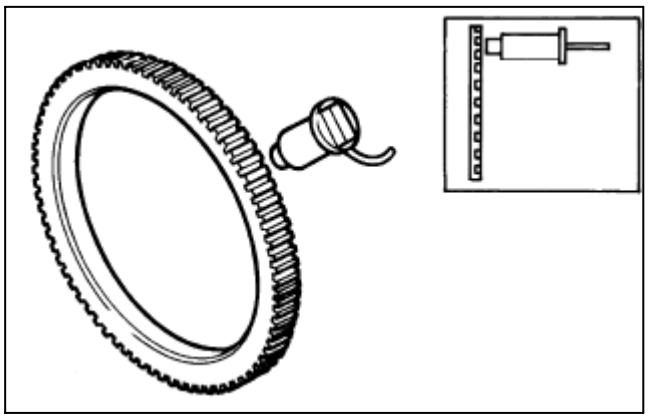


90143

The device brakes the driving wheels, through the brake anti-locking modulator, whenever it detects slipping of one or more wheels under traction.
The valve is a normally closed type.
When the electronic control unit detects slipping of one or more driving wheels, the valve is energized and enables air to pass to the brake anti-lock modulators that brake the relevant wheels. The solenoid valve de-energizes when the wheels reach the correct friction value on the road surface.

## 526713 Rpm sensors
## 566712 Phonic wheels

Figure 47



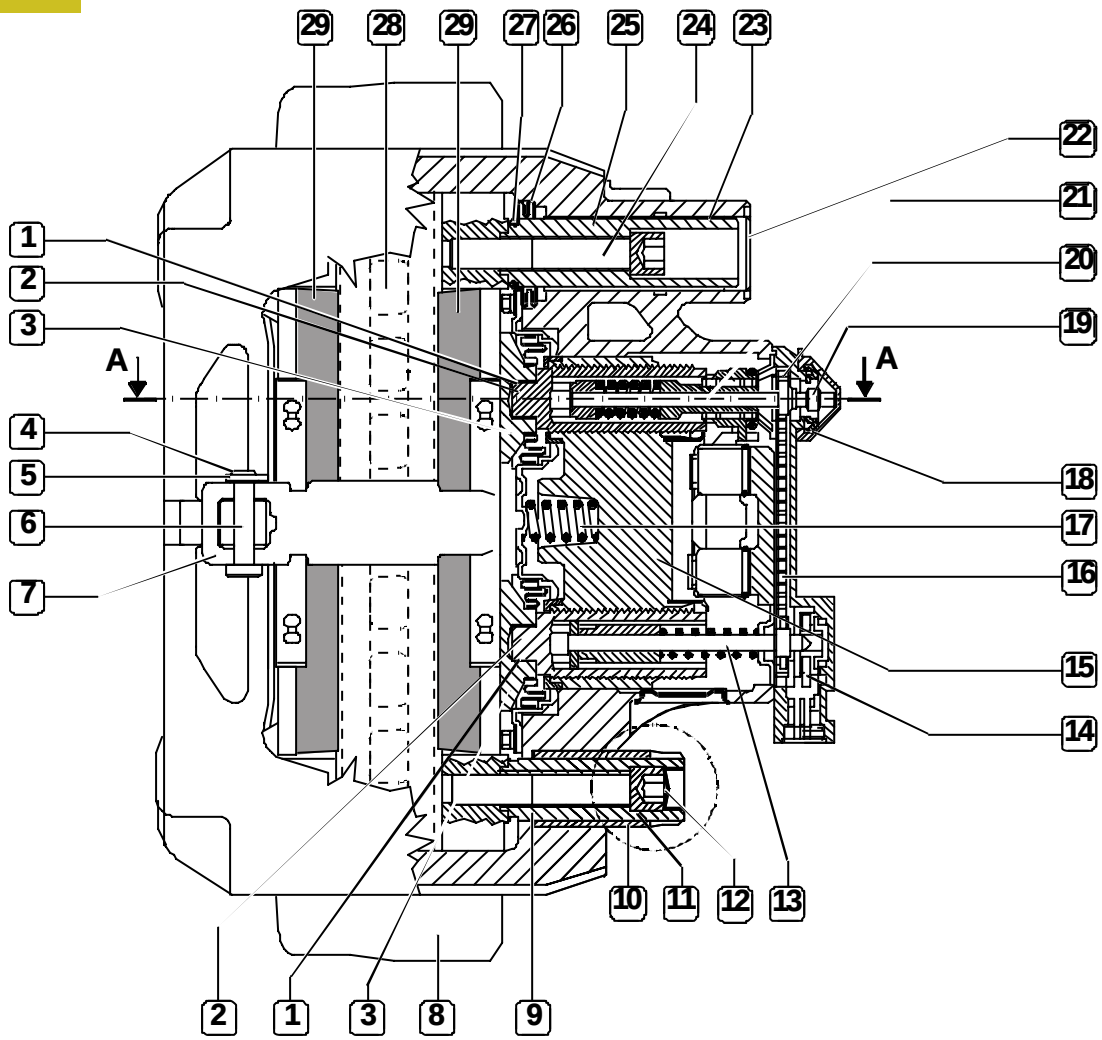
35383

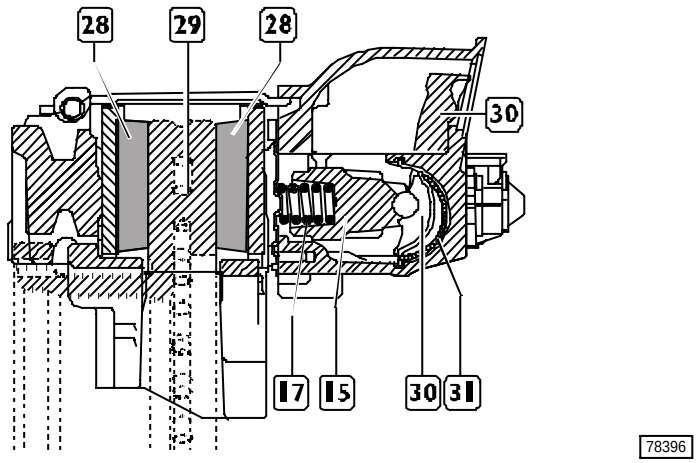
The revolutions sensors and phonic wheels find the revolutions of the respective wheels.
The phonic wheel is housed on the wheel hub and turns at the same speed as the wheel. It generates in the sensors, by induction, alternate voltages having a frequency that is proportional to the rotation speed of the wheel.
These voltage signals are transmitted to the electronic control unit for processing. Each wheel has a sensor and a phonic wheel installed. This enables individual adjustment of the braking pressure for each wheel, thus perfecting the driving stability and braking space.

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## 5274 FRONT DISC BRAKES SN7 TYPE

Figure 48




SEC. AA

1. Dry bush - 2. Threaded hose - 3. Piston - 4. Washer - 5. Spring split pin - 6. Pin - 7. Retaining plate - 8. Supporting plate - 9. Guide pin - 10. Guide bush - 11. Sliding pin - 12. Plug - 13. Dragging device - 14. Wear sensor - 15. Rear axle- 16. Chain - 17. Spring- -18. Cover - 19. Adapter - 20. Chain gear - 21. Adjusting device- -22. Cover - 23. Brass bush - 24. Sliding pin - 25. Sliding bush - 26. Inner protection - 27. Ring - 28. Brake lining - 29. Brake disc body - 30. Lever - 31. Cam bearing.

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## Operation (See previous figure)

Braking stage

During braking, the diaphragm cylinder rod presses down on the lever (30).
The force is transferred to the axle (15) by the bearing in an off - centered position (31)
Through the threaded sleeves (2) and pistons (3), the force is conveyed to the inner braking lining (28).
Once the play between brake linings (28) and brake disc (29) has been recovered, the force is conveyed to the outer brake lining (28), due to brake caliper displacement.
The brake linings (28) pressing on the brake disc (29) produce the braking power.

Releasing stage

As soon as the pressure on the brake is reduced, the pressure spring (17), the rear axle (15) along with threaded sleeves (2) and lever (32) go back to their original positions.

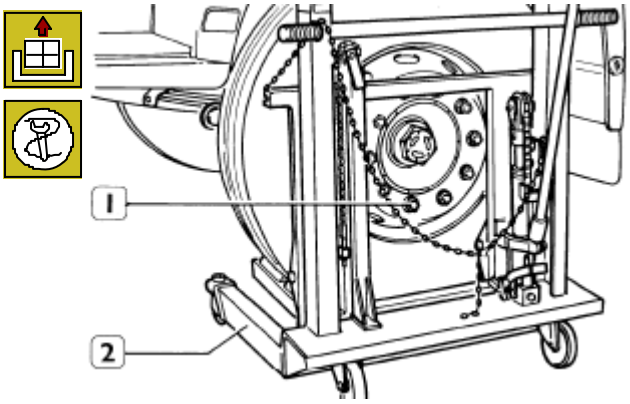
Automatic play recovery

The brake is equipped with automatic adjustment device, which keeps the operating play between brake linings and brake disc constant.
Every time the brake is operated, the adjustment device (21), which is integral with the lever (32), is automatically started.
If worn brake linings and brake discs increase the operating play, the adjustment device (21) and drag link (13) turn the threaded sleeves (2) so to recover said increase in play.
The operating clearance should be between 0.6 and 1.1 mm; lower clearances might cause overheating problems.

## CHECKS

### Checking the automatic play recovery system efficiency

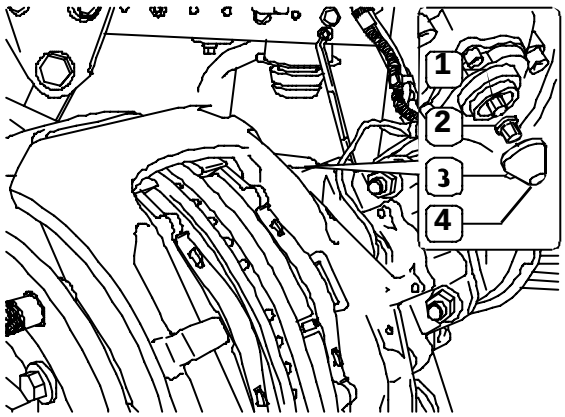
Figure 49




40570

Remove the lock nuts and wheels, using hydraulic stand 99321024 (1).

Figure 50

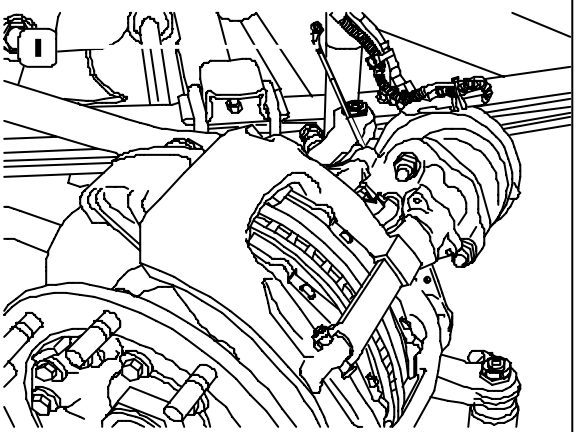



78622

Remove the plug (4) using the tab (3) and make sure the adapter (2) is not lost.

Never turn the adjusting pinion (1) without fitting the adapter (2) first. If the adapter cut torque is overcome, the adapter gets broken.
Try again with a new adapter and if also in this case it gets broken, the caliper should be replaced because there is an inner damage.

Figure 51




60759

Using a suitable wrench (1), rotate the adjustment pinion counterclockwise by 2-3 with the adapter (2, Figure 50) installed turns, thus increasing the play between brake linings and brake disc.

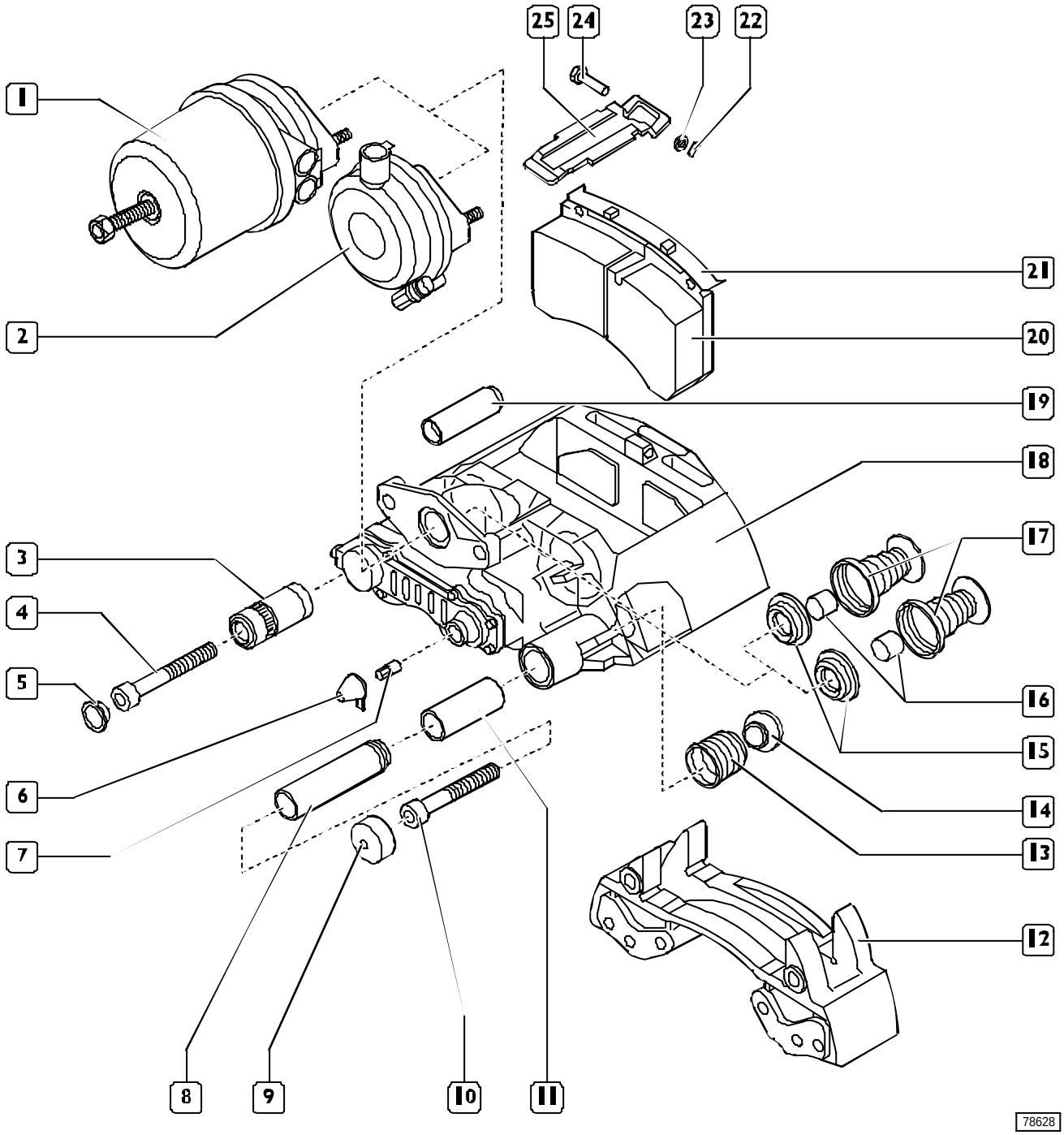
Operate the brakes for about 5-10 times and make sure the wrench (1) moves clockwise with small increments, up to complete recover of play between braking linings and brake disc.

Otherwise, i.e. if the wrench does not turn, turns just once or turns in both directions, this means the automatic play recovery system is faulty. Replace the caliper, following the procedure given subsequently, then fit back the wheels.

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## SN7 brake caliper components

Figure 52

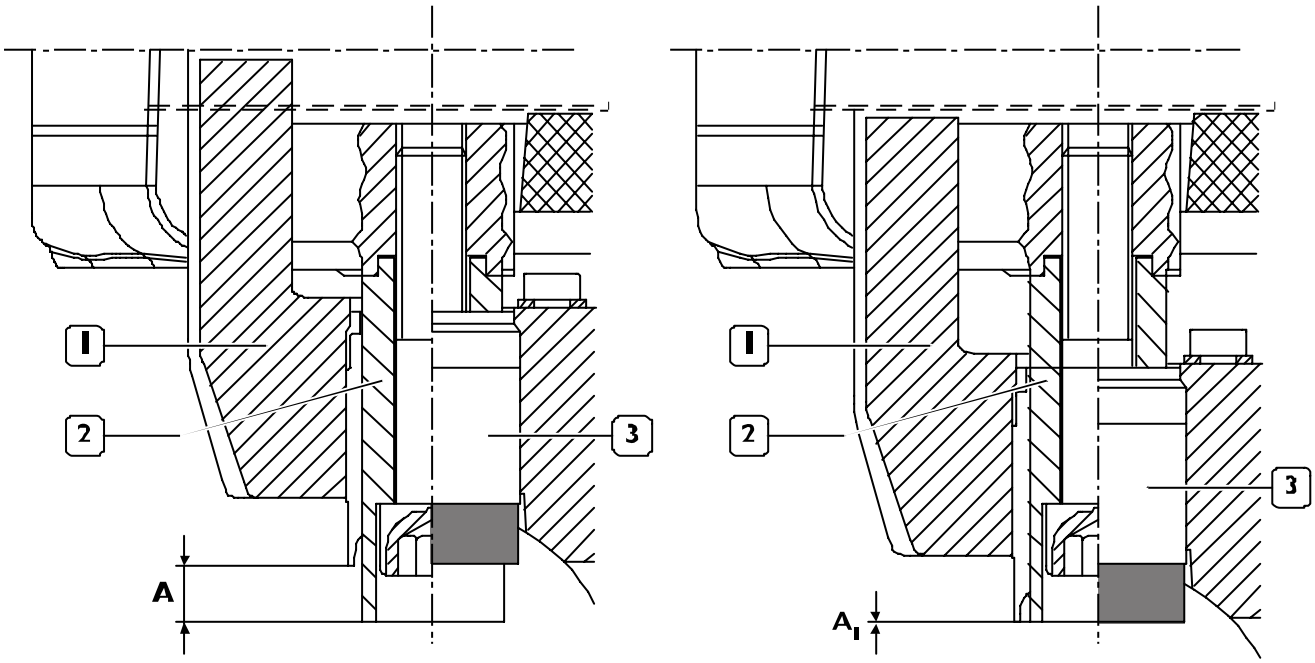



1. Combined brake cylinder - 2. Membrane brake cylinder - 3. Rubber bushes - 4. Sliding pins - 5. Plug - 6. Adjusting unit cover - 7. Adapter - 8. Guide pin - 9. Cover - 10. Sliding pin - 11. Brass bushes - 12. Carrying plate - 13. Protection cowling - 14. Ring - 15. Inner seals - 16. Bushes - 17. Plungers - 18. Brake caliper - 19. Guide pin - 20. Braking seal - 21. Spring - 22. Split pin - 23. Washer - 24. Pintle - 25. Check plate.

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## SN7 brake calliper braking gaskets thickness check

Figure 53



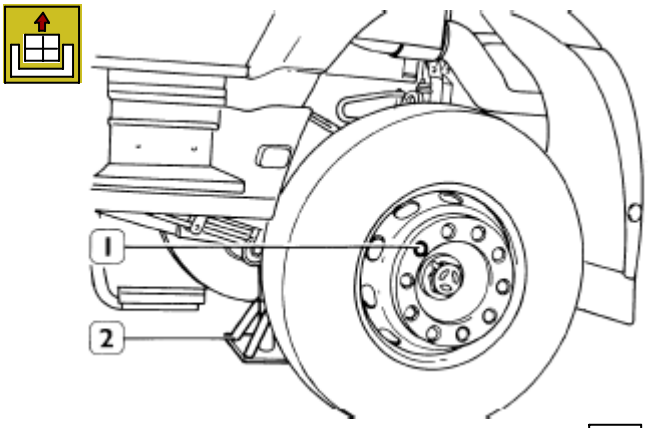

1. Brake caliper - 2. Sliding bush - 3. Rubber bush - A. Bush position with new seals - $A_1$. Bush position with worn out braking seals (perform an accurate check with wheels dismounted).

The condition of braking seals can be visually determined without dismounting wheels, by checking that A > 1 mm. Otherwise, it is needed to dismount the wheels and perform an accurate check as described below.

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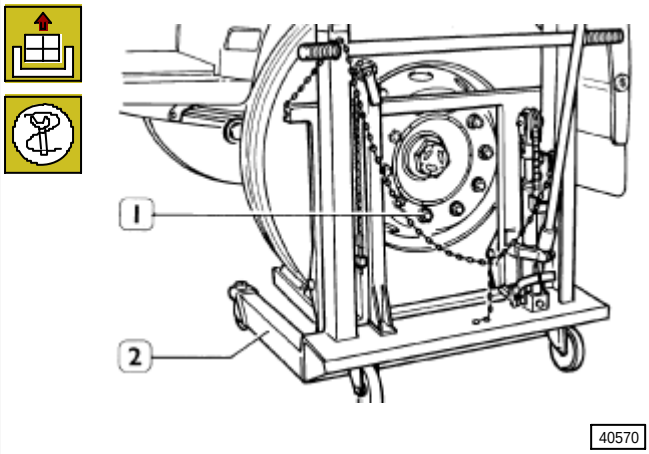
## 527417 Replacing brake linings

Figure 54



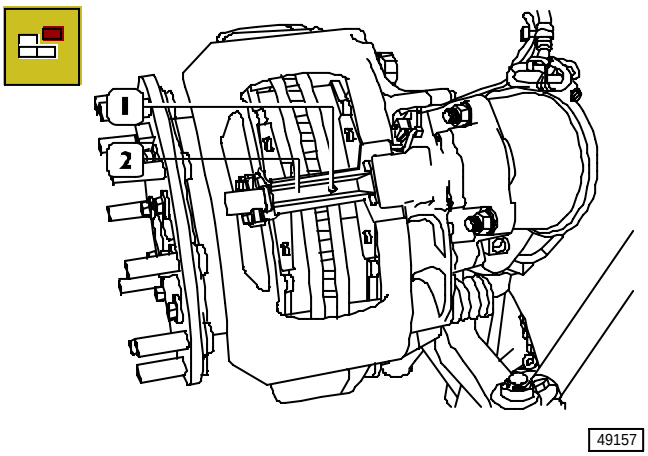

Set the vehicle on flat ground and lock the rear wheels. Loosen the nuts (1) fixing the front wheels.
Lift the vehicle at the front with a hydraulic lift and set it on two stands (2).

Figure 55



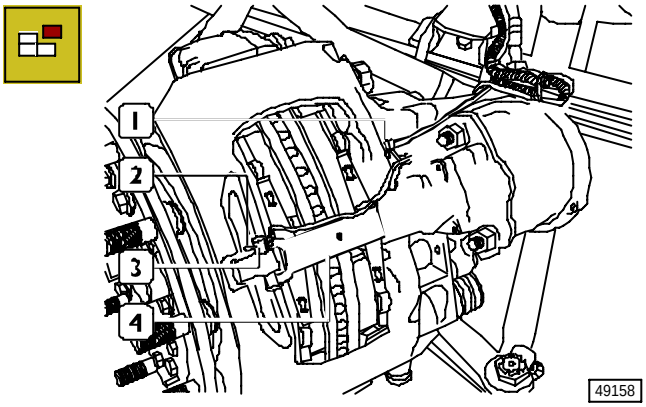

Unscrew the fixing nuts (1) and with the aid of the hydraulic trolley 99321024 (1) remove the wheels.

Figure 56



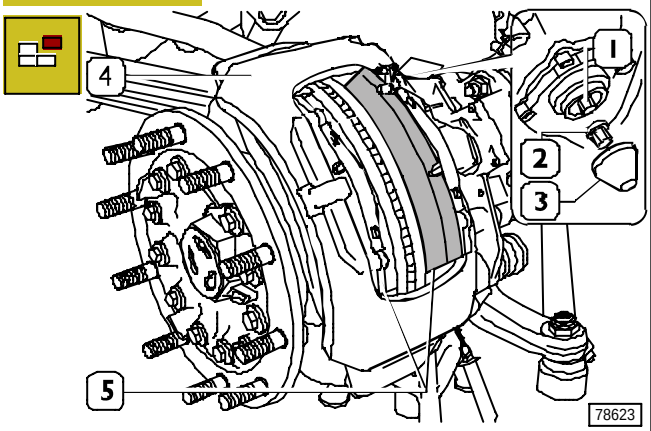

Remove the screw (1) and the wear sensor cable retaining plate (2).

Figure 57




Disconnect the electrical connection (1) from the calliper body.
Remove the split pin (2), pin (3) and brake lining retaining plate (4).

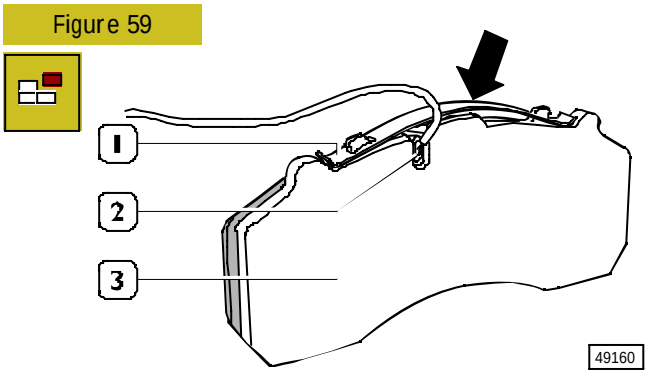
Figure 58




Remove the plug (3). Turn the adjustment device (1) operating on the adapter counterclockwise with a wrench, to insert the pistons within the caliper body and extract brake linings (4), suitably moving the caliper body (3).

**NOTE** Never operate directly on the registration pinion (1) without having first of all fitted the adapter (2). If the cutting torque of the adapter is exceeded, this will break.
Test with a new adapter. If this also breaks, the caliper must be replaced because it is damaged.

Figure 59

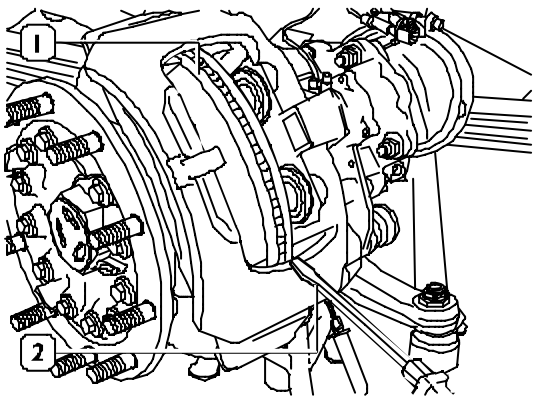



Press (→) on the spring (1) and remove it. Remove the wear sensors (2) from the brake linings (3).

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Figure 60



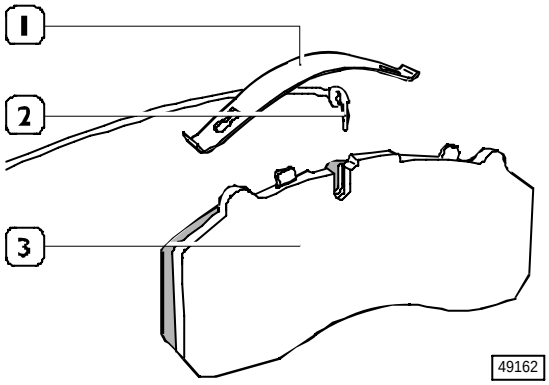

49161

Remove dirt and rust from around the edge of the brake disc with a scraper or an old screwdriver (2) resting on the calliper body, turning the disc (1).
Finish the job with abrasive cloth. Remove the remains with the aid of an aspirator, or rags and a brush.
Do not use petrol or other petroleum products that could cause trouble for the brakes.
Use only methylated spirit or isopropyl alcohol.
Carefully clean the surfaces of the braking area of the brake disc.

**NOTE** Visually check the conditions of the dust caps, if deformed or broken it is necessary to replace them. This requires removing the brake calliper, so it is recommended to remove the brake calliper body together with the bearing plate for a thorough overhaul.

Check that the calliper slides freely on its guides.
If you find any trouble on a single brake calliper it is wise to overhaul both brake callipers completely.
Remove the dirt from the brake calliper with a wire brush, without damaging the dust caps.
Clean the sliding surfaces of the brake linings.
Check the conditions of the brake disc and make sure it is not corroded, scored or grooved. Light surface cracks are acceptable, but it is necessary to grind the brake disc as described under the relevant section heading. On the contrary, if it is worn, replace the brake disc.
If one needs to be replaced, it is recommended to replace both brake discs.
Check the state of the springs and wear sensors, replace them if necessary.

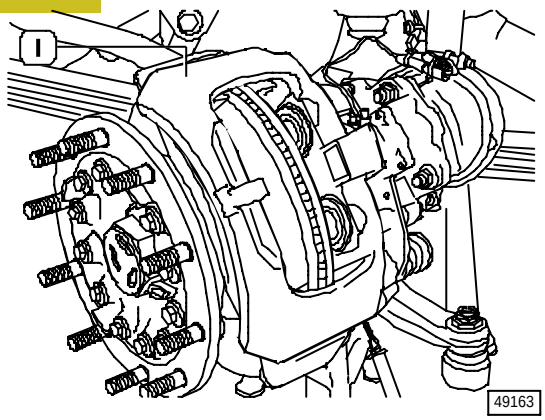
Figure 61




49162

Insert the wear sensor (2) into its seat on the brake lining (3). Mount the spring (1) in the opposite sequence to that for disassembly.

Figure 62

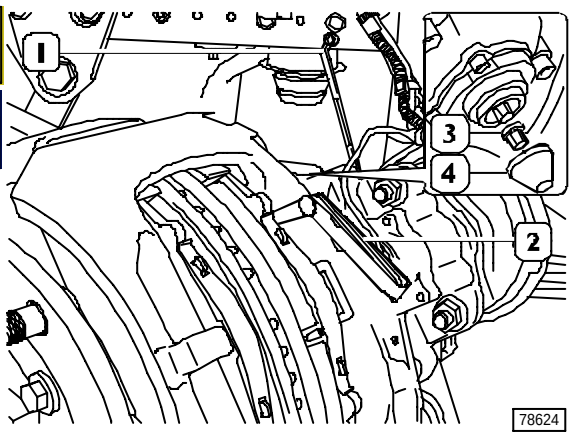



49163

Insert the new linings in the brake calliper (1) and check they slide freely in their seats.

If you find it necessary to replace the pair of brake linings, always replace them with a full set for each axle.

Figure 63



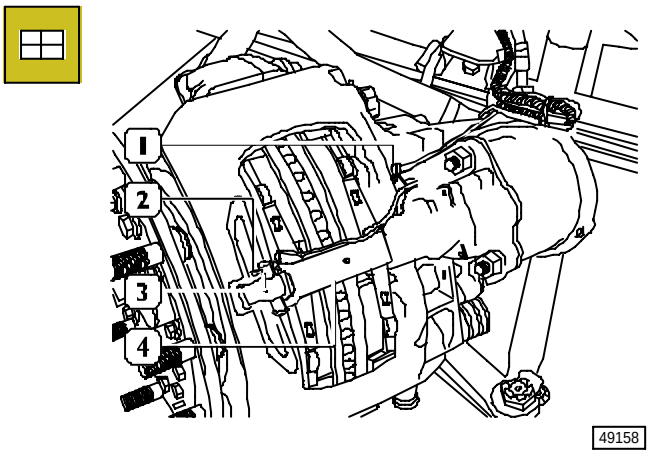

78624

Using the wrench (1), act on the adaptator retriever pin to get a play not lower than 0.7 mm between brake lining and brake disk, which can be measured using the thickness gauge (2). Replace the cover (4) and lubricate it with white grease RENOLIT HLT2.

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**NOTE** Make sure the external safety plug and the seal are fitted properly in order to prevent water getting inside the automatic clearance recovery device.

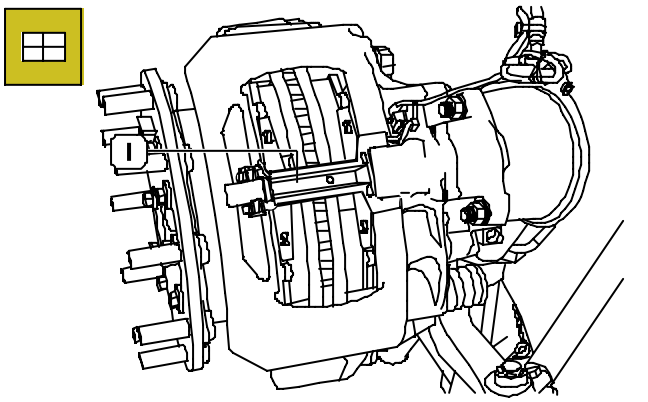
Figure 64




49158

Make the electrical connection (1) and secure it to the calliper body.
Mount the plate (4), pin (3) and split pin (2).

Figure 65



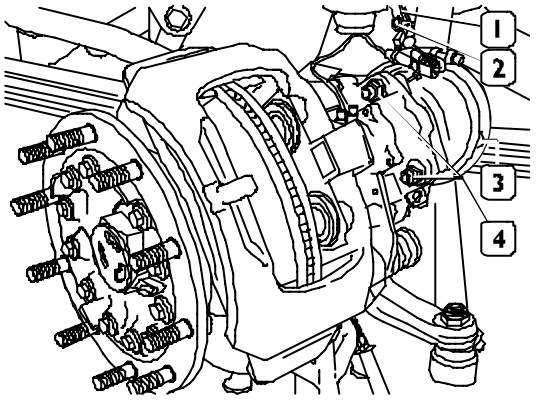

49165

Mount the wear sensor cable retaining plate (1).
Using the hydraulic trolley 99321024, fit on the wheels. Lower the vehicle. Lock the nuts fixing the wheels to the required torque.
Fit the safety cap onto the wheel hubs.
Proceed as described on the opposite side.
After repairing the vehicle brakes, press the brake pedal repeatedly, while the vehicle is moving, in both directions, in order to wear in the brake linings.

## 527413 Removing and refitting brake callipers

### Removal

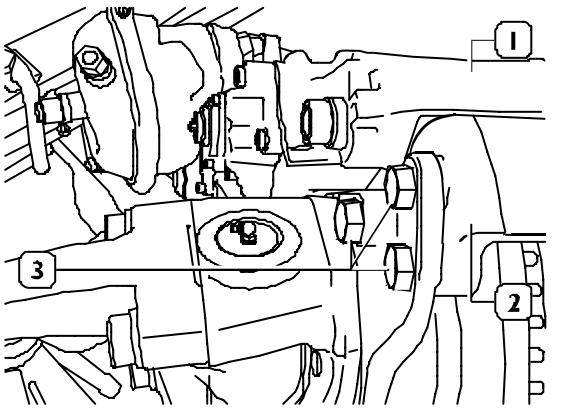
Figure 66




49166

To remove the brake linings, keep to the above description in the paragraph for replacing brake linings. Remove the clamps (2). Disconnect the diaphragm cylinder supply pipe (1). Unscrew the nuts (4) and remove the diaphragm cylinder (3).

Figure 67




49167

Remove the screws (3) and disconnect the brake calliper (1) together with the bearing plate (2).

Take care when removing and carrying the calliper (1) as it is heavy and floats on the bearing plate (2).

### Refitting

For refitting, carry out the steps described for removal in reverse order, keeping to the required tightening torques.

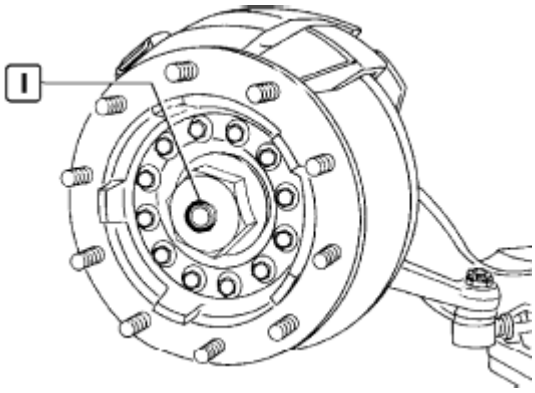
**NOTE** Before inserting the diaphragm brake cylinder, spread the cap in the brake calliper operating lever with RENOLIT HLT2 white grease.

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## 520620 Removing and refitting wheel hubs

### Removal

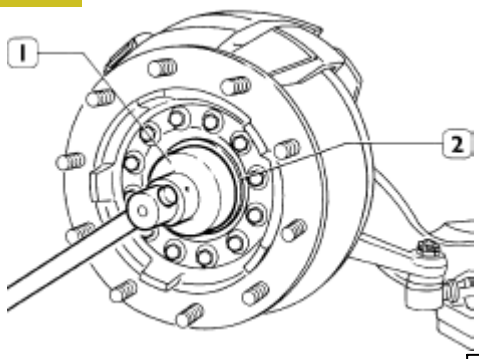
Figure 68




77206

Arrange an oil recover collector as a precaution.
Rotate hub so as to take plug (1) downwards.
Unscrew the plug and drain oil into the container.

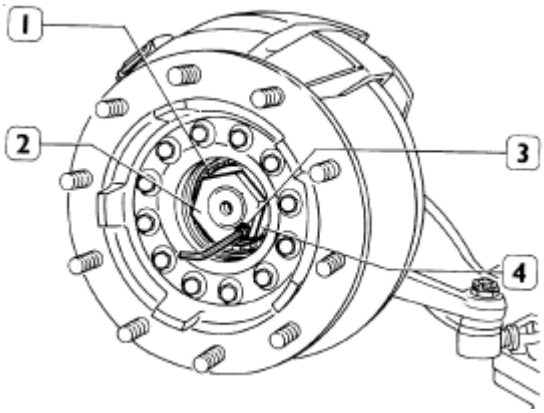
Figure 69




36407

Block rotation of the wheel hub suitably and with the wrench 99354207 (1) unscrew the oil cover (2).

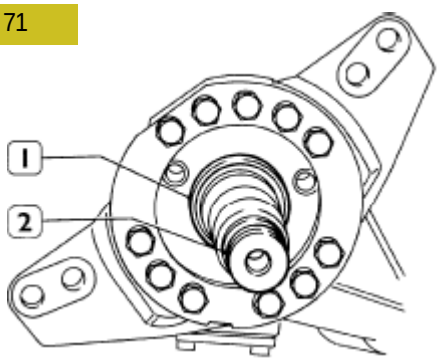
Figure 70




36408

Undo the safety screw (3). With the wrench 99388001, unscrew the adjustment ring nut (2), remove the washer (4), outer bearing (1) and remove the brake disc together with the wheel hub, spacer and internal bearing.

Figure 71



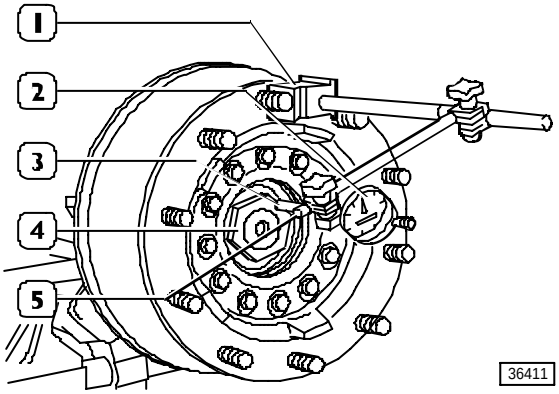

38596

Visually check the diameter of the gasket ring (1) has no accidental dents or scratches.
Replace the internal gaskets of the wheel hubs and, if necessary, the ring (1), keeping to the description given in the "Front axle" section.
Using the adjustment ring nut, check that the thread (2) has no stiffness. If it has, use appropriate means to get rid of the stiffness.
Remove the opposite brake assembly, keeping the components separate.

### Refitting

**NOTE** Make sure the surfaces of all the parts inside the hub are thoroughly clean, with no waste or burrs.
Lubricate the bearings with Tutela W 140/M DA oil.
Key the wheel hub on the stub axle together with the brake disc. Insert the internal spacer onto the stub axle then position the external bearing and thrust washer.
Screw down and lock the adjustment ring nut to the required torque.

Figure 72

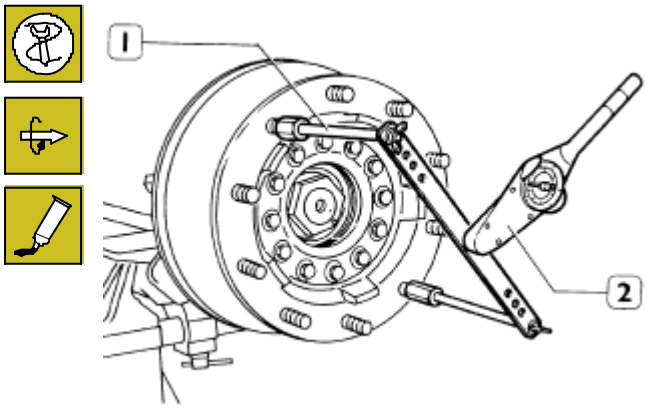



36411

Strike the wheel hub a few times with a mallet in an axial direction, turn it in both directions to free the bearing rollers.
Fit the magnetic base (1) together with the dial gauge (2) on the wheel hub. Set the pointer of the dial gauge (3) at right angles to the shank of the stub axle.
Reset the dial gauge with a pre-load of 1.5 - 2 mm.
With the aid of a lever, move the wheel hub axially and measure the end float, which must be 0.16 mm (maximum value).
On obtaining the required end float, lock the screw (5) retaining the adjustment ring nut (4) to the required torque.

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Figure 73

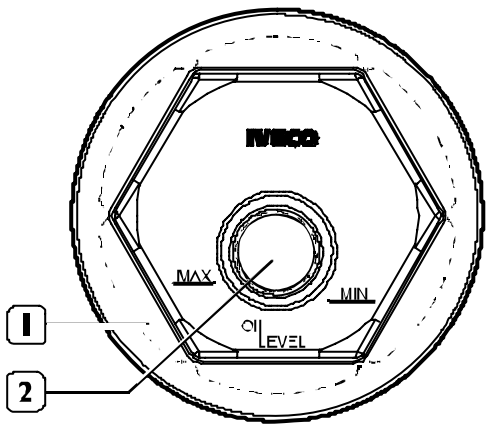



Apply tool (1) 99395026 on wheel hub stud bolts and use torque meter 99389819 (2) to check whether the wheel hub rolling torque is at the set value.

Deposit a sealing bead (Loctite type 574) exclusively on the hub cover ledge surface and protect the threaded part.

Tighten to torque the hub cover (1, Figure 74).

Figure 74



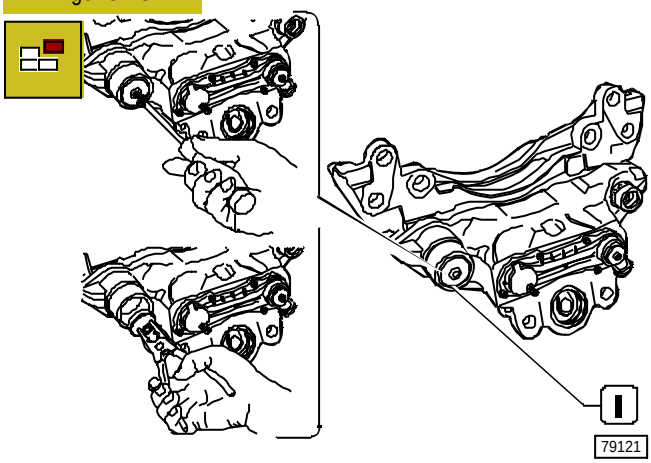

79068

Rotate the wheel hub until when hub cover (1) is positioned as shown in the figure. Restore the prescribed quantity of oil into the hub cover (1) through filling hole (2). Tighten the plug on the hub cover (1) to the set torque.

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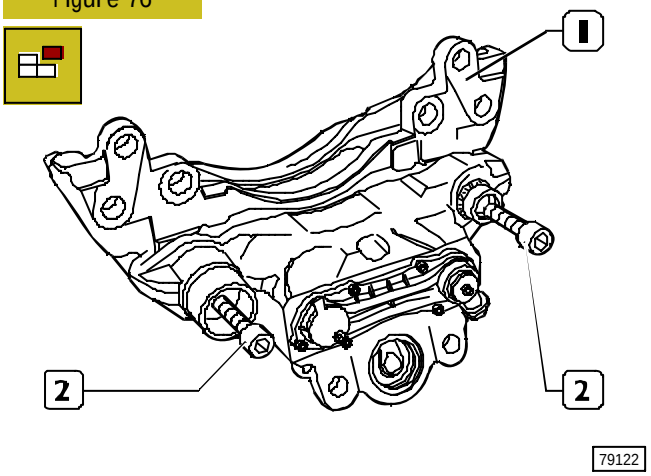
## SN7 BRAKE CALIPER OVERHAUL
### Disassembly

Figure 75



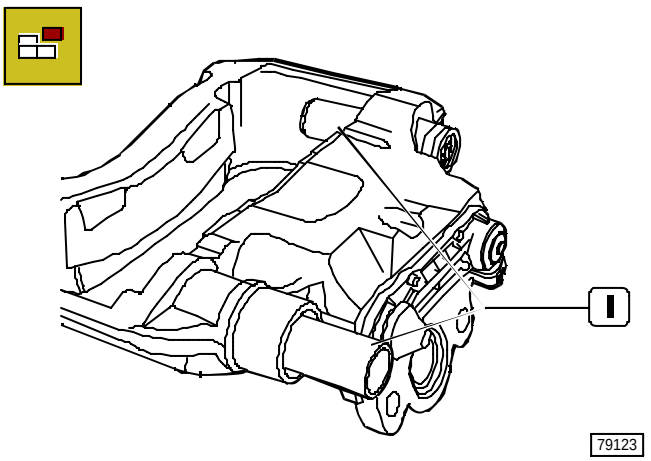

Place the brake caliper on the bench and block it in a vice. Remove the cover (1) and make a hole in it with a Parker screw.

Figure 76



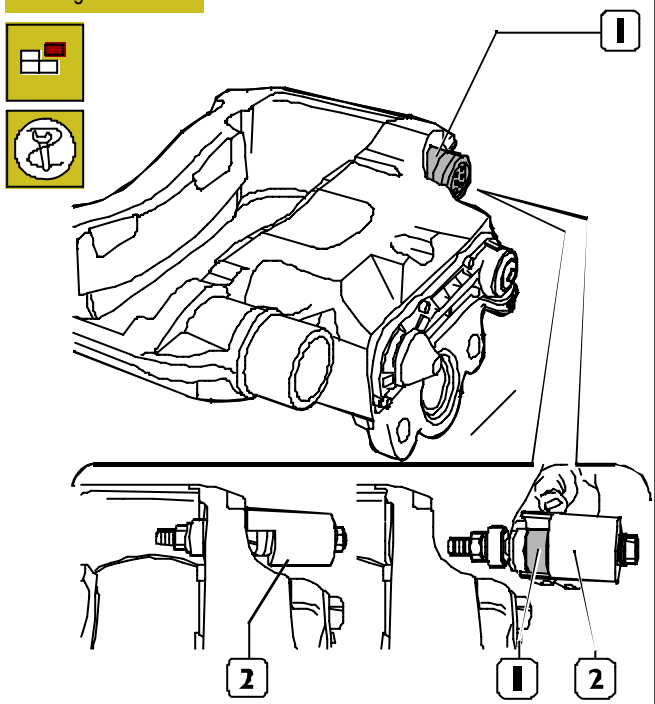

Refit the supporting plate (1) and remove the fastening screws (2).

Figure 77



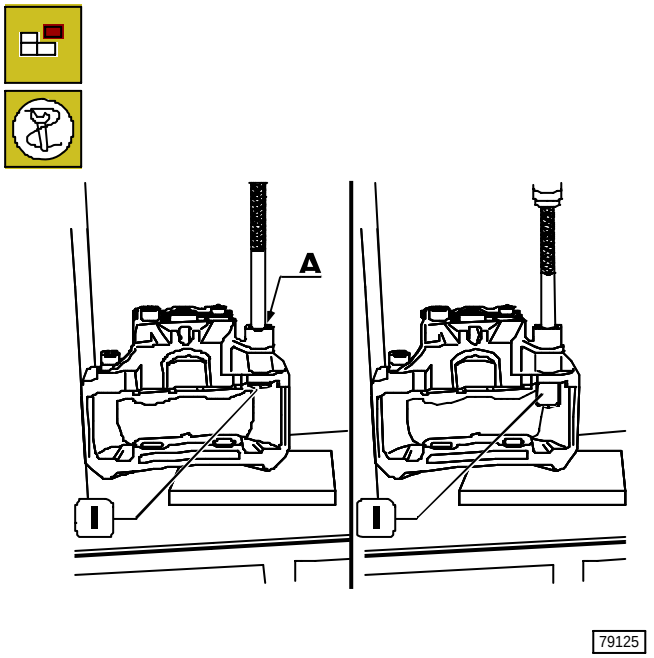

Remove the sliding bushes (1).

Figure 78




Use tool 99372245 (2) (to be used with screw in tool 99372237) to disassemble the rubber sleeve (1).

Figure 79

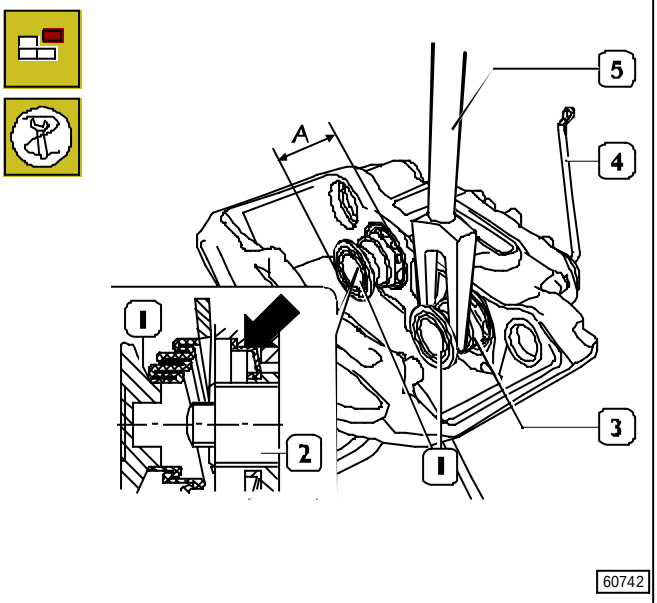



Take the caliper to the press.

Insert the appropriate beater in the brass bush housing (1) (See arrow A). Use the press to remove the bush (1).

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Figure 80




Place the caliper on the bench and block it in a vice. Use the wrench (4) to operate the clearance recovery device so that the piston (1) comes out of the caliper body for a maximum of 30 mm (value A).
Take off the dust-guard from the caliper body and use tool 99372238 (5) to remove the thrust pressing devices (1) of the caliper together with the protection casings (3).

**NOTE** Value A must not be overcome because threaded hoses (2) are synchronised. If the threaded hoses (2) reach their over-travel, they loose synchronism and the brake caliper must be replaced. The brake caliper inner parts must never be removed.
For this reason you are recommended non to slacken or to remove the cover retaining screws..

## Component part cleaning and check

To wash metal parts, use a solution of hot water with Fiat LCD detergent. Use a metal brush to remove dirt from the caliper body and then a little brush to remove the residuals and to clear accurately the guide pin and the sliding bush housings.

Use a synthetic brush with the right dimensions to remove the grease left on the sliding bush housings.

Clean the caliper body accurately with compressed air.

Use a piece of cloth soaked with isopropyl alcohol or similar to clean the sliding bushes accurately.

Check the wear conditions of the sliding bushes and their housings on the brake caliper body. Make sure they are not damaged or worn, especially the sliding surfaces. Fit the bushes in their housings and check they slide regularly.

Fit the bushes in their housings, check they slide correctly, otherwise replace or restore their housings on the caliper body, if needed.

**NOTE** Regular braking depends mainly on the brake caliper sliding on the guide pins.

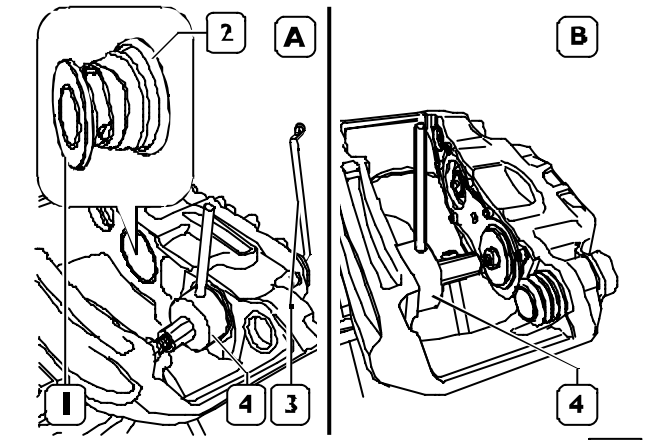
Check the wear conditions of the brake lining retaining pins and the related safety pins. If they are worn or damaged, replace the worn parts.

It is advisable to replace all rubber and plastic parts and the brass bush even if they do not seem damaged or worn at sight.

## Assembly

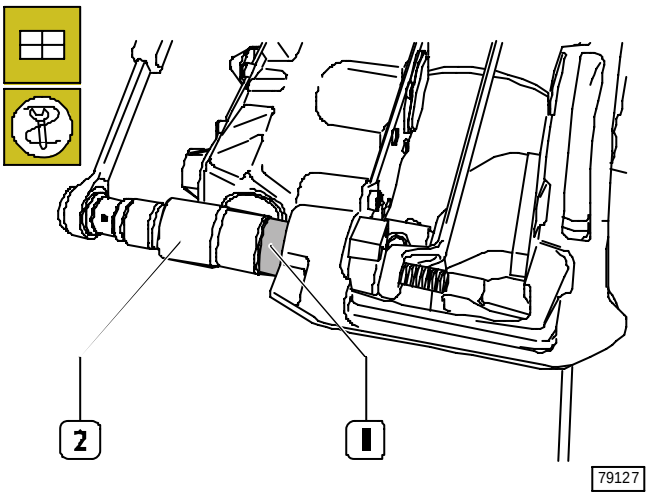
Make sure all the brake caliper components are perfectly clean. Possible abrasive residuals should be removed with a cloth soaked in isopropyl alcohol or similar.

Figure 81




Use tool 99372239 (4) (see figure A) to fit the protection casings (2). Use the same tool 99372239 (4) fitted on the other side (see figure B) to insert the pistons (1). Use the wrench (3) to operate the clearance recovery device and ad just the pistons (1).

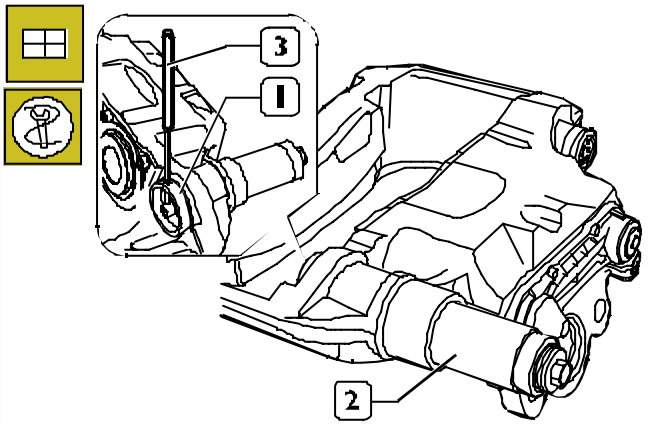
Figure 82




Use tool 99372244 (2) (to be used with the screw in tool 99372237) to assemble the rubber sleeve (1).

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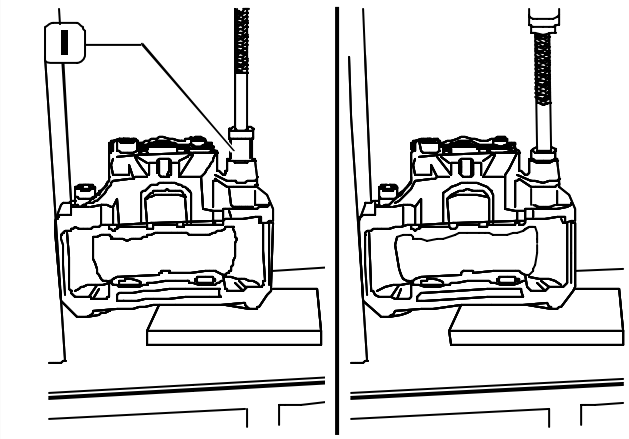
Figure 83




79128

Use tool 99372243 (1) (to be used with tool 99372240 and use screw in tool 99372237) to assemble the brass bush (2) in its seat, by blocking its rotation by means of a suitable tool (3) (punch or screwdriver).

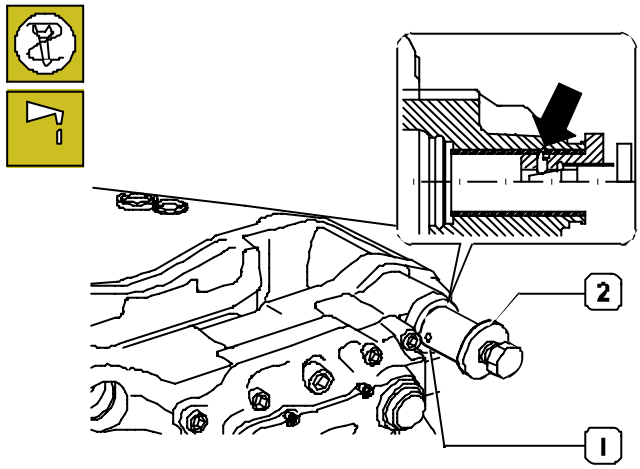
Figure 84




79129

Place the caliper under the press. Use the press to fit the brass bush (1) in its housing until is comes out of the lower side by 1 mm.

Figure 85

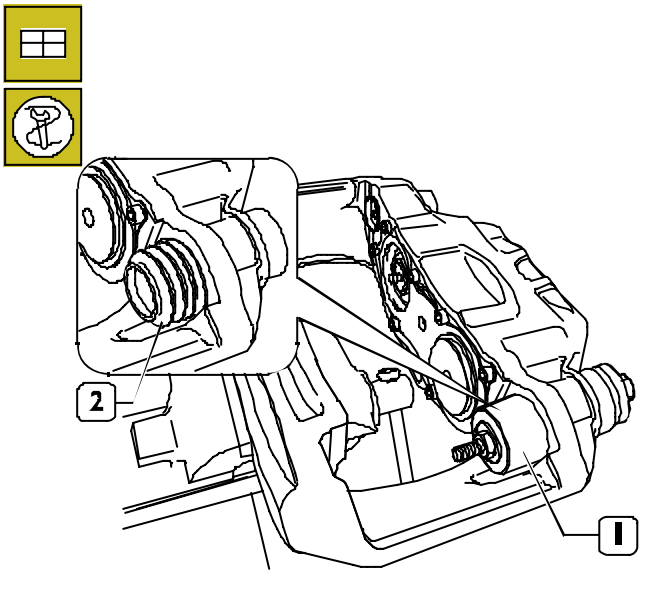



60745

Use the tool 99372242 (2) to carry out bruising in the point (→) next to the caliper body groove, in order to prevent the brass bush (1) from moving.

Make sure there are no burrs in the bush housing, otherwise remove them. Apply white grease RENOLIT HLT2 on the bush.

Figure 86




79130

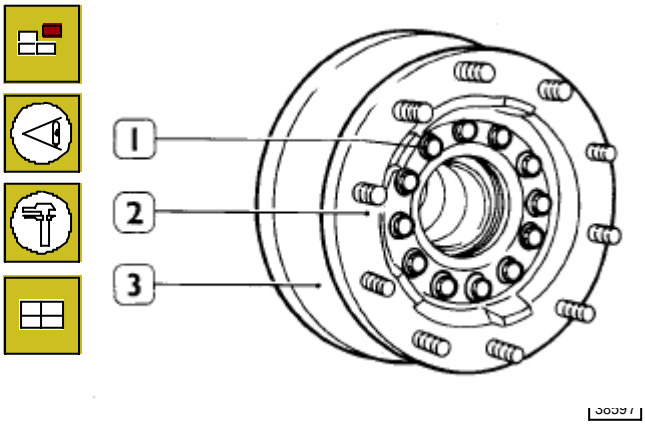
Place the caliper on the bench and block it in the vice. Fit the protection casing (2) by means of tool (1) 99372237.

**NOTE** Reverse the removal order to fit the sliding bushes and the supporting plate.

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## 527411 OVERHAULING BRAKE DISCS

Figure 87

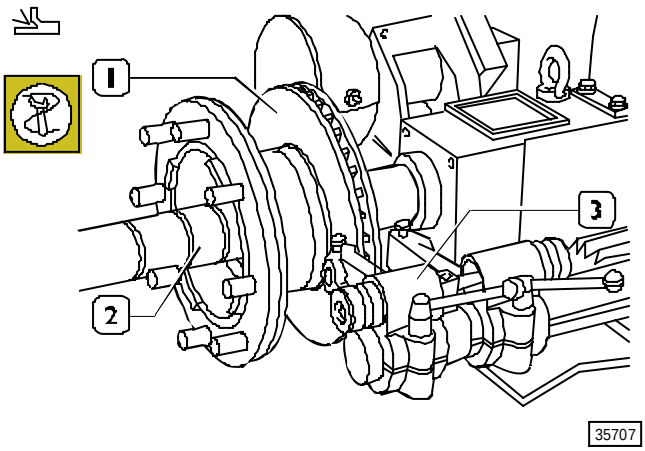



Examine the state of wear of the surfaces of the brake discs. Finding other values to the ones given in the characteristics and data, turn and grind the brake discs or, if necessary, replace them.
Remove the screws (1) and detach the hub (2) from the disc (3). Replace the disc (3) and refit it following the reverse procedure to the one described above.

**NOTE** For regular braking, always replace a complete set of disks per axle.

## 527411 TURNING AND GRINDING BRAKE DISCS ON THE BENCH

Figure 88

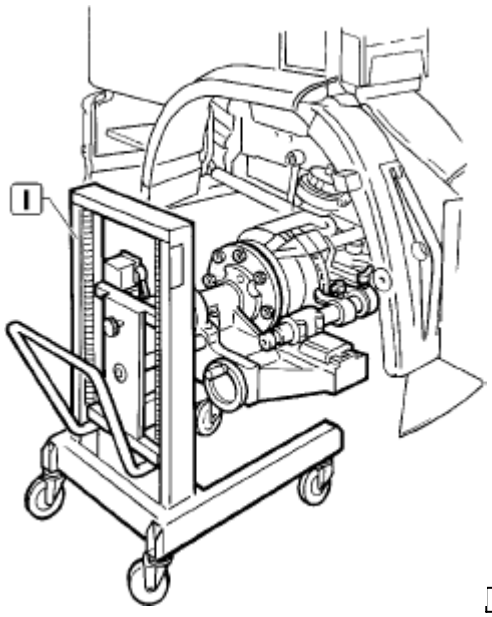



35707

- Key onto the shaft of the lathe 99301001 (2) the brake disc (1) together with the hub.
- Key onto the shaft a set of spacers that eliminate the end float of the assembly; screw on the locking nut and fit the mount of the lathe shaft.
- Position the tool holder (3) in line with the brake disc (1), then adjust the depth of the tools.
- Proceed with turning and grinding the brake disc (1), operating with one or more passes to remove material depending on the scoring found.

## 527411 TURNING AND GRINDING BRAKE DISCS ON THE VEHICLE

Figure 89




71848

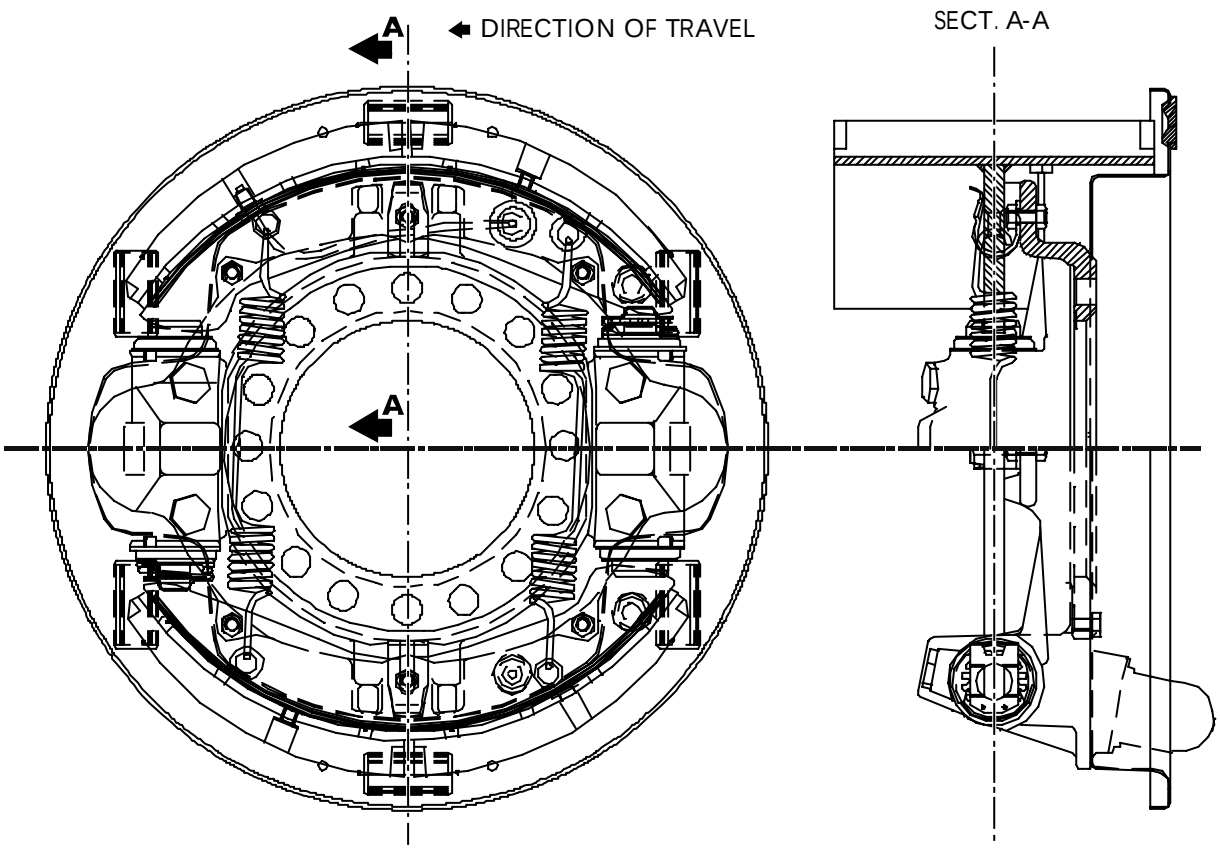
Remove the wheel.
Fit the tool 99301005 (1) onto the wheel hub.
Proceed with turning and grinding the brake disc.

**NOTE** During grinding, proceed gradually, advancing the wheel in sectors to remove the turning remains entirely.

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## 5272 DRUM BRAKES

Figure 90




MERITOR DUO-DUPLEX DRUM BRAKE

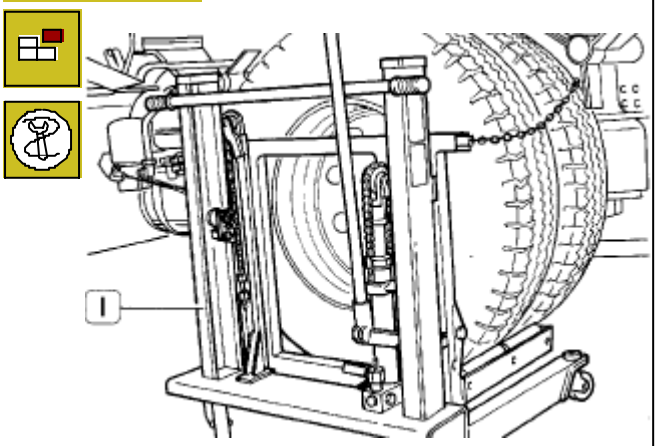
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## 5272 DUO DUPLEX DRUM FRONT/REAR BRAKES

**NOTE** Braking assembly overhaul was performed on rear brakes.

### Disassembly

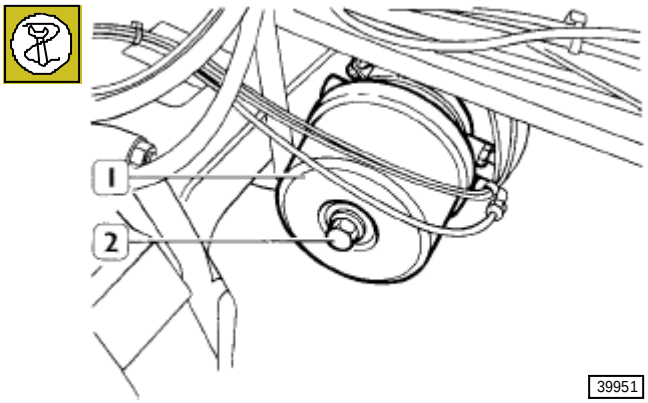
Figure 91




40510

Set the vehicle on level ground. Take the covers off the nuts fixing the wheel and loosen the nuts.
Lift the vehicle from the concerned side, then place it on special stands.
Position the hydraulic trolley 99321024 under the wheels.
Take out the nuts fixing the wheels and take them off.

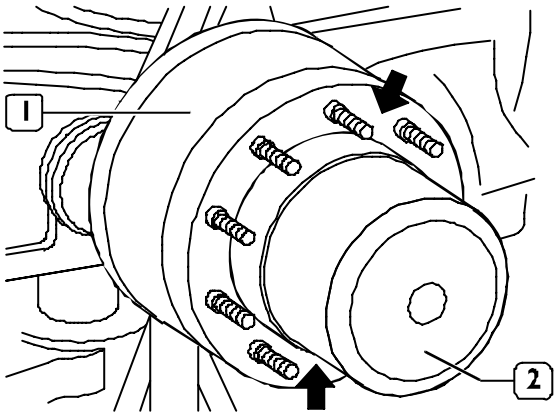
Figure 92




39951

Fully unscrew the manual braking screw (2) of the combined cylinder (1).

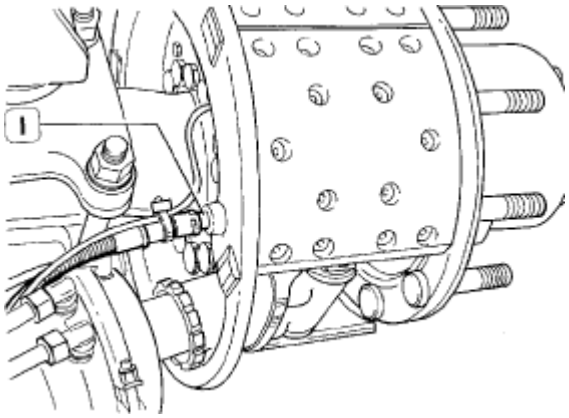
Figure 93




71782

Take out the screws fixing the brake drum (1) to the wheel hub (2). Screw two appropriate screws (⇒) into the holes in the drum and take this out of the wheel hub.

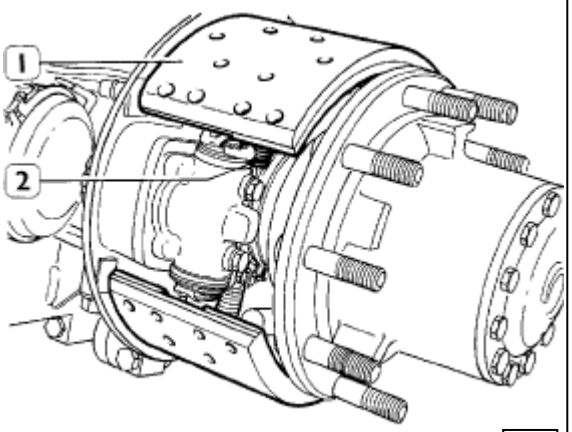
Figure 94




40513

Disconnect the electrical connection (1) for the cable signalling brake lining wear.

Figure 95

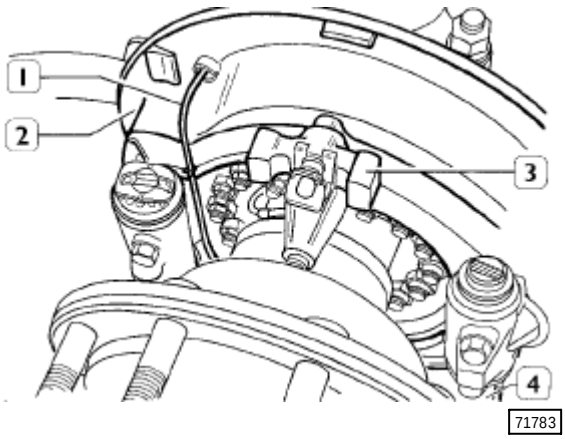



40514

Take out the shoe return springs (2).
Remove the top shoe (1).

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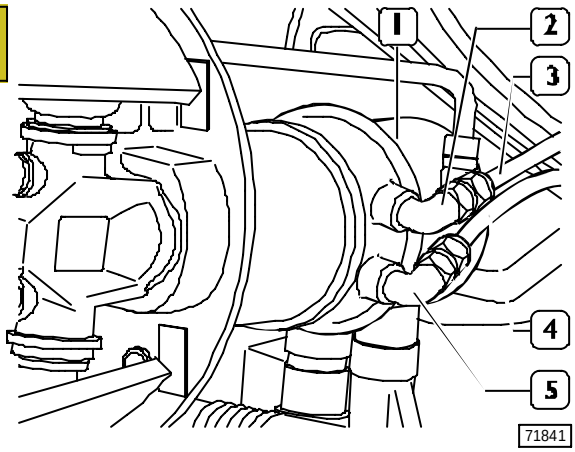
Figure 96




71783

Free the brake wear indicator cable (1) from the clips of the brake plate (3) and take the cable out of the guard (2). Remove the bottom shoe (4).

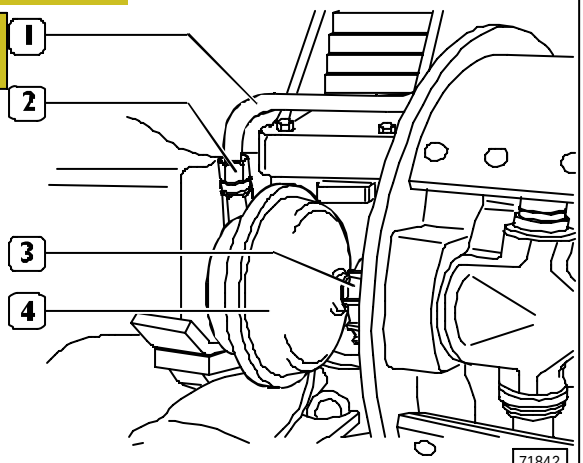
Figure 97




71841

Disconnect the pipes (3 and 4) from the fittings (5 and 2) and remove these from the combined cylinder (1). Using wrench 99356006, loosen the fixing ring nut. Turn the combined cylinder (1) anticlockwise, remove it from the brake body.

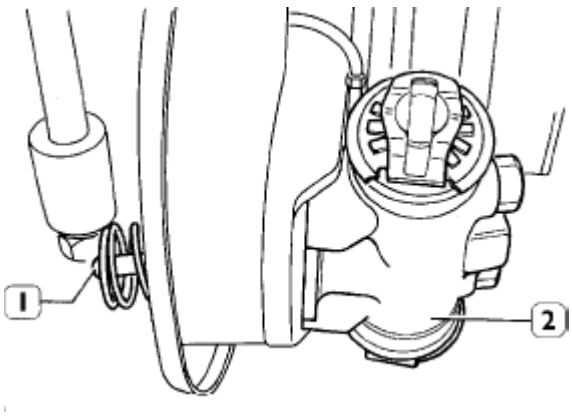
Figure 98




71842

Disconnect the pipe (1) from the fitting (2) and remove this from the diaphragm brake cylinder (4). Using wrench 99366006, loosen the ring nut (3). Turn the diaphragm brake cylinder (4) anticlockwise, remove it from the brake body.

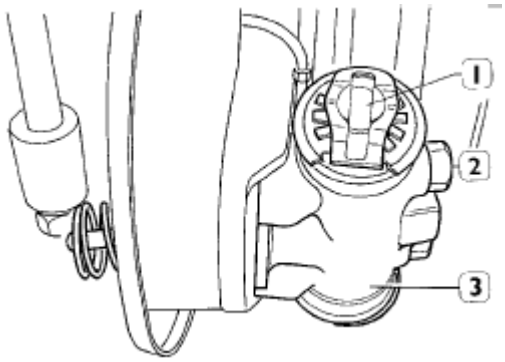
Figure 99




40517

Extract the wedge-shaped control unit (1) from the brake body (2).

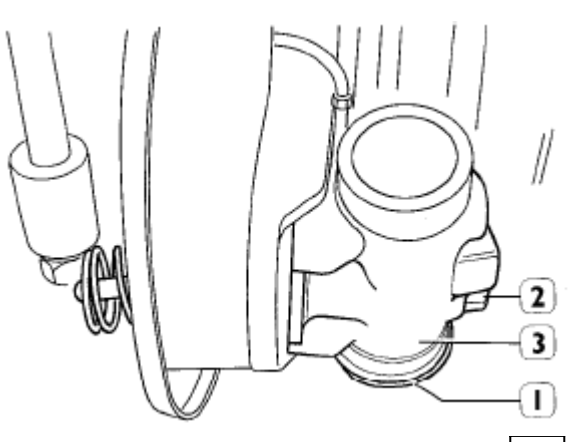
Figure 100




71791

Unscrew the guide pins (2) and take them out. Extract the adjustment unit (1) together with the thrust pin from the brake body (3).

Figure 101

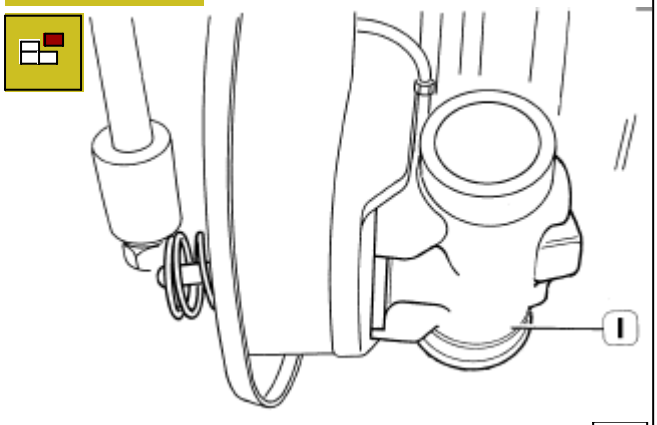



71789

Unscrew the guide pins (2) and take them out.
Extract the reaction pin (1) together with the thrust pin from the brake body (3).

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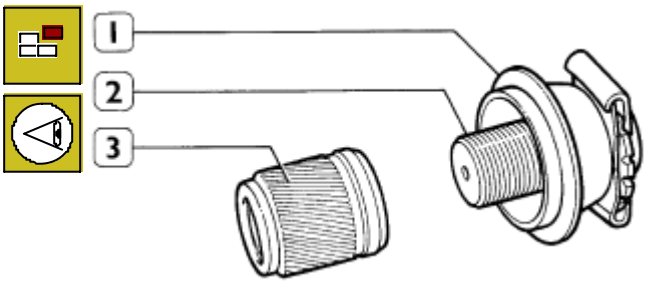
Figure 102




71790

Check the state of wear of the pin seats on the brake body (1), if they are scored or excessively worn, replace the abnormal brake bodies.
Examine the wear of the drums to decide on their reuse.
Measure the diameter of the drums with a sliding gauge without angling the arms.
Measure the diameter at several points to establish roundness and wear, also considering the depth of the scoring on the braking surface.
Admitted tolerance on roundness and/or eccentricity 0.25 mm.
If you find such wear or scoring as not to permit restoring the braking surface by turning, or clear signs of overheating, replace the drum (see Characteristics and Data table).
Check the state of the brake shoes and replace them if cracked.
If the braking surface of the linings shows signs of grease, you need to find the cause and eliminate it.
The minimum admitted thickness of the brake linings is 6.95 mm.
If you find a lower or slightly higher value, replace them.
Check the integrity and/or efficiency of the brake lining wear signal cable.
Check the integrity and/or efficiency of the shoe return springs.

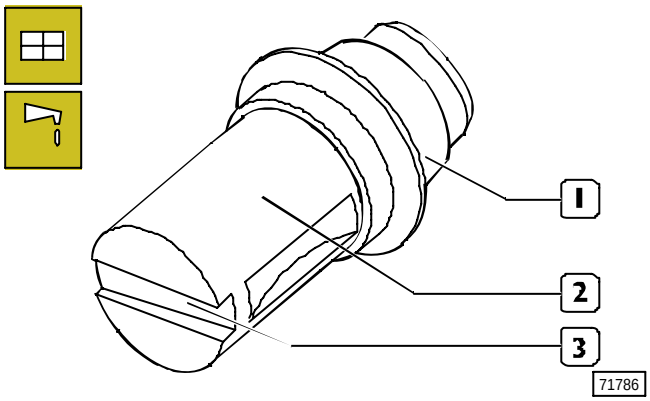
Figure 103




38357

Disassemble the automatic adjustment unit.
Unscrew the adjustment bushes (3) from the adjustment pins (2) and then remove the seals (1).
Check the wear condition of the adjustment bush outer helical toothing and check whether bushes are sliding freely on the relevant adjustment pins when screwing.

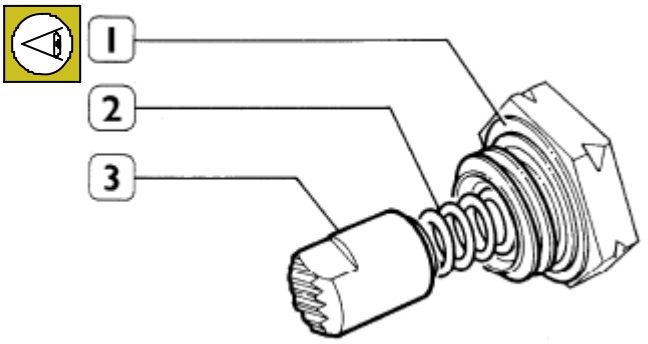
Figure 104




71786

Take seal (1) off thrust pin (2). Check wear conditions for thrust pin (2) and surfaces of sloping planes (3) subjected to the operation of shoe opening drive rollers.

Figure 105

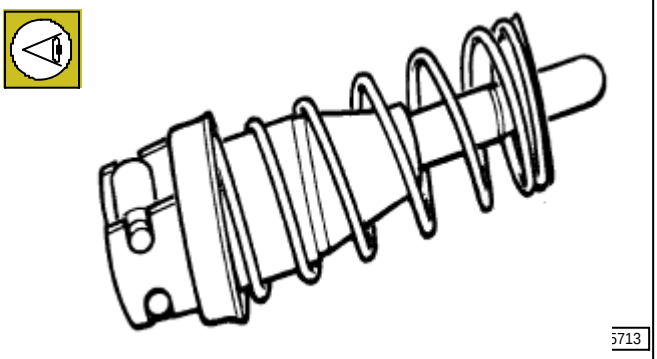



38360

Check the condition of the pressure pin teeth (3), of the relevant compression springs (2) and of the copper washers (1).

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Figure 106



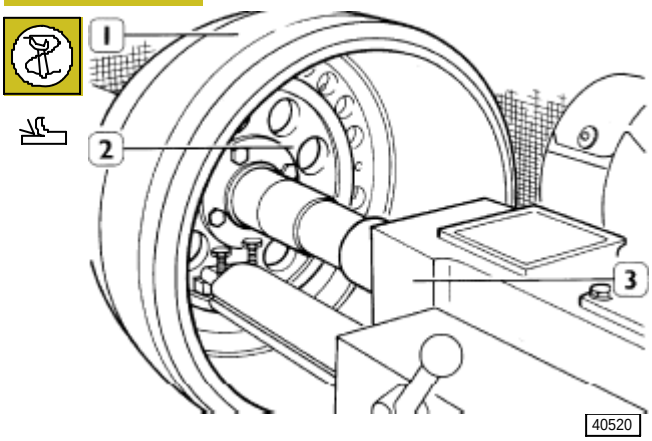

Check that the wedge units slide easily and that there are no abrasions.

If wear is found on the wedge components the complete unit must be replaced.

## 527231 Drum turning

Measure the drum diameters using a gauge without bending the arms, find the diameter in several points to establish the ovality and wear.

Figure 107



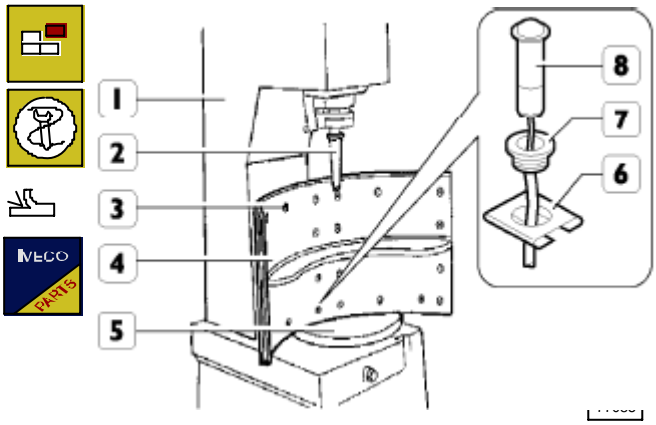

Fit tool 99372213 (2) into the brake drum.
Fit this combined unit onto the lathe shaft 99301001 (3).
Fit a set of spacers on the shaft to remove unit end play, tighten the lock nut and place the lathe support.
Fit the antivibration band on the brake drum.
Turn the drums by stages, removing the amount of material necessary to correct the imperfections found.
After turning remove the drum brake and carefully clean it.

The maximum diametral oversizing admitted for the drum is indicated on the drum itself.
This limit must not for any reason be exceeded as it would jeopardize the braking effect and the drum resistance characteristics.

Couple the brake linings suitable for each drum according to the oversizing.
Each vehicle axle must be fitted with linings of the same type.

## 527233 Replacing brake linings

Figure 108

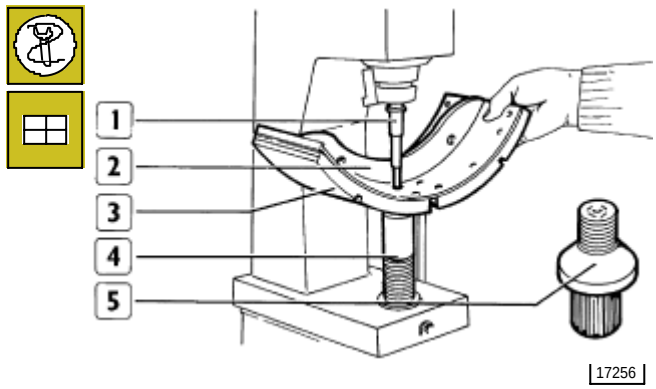



Remove the worn brake linings from the shoes with compressed air press 99305087 (1).

**NOTE** From the lower shoes open clip tabs (6) releasing the bushing (7). Now remove lining wear sensor (8) and associated cable.

Set the complete shoes (4) on an adjustable stand (5).
With a chisel (2) in the press tooling head (1) shear the rivet heads (3).
Eject the rivets from the shoes.
Carefully wash and blow the shoes to clean them.

Figure 109




Set the contact pin (5) on the press moving support (4).
Rivet the brake linings (3) onto the shoes (2) with the beater (1) fitted in the press tooling head.

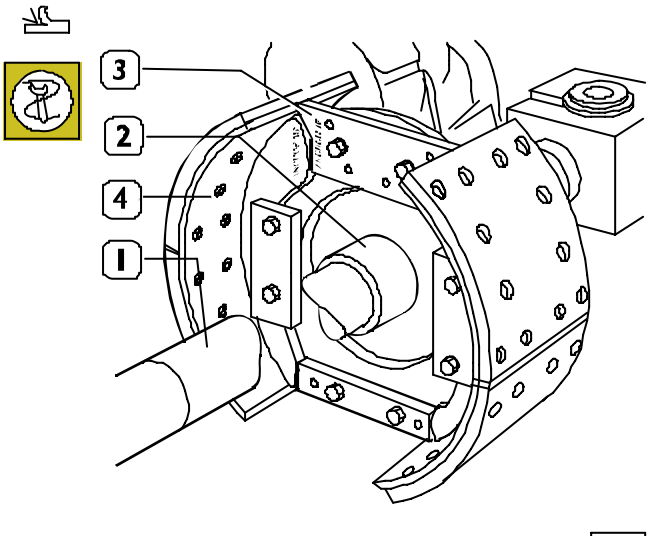
**NOTE** To rivet the brake linings correctly start in the centre, gradually extending to the braking sectors.

Mount seal wear cable inverting operations described for dismounting.

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## Turning brake linings

Figure 110

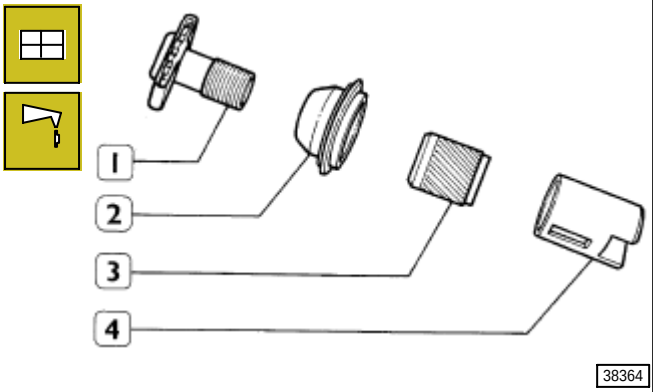



71849

Fit the hub 99372228 (2) on the shaft of the lathe 99301001 (1). Fit the plate 99372230 (3) on the hub (2) and secure the brake linings (4), making the wording "ANCHOR 15" coincide as shown in the figure. Turn the brake linings.

## Assembly

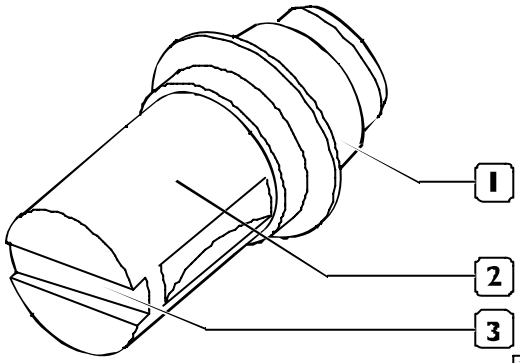
Figure 111




38364

Fit the seals (2) on the units of the adjustment pins (1). Grease the thread of the pins (1).
Fully screw down the adjustment bushings (3) and grease them thoroughly on the outside diameter.
Grease the inside diameter of the thrust pins (4).

Figure 112

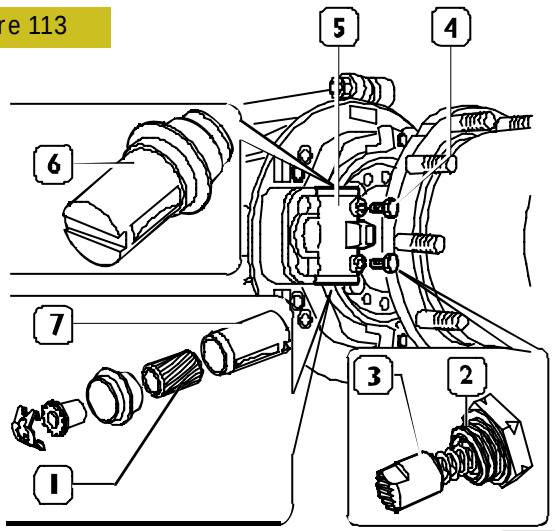



71786

Grease the seal (1) and fit it on the thrust pin (2).

When repairing the brakes, replace the seals of the reaction and thrust pins.
To lubricate the components, use Rockwell RBSK 0253 grease.

Figure 113




71788

Grease the inside of the brake body (5).
Mount the thrust pin - seal assembly (6) with the slot facing the guiding pin (4).
Insert the thrust pin (7) into the brake body (5) and insert the adjustment pin - seal - adjustment bushing assembly (1).

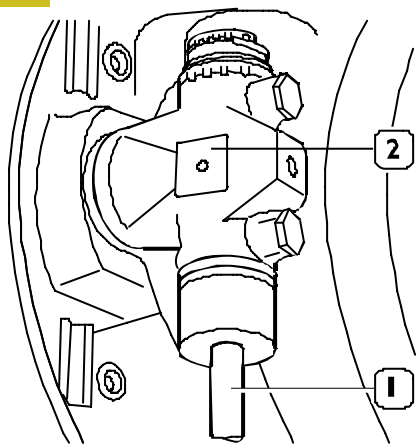
Take great care to observe the assembly order of the pins that has to be as illustrated in Figure 111.

Grease and insert the guide pin assemblies (4) into the seats on the brake body (5). Check the washers (2) are inserted and screw down by a few turns.

**NOTE** The guide pins (4) need to be mounted so that the tips (3) slide in the seats of the holes in the brake body (5).

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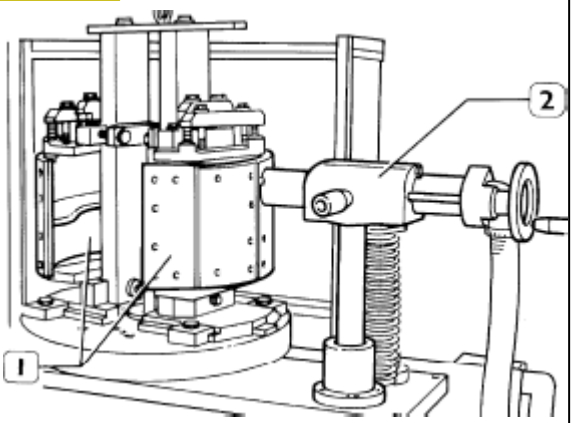
Figure 114




71787

Using the key 99373002 (1), drive the metal rings of the seals onto the brake assembly (2).

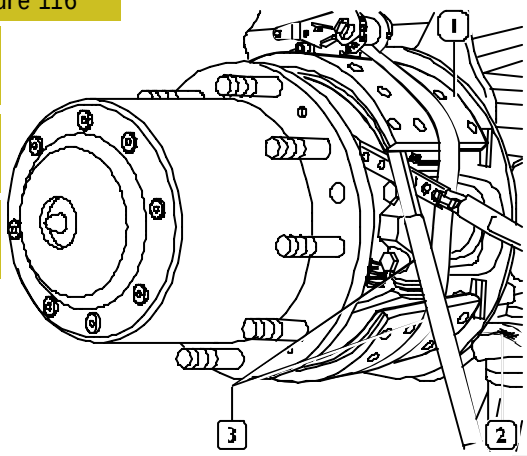
Figure 115




40524

Using device 99301006 (2), turn the brake linings (1).

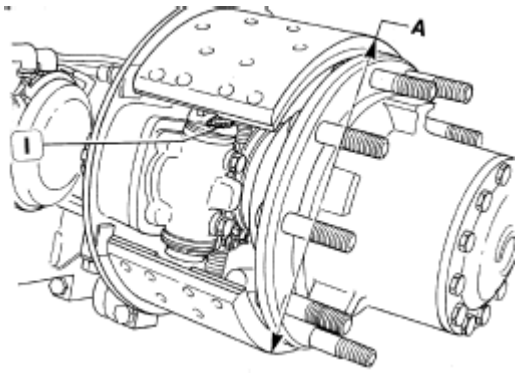
Figure 116




71785

Connect the lining wear indicator cable electrical connection (2) helping the fixing nut on the shoe. Fit the shoes (1) in the seat.
Hook on the shoe return springs with the aid of tool 99372211 (3).

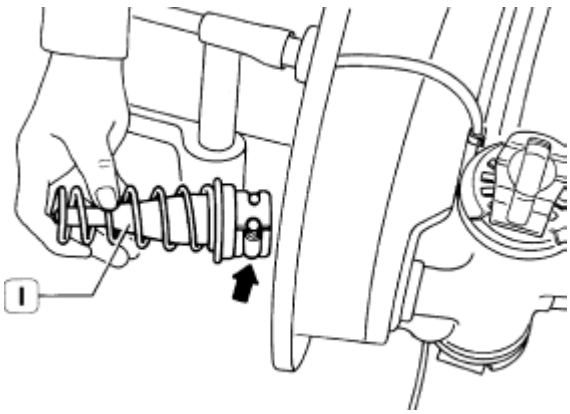
Figure 117




71784

Unscrew the adjustment unit (1) to the same extent to obtain the diameter A, 2 mm less than the diameter of the brake drum to mount.

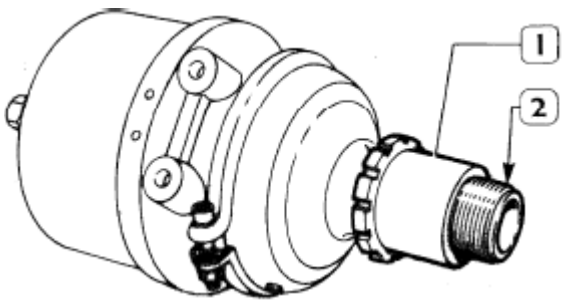
Figure 118




40530

Grease the wedge-shaped control unit (1). Insert it in its seat, taking care that the rollers (⇒) are positioned in the sliding race.

Figure 119

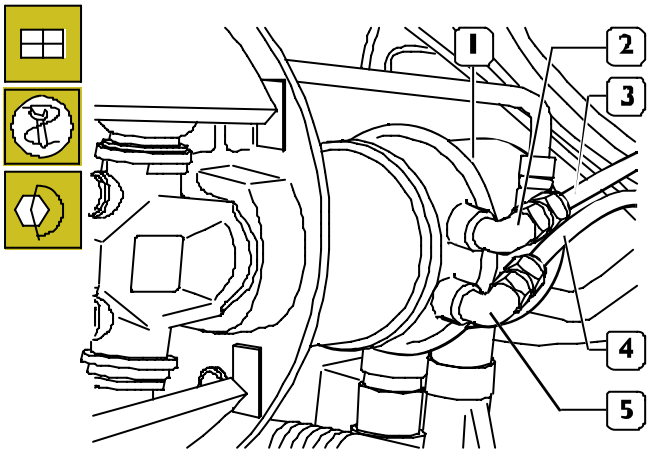



36757

Screw the ring nut (1) by hand onto the sleeve (2) as far as it will go.
Apply non-hardening sealant type LOCTITE 573 on the first few threads of the sleeve (2).

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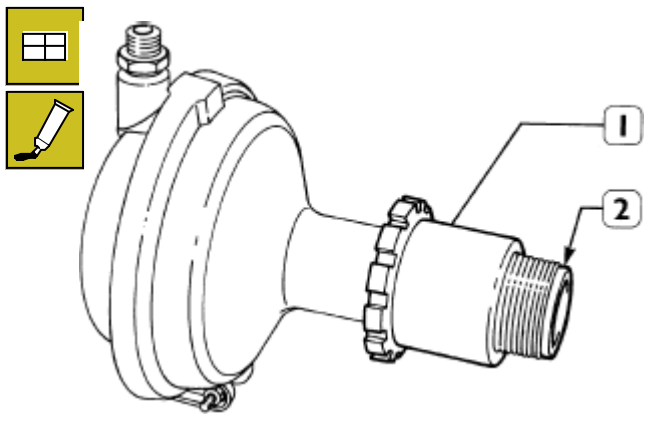
Figure 120




71841

Screw the combined cylinder (1) fully down into its seat. Check that the holes for the supply fittings are in the same position found on removal; if they are not, unscrew the combined cylinder appropriately. Mount the fittings (2 and 5) and connect the supply pipes (3 and 4). Supply the diaphragm sections of the combined cylinder by applying the service brake. With the wrench 99356006, tighten the ring nut to the required torque. Connect the brake lining wear indicator cable electrical connection. Restore the operation of the combined cylinder (1) screwing down the screw (2, Figure 119) fully.

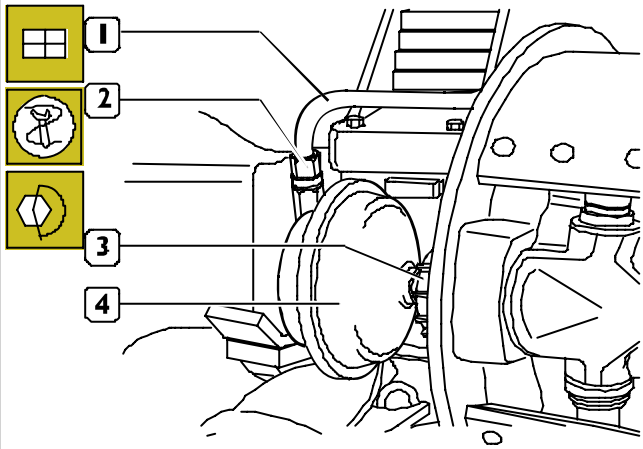
Figure 121




39941

Screw the ring nut (1) by hand onto the sleeve (2) as far as it will go. Apply non setting seal paste of LOCTITE type 573 on the first three threads of pipe (2).

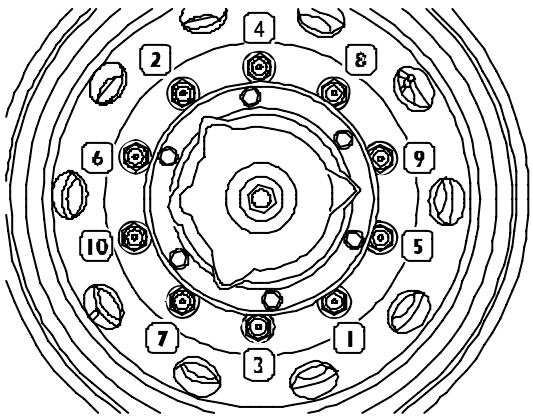
Figure 122




71842

Screw the diaphragm brake cylinder (4) fully down into its seat. Check that the hole for the supply fitting is in the same position found on removal; if it is not, unscrew the diaphragm brake cylinder (4) appropriately. Mount the fitting (2) on the diaphragm brake cylinder (4), hook up the supply pipe (1). Supply the brake cylinder by applying the service brake and with wrench 99356006 tighten the ring nut (3) to the required torque.

Figure 123




60229

Mount the wheels and tighten the fixing nuts to the required torque according to the diagram shown in the figure.
Mount the opposite brake assembly.
Start the vehicle's engine and run it for a sufficiently long time to fill the system.
Brake repeatedly to wear in the brake assembly and recover the clearance between the brake lining and the drum when the vehicle is running.

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Aquila Trucks Centres

SECTION 14

**5501 Bodywork**
**5001 Chassis frame**


| | Page |
|---|---|
| CAB | 7 |
| - General information | 7 |
| MAIN DATA | 7 |
| TOOLS | 7 |
| TIGHTENING TORQUES | 8 |
| REPAIR OPERATIONS | 13 |
| BUMPER | 13 |
| - Removal | 13 |
| - Refitting | 13 |
| CABIN | 14 |
| - Removal the cabin | 14 |
| - Refitting | 18 |
| REPLACING THE FRONT SHOCK ABSORBER | 19 |
| - Removal | 19 |
| - Refitting | 19 |
| REPLACING THE CAB SUSPENSION FRONT MOUNTING RUBBER-TYPE BUSHINGS | 19 |
| - Removal | 19 |
| - Refitting | 20 |
| REPLACING CAB FRONT UPPER SUPPORT BUSHINGS | 20 |
| - Removal | 20 |
| - Refitting | 20 |
| REMOVING – REFITTING THE STABILIZER BAR | 20 |
| - Removal | 20 |
| - Refitting | 20 |

https://truckmanualshub.com/
Aquila Trucks Centres

Page

REPLACING REAR CAB SUSPENSION DAMPERS . . . . . 22
- Removal . . . . . 22
- Refitting . . . . . 22
REPLACING THE TRANSVERSE TIE ROD BUSHINGS . . . . . 22
- Removal . . . . . 22
- Disassembling/reassembling the bushings . . . . . 22
- Refitting . . . . . 22
LEVELLING VALVE . . . . . 23
- Removal . . . . . 23
- Refitting . . . . . 23
CHANGING THE CAB LOCK . . . . . 23
- Removal . . . . . 23
- Refitting . . . . . 23
CAB TILT CYLINDER . . . . . 23
REPLACING HYDRAULIC CAB TILT CYLINDER . . . . . 23
- Removal . . . . . 23
- Refitting . . . . . 23
- Checking oil level . . . . . 25
- Bleeding cab tilt system . . . . . 25
- Cab mechanic suspension . . . . . 26
- Cab driving position adjustment . . . . . 26
- Cab pneumatic suspension . . . . . 27
- Adjusting the levelling valve linkage . . . . . 27
REPLACING THE WINDSHIELD . . . . . 28
- Removal . . . . . 28
- Refitting . . . . . 28
REPLACING THE WINDING WINDOW . . . . . 29
- Removal . . . . . 29
- Refitting . . . . . 30

Page

REPLACING THE WINDOW WINDER . . . . . 31
- Removal . . . . . 31
- Refitting . . . . . 31
REPLACING THE DOOR LOCK . . . . . 31
- Removal . . . . . 31
- Refitting . . . . . 32
REPLACING THE OUTSIDE HANDLE OF THE DOOR . 32
- Removal . . . . . 32
- Refitting . . . . . 32
REPLACING THE INSIDE HANDLE . . . . . 32
- Removal . . . . . 32
- Refitting . . . . . 33
REPLACING THE SIDE MIRRORS . . . . . 33
- Removal . . . . . 33
- Refitting . . . . . 33
REPLACING THE DOOR . . . . . 33
- Removal . . . . . 33
- Refitting . . . . . 33
REPLACING THE FIXED WINDOW . . . . . 34
- Removal . . . . . 34
- Preparing the window bay . . . . . 34
- Preparing the window . . . . . 34
- Refitting . . . . . 34
INSTRUMENT PANEL . . . . . 36
- Removal . . . . . 36
- Refitting . . . . . 36
CENTRAL SWITCH DASHBOARD . . . . . 36
- Removal . . . . . 36
- Refitting . . . . . 37
PROTECTIONS . . . . . 37
- Removal . . . . . 37
- Refitting . . . . . 40

Aquila Trucks Centres

Page

WINDSCREEN VISOR ROLLING DEVICE ..... 40
- Removal ..... 40
- Refitting ..... 41
WINDSCREEN SUN VISOR REEL MOTOR REPLACEMENT ..... 41
- Removal ..... 41
- Refitting ..... 41
AIR INTAKE LID ..... 42
- Removal ..... 42
- Refitting ..... 42
AIR INTAKE LID MOTOR REPLACEMENT ..... 42
- Removing ..... 42
- Refitting ..... 43
REPLACING SIDE DOOR OPENING CONTROL CABLE (AT VEHICLES) ..... 43
- Removing ..... 43
- Refitting ..... 45
- Lid opening control cable adjustment ..... 45
DRIVER'S SEAT ..... 46
- Removal ..... 46
- Refitting ..... 46
- Component layout ..... 47
REMOVING THE DRIVER'S SEAT ..... 48
- Removing - refitting the cushion ..... 48
- Removing ..... 48
- Refitting ..... 48
- Removing - refitting cushion sliding blocks .... 48
- Removing ..... 48
- Refitting ..... 48
- Removing - refitting the seatbelt ..... 49
- Refitting ..... 49

Page

- Removing - refitting seatbelt connection and right-hand side upholstery ..... 49
- Refitting ..... 49
- Removing - refitting the left-hand side upholstery, IPS valve and heating switch ..... 50
- Removing ..... 50
- Refitting ..... 50
- Removing - Refitting the back ..... 50
- Removing ..... 50
- Refitting ..... 50
- Removing - Refitting the back adjustment lever ..... 51
- Removing ..... 51
- Refitting ..... 51
- Removing- refitting the height adjustment device ..... 51
- Removing ..... 51
- Refitting ..... 51
- Removing- refitting the seat angle adjustment device ..... 51
- Removing ..... 51
- Refitting ..... 51
- Removing – Refitting the flexible cable of the shock absorber adjustment device ..... 51
- Removing ..... 51
- Refitting ..... 52
- Removing – Refitting the back adjustment lever segment ..... 52
- Removing ..... 52
- Refitting ..... 52
- Removing- refitting the air spring ..... 52
- Removing ..... 52
- Refitting ..... 52
- Removing- refitting the shock absorber ..... 52
- Removing ..... 52
- Refitting ..... 53

Aquila Trucks Centres

Page

- Removing - refitting the height adjustment valve . . . . . 53
- Removing . . . . . 53
- Refitting . . . . . 53
- Removing - refitting the height locking system . . . . . 53
- Removing . . . . . 53
- Refitting . . . . . 53
- Removing - refitting the flexible cable of the horizontal lever suspension . . . . . 53
- Removing . . . . . 53
- Refitting . . . . . 54
- Removing - refitting the fast lowering magnetic valve . . . . . 54
- Removing . . . . . 54
- Refitting . . . . . 54
- Removing - refitting the fast lowering switch . . 54
- Removing . . . . . 54
- Refitting . . . . . 54
- Removing - refitting the lumbar support device . . . . . 54
- Removing . . . . . 54
- Refitting . . . . . 54
- Removing - refitting the back upholstery . . . . . 55
- Removing . . . . . 55
- Refitting . . . . . 55
- Removing - refitting the cushion upholstery . . 55
- Removing . . . . . 55
- Refitting . . . . . 55

DRIVER'S SEAT PNEUMATIC SCHEME . . . . . 56

PASSENGER'S SEAT PNEUMATIC DIAGRAM . . 57

CABIN REFRIGERATOR . . . . . 58

- Preliminary checks . . . . . 58

Page

- Removal . . . . . 58
- Refitting . . . . . 58

OVERHAULING . . . . . 59

- Removing . . . . . 59
- Fan removing . . . . . 59
- Removing the anti-tipping probe with electronic circuit on the control unit . . . . . 59
- Electronic control unit disassembling . . . . . 60
- Checks . . . . . 60
- Refitting . . . . . 60

CAB AIR-CONDITIONING . . . . . 61

- General . . . . . 61

VENTILATION . . . . . 61

- Description . . . . . 61

AIR-CONDITIONING AND HEATING . . . . . 62

- Description . . . . . 62
- Air-conditioning . . . . . 62
- Heating . . . . . 62
- Air-conditioning controls assembly . . . . . 62
- Manual . . . . . 62
- Heating and ventilation . . . . . 62

COMPONENT LAYOUT (WEBASTO AIR CONDITIONER) . . . . . 63

HEATER ASSEMBLY COMPONENT LAYOUT (WEBASTO) . . . . . 64

- Outside temperature sensor . . . . . 65
- Compressor . . . . . 65
- Condenser and safety pressure switches . . . . . 66
- Stepper motors . . . . . 67
- Evaporator temperature sensor . . . . . 68
- Expansion valve . . . . . 68

ADDITIONAL AIR HEATER SYSTEM (ON REQUEST) . . . . . 69

- Description . . . . . 69
- Operation . . . . . 69

Aquila Trucks Centres

Page

FAULT DIAGNOSIS . . . . . 70
- Troubleshooting . . . . . 70
- Introduction . . . . . 70
MAIN DATA . . . . . 74
AUXILIARY AIR HEATER . . . . . 74
GENERAL WARNINGS . . . . . 75
TIGHTENING TORQUES . . . . . 75
REPAIR OPERATIONS . . . . . 76
HEATER . . . . . 76
- Removal . . . . . 76
- Refitting . . . . . 76
ADDITIONAL AIR HEATER SYSTEM . . . . . 77
- Removal . . . . . 77
- Refitting . . . . . 77
AIR RECIRCULATION DOOR CONTROL MOTOR . . . . . 77
- Removal . . . . . 77
- Refitting . . . . . 77
ELECTRIC FAN . . . . . 78
- Removal . . . . . 78
- Refitting . . . . . 78
HEATER RADIATOR . . . . . 78
- Removal . . . . . 78
- Refitting . . . . . 79
TAP . . . . . 79
- Removal . . . . . 79
- Refitting . . . . . 80
POLLEN FILTER . . . . . 80
- Removal . . . . . 80
- Refitting . . . . . 80

Page

AIR-CONDITIONER COMPRESSOR . . . . . 80
- Removal . . . . . 80
- Refitting . . . . . 81
AIR-CONDITIONER CONDENSER . . . . . 81
- Removal . . . . . 81
- Refitting . . . . . 81
OUTSIDE AIR TEMPERATURE SENSOR . . . . . 81
- Removal . . . . . 81
- Refitting . . . . . 81
REPLACING THE ELECTROMAGNETIC CLUTCH 82
PROCEDURE FOR DRAINING AND RECHARGING AIR CONDITIONING SYSTEMS WITH RECHARGING STATION 99305146 AND RECOVERY OF R134A COOLANT . . . . . 84
SAFETY STANDARDS . . . . . 85
CONTROL FASCIA . . . . . 86
OPERATION FLOW CHART . . . . . 88
RECOVERING REFRIGERANT FROM THE VEHICLE SYSTEM . . . . . 89
CREATING A VACUUM IN THE SYSTEM . . . . . 91
RESTORING OIL IN THE SYSTEM . . . . . 93
FILLING THE SYSTEM WITH REFRIGERANT . . . 94
CHECKING THE PRESSURES IN THE SYSTEM . . . . . 96
OPERATIONS PRIOR TO DISCONNECTING THE STATION FROM THE SYSTEM . . . . . 96
PROCEDURE FOR DRAINING AND RECHARGING AIR CONDITIONING SYSTEMS WITH RECHARGING STATION 99305148 AND RECOVERY OF R134A COOLANT . . . . . 97
- Main components . . . . . 97
SAFETY STANDARDS . . . . . 98
CONTROL PANEL . . . . . 99
- Keypad functions . . . . . 99
- Emergency warning light panel . . . . . 99

https://truckmanualshub.com/
Aquila Trucks Centres

Page


PRELIMINARY CHECKS . . . . . 100

AUTOMATIC PROCEDURE . . . . . 100

ASSISTED PROCEDURE . . . . . 102

LEAK FINDER FOR AIR-CONDITIONING SYSTEMS WITH HFC R134A (99305147) . . . . . 104

CHASSIS FRAME . . . . . 105

TIGHTENING TORQUES . . . . . 105

REPAIRS . . . . . 106

CHECKS . . . . . 106

- Measuring the bend of the chassis frame downwards or upwards . . . . . 107
- Measuring the side bend of the chassis frame . 107
- Measuring the movement of the chassis frame 107
- Measuring the torsion of the chassis frame . . . 108

PRECAUTIONS . . . . . 108

- Welds on the chassis frame . . . . . 110

Aquila Trucks Centres

## 5501 CAB

### General information

The cab is of an advanced type, hydraulically tilting by manual control.
Tilting angle 60°.
Construction in pressed and welded steel.
Protection: Box opening anticorrosive protection.
Door and outer panel inner side framework coated with galvanised metal sheet.
Cab suspension type:

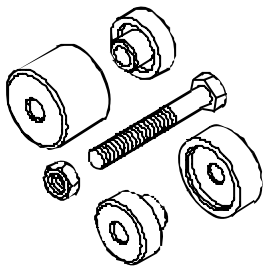
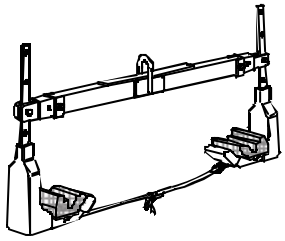
- mechanic
- pneumatic on request only on AT.

| CAB TYPE | CAB LENGTH | LOW ROOF | INTERMEDIATE HEIGHT ROOF |
|---|---|---|---|
| AT | LONG (2280x2100 mm) | F | F |
| AD | SHORT (2280x1660 mm) | F | |

## MAIN DATA

| DESIGNATION | | |
|---|---|---|
| Cabin with mechanic suspension | | |
| Front suspension made up of: | | |
| - stabilizer bar | 1 | |
| - shock absorber with coaxial cylindric spring with adjusting device | 2 | |
| Rear suspension made up of: | | |
| - shock absorber with coaxial cylindric spring with adjusting device | 2 | |
| - elastic pads | 2 | |
| Cabin with pneumatic suspension, made up of: | | |
| - stabilizer bar | | |
| - shock absorber with coaxial air spring | 1 | |
| - levelling valve | 2 | |
| Rear suspension made up of: | | |
| - shock absorber with coaxial air spring | 2 | |
| - levelling valve | 1 | |
| Levelling valve | | |
| - KNORR - BREMSE: | | |
| - front, type SV1490 - K000264 | 2 | |
| - rear, type SV1491 - K000661 | 1 | |
| Working pressure | 8.5 bar | |
| Minimum pressure assured | 0,5 $^{+0.8}_{-0.2}$ | bar |
| Lever working maximum travel | ± 20 | |
| - KNORR/BREMSE SV 1490-K0002464 (front and rear) | | |
| Working maximum pressure | 8.5 bar | |
| Guaranteed minimum pressure | 0,5 $^{+0.8}_{-0.2}$ | bar |
| Lever maximum working travel | ± 20 | |

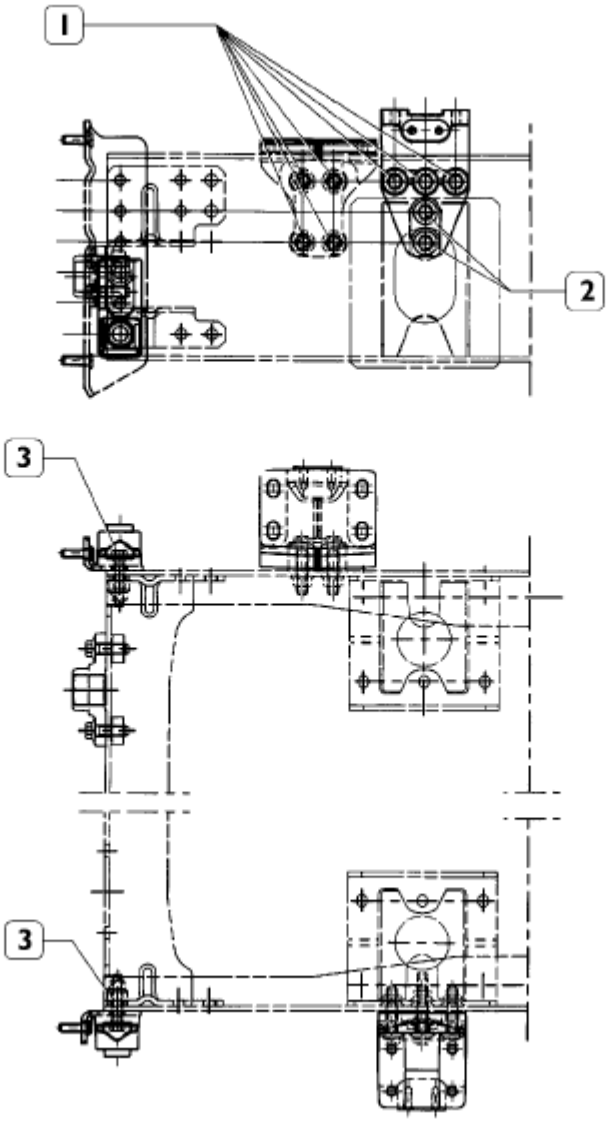
## TOOLS

| TOOL NO. | | DESCRIPTION |
|---|---|---|
| **99346051** |  | Cabin front suspension bracket rubber bush disassembling/assembling tool |
| **99378039** |  | Cabin removal-refitting swing bar |

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## TIGHTENING TORQUES

Figure 1




19

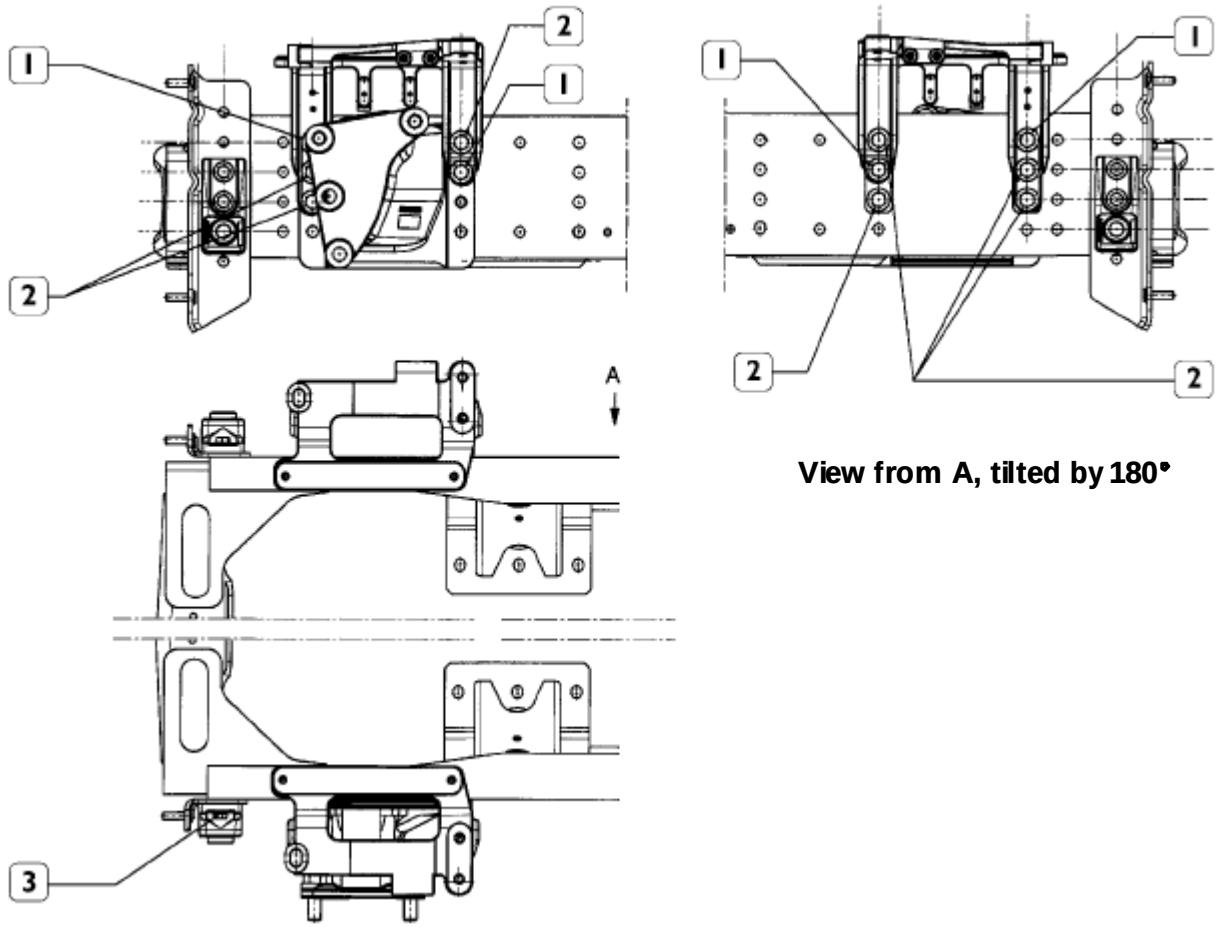
CAB SUPPORT FOR VEHICLES 4X2 - 6X4

| DESCRIPTION | | TORQUE | |
|---|---|---|---|
| | | Nm | Kgm |
| 1 | Nut | 226.5 ± 22.5 | 22.6 ± 2.2 |
| | Screw | 278 ± 28 | 27.8 ± 2.8 |
| 2 | Nut | 226.5 ± 22.5 | 22.6 ± 2.2 |
| 3 | Nut | 179 ± 18 | 17.9 ± 1.8 |
| | Screw | 146.5 ± 14.5 | 14.6 ± 1.4 |

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## TIGHTENING TORQUES

Figure 2




20

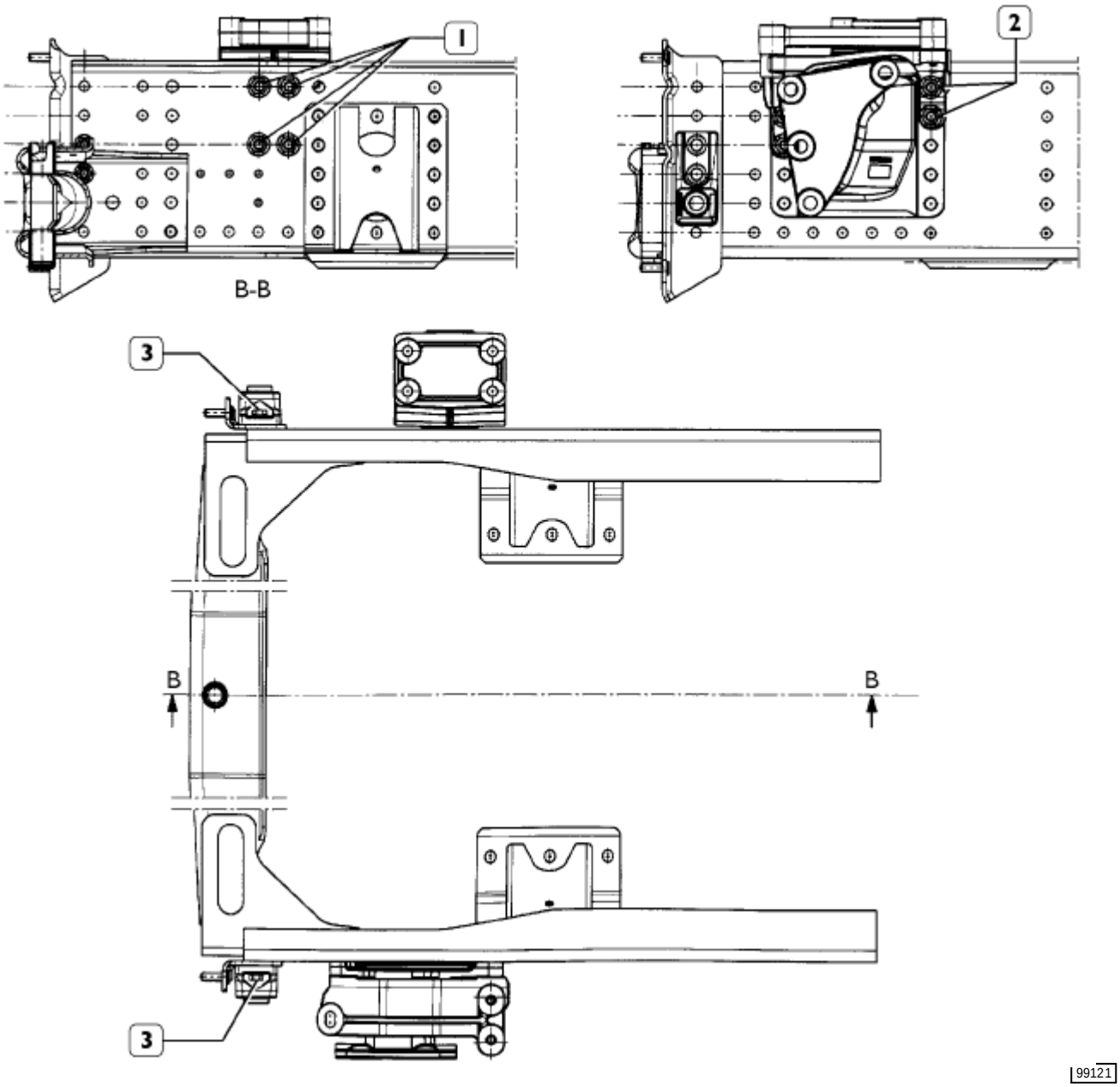
CAB SUPPORT FOR VEHICLES 4x4 - 6x6

| DESCRIPTION | | TORQUE | |
|---|---|---|---|
| | | Nm | Kgm |
| 1 | Nut | 226.5 ± 22.5 | 22.6 ± 2.2 |
| | Screw | 278 ± 28 | 27.8 ± 2.8 |
| 2 | Nut | 226.5 ± 22.5 | 22.6 ± 2.2 |
| 3 | Nut | 179 ± 18 | 17.9 ± 1.8 |
| | Screw | 146.5 ± 14.5 | 14.6 ± 1.4 |

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## TIGHTENING TORQUES

Figure 3



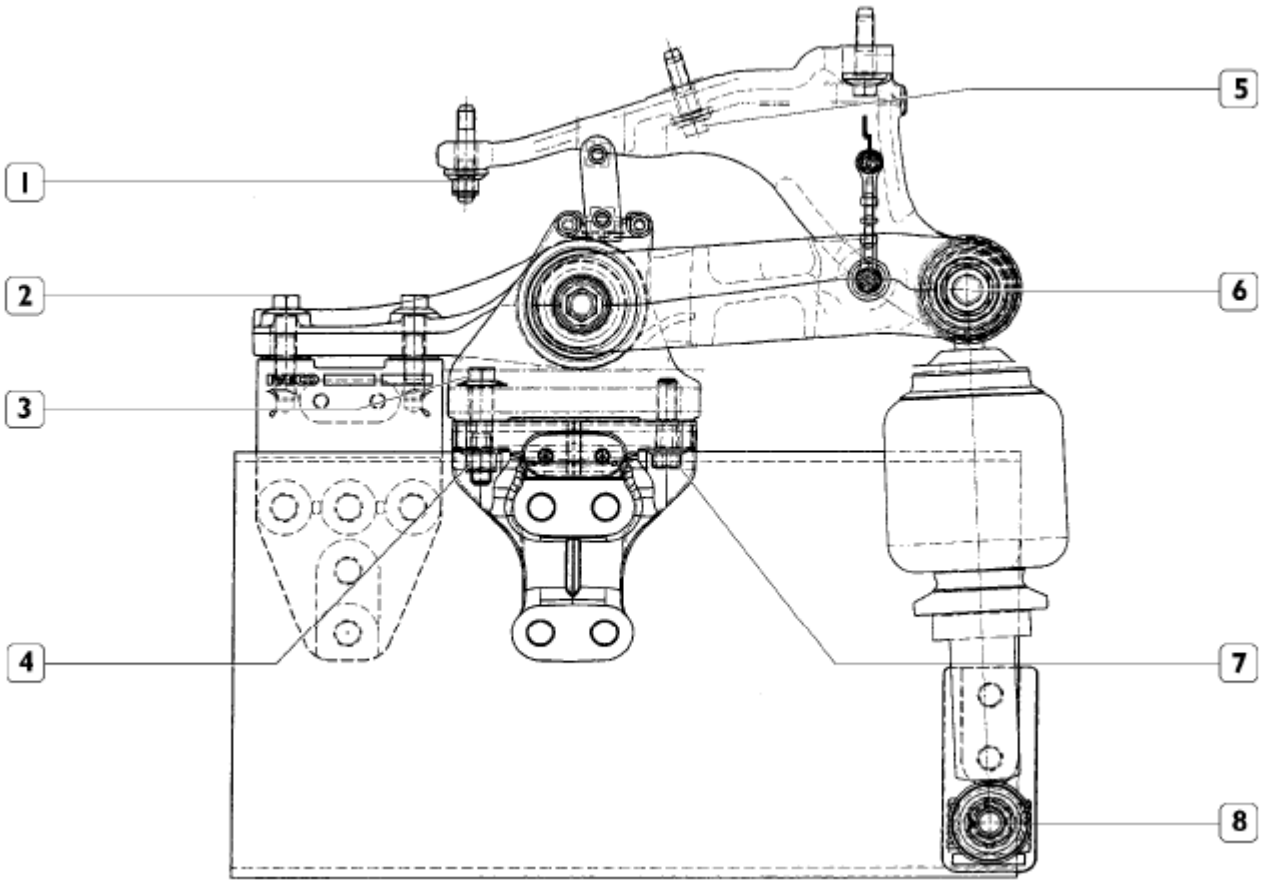

CAB SUPPORT FOR VEHICLES 8x4 - 8x8

| DESCRIPTION | | TORQUE | |
|---|---|---|---|
| | | Nm | Kgm |
| 1 | Nut | 226.5 ± 22.5 | 22.6 ± 2.2 |
| | Screw | 278 ± 28 | 27.8 ± 2.8 |
| 2 | Nut | 226.5 ± 22.5 | 22.6 ± 2.2 |
| 3 | Nut | 179 ± 18 | 17.9 ± 1.8 |
| | Screw | 146.5 ± 14.5 | 14.6 ± 1.4 |

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## TIGHTENING TORQUE

Figure 4



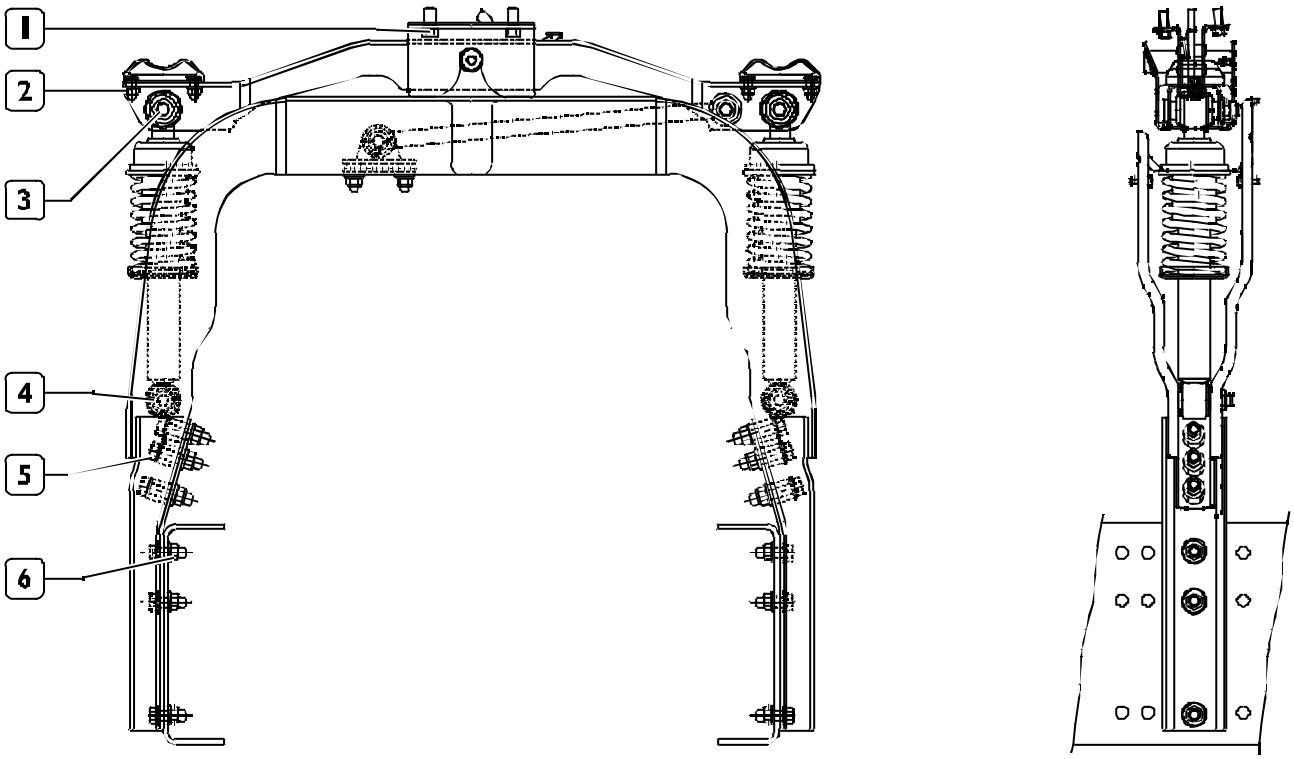

CABIN FRONT SUSPENSION

| | DESCRIPTION | TORQUE Nm | TORQUE Kgm |
|---|---|---|---|
| 1 | Cabin front support fastening nut | 83 ÷ 101 | 8.3 ÷ 10 |
| 2 | Front left support fastening screw | 173 ÷ 212 | 17.3 ÷ 21.2 |
| 3 | Front right support fastening screw | 161 ÷ 197 | 16 ÷ 19.7 |
| 4 | Nut for screw securing right front support | 132 ÷ 161 | 13.2 ÷ 16.1 |
| 5 | Cabin front support fastening screw | 109 ÷ 133 | 10.9 ÷ 13.3 |
| 6 | Air spring/shock absober upper fastening screw | 400 | 40 |
| 7 | Front right support fastening screw | 173 ÷ 212 | 17.3 ÷ 21.2 |
| 8 | Air spring/shock absober upper fastening screw<br>Air spring/shock absorber upper fastening nut | 490 ÷ 600<br>398 ÷ 487 | 49 ÷ 60<br>39.8 ÷ 48.7 |

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## TIGHTENING TORQUE

Figure 5




| DESCRIPTION | | TORQUE Nm | TORQUE (Kgm) |
|---|---|---|---|
| Cab rear suspension | | | |
| 1 | Flanged hexagonal headed screw retaining lock | 82 ± 9 | (8.2 ± 0.8) |
| 2 | Self-locking hexagonal nut retaining flexible buffer to beam | 140 ± 14 | (14 ± 1.4) |
| 3 | Hexagonal headed screw retaining top of damper | 82 ± 8 | (8.2 ± 0.8) |
| 4 | Self-locking nut and hexagonal headed screw retaining lower end of damper | 154 ± 15.5 | (15,4 ± 1.5) |
| 5 | Hexagonal screw with flange for fastening the bracket to the crossbar | 146.5 ± 14.5 | (14.6 ± 1.4) |
| 6 | Hexagonal nut with self-locking flange and hexagonal headed screw with flange retaining bracket to chassis | 179 ± 18 | (17.9 ± 1.8) |
| | Hex screw with flange to secure support to cab (vehicles 8x4) | 204.5 ± 21.5 | (20.4 ± 2.1) |
| GAS PIPE FITTINGS | | | |
| 5/8'' - 18 UNF | | 15.9 | 1.6 |
| 3/4'' - 18 UNF | | 15.9 | 1.6 |
| 1'' - 14 UNF | | 29.8 | 3 |

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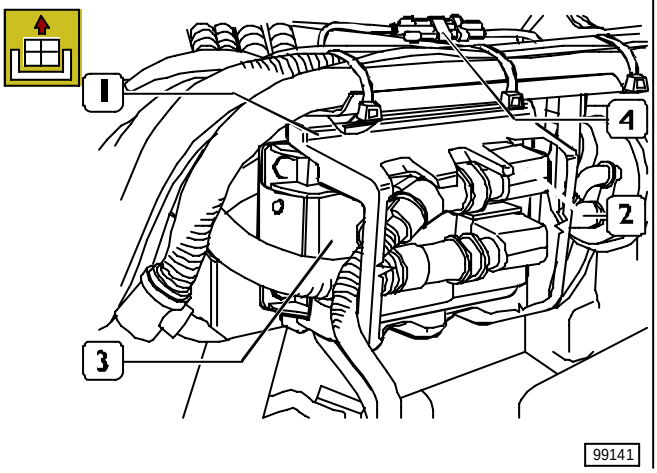
## REPAIR OPERATIONS

**NOTE** Operations described and illustrated in following chapters refer to vehicle Tractor AD 380T having its cab with a mechanical suspension. Unless another indication is provided, these operations are also valid for a cab with a pneumatic suspension. Some operations, or part of them, may be either unnecessary or unsuitable to vehicles of other versions.

### 500210 BUMPER

### Removal

Figure 6




**See Figure 6**

Operating on main switch, take current off the electric system.

Tilt the cab.

Remove cover (1).

Disconnect the connector (2) from the F.F.C. control unit (3).

Cut wiring harness retaining clamps and disconnect connection (4).

**See Figure 7**

Lift the cowling.

Remove tow hook pin (1).

Remove the four screws (3) assuring bumper (2).

While supporting it, draw bumper (2) off securing brackets (6).

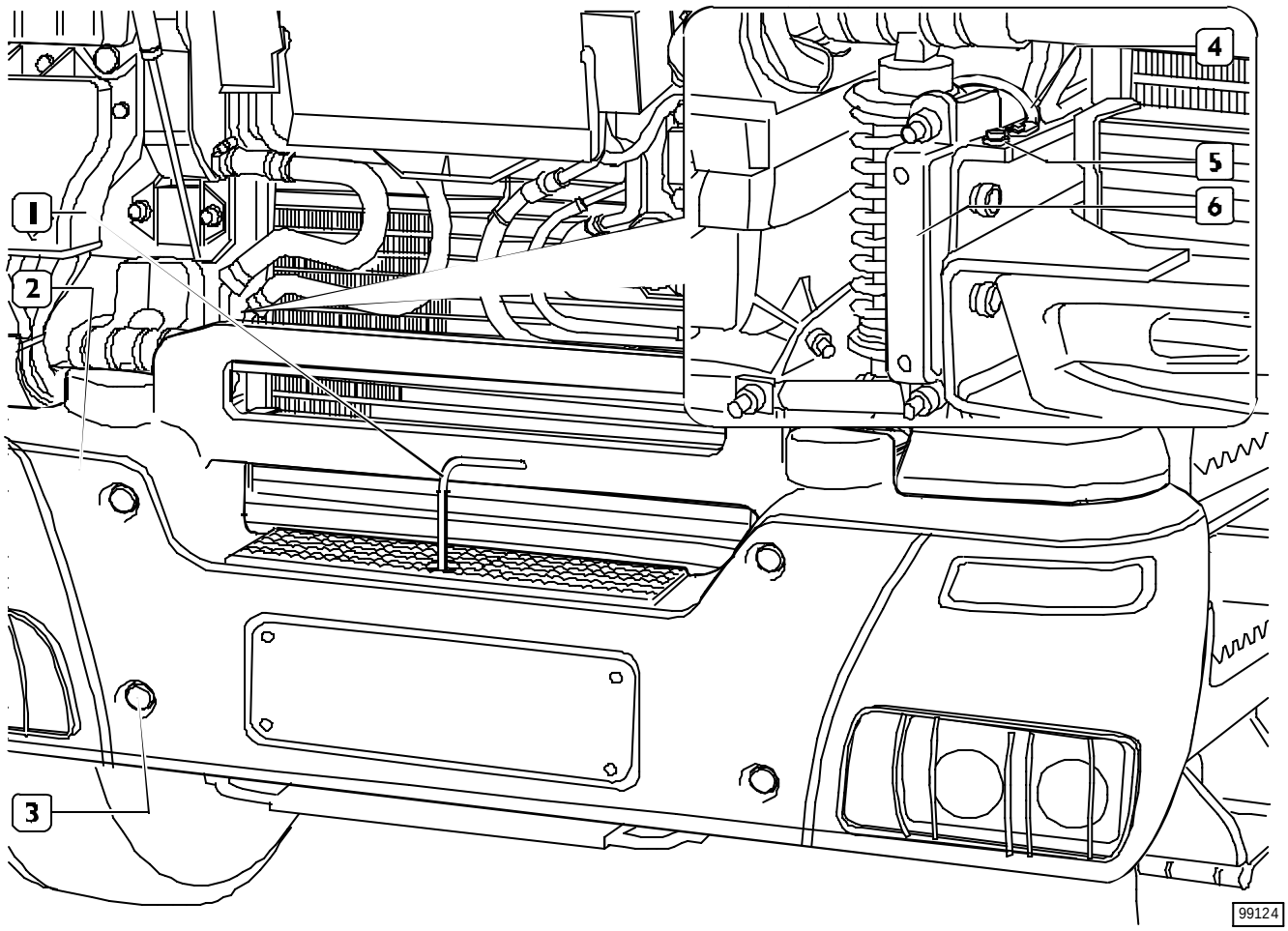
Remove screw (5) securing earth cable (4) to the chassis and accurately set bumper (2) in order not to damage it.

### Refitting

Reattachment is carried out by properly reversing the detachment operations and tightening the nuts and screws to the specified torque

When reattachment operations have been completed, check correct operation of the lights or units affected by detachment.

Figure 7



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## 550101 CABIN

### Removal the cabin

Position the vehicle with the front wheels in the straight direction of running. Lift the front grille. Remove the expansion tank cap, then partially drain the coolant off the engine cooling system.
If the cabin is equipped with an air-conditioning unit, remove the caps (1 and 2, Figure 8), apply unit 99305146 pipes to the adapters below, then blow the gas off the cabin conditioning system, as described in the respective chapter.

**NOTE** This operation must be carried out only by authorized, qualified skilled personnel.

Drain the pneumatic system.

Figure 8

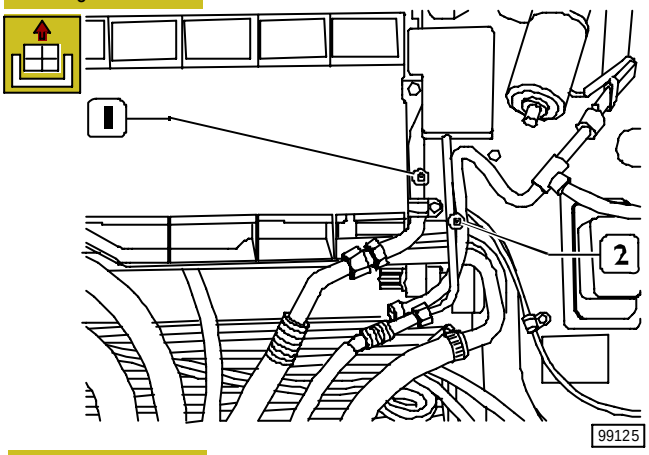
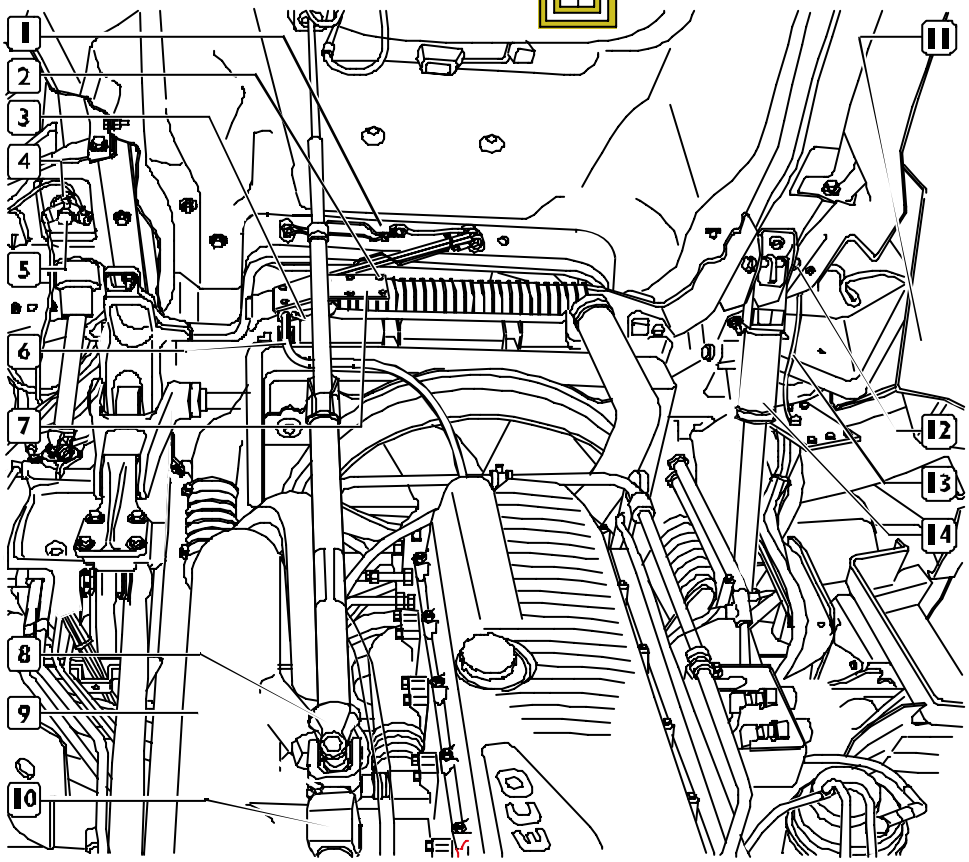



Figure 9




Disconnect the coolant pipes: (6), (3) from radiator (1).

Remove screws (2) fastening the pipe support bracket (7) on radiator (1).

Remove nuts (4), then take off the steering control assembly adjusting pedal distributor (5).

Only for vehicles equipped with mechanic gearbox.

Mark the assembly position of the telescopic tie-rod Cardan joint (8) on gearbox control rod (10), then remove nut (9) with its respective screw and disconnect Cardan joint (8) from rod (10).

Properly secure the telescopic tie-rod to the cabin.

Remove the screws and take wheel splash guard (11) off the cabin.

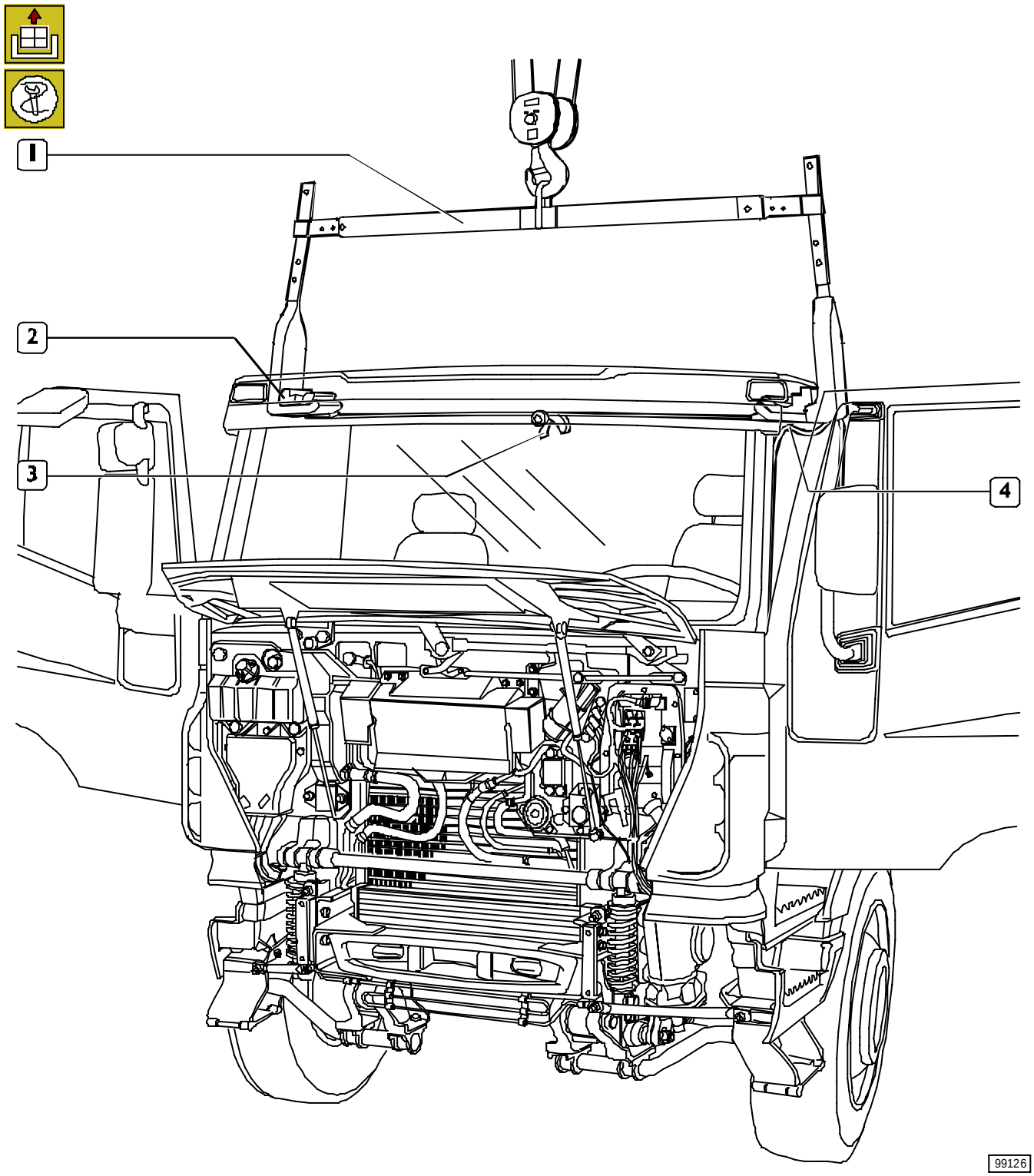
Disconnect the heater fuel pipe (13), (where available), from the adapter.

Loosen the cabin tilting support cylinder (14) fastening nut (12).

Position the two wooden dowels of suitable thickness onto the cabin supporting rear crossbar, to avoid cabin lock engagement after the cabin has been lowered.
Lower the cabin.

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Figure 10

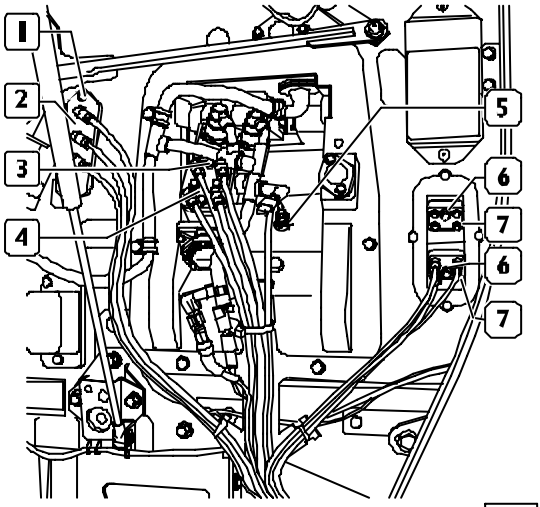



Remove the bumper as described in the respective chapter (operation 500210).
From the door compartment upper side, remove gasket (4).
Hook swing bar 99378039 (1) to a bridge crane or other suitable lifting means, then harness the cabin.

Swing bar (1) hooks (2) must be positioned at about the door compartment centre line and secured to the latter by means of stretching device (3).

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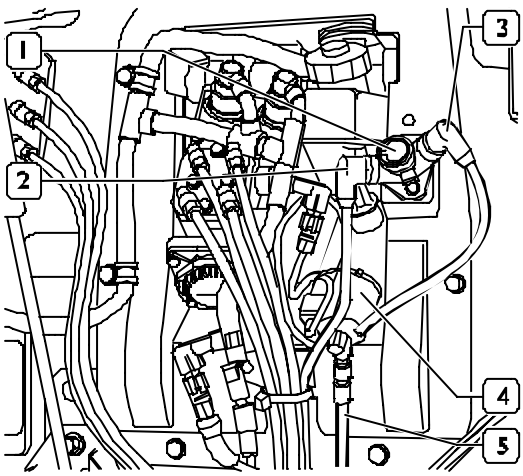
Figure 11




87331

Remove the nuts (1) and detach the cover (2) together with the pipes from the bulkhead connector.
Take out the screws (3) and detach the cover (4) together with the pipe from the control valve.
Remove screws (6), then take cover (7) off the bulkhead complete with pipes from the distributor.
Disconnect the pipe (5) of the steering assembly control device.

Figure 12



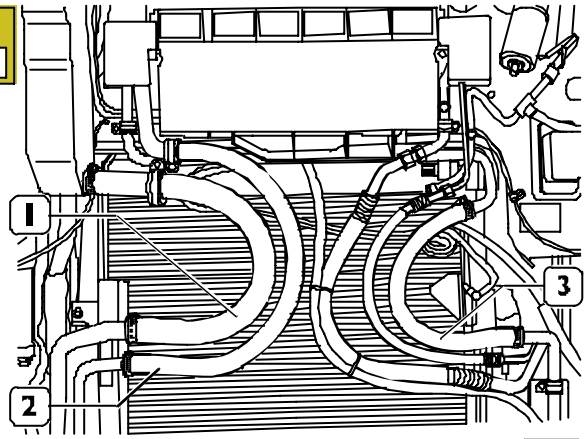

87332

Only for vehicles equipped with automatic gearbox:

- from distributor (1), disconnect pipes (2 and 3).
- place a container below master cylinder (4), disconnect piping (5) from the same, then drain the clutch fluid.

Properly plug the piping (5) and master cylinder (4) adapter, to prevent the clutch fluid from damaging painted parts. The clutch fluid is poisonous and corrosive: in case of contact, wash immediately with water and mild soap.

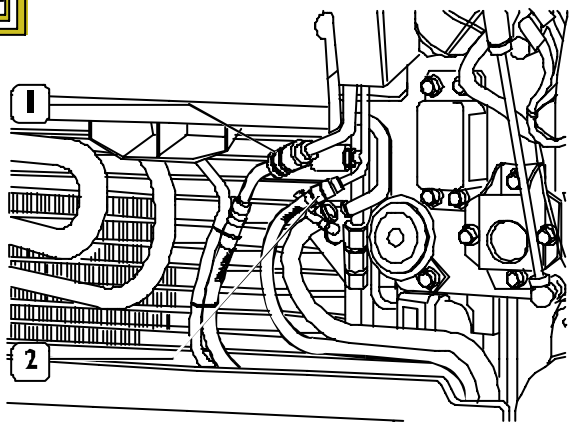
Figure 13




99127

Disconnect engine coolant pipes (1 - 2 and 3).
Cut the pipe-electric cable joining straps.
ect the air-conditioning system gas pipes (3) and (4).

Figure 14



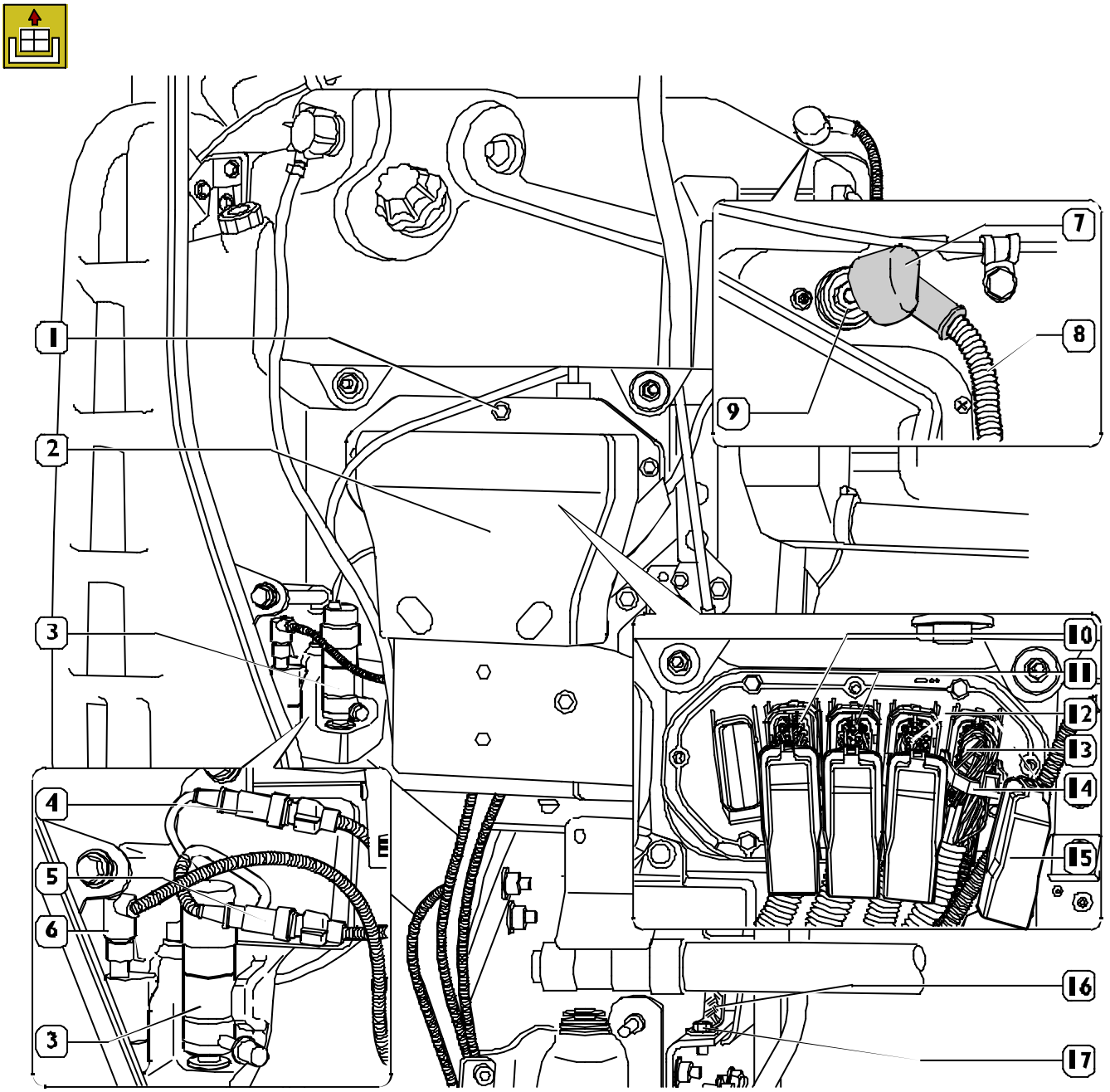

87333

Disconnect quick engagement air-conditioning system gas pipings (1 and 2), if present, by axially pressing them.

**NOTE** Seal the air-conditioning system pipes so as to prevent moisture or impurities getting into the system.

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Figure 15



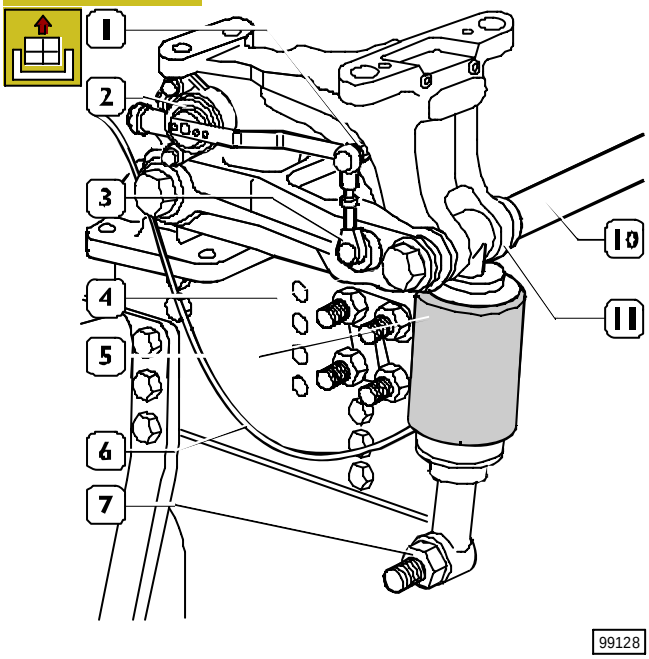

Remove nuts (1) and take off cover (2).
Remove covers (15), release safety levers (14) and disconnect connections (10 - 11 - 12 and 13).

Disconnect the electric connections (4) and (5) of the motor pump (3) for the windscreen-headlight washer fluid.

Disconnect the electric connection (6) for the tank fluid level gauge.
Lift the protective cap (7), remove the nut (9) and disconnect the cable (8) from the cab.
Remove the nut (17) and disconnect the earth cable (16) from the chassis frame.

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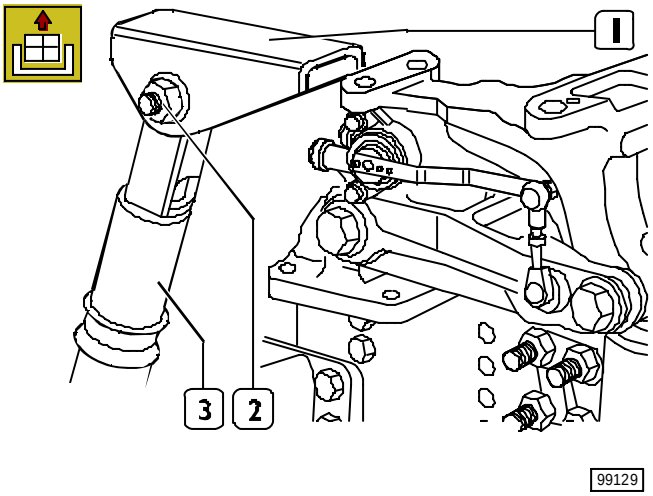
Figure 16




Take out the screw (4) fixing the air spring mating pin (5), bar (8) and mount (9).
* Disconnect the pipe (6) from the shock absorber.
Remove bolt (7) securing the air spring (5) or shock absorber with coaxial spring to the chassis.
Repeat these steps on the opposite side.
* Remove the nut (1) and disconnect the tie rod (3) from the levelling valve (2).

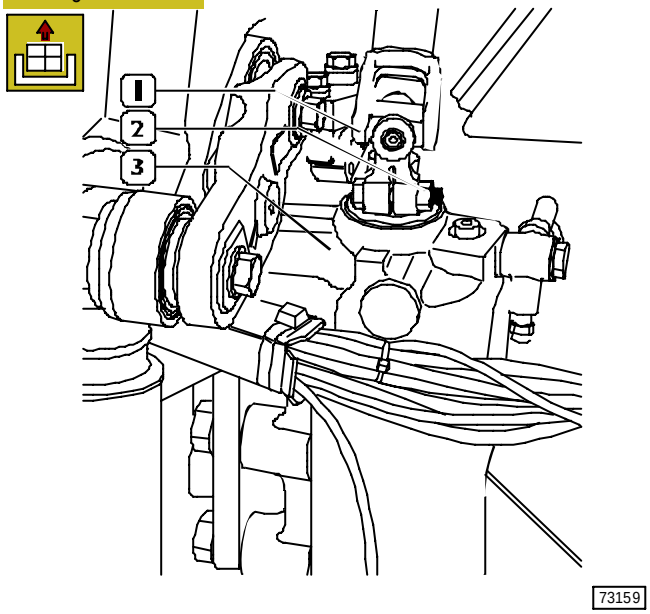
* Only for pneumatic suspension cabins.

Figure 17



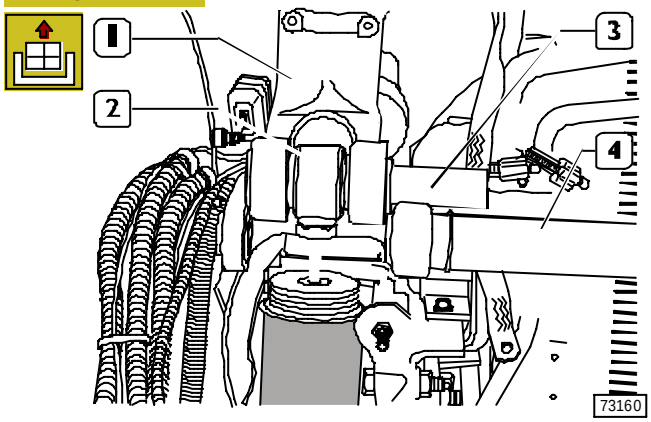

Remove the bolt (2) fixing the cylinder (3) for tilting the cab from the cab mounting (1).

Figure 18




Mark the assembly position of the universal joint (1) on the power steering shaft (3). Remove the bolt (2) and disconnect the universal joint (1) from the power steering shaft (3).

Figure 19




Lift the cab and extract the mating pin (3) of the shock absorber (2), bar (4) and front cab mounting (1). Carefully lift the cab to detach it from the chassis frame and put it aside appropriately.

## Refitting

Reattachment is carried out by reversing the order of detachment operations and by taking the following precautions:

- tighten the nuts or screws to the specified torque;
- the pneumatic piping adapter seal rings (O-rings) must not be reused; they must be replaced with new ones upon every reassembling operation;
- seal up the tachometer electric cable ring with proper sealing medium;
- check correct operation of instrument board warning lamps;
- in case of vehicles equipped with mechanic gearbox, restore the clutch hydraulic system oil tank level, then blow off air as described in the relevant chapter;
- restore the engine coolant level.

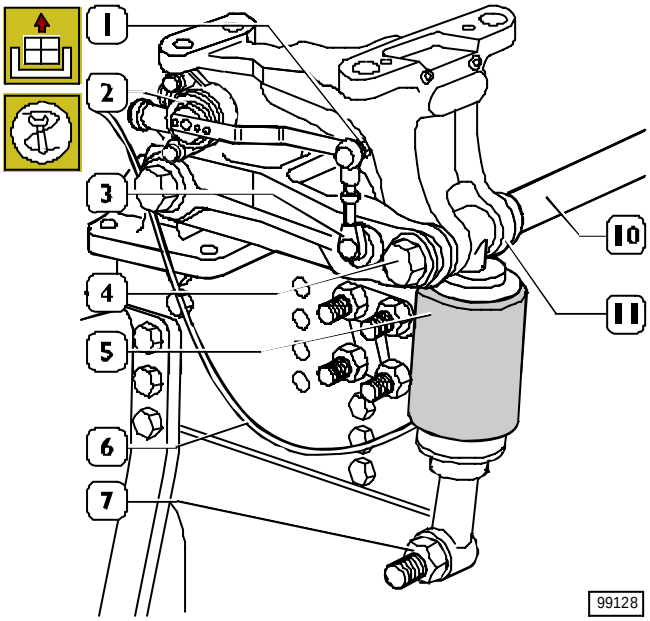
Fill up the air-conditioning system (where available) as described in the respective chapter.

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## 554243 REPLACING THE FRONT SHOCK ABSORBER

### Removal

Figure 20

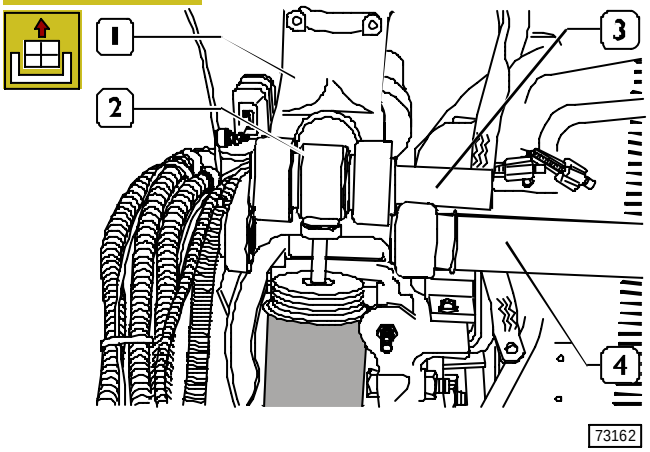



Using the arm 99378039, sling the cab as described under the heading "Cab Removal-Refitting" and proceed as follows:
Remove the front bumper (operation 500210) as described under the relevant heading.
Remove the bolt (7) fixing the shock absorber (5) to the chassis frame.
Disconnect the pipe (6) from the shock absorber (5).
Take out the screw (4) fixing the shock absorber mating pin (5), bar (8) and mounting (9).
Repeat these steps on the opposite side.

For the right-hand air spring only

Remove the nut (1) and disconnect the tie rod (3) from the levelling valve (2).

Figure 21




Lift the cab and extract the mating pin (3) of the shock absorber (2), bar (4), front cab mounting (1) and remove the shock absorber (2).

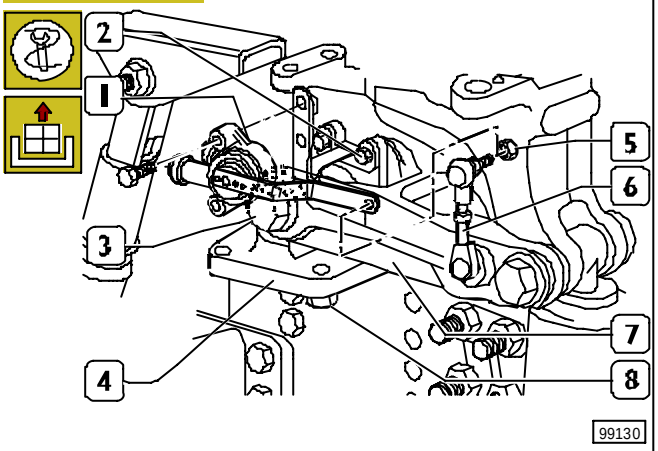
### Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

## REPLACING THE CAB SUSPENSION FRONT MOUNTING RUBBERTYPE BUSHINGS

### Removal

Figure 22




Using the arm 99378039, sling the cab as described under the heading "Cab Removal-Refitting" and proceed as follows:
Remove the front bumper (operation 500210) as described under the same heading.

Removing the right-hand front suspension mounting

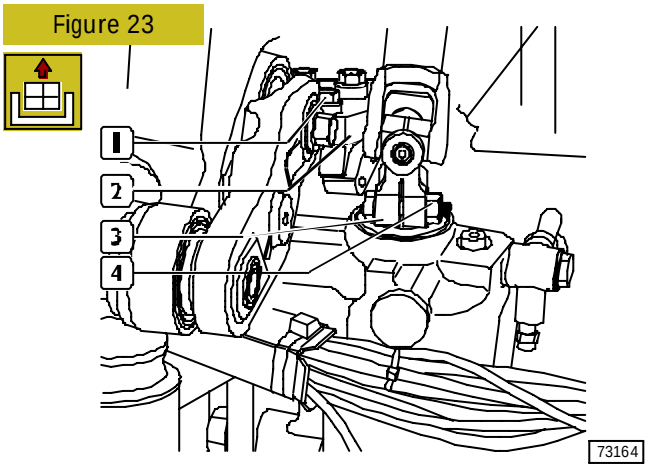
* Remove the nut (5) and disconnect the tie rod (6) from the levelling valve (1).
* Take out the screws (2) and remove the bracket together with the levelling valve (1).
* Disconnect the air pipe (6, Figure 20) from the shock absorber (5, Figure 20).

Remove screw (3) joining bar (7) to lower support (4).
Remove the bolt (7, Figure 20) fixing the shock absorber (5, Figure 20) to the chassis frame.
Remove screws (8), and disconnect lower support (4) from the chassis.

* Only for cab with pneumatic suspension

Removing the left-hand front suspension mounting

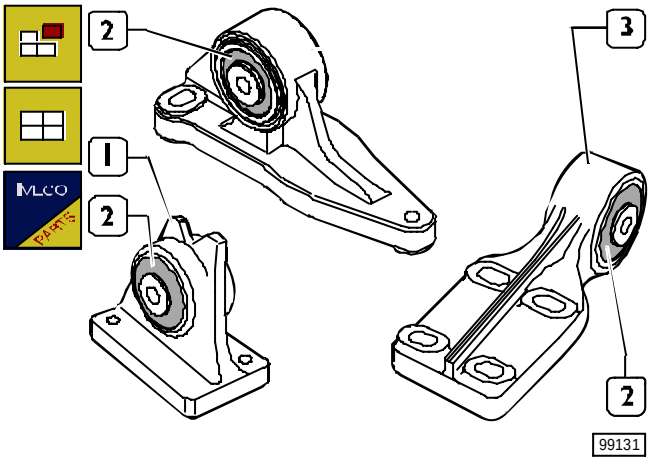
Figure 23




Remove the bolt (4) and disconnect the universal joint (3) from the power steering shaft.
Repeat the operations described for disconnecting right lower support.
Remove screws (1), and disconnect lower support (2) from the chassis.

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Figure 24




Cab suspension lower supports are of different types and their matching depends on vehicle version.
Replacing bushings (2) from supports (1-3) is by using a press and suitable beater.

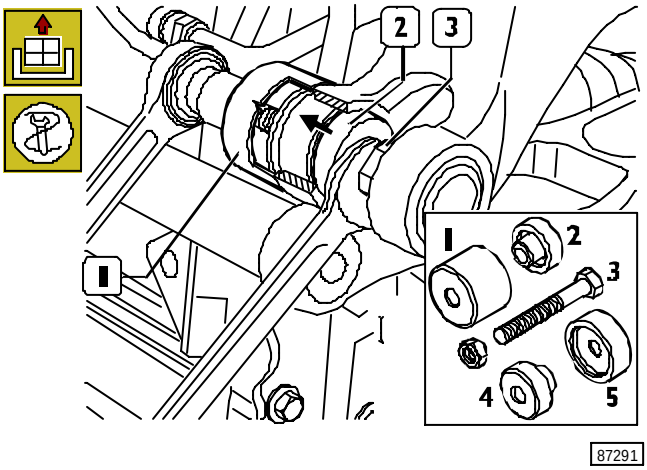
### Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

## REPLACING CAB FRONT UPPER SUPPORT BUSHINGS

### Removal

Figure 25

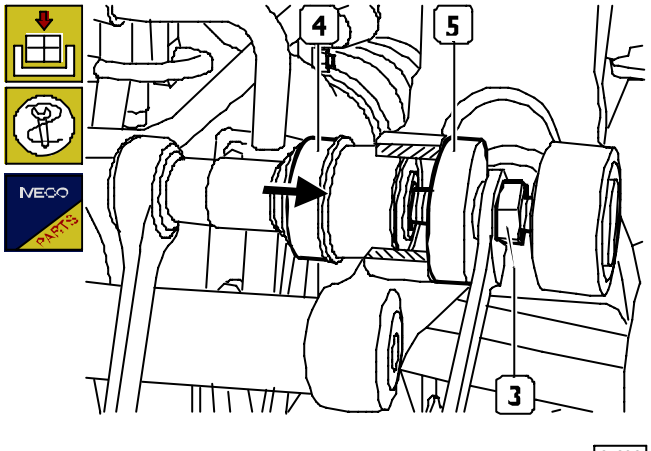



Remove the shock absorbers as described in the "Front shock absorber replacement" chapter.

Extract the bush with elements (1, 2 and 3) of tool 99346051 and remove the bush.

### Refitting

Figure 26

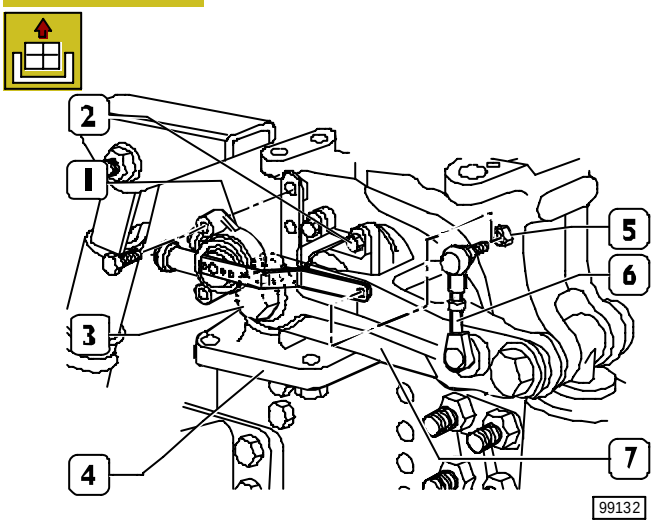



Use elements (3, 4 and 5) of tool 99346051 to fit the bush in its seat.

## REMOVING – REFITTING THE STABILIZER BAR

### Removal

Figure 27




Using the arm 99378039, sling the cab as described under the heading "Cab Removal-Refitting" and proceed as follows. Remove the front bumper, operation 500210 as described under the same heading. * Remove the nut (5) and disconnect the tie rod (6) from the levelling valve (1). * Take out the screws (2) and remove the bracket together with the levelling valve (1). Remove the bolt (4, Figure 23) and disconnect the universal joint (3) from the power steering shaft. Remove the shock absorbers as described under the relevant heading. Take out the screw (3) and remove the stabilizer bar (7) from the mounting (4).

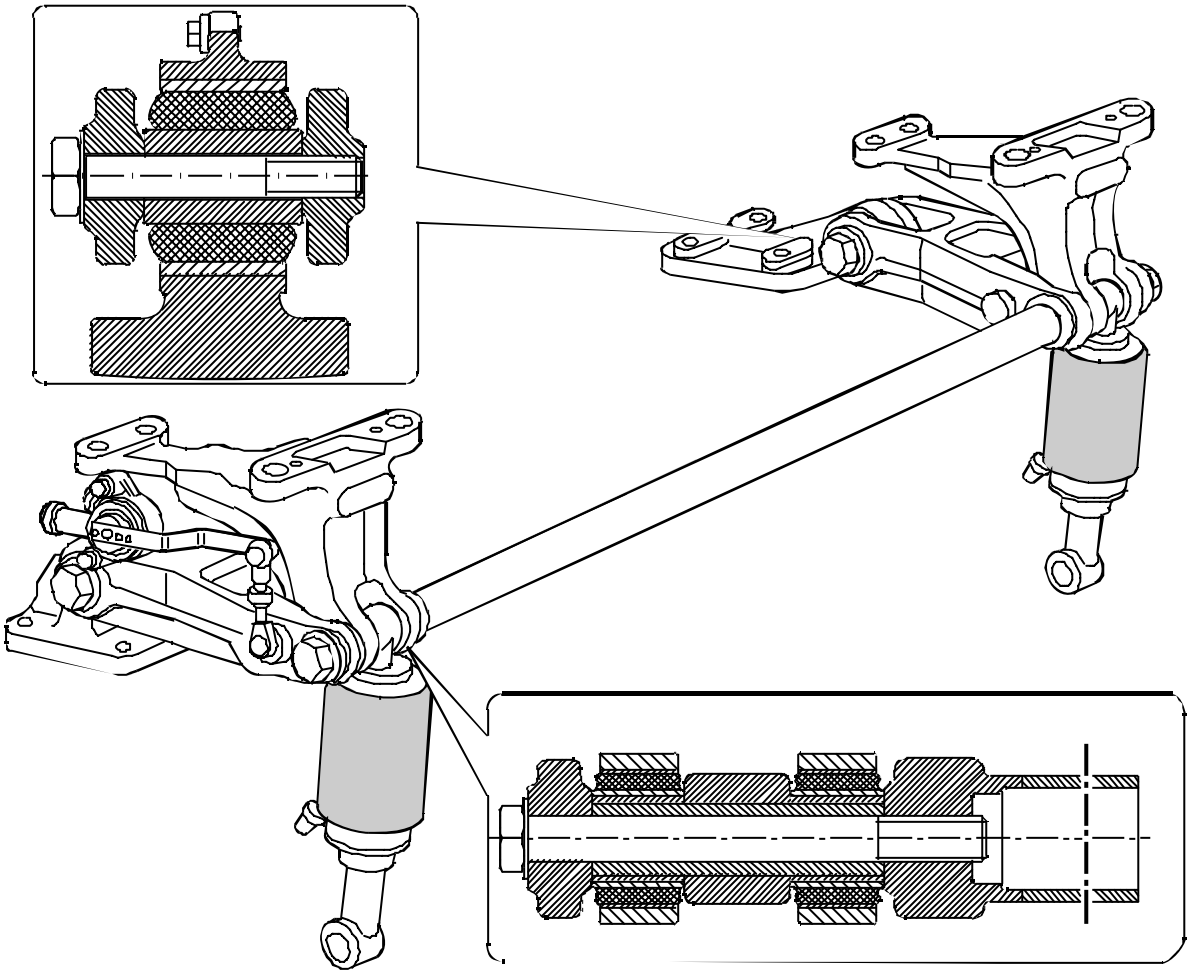
* Cab with pneumatic suspension

### Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

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Figure 28



99133

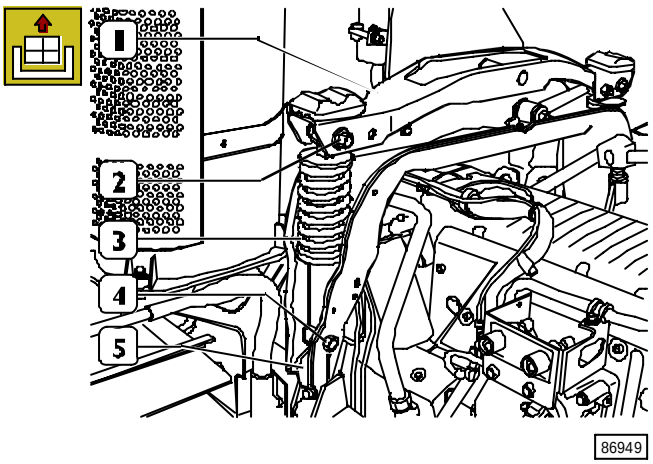
CAB FRONT ANCHORING COMPONENTS

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## 554243 REPLACING REAR CAB SUSPENSION DAMPERS

### Removal

Figure 29




86949

Tilt over the cabin.

On pneumatic suspensions cabins, disconnect the pipe from the air spring.

Remove bolts (2 and 4) and take shock absorber (3) off the upper (1) and lower (5) crossbars.

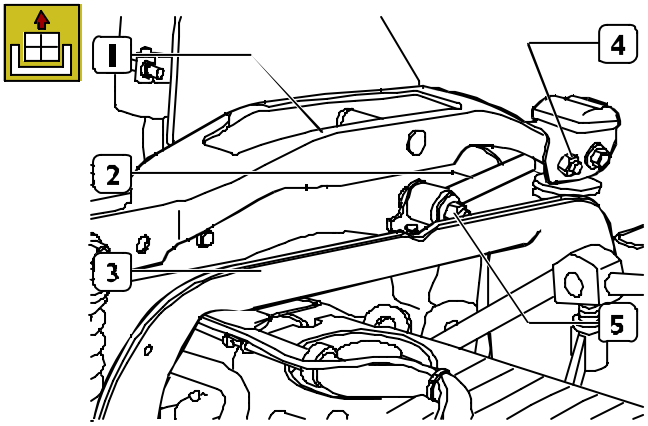
### Refitting

Reattachment is carried out by reversing the order of detachment operations and by following the specified tightening torque values.

## REPLACING THE TRANSVERSE TIE ROD BUSHINGS

### Removal

Figure 30

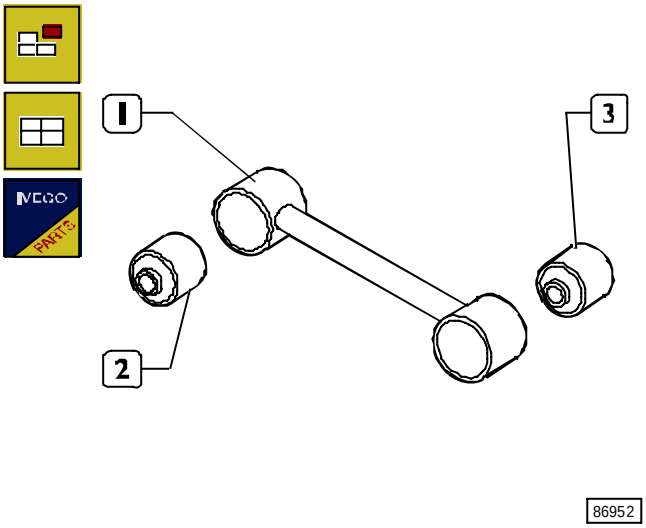



86951

Remove bolts (4 and 5), then take transverse tie rod (2) off crossbars (1 and 3).

### Disassembling/reassembling the bushings

Figure 31




86952

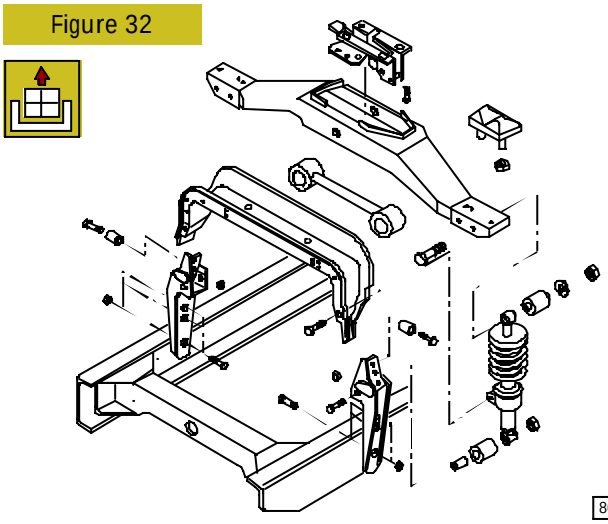
Transverse tie rod (1) elastic bushings (2 and 3) can be replaced by using a suitable beater and press for disassembling/reassembling operations.

### Refitting

To reattach the transverse tie rod, reverse the order of detaching operations, by tightening bolt (4, 5, Figure 30) nuts to the specified torque.

Nuts are of the self-braking type; it is recommended that they are replaced with new parts every time disassembling is performed.

Figure 32



86953

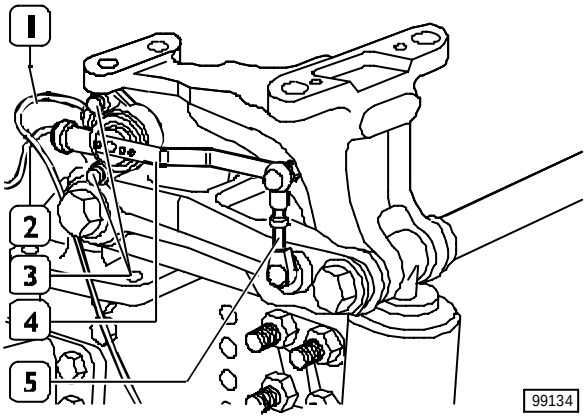
PARTS MAKING UP THE CABIN REAR SUPPORT AND LEFT SIDE MECHANIC SUSPENSION

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## LEVELLING VALVE

### Removal

Figure 33




The figure shows the front levelling valve; similarly, the descriptions of detachment operations also apply to the rear levelling valve. Disconnect pneumatic pipes (1 and 2) from levelling valve (4). Disconnect tie-rod (5) from the articulation pin, then remove the fastening screws (3) and take off levelling valve (4).

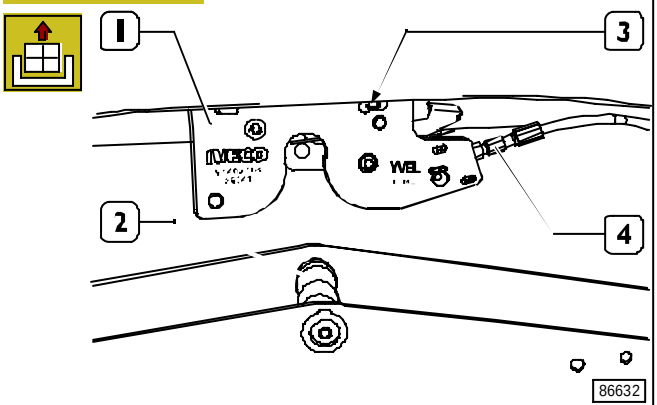
### Refitting

Reverse the order of detachment operations, and tighten the screws to the specified tightening torque. As far as tie-rod (5) check and adjustment are concerned, see the respective chapter.

## CHANGING THE CAB LOCK

### Removal

Figure 34




Disconnect piping (4) from lock (1), then recover the oil in a special container.
Remove screws (3), then take off the lock.

### Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

**NOTE** Lock (4) fastening screws (3) must be locked when cabin anchoring pin (2) is aligned to the respective seat of lock (4).

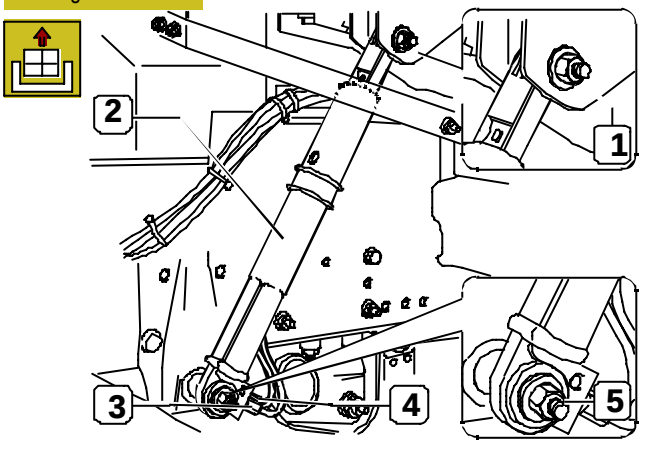
After reattachment has been completed, check the oil level and proceed with drain as described in the relevant chapter.

## CAB TILT CYLINDER

### 554255 REPLACING HYDRAULIC CAB TILT CYLINDER

### Removal

Figure 35




Place a container under oil piping (3 and 4) to recover the oil from the system. Disconnect oil piping (3 and 4) from cabin tilting cylinder (2) adapter. Remove bolt (1) and nut (5), then take off cylinder (2).

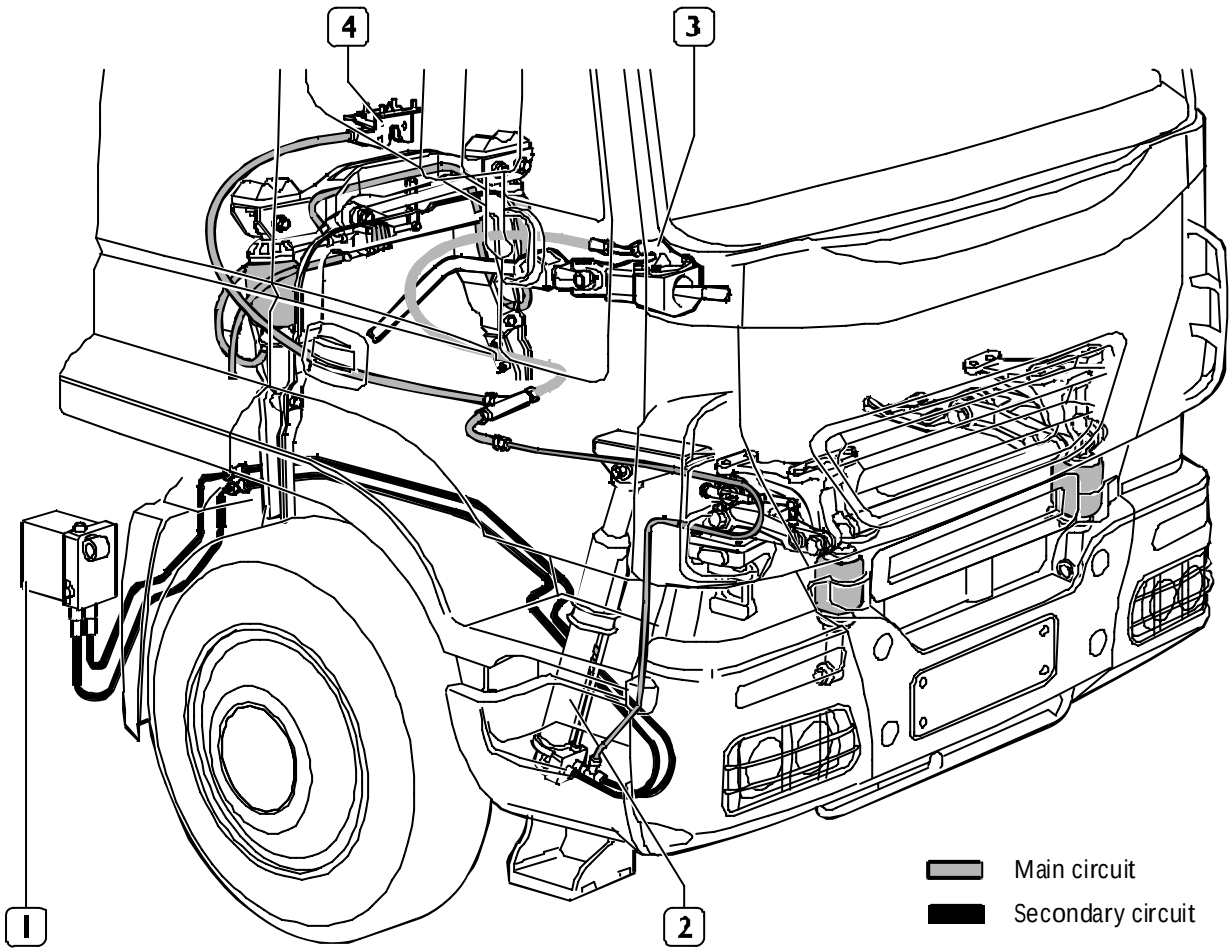
This operation must be carried out with the cab lowered.

### Refitting

Reattachment is carried out by reversing the order of detachment operations, by tightening the nuts to the specified torque.
After reattachment has been completed, fill up and blow air off the hydraulic system, as described in the relevant chapter.

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Figure 36




102622

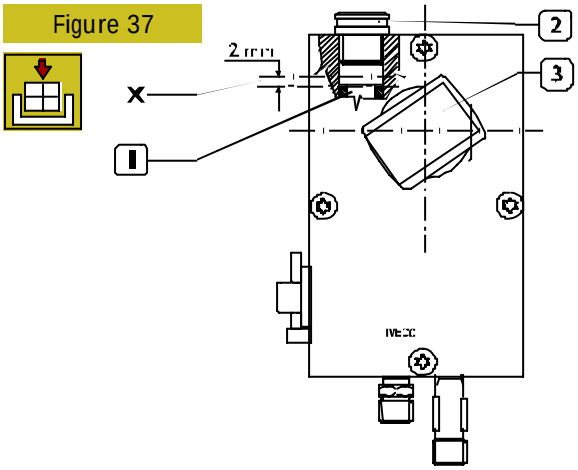
CAB TILTING SYSTEM COMPONENT PARTS

1. Hand driven pump - 2. Cab lifting cylinder - 3. Hydraulic actuator to release gearbox control telescopic tie rod (only for mechanic gearbox) - 4. Cab hitching up lock

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## Checking oil level

Figure 37




**NOTE** Cab must be lowered in ride condition.

Position pump drive lever (3) as indicated in figure.
Remove plug (2) and check that oil level X results to be above plunger (1) by some 2 mm; otherwise, top up.

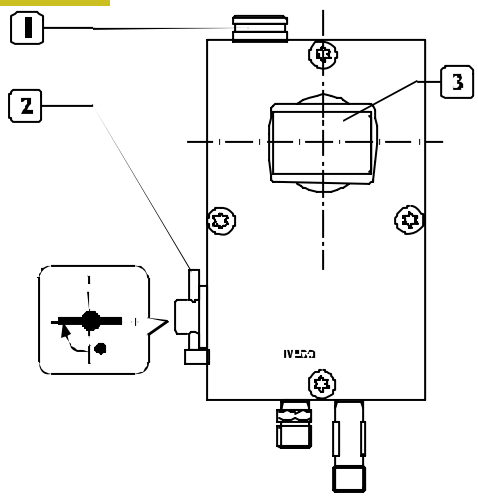
## Bleeding cab tilt system

**NOTE** Bleed the air in the event of general tilt system malfunctioning and for the following operations (see Figure 36).

1) Replacing manual drive pump (1);
2) replacing cab tilting cylinder (2) and main circuit pipings;
3) replacing lock (4) and secondary circuit pipings;
4) replacing all components of tilting system.

## Bleeding air from manual drive pump (point 1)

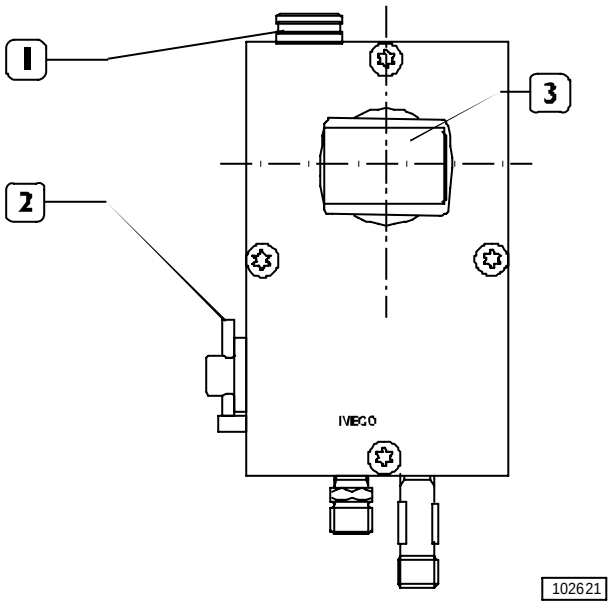
Figure 38




- Rotate tap (2) to the position shown in figure;
- take off plug (1);
- slowly drive lever (3) five times, (through full range);
- check the level as described in relating chapter.

## Bleeding air from cab tilting cylinder (point 2)

Figure 39




- Cab lowered to drive position
- take off plug (1) and check oil level as described in relating chapter, topping up, if required;
- rotate tap (2) to cab lowered position;
- slowly drive lever (3) at least forty times (through full range);
- check oil level as described in relating chapter

## Bleeding air from secondary circuit (point 3)

- Disconnect piping from lock (4, Figure 38) and hydraulic actuator (3, Figure 38);
- drive lever (3) until oil is drained away into special container;
- check oil level as described in relating chapter.

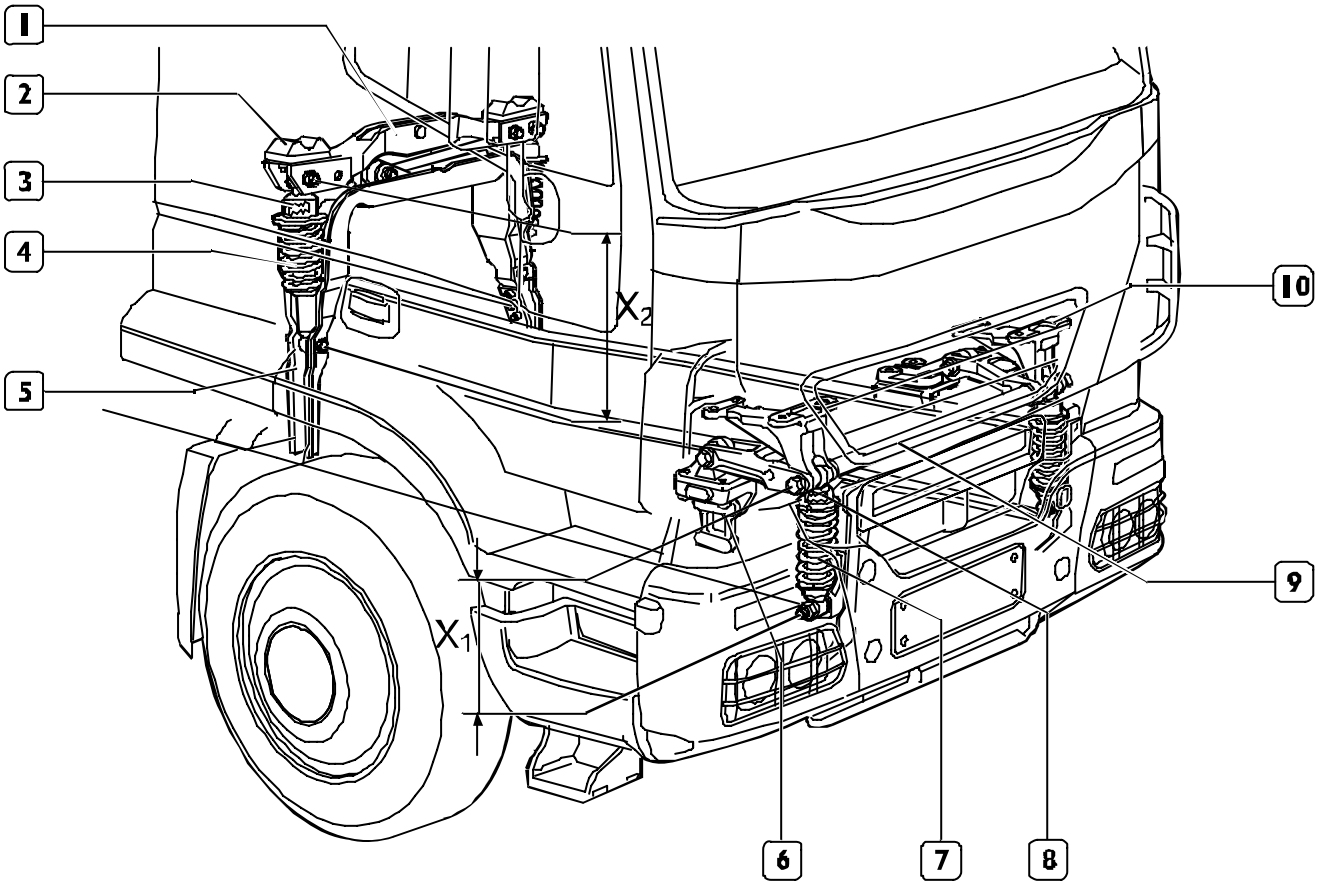
## Bleeding air fully

In case all cab tilting system components are replaced, bleed air as described on points 1-2-3.

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## Cab mechanic suspension

Figure 40




LOCATION OF CAB SUSPENSION COMPONENTS

1. Cross member - 2. Rubber block - 3. Rear shock absorber regulator - 4. Rear shock absorber - 5. Bracket - 6. Support - 7. Front shock absorber - 8. Front shock absorber regulator - 9. Torsion bar - 10. Brackets - 11. Torsion bar

## Cab driving position adjustment

With cab under static load condition, check length $X_1$ of front shock absorbers (7) and length $X_2$ of rear shock absorbers (4).

**NOTE** By static load it is only meant the load that is determined by the type of cab fitting.

$X_1$ = 380 mm
$X_2$ :
- vehicles: 4x2 - 6x4 - 8x4 = 400±3 mm
- vehicles: 4x4 - 6x6 - 8x8 AD (short cab) = 362±3 mm
- vehicles: 8x8 AT (long cab) = 400±10 mm

If different values are found, rotate the regulator (3 and/or 8) of relevant shock absorbers with a suitable wrench.

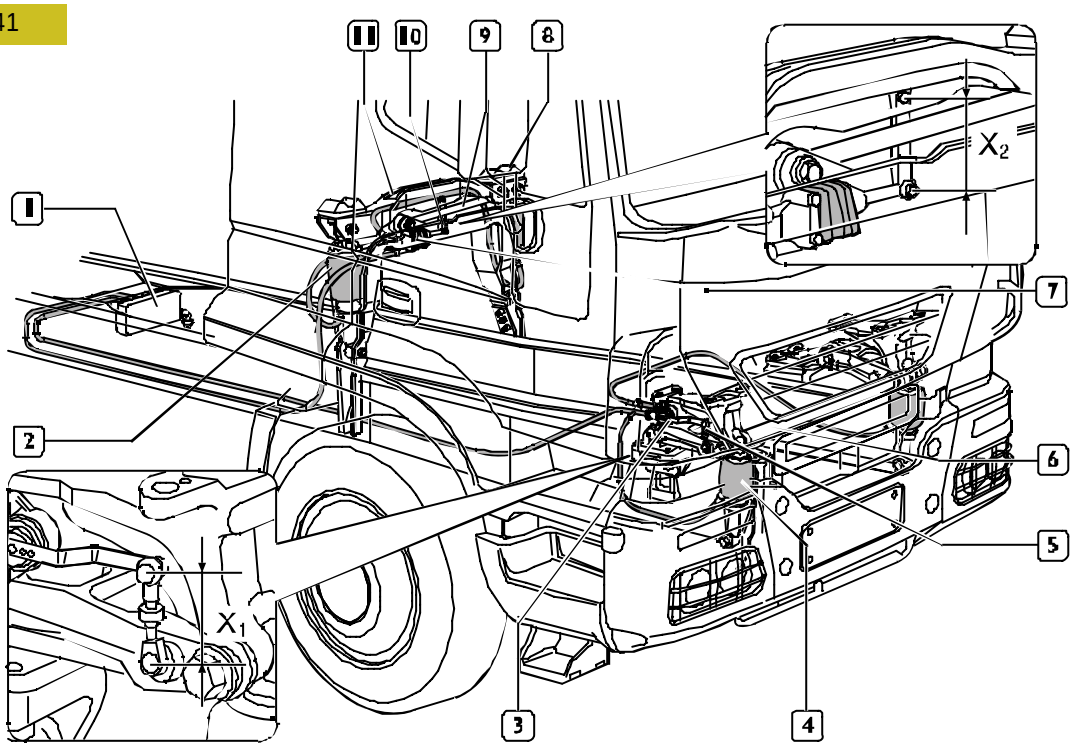
**NOTE** The regulator is provided with 5 marks, each mark, starting from the central reference mark, corresponding to a length shift of 4 mm.

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## Cab pneumatic suspension

### 554275 Adjusting the levelling valve linkage

Figure 41



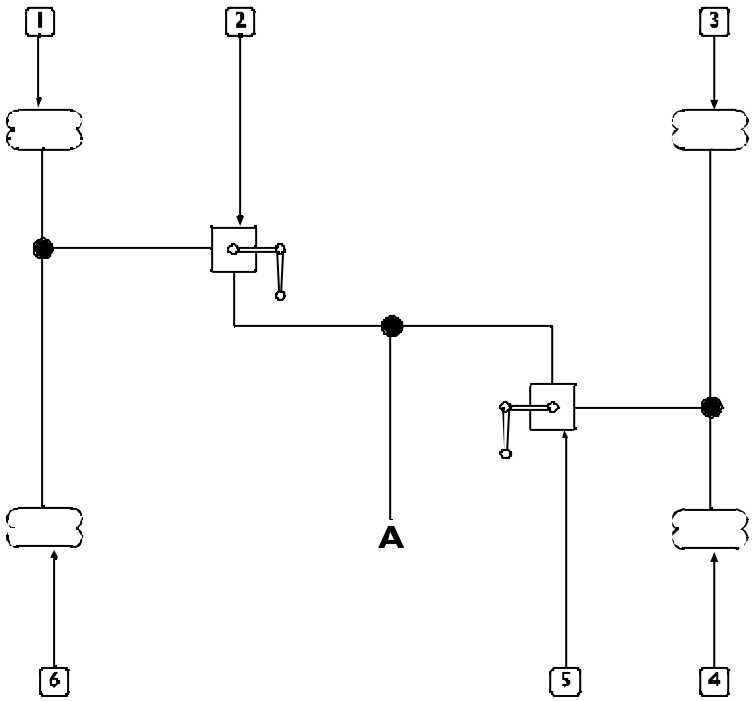

LOCATION OF CAB SUSPENSION COMPONENTS

1. Service supply – 2. Rear shock absorber – 3. Front levelling valve – 4. Front shock absorber – 5. Tie rod for valve (3) 6. Torsion bar – 7. Rear levelling valve – 8. Tie rod for valve (7) – 9. Stabilizer bar.

Check and/or adjust length $X_1$ of tie rods (5) and length $X_2$ of tie rod (8). Such length, measured between the center distances of articulated pins, must be:

$X_1 = 94 \pm 1$ mm - $X_2 = 83 \pm 1$ mm

Figure 42




CAB SUSPENSION PNEUMATIC SYSTEM WORKING DIAGRAM

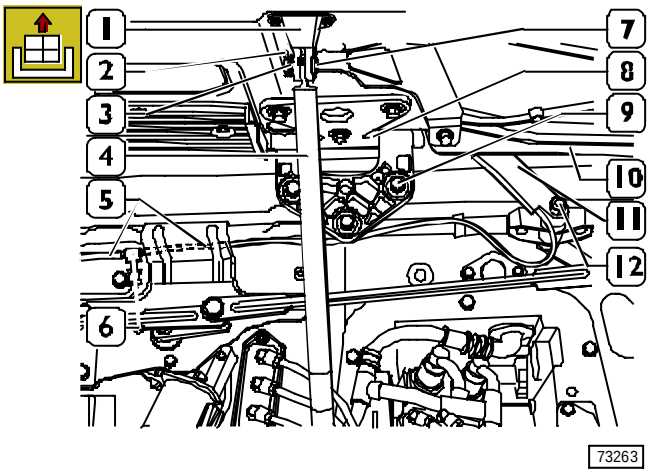
1. Right-hand front air spring – 2. Front levelling valve – 3. Right-hand rear air spring – 4. Left-hand rear air spring 5. Rear levelling valve – 6. Left-hand front air spring – A. Service supply (8.5 bars)

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# 552410 REPLACING THE WINDSHIELD

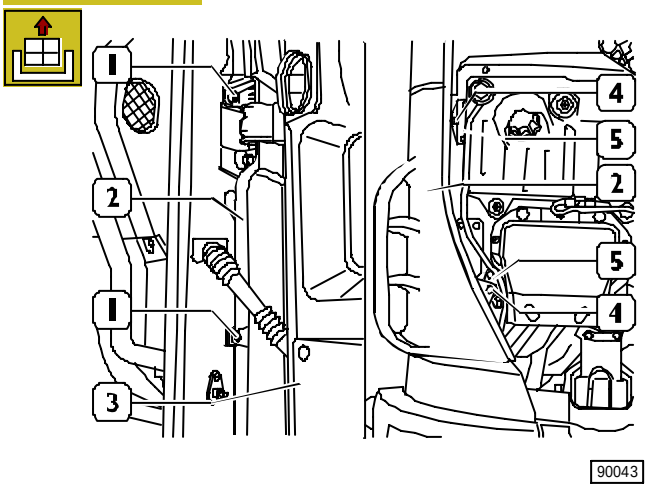
## Removal

Figure 43




Lift the radiator cowling (10). Take out the split pin (2), extract the pin (7) with the thrust washers (3) and disconnect the shock absorber (4) from the mount (1).
Repeat these steps for the other shock absorber.
Take out the screws (9) fixing the hinges (8) and remove the radiator cowling (10) from the cab.
Disconnect the pipes (5) for the window-washer liquid from the fitting (6).
Remove the nuts (12) and disconnect the windscreen wiper (11).

Figure 44

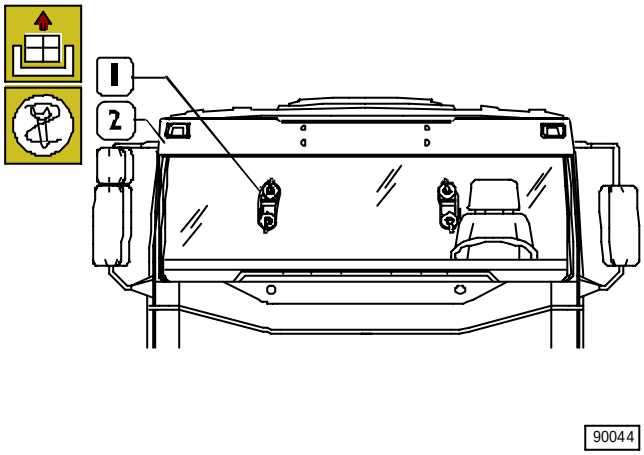



Open door (3) and remove screws (1) to laterally secure right hand vent (2).

From front side, remove screws (4) and take right hand vent (2) off supports (5).

Repeat operations for taking off left hand vent.

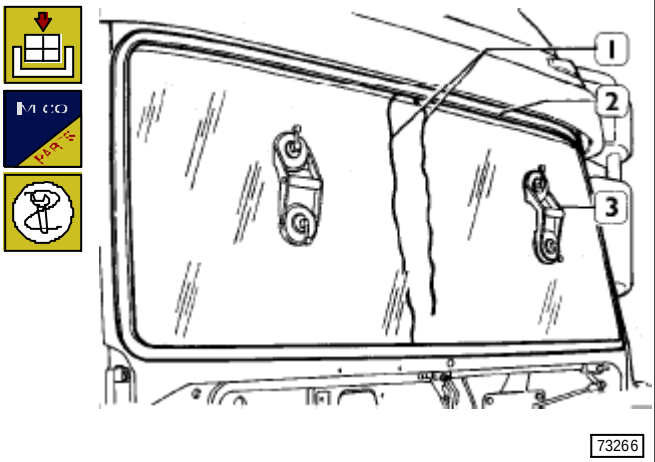
Figure 45




If present, take out the fixing screws. Remove the visor.
Put the pair of suction cups 99378031 (1) on the windscreen and with two operators, one inside the cab who, using the right tool, removes the seal while applying pressure on the top corners of the windscreen, while the other, on the outside, pulling on the handles of the suction cups 99378031, removes the windscreen from its housing.

## Refitting

Figure 46




To refit the windscreen, carry out the following operations:

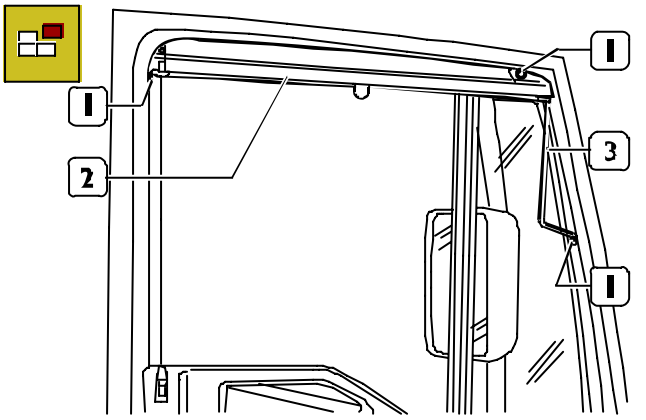
- Fit the rubber seal on the windscreen, insert a cord (1) in the seal (2).
- Put the suction cups of tool 99378031 on the windscreen.
- Position it against the cab flanging.
- Press firmly on the suction cups while pulling both ends of the cord (1) from the inside so that the seal fits onto the flanging of the bodywork.
- Finish fitting the parts taken down during removal.

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## 550740 REPLACING THE WINDING WINDOW

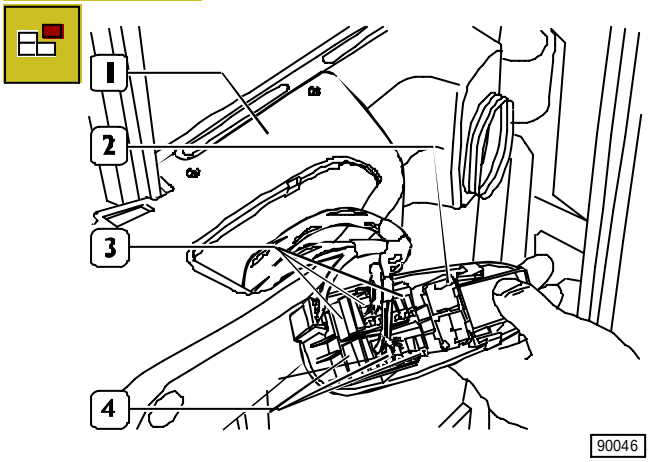
### Removal

Figure 47



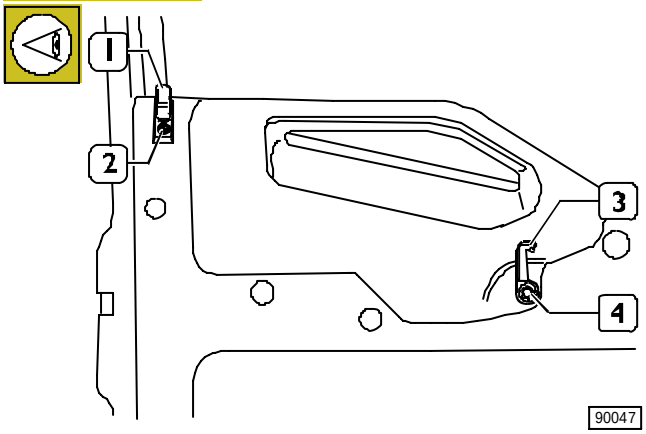

Lower the window.
Remove screws (1), unthread tie rod (3) and take sun roller blind assembly (2) off the door.

Figure 48



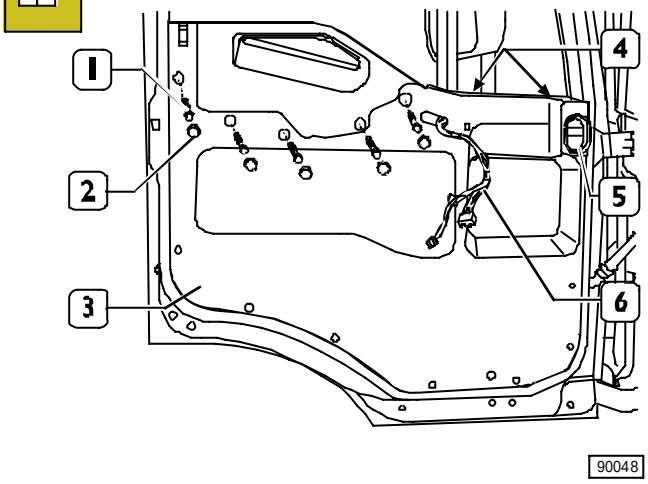

Remove the push-button panel (2) from the armrest (1).
Disconnect the electric connections (3), (4), from the push-button panel (2).

Figure 49



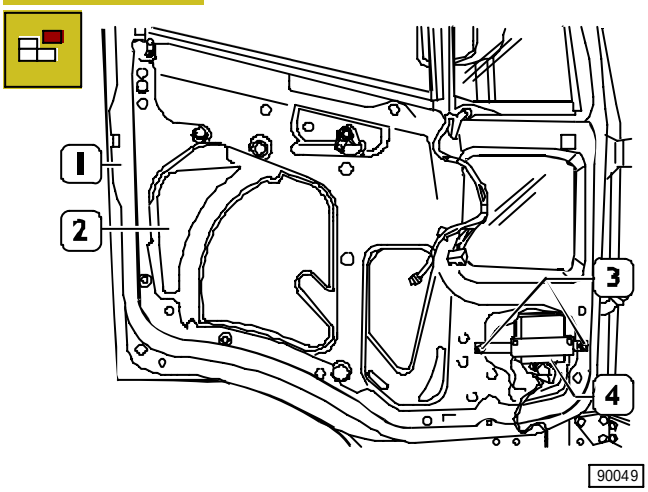

Loosen screw (2) and remove handgrip (1) from door closing tie rod.
Press the fins of stem (4) and remove handle (3).

Figure 50




Remove mouth (5) and remove screw under it.
Remove screws (4).
Remove caps (2) and screws (1) under them securing coating (3).
Take coating (2) off the door paying attention on unthreading cables (6) from coating slot.

Figure 51

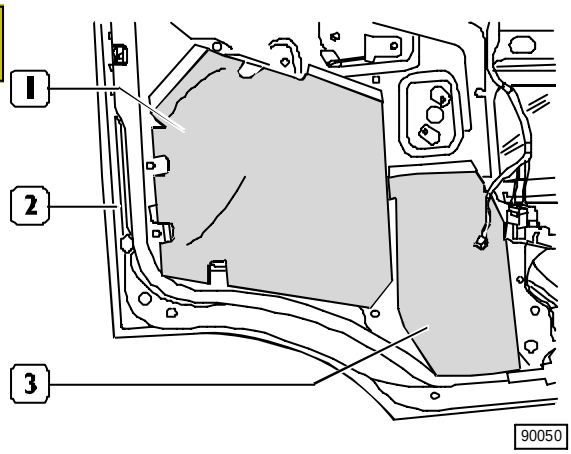



Remove screws (3) securing central unit support bracket (4) to door (1).

Remove sound deadening guard (2) from the door.

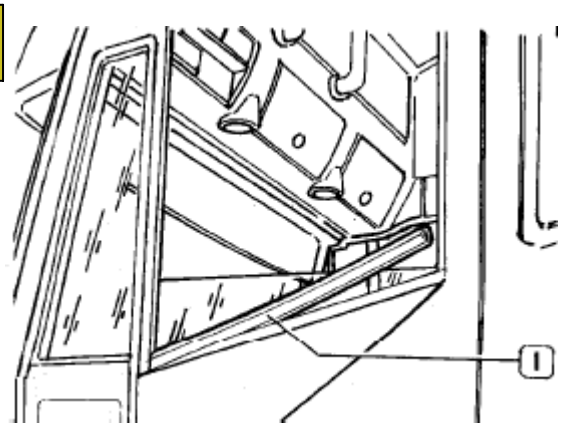
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Figure 52



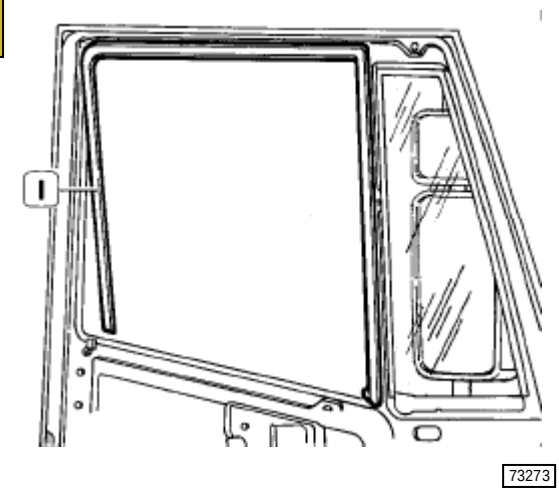

Remove plastic guards (1 and 3) from door (2).

Figure 53



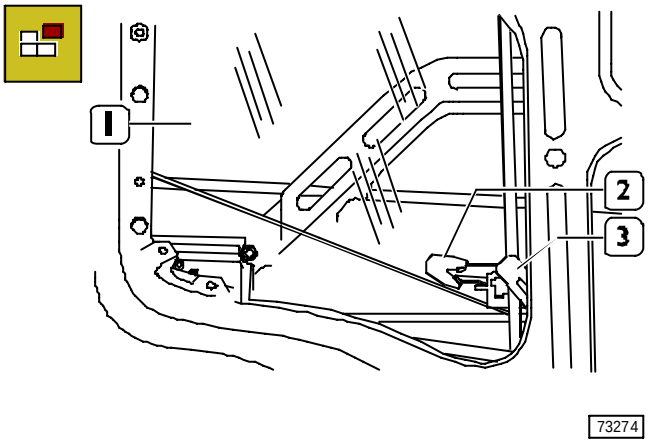

Extract the outside and inside bottom seals (1) from the window compartment.

Figure 54




Extract the window guide seal (1).

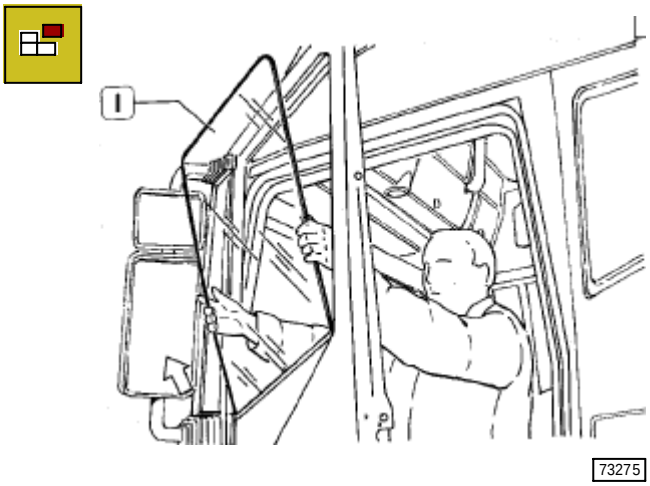
Figure 55




Temporarily connect electric connections to pushbutton panel and lift glass until fastener (2) is made accessible.

Disconnect the electric window device (3) from the window (1) by removing the clamp (2).

Figure 56




Lift the window (1) and extract it from the top (arrow).

## Refitting

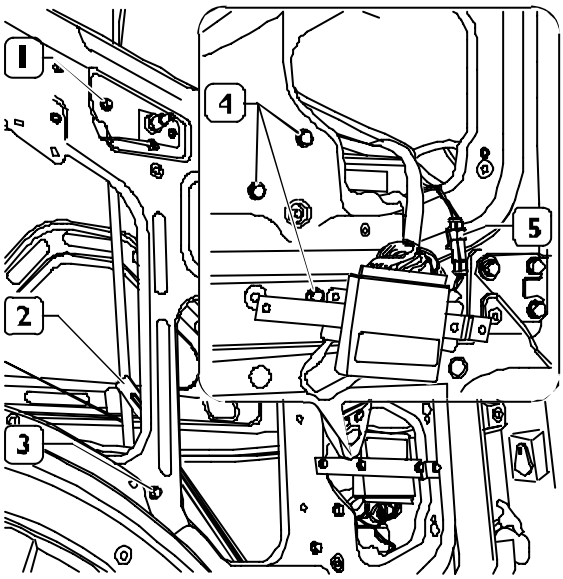
Carry out the steps performed for removal in reverse order, observing the required tightening torques.

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## 550730 REPLACING THE WINDOW WINDER

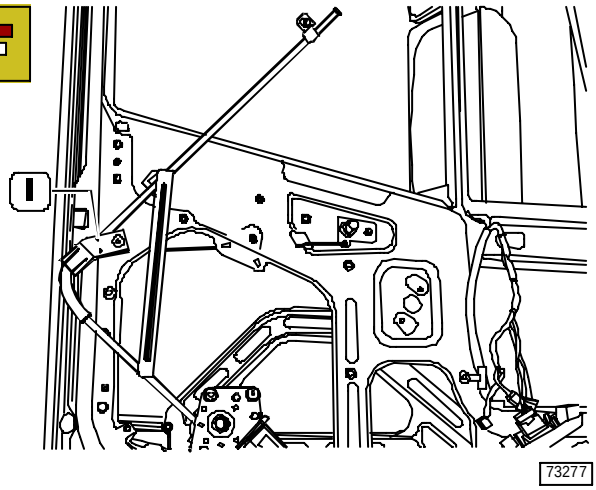
### Removal

Figure 57




Remove the window as described in operation 550740.
Disconnect the electric connection (5).
Take out the screws (1), (3) and (4) fixing the electric window device (2) on the door.

Figure 58




Extract the electric window device (1) from the door.

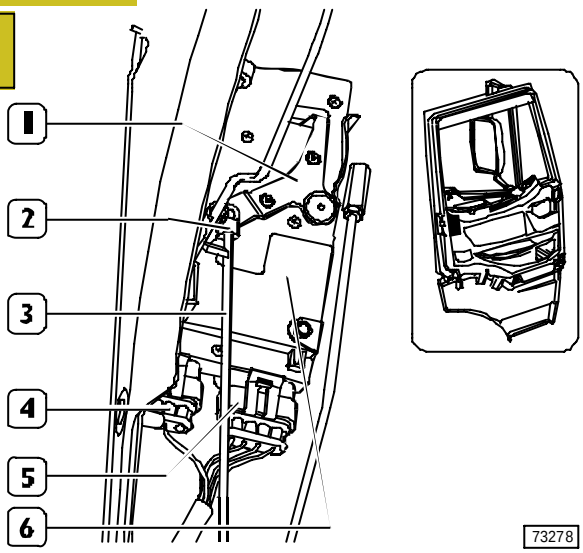
### Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

## 550714 REPLACING THE DOOR LOCK

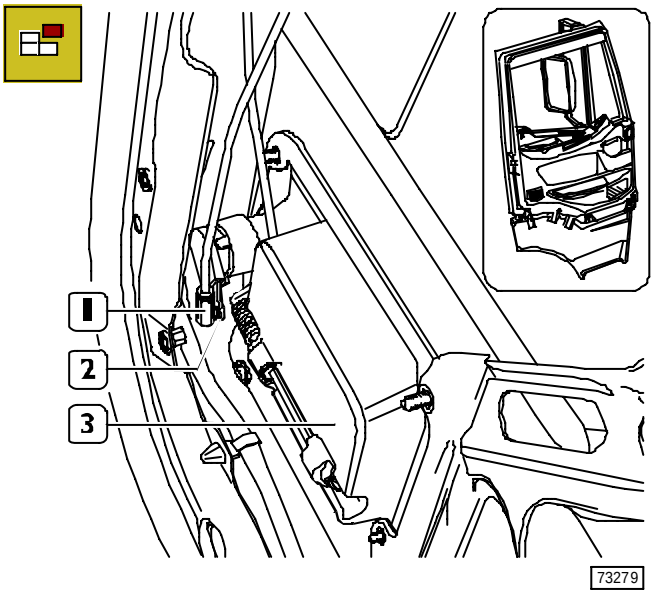
### Removal

Figure 59




Remove the door trim as described in operation 550740.
Unhook the clip (2) from the tie rod (3) and disconnect this from the idler (1).
If present, disconnect the electric connections (4) and (5) from the lock (6).

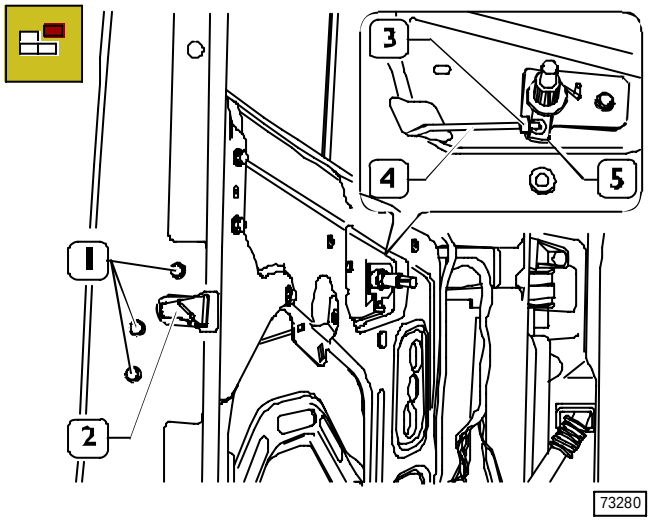
Figure 60




Disconnect the tie rod (1) from the lever (2) of the outside handle (3).

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Figure 61




Unhook the clip (3) from the tie rod (4) and disconnect this from the lever (5) of the internal handle.
Take out the screws (1) and remove the lock (2) from the door.

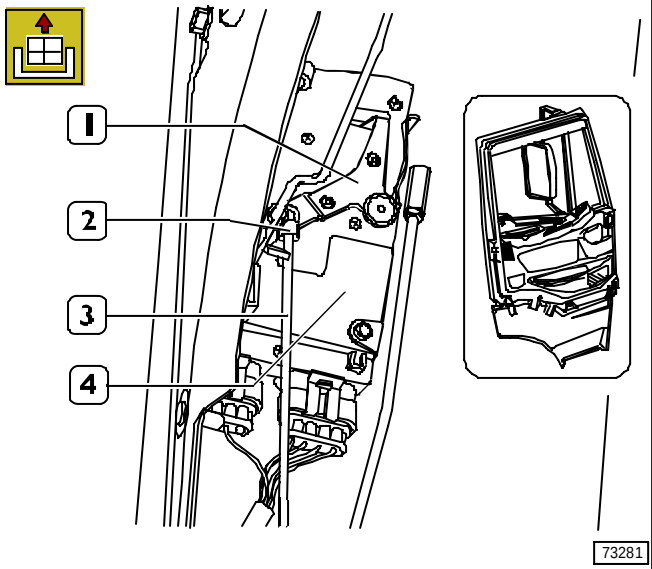
### Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

## 550717 REPLACING THE OUTSIDE HANDLE OF THE DOOR

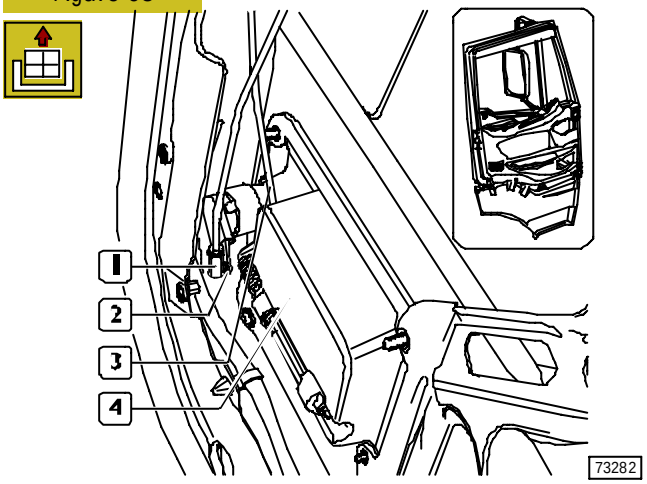
### Removal

Figure 62



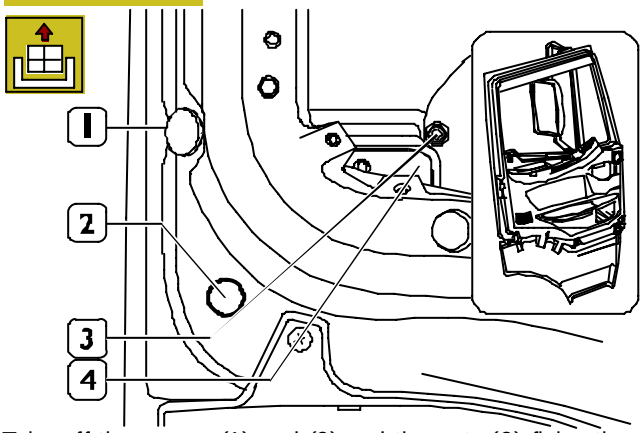

Remove the door trim as described in operation 550740.
Unhook the clip (2) from the tie rod (3) and disconnect this from the idler (1) of the lock (4).

Figure 63




Disconnect the tie rod (1) from the lever (2) of the external handle (3).

Figure 64




Take off the covers (1) and (2) and the nuts (3) fixing the external handle (4) and detach this from the door.
Remove the tie rod (3, Figure 63) from the handle (4).

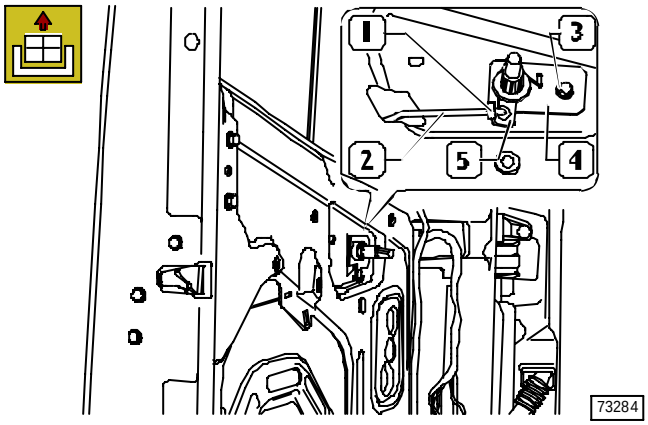
### Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

## REPLACING THE INSIDE HANDLE

### Removal

Figure 65




Take off the trim as described in operation 550740.
Unhook the clip (1) from the tie rod (2) and disconnect this from the lever (5) of the inside handle (4). Take out the screws (3) and remove the handle (4) from the door.

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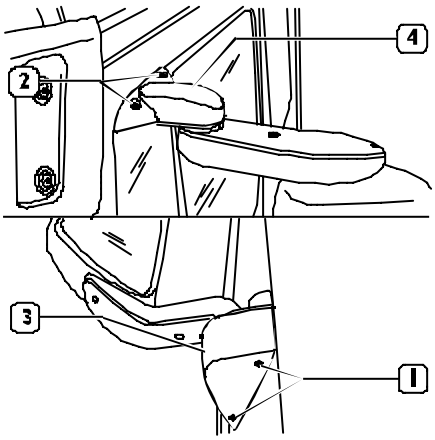
### Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

## REPLACING THE SIDE MIRRORS

### Removal

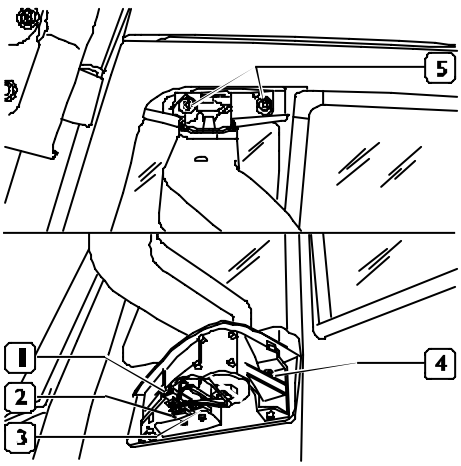
Figure 66




108622

Unscrew screws (1) and (2) and remove plastic guards (3) and (4).

Figure 67




108877

Disconnect electrical connections (1), (2) and (3).Remove screws (4) and (5) and take assembly off the vehicle.

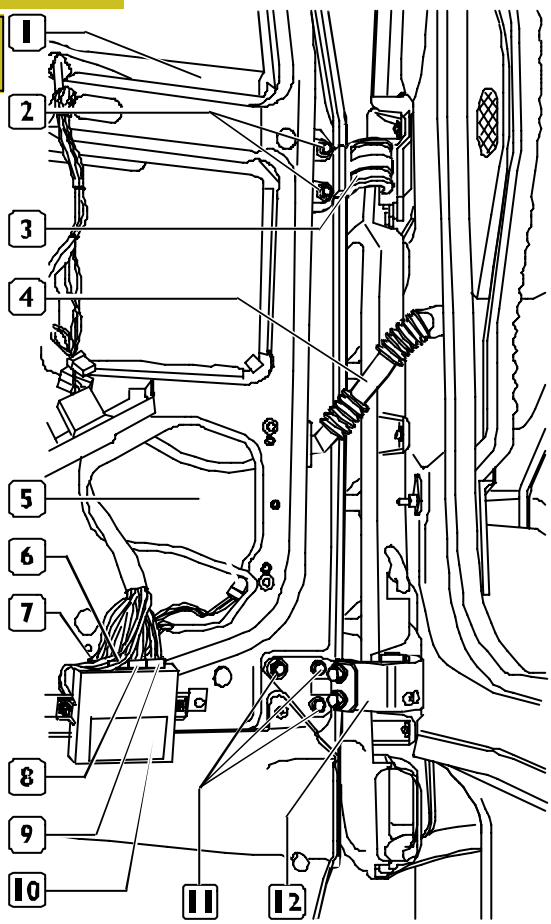
### Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

## REPLACING THE DOOR

### Removal

Figure 68




73286

Take off the side mirror mounting as described in the previous operation.
Detach the inside door trim as described in operation 550740.
Remove the electric window device as described in operation 550730.
Disconnect the electric connections (5), (6), (7), (8) and (9) from the control unit and take this out (10).
Support the door (1), take out the screws (2) and (11) and take the door (1) off its hinges (3) and (12).

**NOTE** When taking off the door (1), extract the wiring (4) from it with great care.

### Refitting

Carry out the steps performed for removal in reverse order, observing the required tightening torques.

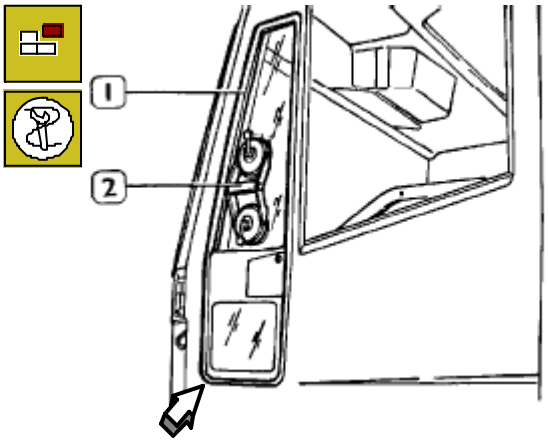
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## 550748 REPLACING THE FIXED WINDOW

### Removal

Take off the side mirror mounting as described in the related operation.
Detach the inside door trim as described in operation 550740.

Figure 69




Extract the outside seal (1), apply the suction cup 99378031 (2).

**NOTE** Before starting to cut, you need to protect the paintwork with adhesive tape to prevent any damage.

Insert a suitable tool through the sealant by a corner (arrow) of the window.
Make the cut all along the perimeter. Remove the window with a suction cup handle (2).

**NOTE** Do not use any lubricant during cutting.
The blades must always be sharp.

### Preparing the window bay

Using an appropriate knife, cut and level the sealant of the window bay so as to leave a thickness of between 0.25 and 1 mm to prevent chipping the paintwork.
Get rid of the remaining dust and degrease the window bay with the BETACLEAN 3300 detergent towelette contained in the BETASEAL 1703 Sprint kit (IVECO PARTS 93162553).

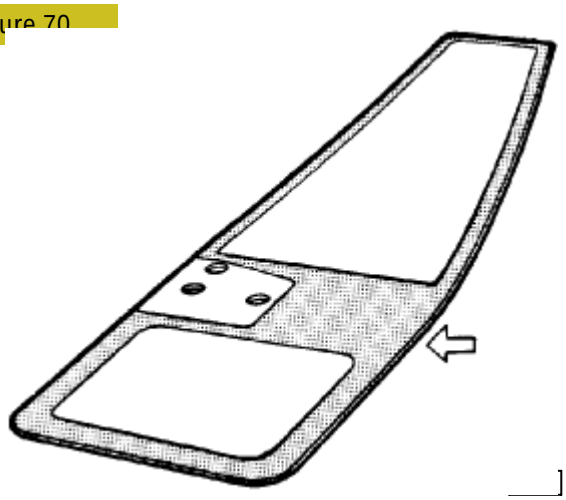
**NOTE** The film of sealant remaining on the windscreen will be a support for subsequent gluing.

**NOTE** If the window bay has been painted after repair work, treat it with the COMBI primer 5061 contained in the kit and wait for 15 minutes.

### Preparing the window

Using an appropriate knife, cut and level the sealant of the window bay so as to leave a thickness of between 0.25 and 1 mm to prevent chipping the paintwork.
Get rid of the remaining dust and degrease the window bay with the BETACLEAN 3300 detergent towelette contained in the BETASEAL 1703 Sprint kit (IVECO PARTS 93162553).

Figure 70



- Degrease the screen-printed portion of the windscreen with the BETACLEAN 3300 detergent towelette contained in the kit.

**NOTE** If using a new window, it is still necessary to degrease the screen-printed portion with the BETACLEAN 3300 detergent towelette.

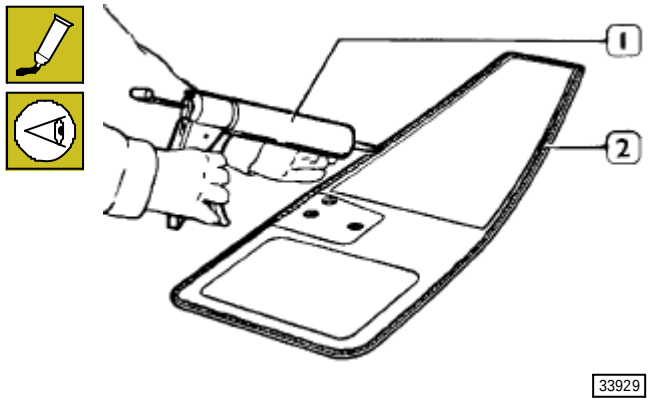
- Using the applicator contained in the kit, spread the glass adhesion promoter (COMBI primer 5061) on the screen-printed portion. It is not necessary to use it on the remaining sealant.
- Wait for 15 minutes before going ahead with the operations so as to allow the solvent of the adhesion promoter (COMBI primer 5061) to evaporate.

### Refitting

Mount the seals on the inside of the door, without touching the area where the adhesion promoter (primer) has been applied.
Mount the rubber seal on the window.
Perform a trial assembly and centre the window exactly.
After centring the window, mark the reciprocal position between the window and its seat with strips of adhesive tape (1).
Cut the strips of adhesive tape and remove the window.

Aquila Trucks Centres

Figure 71

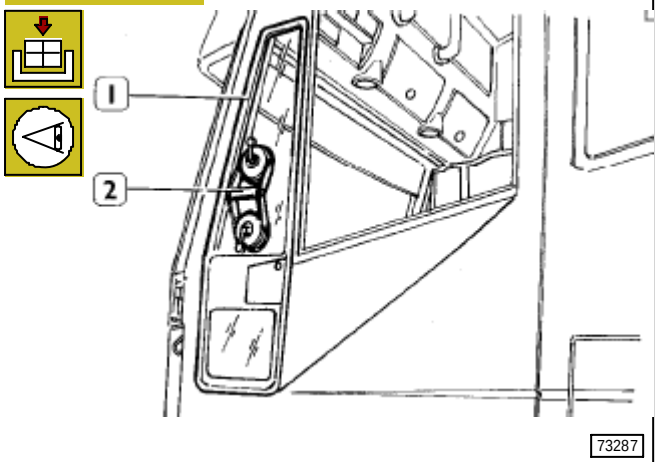



Using an air gun, apply a bead of BETASEAL 1703 SPRINT polyurethane adhesive along the perimeter of the window as evenly as possible.

Start this process from the middle of the bottom side and proceed without stopping all around the perimeter of the window.

Cut off the tip of the adhesive cartridge so that the cross-section of the adhesive bead is triangular in shape with a base of 5-7 mm and a height of 12 mm.

Figure 72

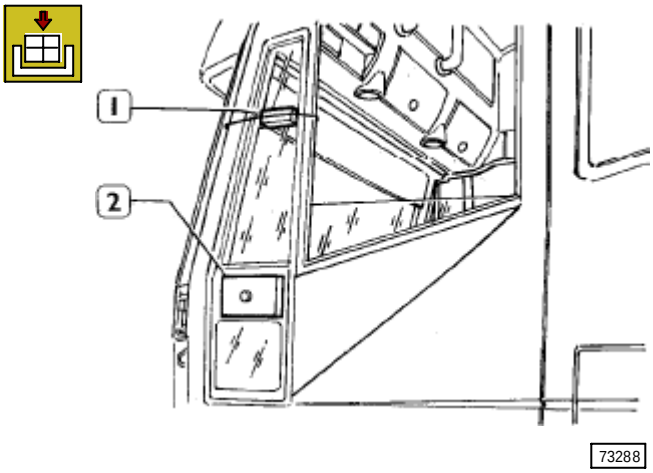



Place the windscreen in its seat with the suction cup handle (2).

- Align the window with its housing bay, using the adhesive tape applied beforehand as a reference.

**NOTE** The window must be positioned within 15 minutes of applying the adhesive.

Figure 73




Keep the window under pressure with two wooden plugs (1) and (2) positioned as shown in the figure.

**NOTE** Keep the window under pressure for at least 1 hour.

Before refitting the parts that had been removed beforehand, check there are no points of infiltration.

Apply soapy water with a sponge along the outer perimeter and blow compressed air from the inside so as to see whether there is any infiltration.

If bubbles form, degrease the relevant part and fill it with adhesive.

Any sealant spilling over on the inside can be removed once it has hardened by cutting it with a knife and detaching it with tweezers.

**NOTE** Take care not to damage the screen-printing on the window with the knife.

Fit the parts that had been removed back on and clean the window.

**NOTE** Do not move or deliver the vehicle until one hour and thirty minutes have passed at a temperature of 23°C and relative humidity (RH) of 50%.
If the temperature or humidity are lower you need to increase the waiting time.

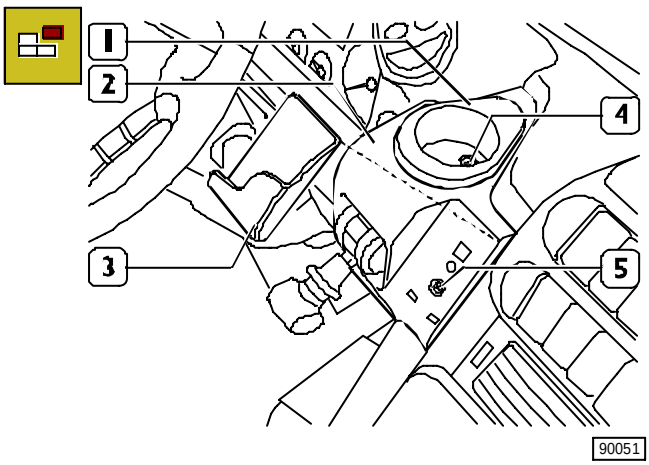
Aquila Trucks Centres

Before performing repair interventions on the vehicle, disconnect batteries by operating on current main switch and observe safety rules.

## 553710 INSTRUMENT PANEL

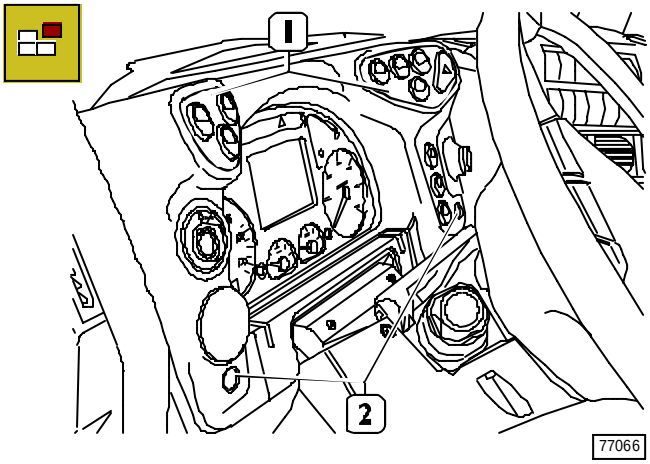
### Removal

Figure 74



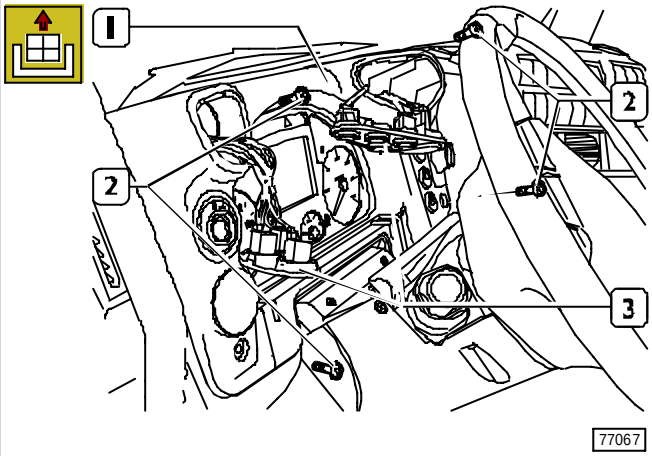

- Remove support (3) from coating (2).
- Remove screws (4 and 5).
- Take off socket holder (1).
- Take coating (2) off dashboard coating.

Figure 75




- Remove plugs (2) from seat.
- Undo the fasteners and remove the light switch assemblies (1) from their compartment.

Figure 76




- Disconnect the electric connectors and remove the light switch assemblies (3).
- Unscrew the screws (2) fixing the instrument panel (1).
- Remove instrument panel (1) from seat.
- Disconnect electric connections affecting dashboard removal, marking the respective mounting positions of the electric connections, in order to make their connection easier on reconnection.

Take then instrument panel (1) off the seat.

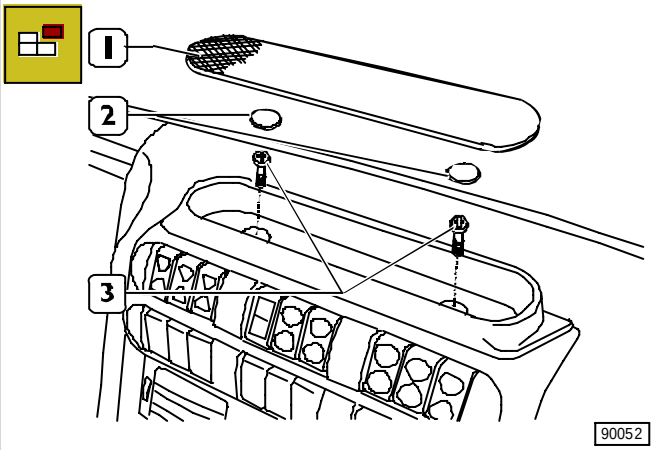
### Refitting

Refit by carrying out the procedures described for removal in reverse order.

## 553712 CENTRAL SWITCH DASHBOARD

### Removal

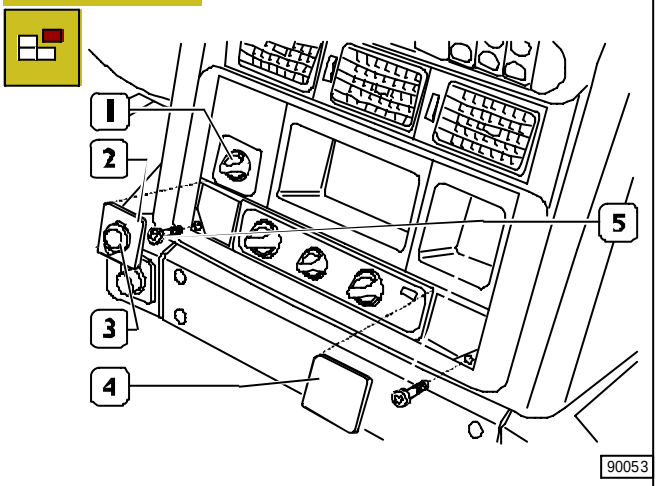
Figure 77




- Remove mat (1), plugs (2) and screws (3) securing central dashboard on top.

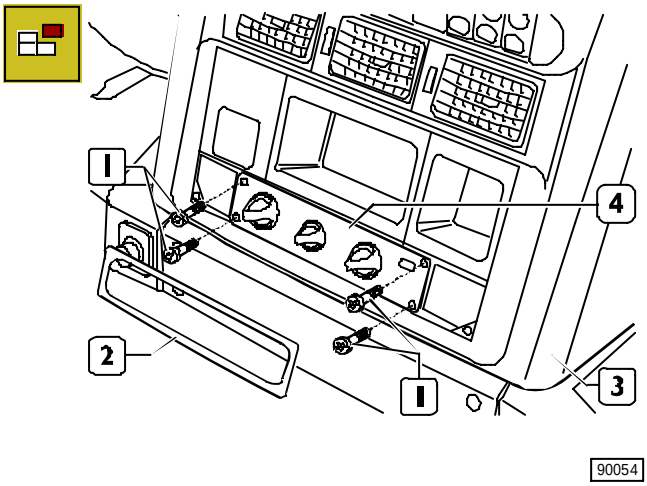
Aquila Trucks Centres

Figure 78




- Remove handgrip (1).
- Remove lid (2) and disconnect the electric connection of socket (3).
- Remove lid (4) and screws (5).

Figure 79




- Remove frame (2).
- Remove screws (1) securing controls (4) to dashboard (3).
- Remove dashboard (3) and disconnect electric connections affecting dashboard removal, marking the respective mounting positions of the electric connections, in order to make their connection easier on mounting.
- Then, take off dashboard (3).

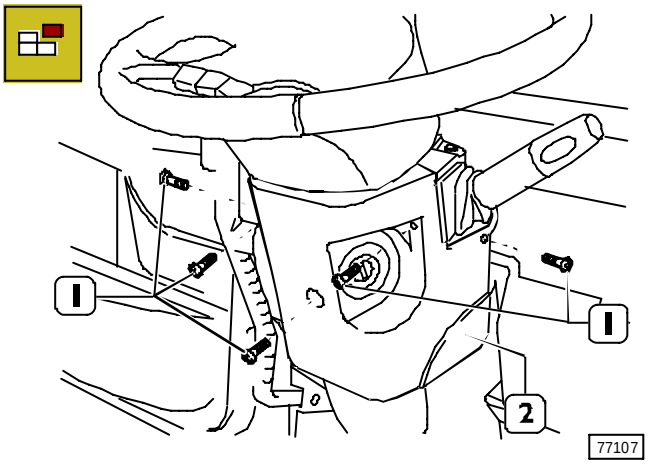
### Refitting

Refit by carrying out the procedures described for removal in reverse order.

## 552211 PROTECTIONS

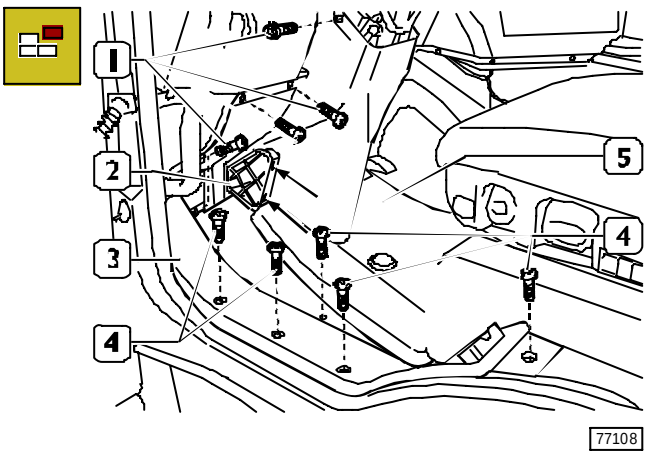
### Removal

Figure 80




- Take off instrument panel (Op. 553710) as described in relating chapter.
- Unscrew securing screws (1) and take off lights control lever coating (2).

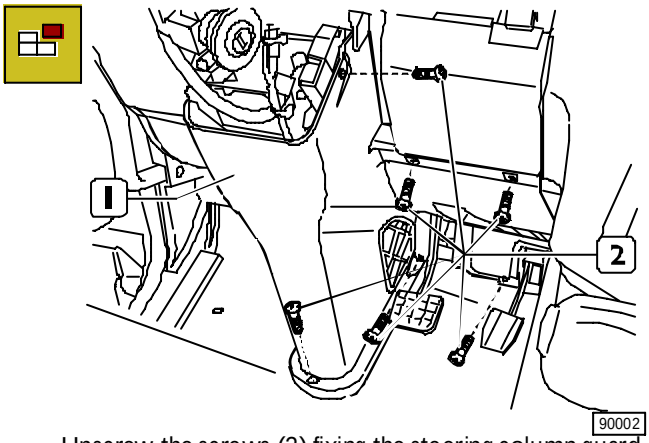
Figure 81




- Unscrew the screws (4) fixing the sill (3).
- Lift the mat (5) to get to one of the fasteners of the sill (3).
- Detach the sill (3) from the vehicle.
- Remove mat.
- Operate on check fins (←) and remove air intake (2) on the floor.
- Unscrew the side screws (1) fixing the steering column guard.

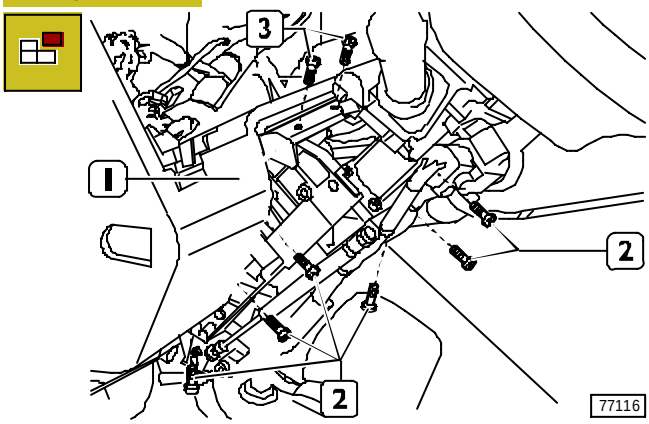
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Figure 82



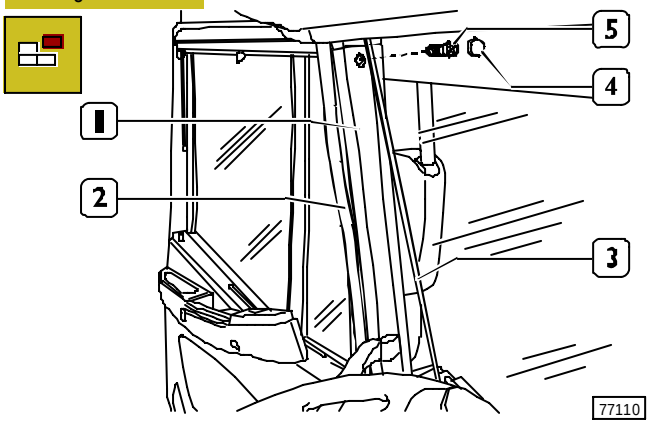

- Unscrew the screws (2) fixing the steering column guard in the area of the pedal board.
- Detach the steering column guard (1) from the vehicle.

Figure 83



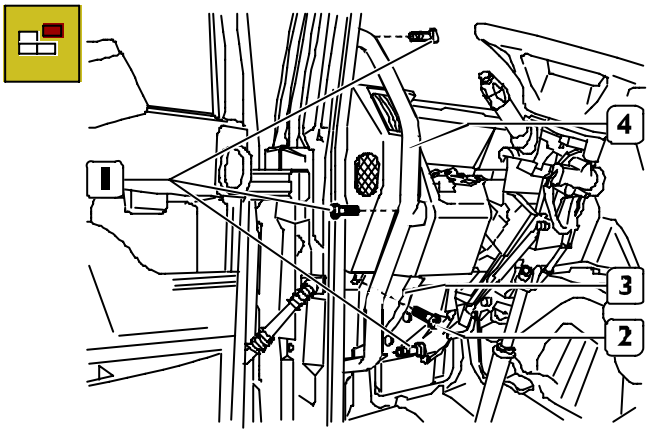

- Unscrew the screws (3) fixing the blind guard (1) on the steering column.
- Unscrew the screws (2) fixing the fascia covering to the steering column and to the body.

Figure 84



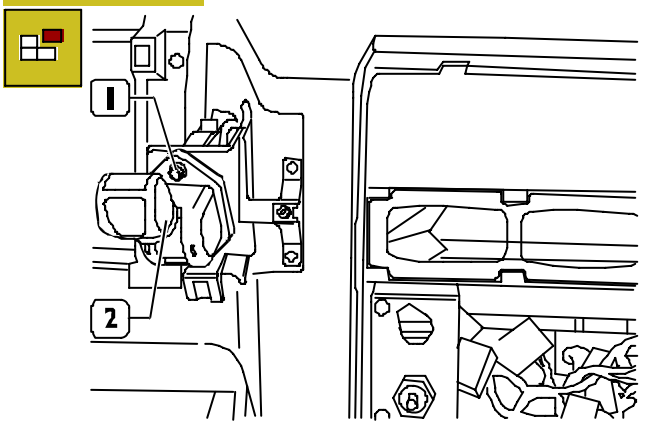

- Partly take off the door seal (2).
- Remove the sunblind rod (3).
- Take off the press-on plug (4) to access the screws beneath.
- Unscrew the fixing screw (5) and remove the windshield upright covering (1).

Figure 85



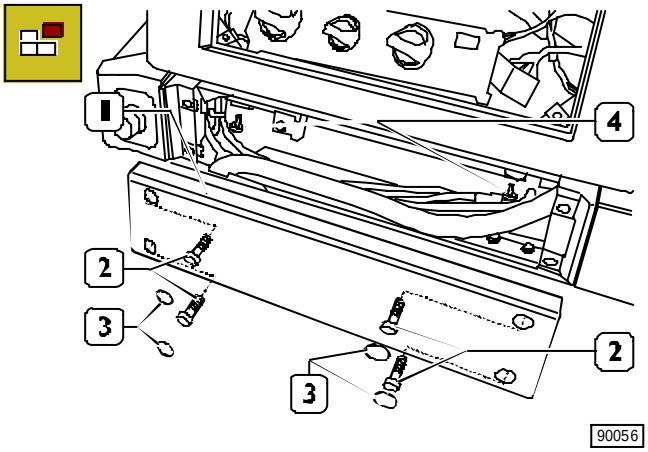

- Take off instrument panel (Op. 553710) as described in relating chapter.
- Unscrew securing scews (1) and take off lights control lever coating (2).

Figure 86




- Take off central switch holder dashboard (Op. 553712) as described in relating chapter.
- Remove screws (1) securing parking brake lever (2) to support.

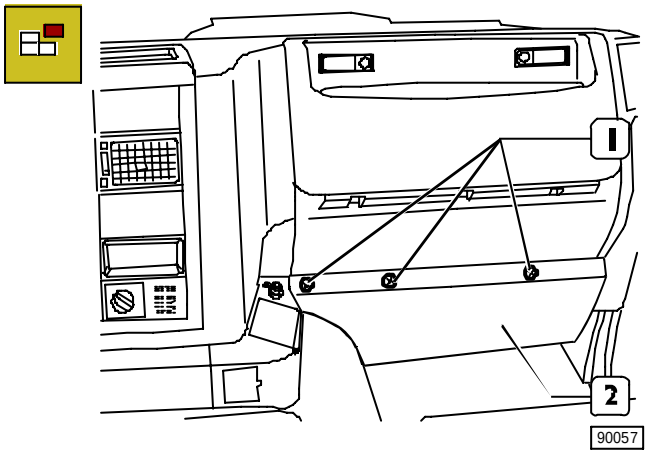
Figure 87




- Remove lids (3) and screws (2) under them, and take off coating (1).
- Remove screws (4).

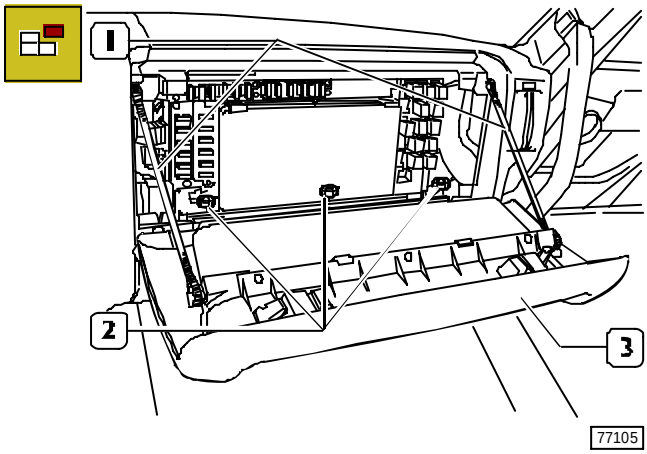
Aquila Trucks Centres

Figure 88



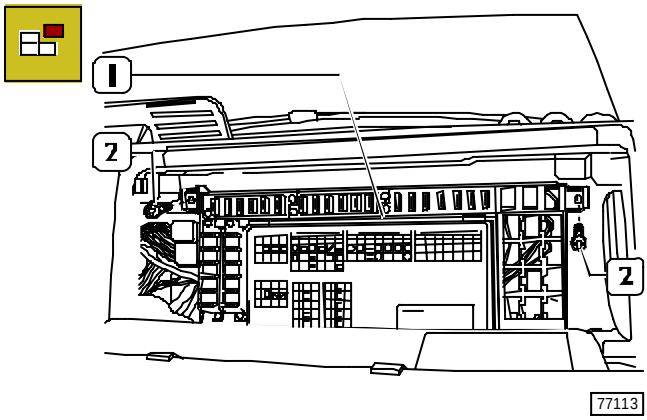

- Remove screws (1) securing lower coating (2) to passenger side.
- Take off coating (2).

Figure 89



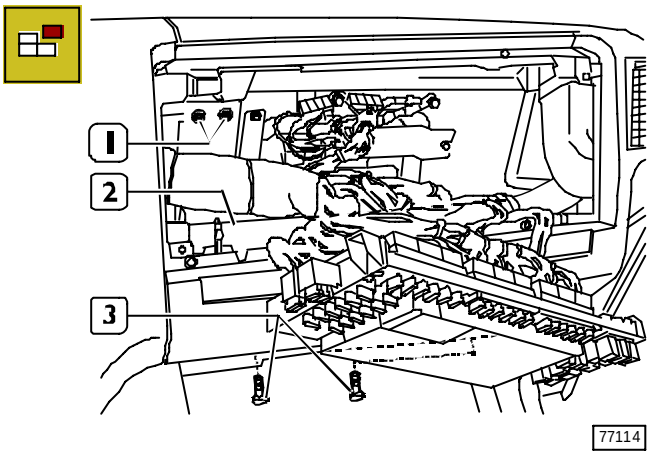

- Open the glove compartment (3).
- Detach the tie rods (1).
- Unscrew the nut (2) and detach the glove compartment (3).

Figure 90



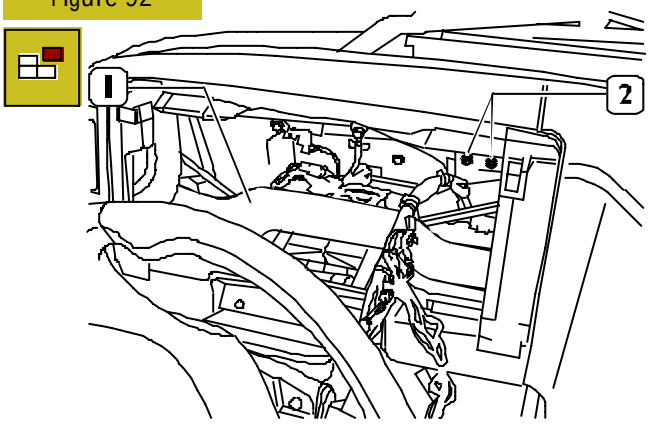

- Unscrew the screws (2) fixing the Body Control.
- Remove the Body Control (1) and to set it aside in order to get to the fasteners beneath.

Figure 91




- Unscrew the nuts (1) fixing the fascia covering to the body.
- Free the right-hand air delivery pipe (2) from the retaining clamps and disconnect it from the fan body and right-hand door air opening.
- Unscrew the bottom screws (3) fixing the fascia covering.
- Perform operations described at Figure 84 and Figure 85.

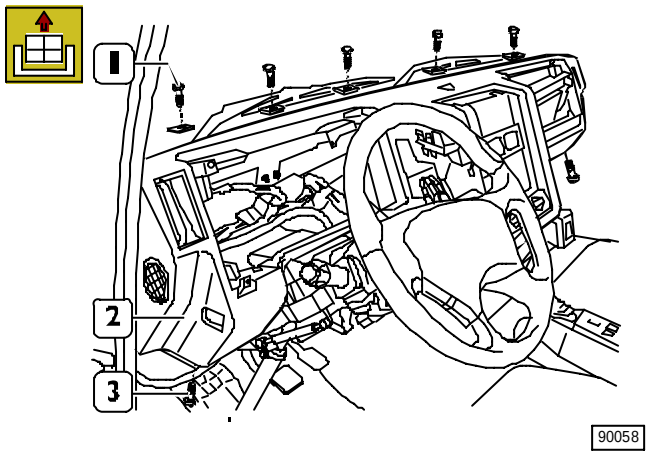
Figure 92




- Operate from the instrument panel compartment and unscrew the nuts (2) fixing the fascia covering to the body.
- Free the left-hand air delivery pipe (1) from the retaining clamps and disconnect it from the fan body and left-hand door air opening.

Aquila Trucks Centres

Figure 93




- Unscrew the top screws (1) fixing the fascia covering (2) along the perimeter of the windshield.
- Remove screws (3) securing coating on bottom.
- With the help of an assistant, detach and rotate the panel trim as required.
- Pay attention to the fasteners and extract the fascia covering (2) from the vehicle.

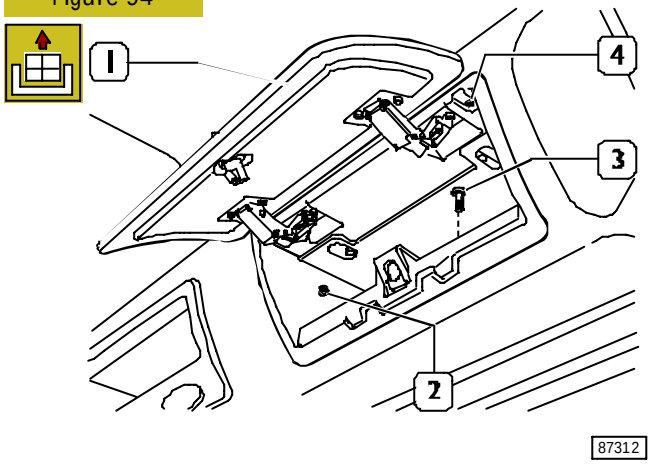
## Refitting

For refitting, invert operations described for removal, paying particular attention to electronic cables and their connections.
Once reconnection has been completed, check the functionality of electric/pneumatic controls and relating indicator lamps.
.

## 553612 WINDSCREEN VISOR ROLLING DEVICE

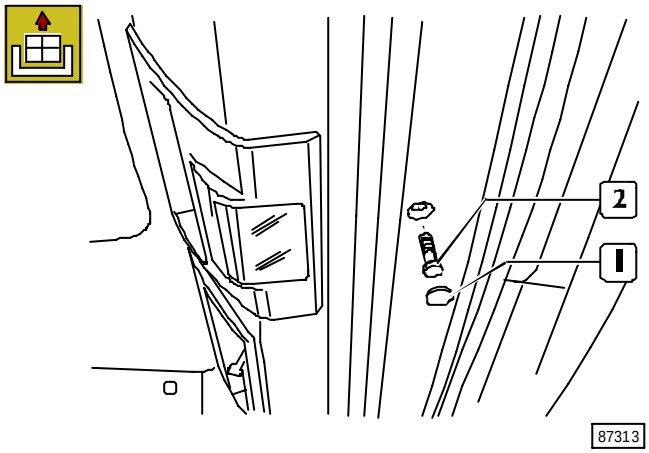
### Removal

Figure 94



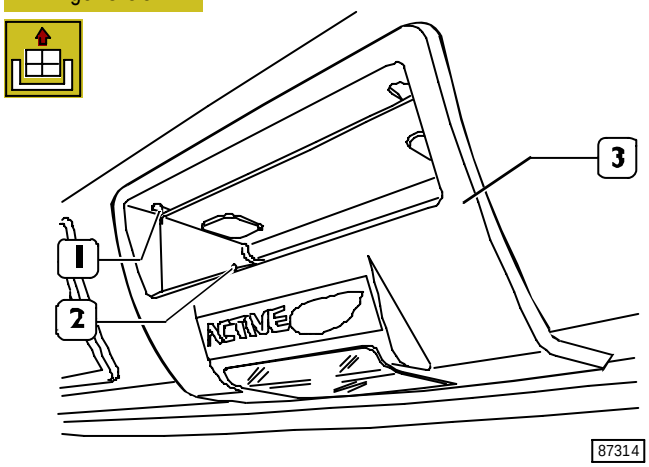

Unscrew upper screws (4), lower screws (3), side screws (2), then remove the side utility compartment (1).

Figure 95




Take off cap (1), then loosen screw (2).

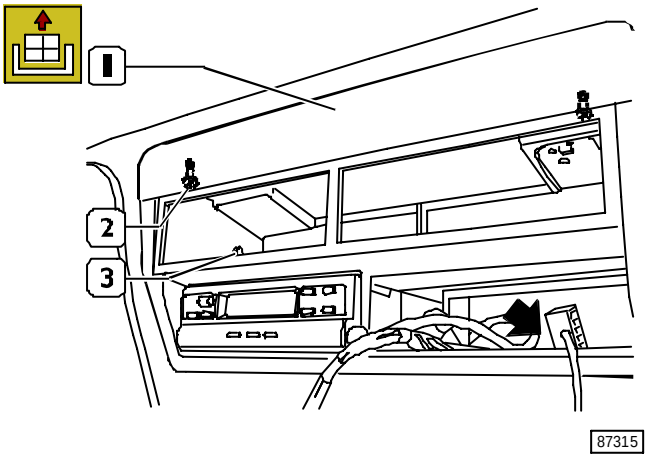
Figure 96




Unscrew upper screws (1) and side screws (2), then carefully take off the utility compartment, disconnect the ceiling light and transformer connections, and remove utility compartment (3).

Aquila Trucks Centres

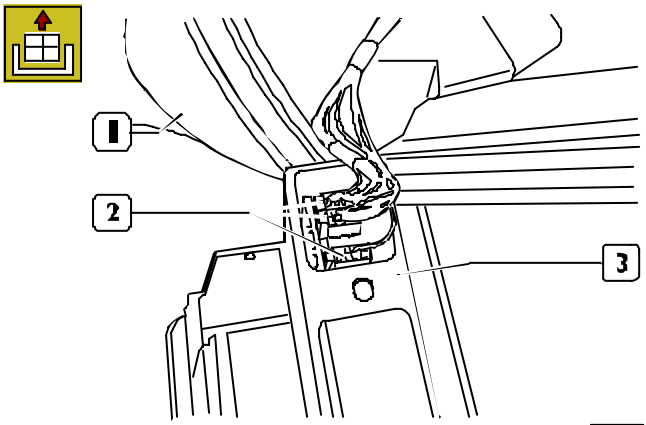
Figure 97




87315

Take off the covers and/or the removed devices (if any). Unscrew upper screws (2), side screws (3) and lower screw (→).
Carefully take off console (1).

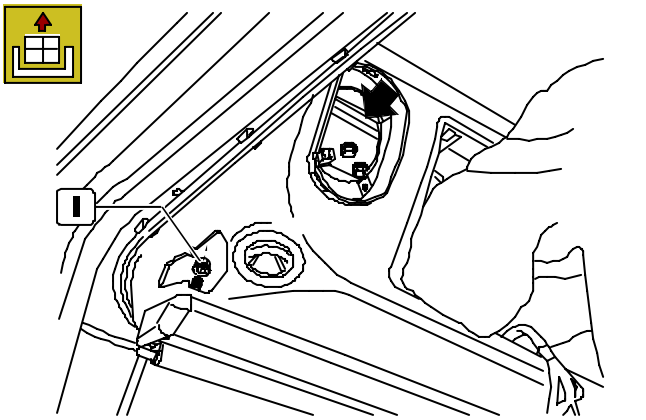
Figure 98




87316

Disconnect tachograph connections (2), then remove console (3). Take off loudspeaker cover (1) and the loudspeaker (where available).

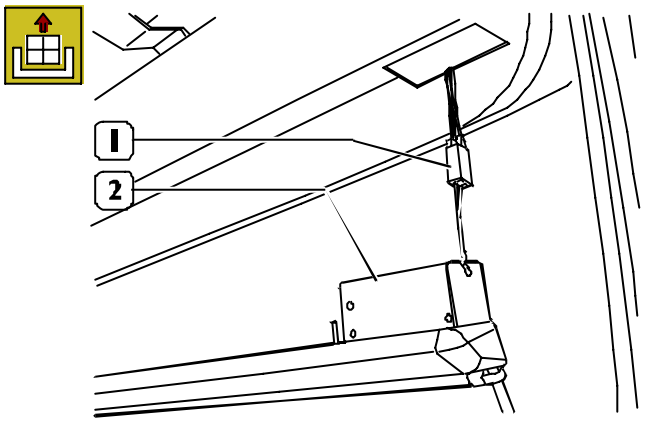
Figure 99




87317

Unscrew the first rolling device fastening nut (1) through the opening from the loudspeaker (→), and the other four nuts through the other openings.

Figure 100




87318

Carefully lower the rolling device assembly (2), disconnect connection (1), then remove the assembly.

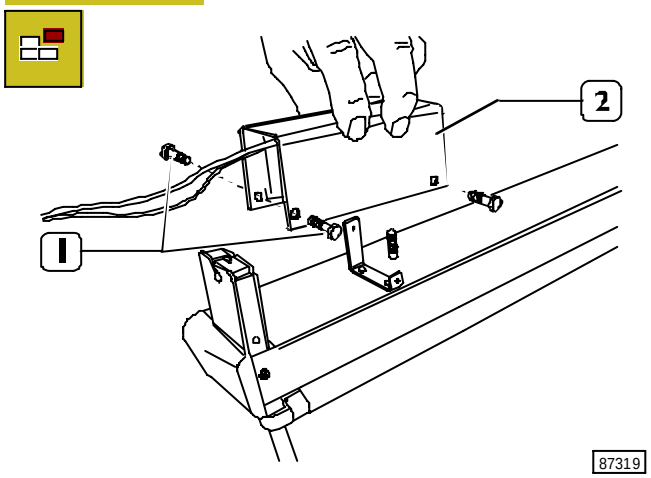
### Refitting

Reverse the removal procedure.

## 553651 WINDSCREEN SUN VISOR REEL MOTOR REPLACEMENT

### Removal

Figure 101




87319

Slacken the four fastening screws (1) and remove the motor (2).

### Refitting

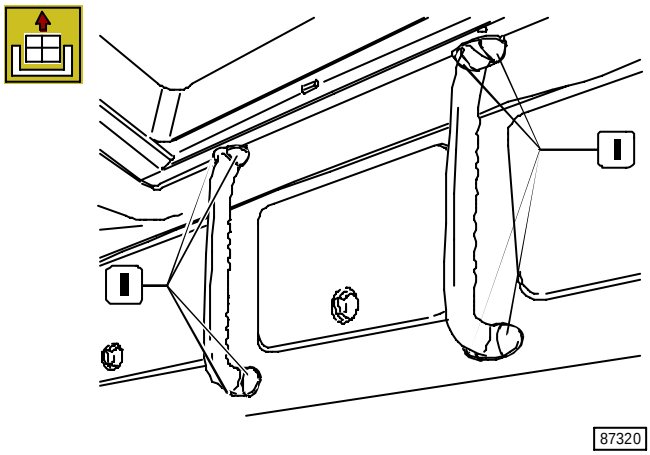
Reverse the removal procedure.

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## 550250 AIR INTAKE LID

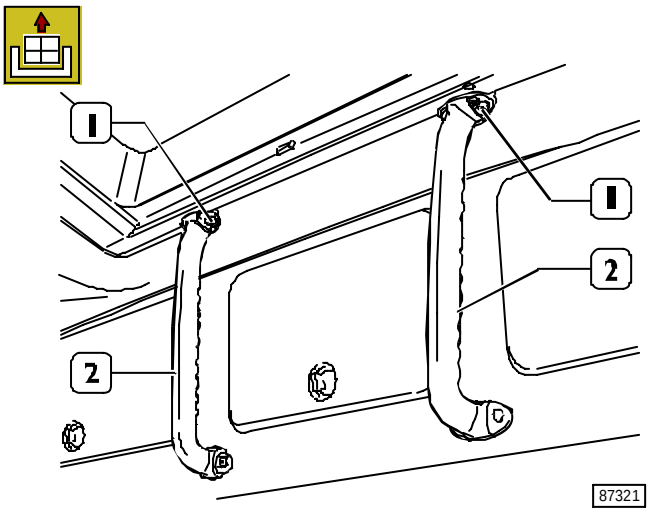
### Removal

Figure 102



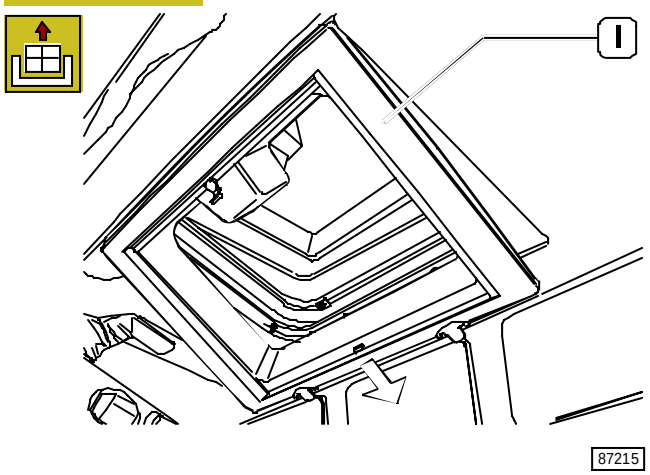

Extract the screw covering trims (1).

Figure 103



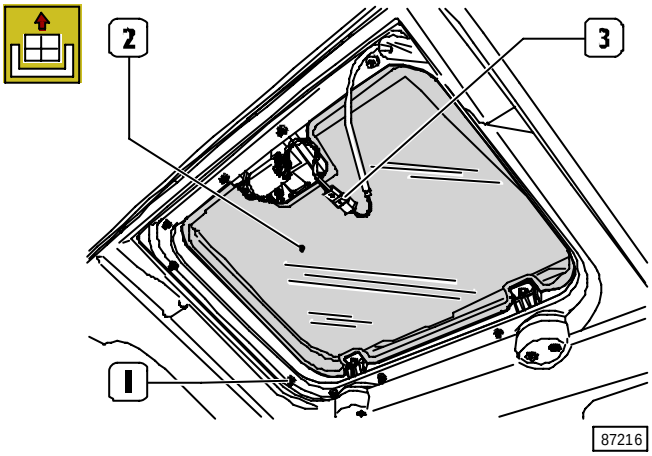

Slacken the fastening screws (1) and remove the handles (2).

Figure 104




Remove the rim (1).

Figure 105




Disconnect the connection (3), slacken the 12 fastening nuts (1) and remove the air intake lid assembly (2).

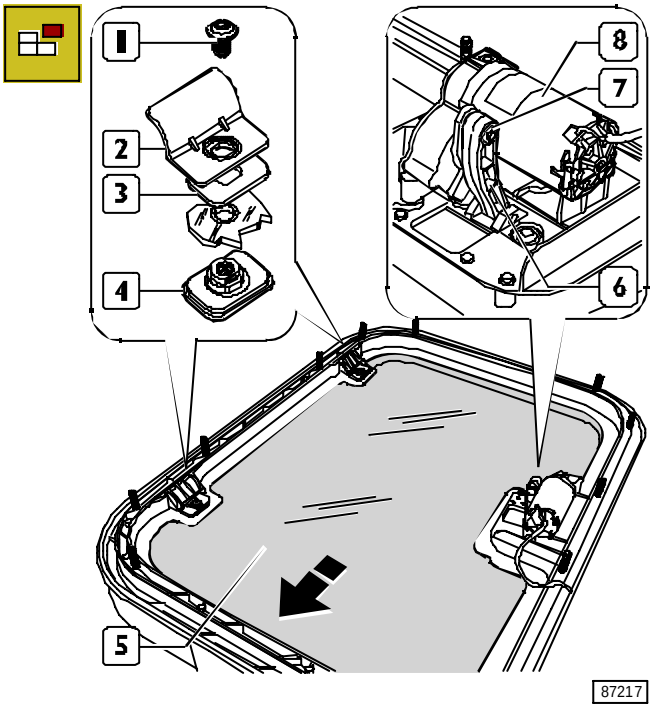
### Refitting

Reverse the removal procedure.

## 550254 AIR INTAKE LID MOTOR REPLACEMENT

### Removing

Figure 106



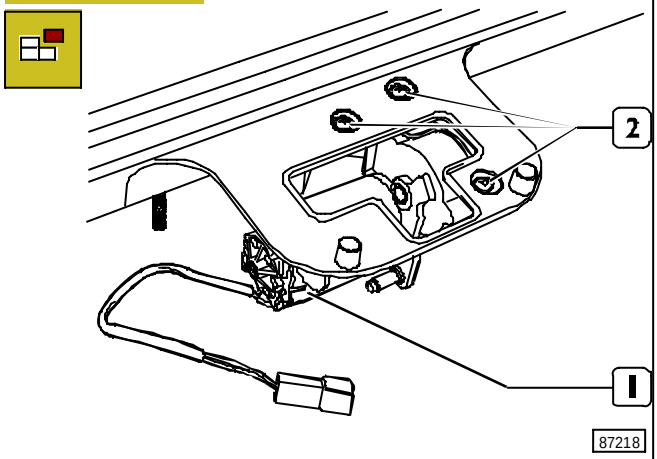

Disconnect the lid as described above and put it on the working stand.

Slacken the screws (1), recover the hinges (2), the gaskets (3) and the bosses (4).

Remove the safety ring (7) and make the window (5) slide in the direction shown by the arrow to release the motor (8) lever (6).

Aquila Trucks Centres

Figure 107

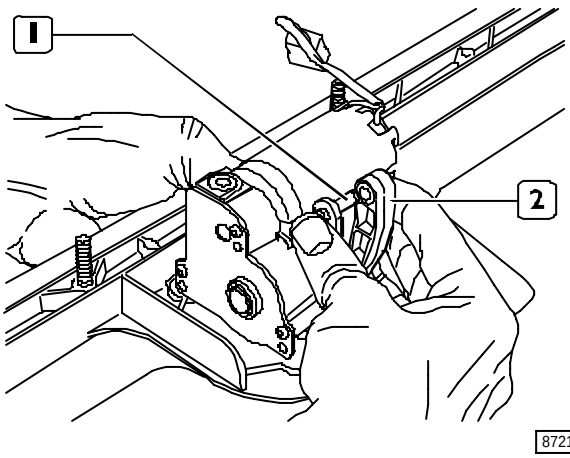



Slacken the screws (2) and remove the motor (1).

## Refitting

Reverse the removal procedure except for the following operations.

Figure 108



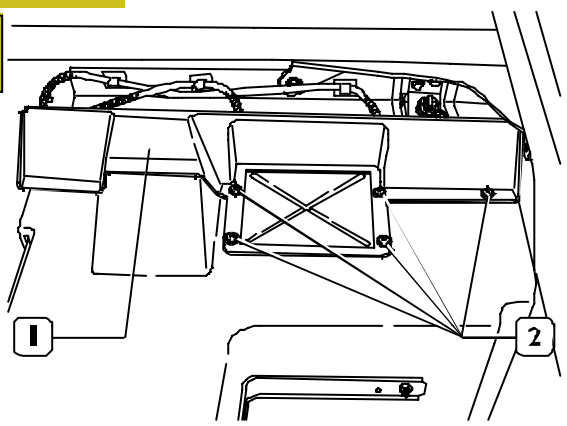

At refitting, press the rim in contact with the window to obtain alignment between the motor lever pin (1) and the window lever hole (2). Make the parts slide until the lever coupling is obtained.

# 551644 REPLACING SIDE DOOR OPENING CONTROL CABLE (AT VEHICLES)

**NOTE** Should the lid opening control cable be broken, you can gain access to the glove compartment from the cabin inside behind the driver's seat.

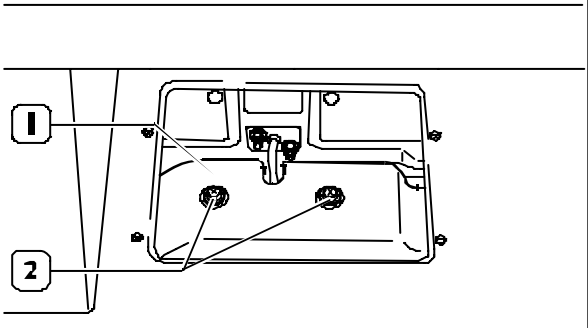
## Removing

Figure 109




Lift the mattress behind the driver's seat.Losen screws (2), then remove covering (1).

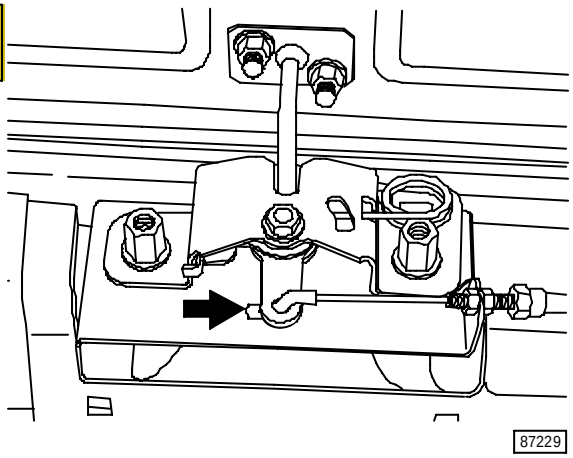
Figure 110




Slacken the screws (2), recover the washers and remove the covering (1).

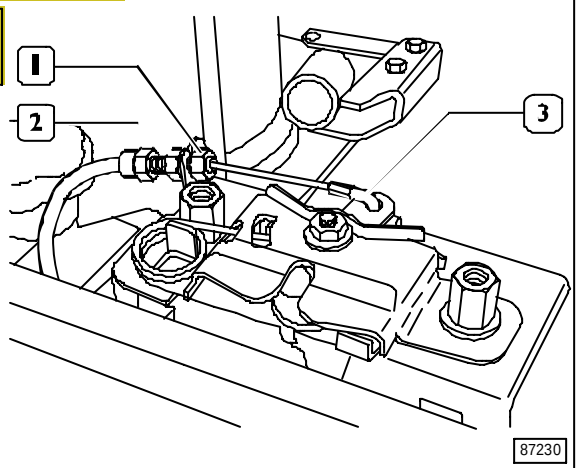
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Figure 111



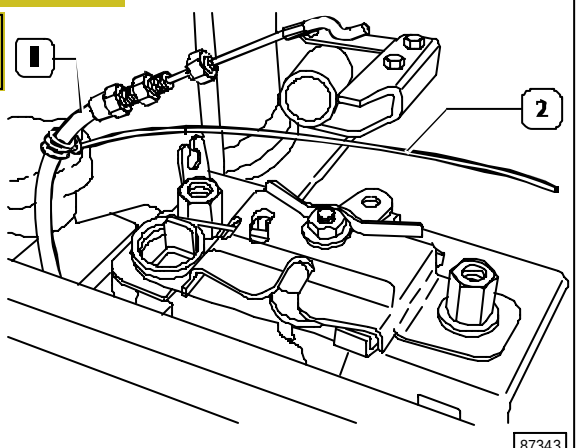

Operate the lever (→) to open the lid.

Figure 112



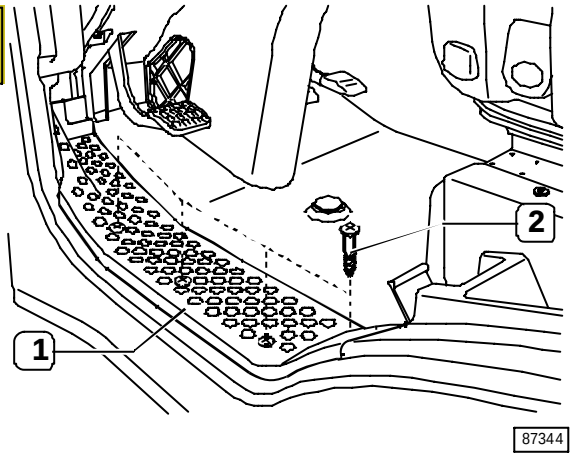

Slacken the lock nut (1) and remove the adjusting terminal (2) from the lock, then release the terminal from the lever cable (3).

Figure 113



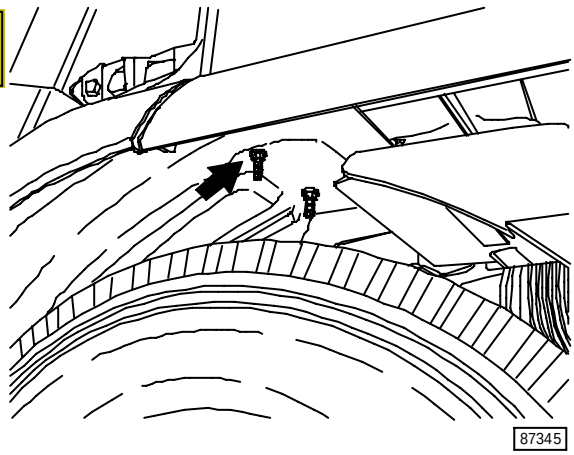

Tie up a probe (2) to the cable (1) to be taken out, so as to allow the new cable to be inserted.

Figure 114



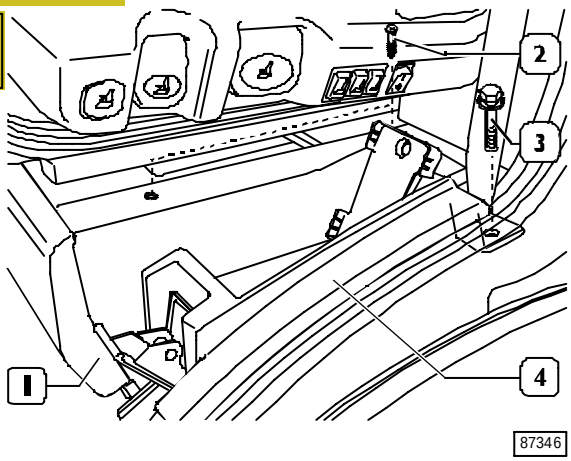

Loosen screws (2), then remove covering (1).

Figure 115




Unscrew nut (→), then recover the washer from below the wheelbox.

Figure 116

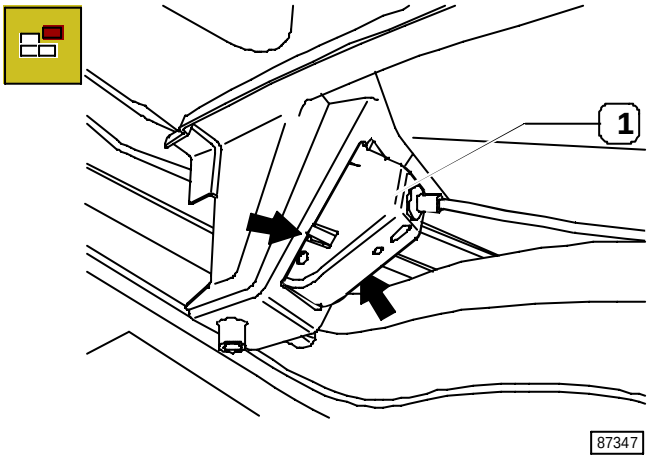



Disconnect and remove the remote control so as not to damage it.

Lower door (1), loosen screws (2) and screw (3), then take off covering (4) carefully

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Figure 117




Act on the points shown (→), then take out handle (1).

Take off handle (1) with its respective cable, then untie the probe.

**NOTE** Leave probe (2, Figure 113) in the space between the cabin and the utility compartment opening.

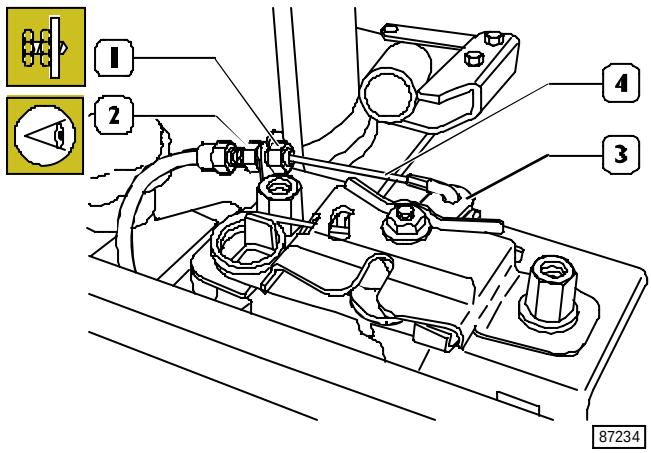
## Refitting

Reverse the removal procedure.

**NOTE** Before refitting the covering (1, Figure 108) carry out the lid opening control adjustment.

## Lid opening control cable adjustment

Figure 118



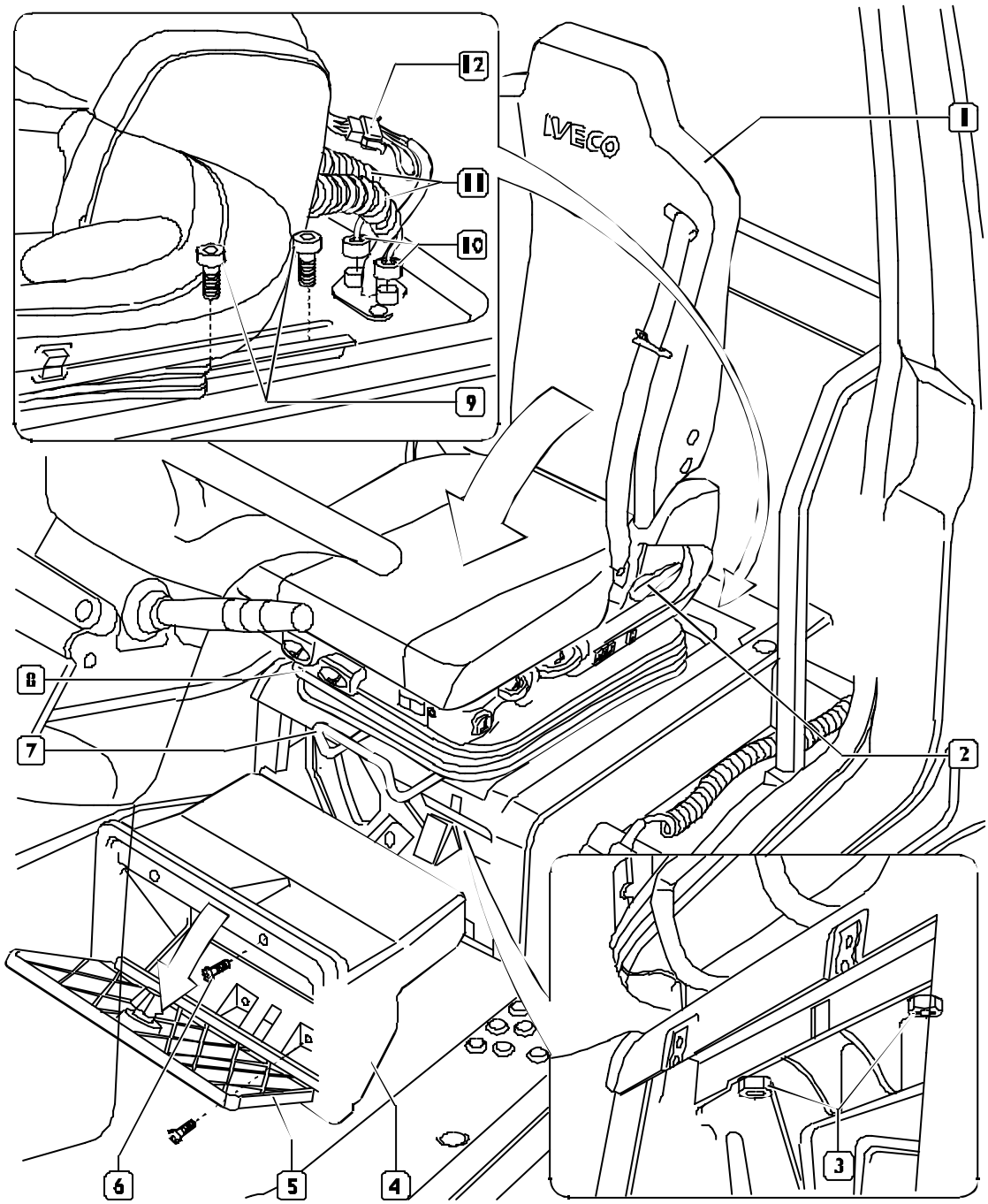

Operate the nut (2) to tension the cable (4) with the lever (3) free and without clearance.

After adjustment, tighten the lock nut (1).

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## 555010 DRIVER'S SEAT

Figure 119




### Removal

Open the door (5) of the glove compartment (4).
Unscrew the fixing screws (6) and remove the glove compartment (4) from the vehicle.
Operate the lever (7) and bring the seat (8) into the "all forward" position.
Operate the lever (2) and tilt the back (1).
Undo the quick couplings (10) and detach the air pipes (11).
Disconnect the electric system connector (12).
Unscrew the fixing nuts (3) and screws (9) and remove the seat (8) from the vehicle.

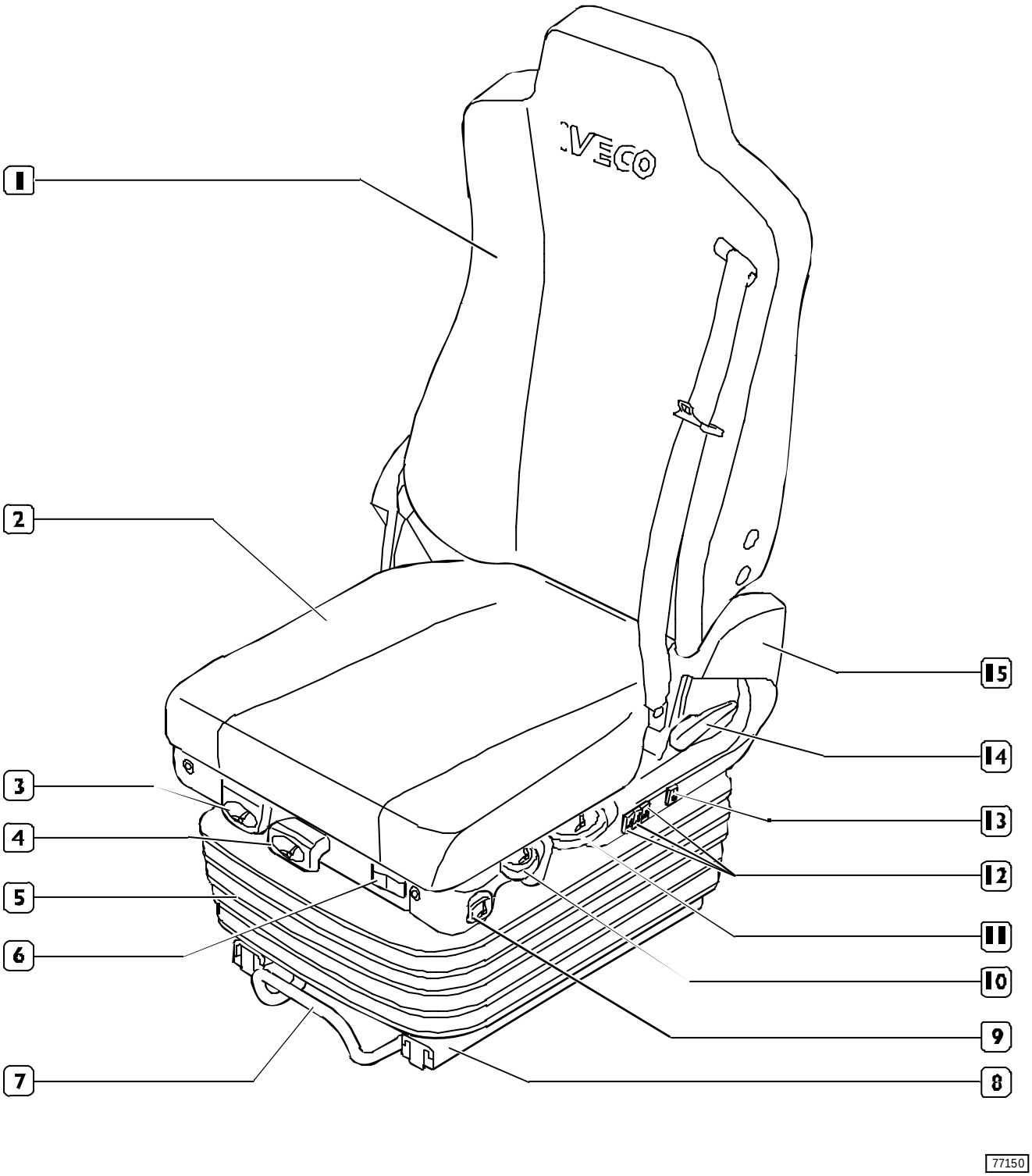
### Refitting

Refit by carrying out the procedures described for removal in reverse order.

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## Component layout

Figure 120

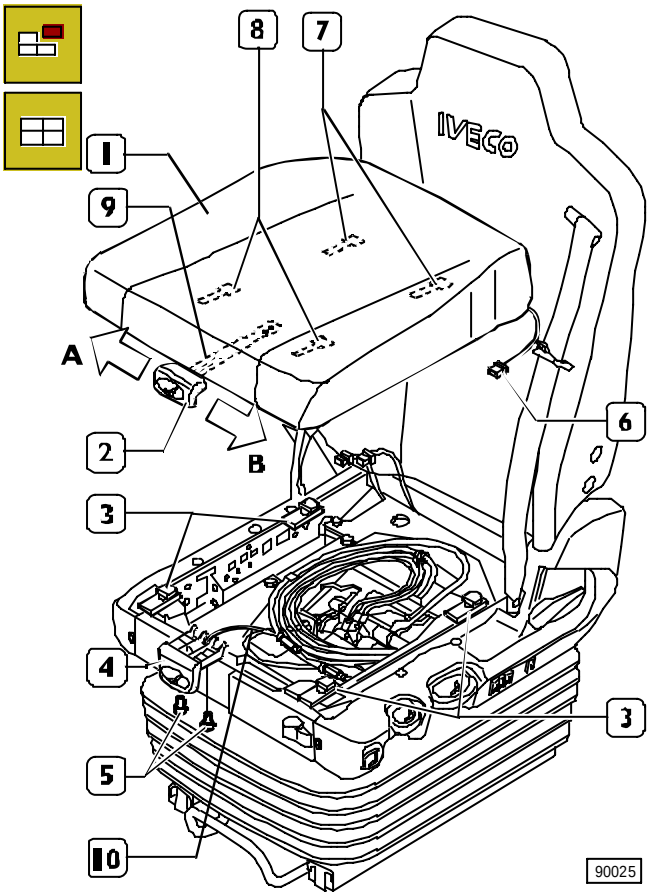



1. Back - 2. Cushion - 3. Seat tilt adjustment - 4. Cushion depth adjustment - 5. Bellows - 6. Horizontal spring - 7. Horizontal adjustment - 8. Guides - 9. Lowering seat - 10. Adjusting the vertical shock absorber - 11. Adjusting the seat height - 12. IPS pneumatic lumbar support - 13. Seat heating - 14. Back adjustment - 15. Upholstery.

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## REMOVING THE DRIVER'S SEAT
### Removing - refitting the cushion

Figure 121




### Removing

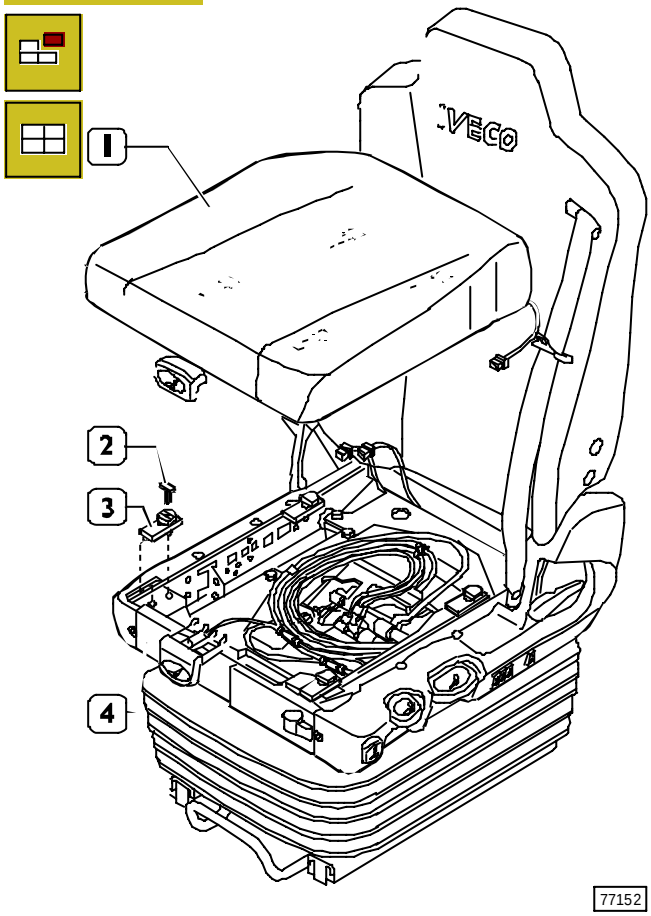
- Lift the lever (2) for adjusting the cushion depth.
- Arrange the cushion (1) in its head position.
- Unscrew the screws (5) fixing the seat tilt adjustment lever (4).
- Keep the lever (2) in the top position and push in the direction of the arrow (A).
- Move the cushion (1) of the seat forward and lift it.
- Disconnect the electrical connection (6) of the seat.
- Detach the cushion (1) from the seat.

### Refitting

- Bowden flexible cable (10) must be positioned between lever (9) and sitting cushion base plate.
- Press cushion with key holes (7) on rear sliding blocks.
- Draw lever (2) upwards (do not displace cushion).
- Press cushion front key holes (8) on front sliding blocks. Push cushion downwards and at the same time push up to the stop towards the seat back.
  Now, check that all the four sliding blocks are still anchored in cushion base plate (cushion vertical movements must not be possible).
- Press lever (2) according to the direction of arrow (B) and push the cushion towards the seat back up to the engagement of lever (2).
- Check the cushion to be steadily secured according to both horizontal and vertical directions.

### Removing - refitting cushion sliding blocks

Figure 122




### Removing

- Remove the cushion as shown alongside.
- Take out plug (2) and push out sliding block (3).

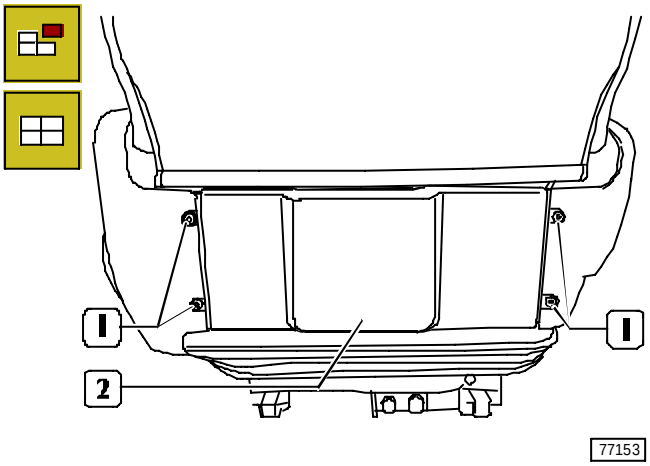
### Refitting

- Mount sliding block (3) to seat frame (4).
- Put plug (2) into sliding block (3) seat.

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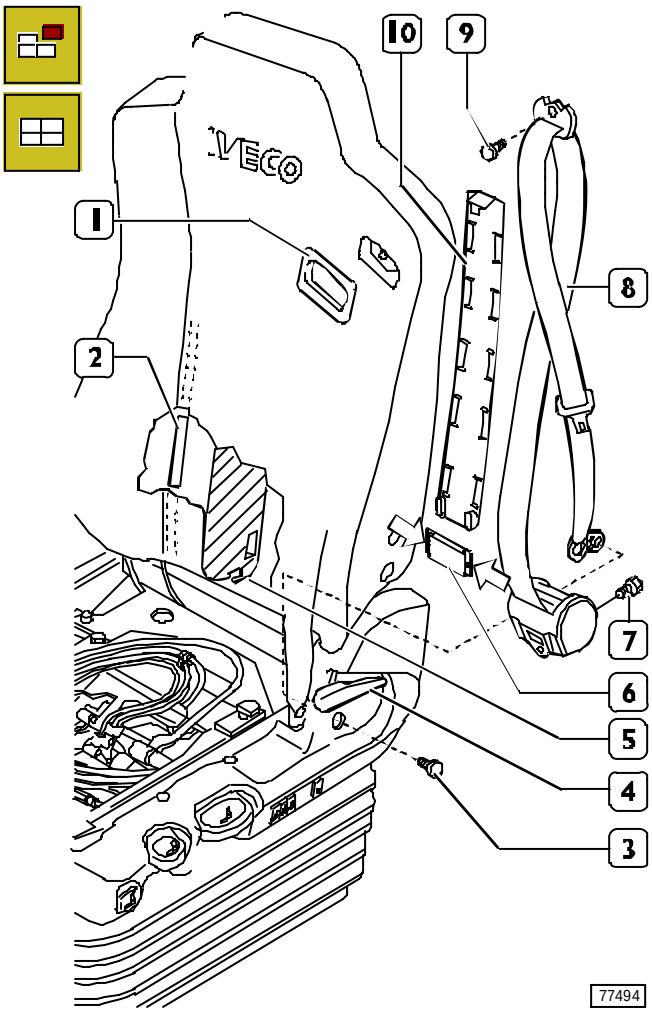
## Removing - refitting the seatbelt

Figure 123




- Detach the seat cushion as described above.
- Unscrew the fasteners (1) and remove the rear upholstery (2) of the back.

Figure 124



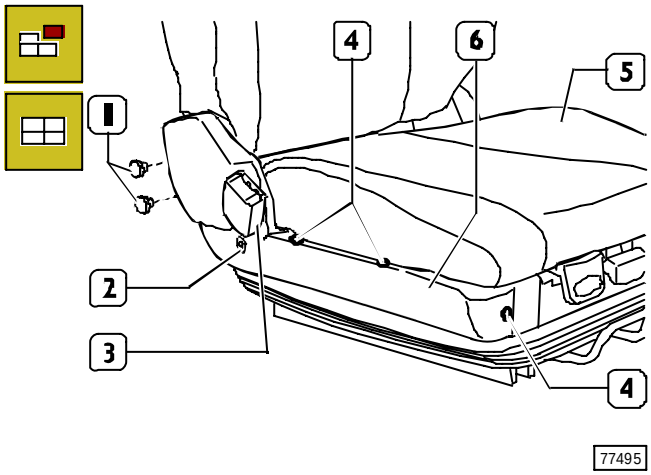

- Lift the back adjustment lever (4) and unscrew the screw (3) fixing the seatbelt hook.
- Unscrew the screw (9) fixing the top of the seatbelt and take off the facing (1).
- Unhook the sections (5) and lift the back upholstery off the fixing tapes (2) (Velcro),
- Remove the retainer (6) of the plastic guide (10) acting in the direction of the arrows.
- Unscrew the screw (7) fixing the reel and remove the seatbelt (8) from the seat.

### Refitting

- For fitting, carry out the steps performed for removal in reverse order.

## Removing - refitting seatbelt connection and right-hand side upholstery

Figure 125




- Position the cushion (5) forwards.
- Unscrew the screws (4) fixing the upholstery (6) and the press-on caps (1).
- Unscrew the screw (2) and remove the belt connection (3) and the side upholstery (6).

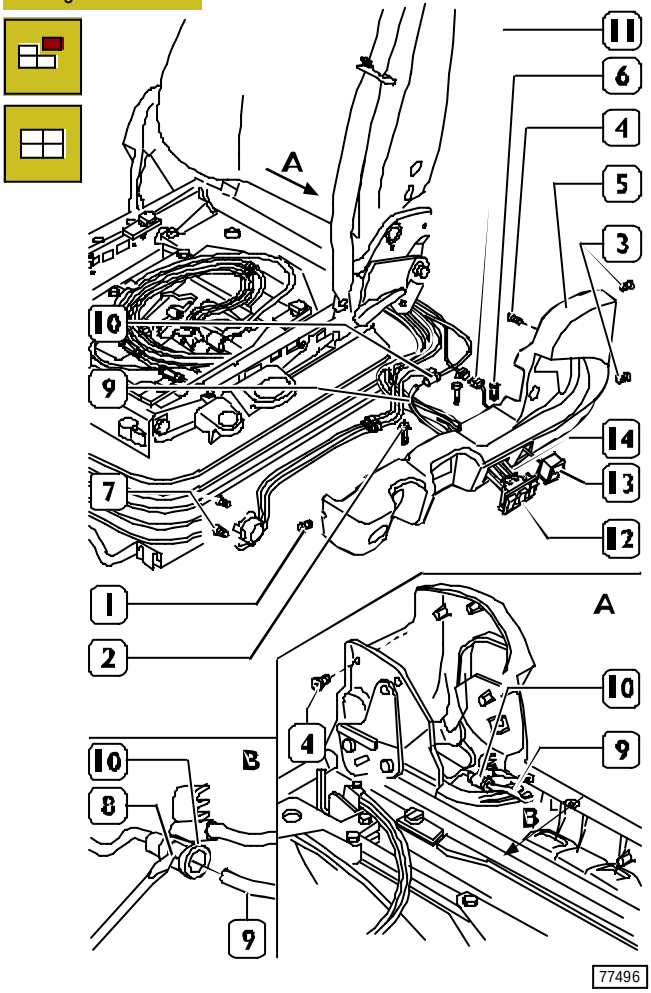
### Refitting

- For fitting, carry out the steps performed for removal in reverse order.

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## Removing - refitting the left-hand side upholstery, IPS valve and heating switch

Figure 126




### Removing

- Remove the seat cushion as described above.
- Unscrew screws (1), (2) and (3).
- Fold the back fully forwards and unscrew the screw (4).
- Remove the side upholstery (5) from the seat framework.
- Unscrew a screw (6) and two screws (7).
- Lift safety hook (8) in a safe way and dismount air tube (9) from connector (10) (see detail A, B).
- Separate the electric connector (11).
- Push the valve (12) and the switch (13) outside the upholstery (5).
- Disconnect the hoses (14) from the valve (12).

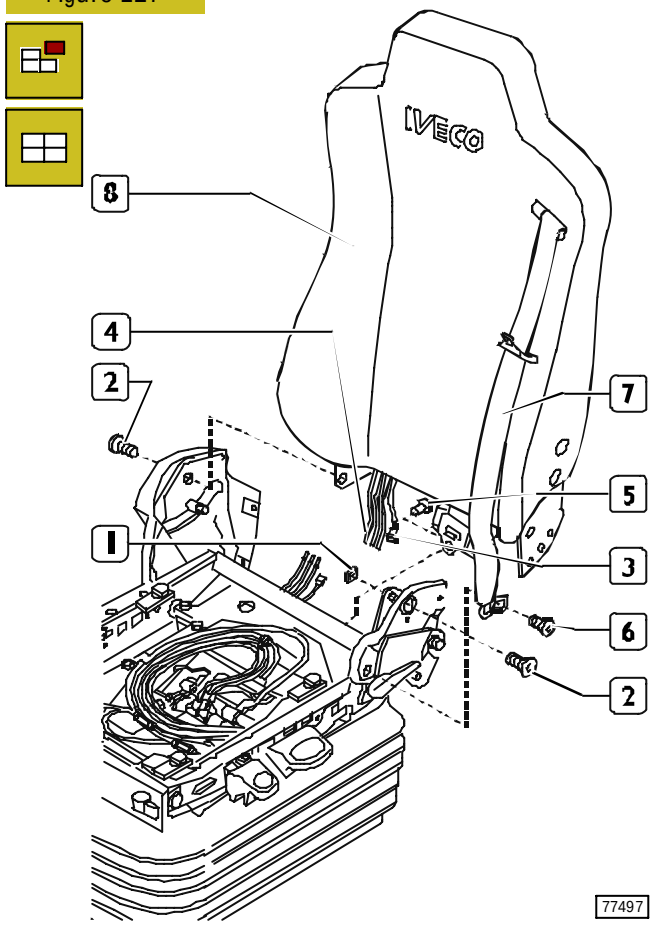
**NOTE** Mark the hoses to facilitate assembly.

### Refitting

- For fitting, carry out the steps performed for removal in reverse order.

## Removing - refitting the back

Figure 127




### Removing

- Remove the seat cushion as described above.
- Adjust inclination at the highest position.
- Take off the side upholstery.
- Disconnect the connector (3) and three air hoses (4) if applicable.
- Remove the safety lock (1).
- Unscrew the screw (5) fixing the seatbelt reel and the screw (6) fixing the seatbelt (7).
- Unscrew the screws (2) fixing the back (8).
- Remove the back (8) from the seat,

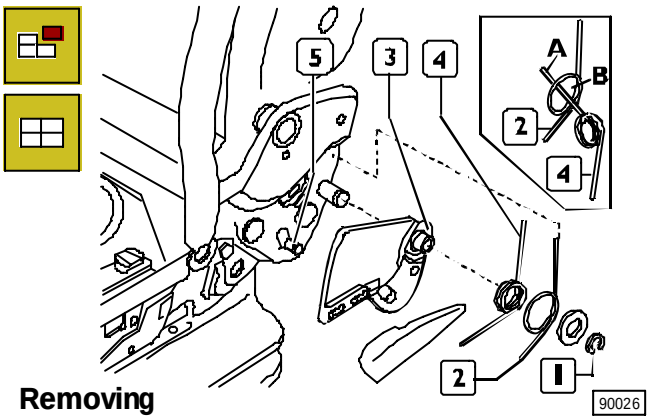
### Refitting

- For fitting, carry out the steps performed for removal in reverse order.

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## Removing - refitting the back adjustment lever

Figure 128




### Removing

- Remove the seat cushion and the left-hand side upholstery as described above.
- Remove the safety washer (1).
- - Dismount spring (2) from lever (3).
- Remove the spring (4) from the pin (5).
- Remove the lever (3).

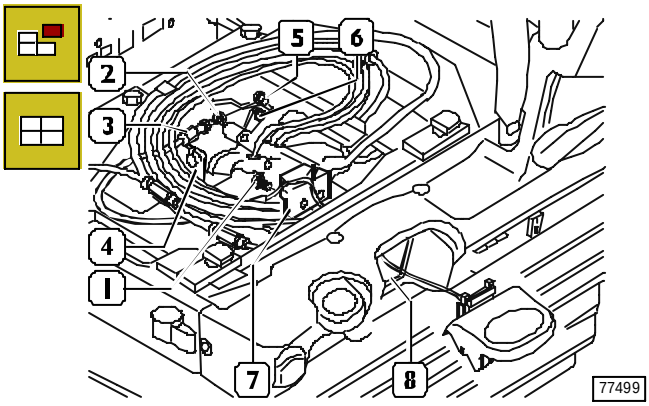
### Refitting

**NOTE** Before putting in the springs, thread end (A) of spring (4) into the opening (B) of spring (2).

- For fitting, carry out the steps performed for removal in reverse order.

## Removing - refitting the height adjustment device

Figure 129




### Removing

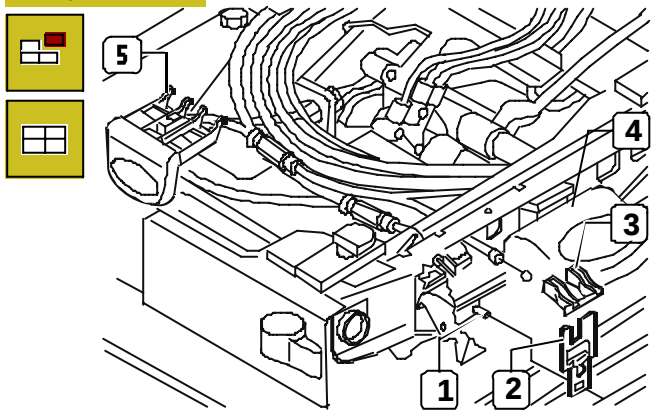
- Remove the seat cushion as described above.
- Adjust inclination at the highest position.
- Unscrew the fixing screws (1), loosen the nut (2) and remove the flexible cable (3) from the fixing (4).
- Free the threaded coupling of the cable (5) from the lever (6).
- Push the flexible cable out of the mount (7) and extract through the opening (8).

### Refitting

- For fitting, carry out the steps performed for removal in reverse order.

## Removing - refitting the seat angle adjustment device

Figure 130




### Removing

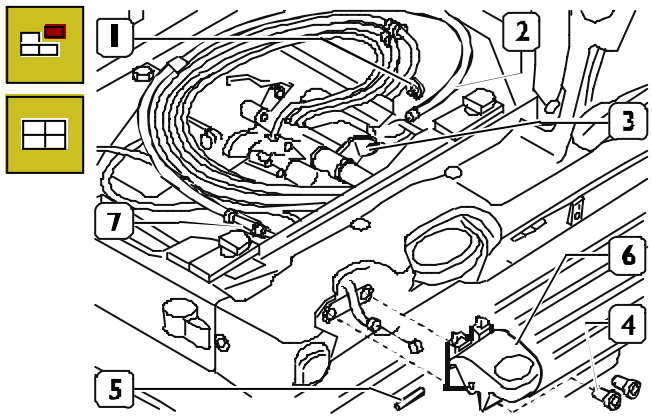
- Remove the seat cushion and the left-hand side upholstery as described above.
- Take off height adjusting lever (4) as above.
- Free the pin (1) from the lever (2).
- Remove the lever mount (3) from the seat framework.
- Loosen the flexible cable from the lever (2).
- Remove the seat adjustment device (5) from the seat.

### Refitting

- For fitting, carry out the steps performed for removal in reverse order.

## Removing - refitting the flexible cable of the shock absorber adjustment device

Figure 131




### Removing

- Remove the seat cushion as described above.
- Remove the supporting washer (1) and the flexible cable (2) of the lever from the fixing system (3).
- Unscrew the screws (4).
- Extract the pin (5) from the lever (6).
- Extract the flexible cable (2) from the seat framework.

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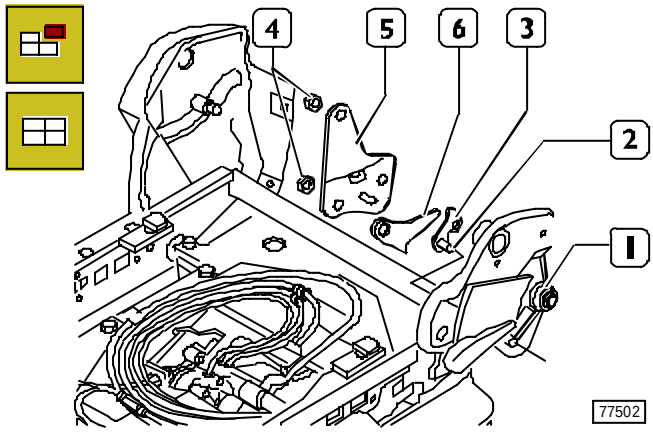
## Refitting

**NOTE** Before fitting the seat cushion, loosen the locking nut (7), adjust the flexible cable (2) so that in the lowest position of the adjustment lever, the stiffest vertical damping is reached, then retighten the locking nut.

- For fitting, carry out the steps performed for removal in reverse order.

## Removing - refitting the back adjustment lever segment

Figure 132




### Removing

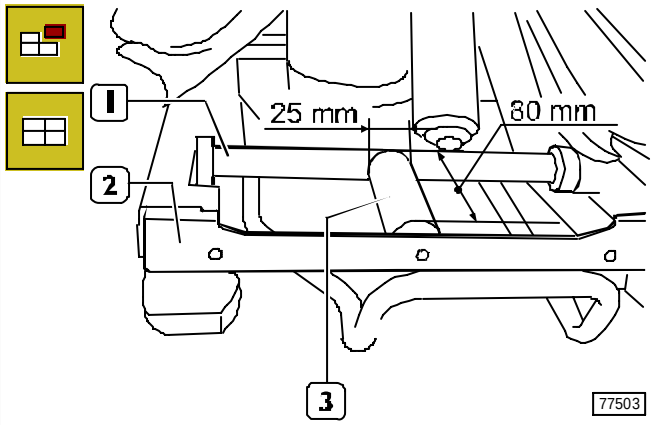
- Remove the seat cushion, left-hand side upholstery and the back as described above.
- Loosen spring (1) from pin (2) of lever (3).
- Unscrew the nuts (4) and remove the plate (5), the toothed segment (6) and the lever (3).

### Refitting

- For fitting, carry out the steps performed for removal in reverse order.

## Removing - refitting the air spring

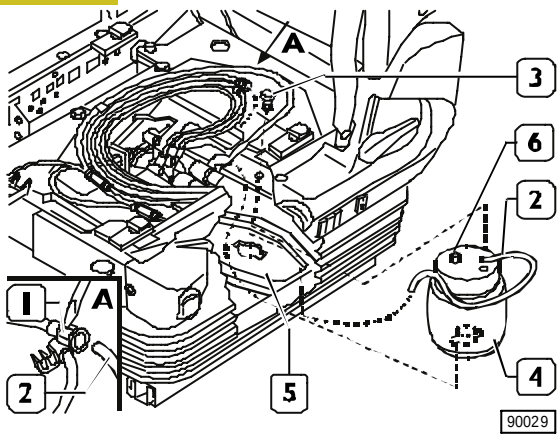
Figure 133




### Removing

- Remove the seat cushion as described above.
- Take out the bottom bellows fastener.
- Secure suspension assembly (1) on the highest position, use special spacer (3) with dimensions shown in figure.
- Put in spacer (3) between frame (2) and seat suspension (1).

Figure 134




- Lift the fixing hook (1) safely and remove the air pipe (2) as shown in the box.
- Unscrew the screw (3), loosen the shock-absorber fixing and move the air spring toward the front.
- Turn the air spring (4) by 90 degrees and remove it from the bottom mount (5).

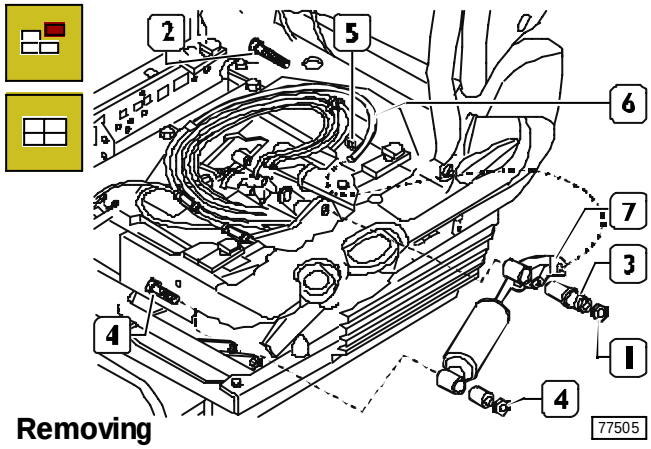
### Refitting

For fitting, carry out the steps performed for removal in reverse order.

**NOTE** After mounting a new suspension, projection (6) must engage with the fixing hole of suspension upper support.

## Removing - refitting the shock absorber

Figure 135




### Removing

- Remove the seat cushion as described above.
- Take out the bottom bellows fastener.
- Move the suspension assembly into its lowest position.
- Unscrew nut (1), take out screw (2) and remove bushing (3).
- Position suspension assembly to the highest position (use spacer (3), Figure 133).

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- Unscrew the bottom shock absorber fastener (4).
- Remove the supporting washer (5) and the flexible cable of the lever (6) out of the fastener (7).

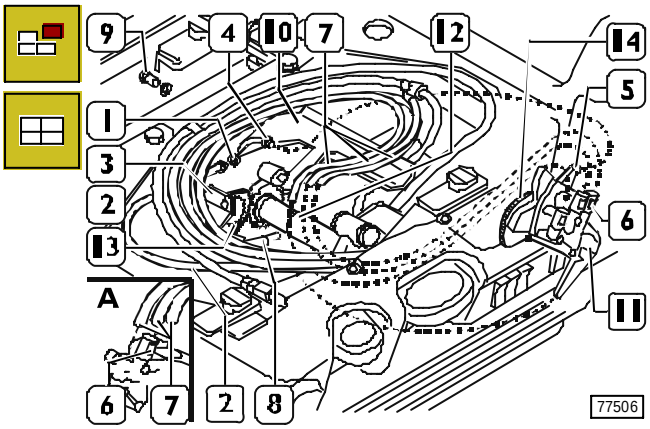
## Refitting

**NOTE** Before fitting the seat cushion, loosen the locking nut (8), adjust the flexible cable (6) so that in the lowest position of the adjustment lever, the stiffest vertical damping is reached, then retighten the locking nut. (8).

- For fitting, carry out the steps performed for removal in reverse order.

## Removing - refitting the height adjustment valve

Figure 136




## Removing

- Remove the seat cushion, as described above.
- Unscrew the nut (1), remove the flexible cable (2) from the fixing (3) and pull the cable with the threaded coupling (4) out of the valve lever (5).
- Lift the fixing hooks (6) safely and remove the air pipes (7) (see box A).
- Unhook the spring (8), extract the bottom bellow fastener, unscrew the screw (9) and turn the bracket (10) upward.
- Turn the valve (11) on the supporting pipe and pull it above the end of the supporting pipe (12).

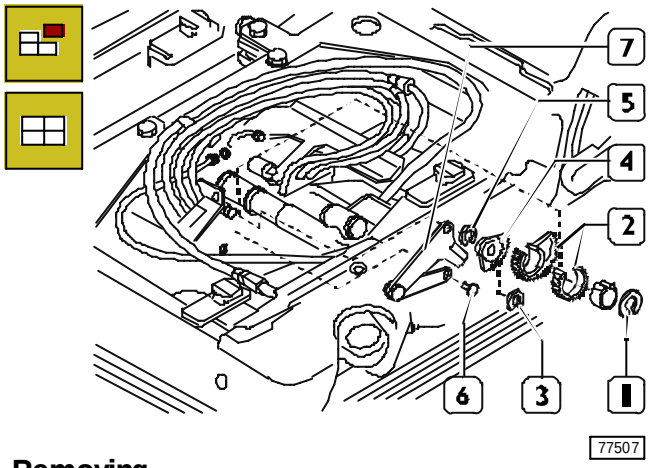
## Refitting

- For fitting, carry out the steps performed for removal in reverse order.

**NOTE** After fitting the new valve, the highest tooth of the toothed segment (13) must adapt to the width of the highest space of the toothed segment of the valve (14).

## Removing - refitting the height locking system

Figure 137




## Removing

- Remove the seat cushion, as described above.
- Remove the height adjustment valve.
- Unscrew support washer (1) and remove toothed segment (2).
- Unscrew supporting washer (3) and remove the toothed segment (4).
- Unscrew the supporting washer (5), unscrew the screw (6) and remove the lever (7).

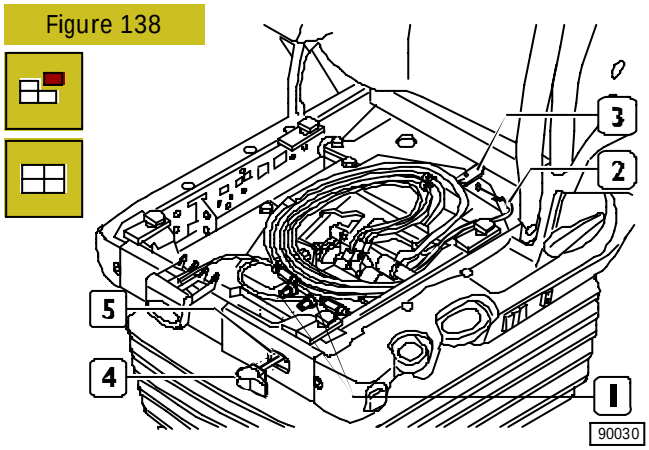
## Refitting

- For fitting, carry out the steps performed for removal in reverse order.

**NOTE** After fitting the new parts, the highest tooth of the toothed segment (2) must adapt to the width of the highest space of the toothed segment of the valve (4).

## Removing - refitting the flexible cable of the horizontal lever suspension

Figure 138




## Removing

- Remove the seat cushion, as described above.
- Unscrew screws (1).

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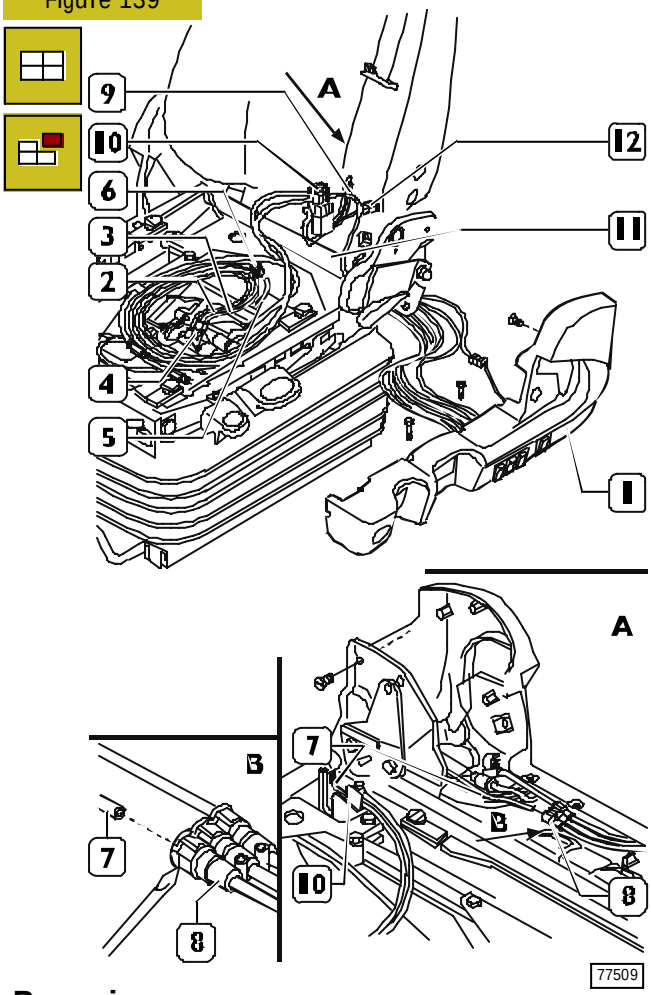
- Unhook the cable (2) from the lever (3).
- Extract the flexible cable (2) comprehensive of the lever (4) from the opening (5).

### Refitting

- For fitting, carry out the steps performed for removal in reverse order.

## Removing - refitting the fast lowering magnetic valve

Figure 139




### Removing

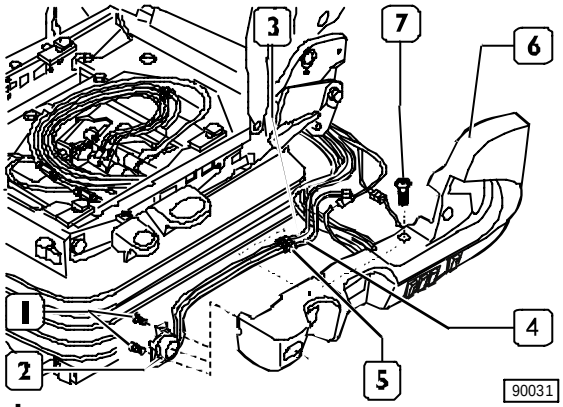
- Remove the seat cushion, as described above.
- Loosen the plastic covering (1) as described above.
- Disconnect the hoses (2) and (3) from the valve (4), the hose (5) from the coupling (6) and the hose (7) from the coupling (8) inside the plastic covering (1) (boxes A/B).
- Extract the fixing arm (9) of the magnetic valve (10) from the transverse pipe (11) and lift the valve (10).
- Disconnect the electric connector (12).
- Remove the magnetic valve (10) for fast lowering from its seat.

### Refitting

- For fitting, carry out the steps performed for removal in reverse order.

## Removing - refitting the fast lowering switch

Figure 140




### Removing

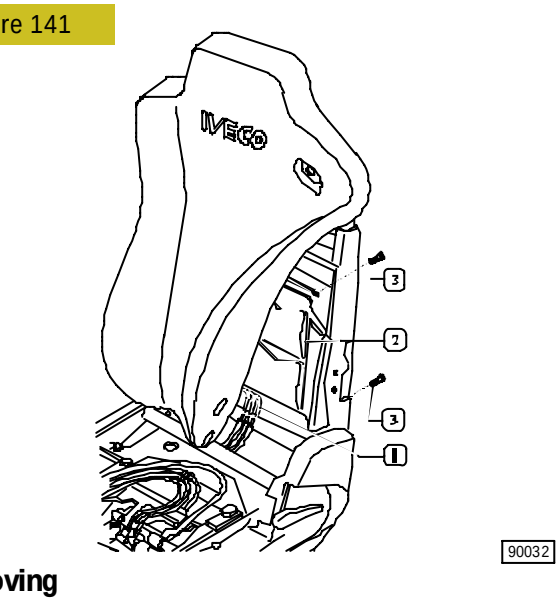
- Remove the seat cushion, as described above.
- Loosen the plastic covering (6) as described above.
- Unscrew screw (7).
- Disconnect the hoses (3) (4) from the coupling (5).
- Unscrew the fixing screws (1) and disconnect the switch (2) for fast lowering from its seat.

### Refitting

- For fitting, carry out the steps performed for removal in reverse order.

## Removing - refitting the lumbar support device

Figure 141




### Removing

- Partially remove the back upholstery.
- Unscrew screws (3) and take the foam off seat back frame.
- Disconnect the hoses (1).
- Remove the lumbar support device (2).

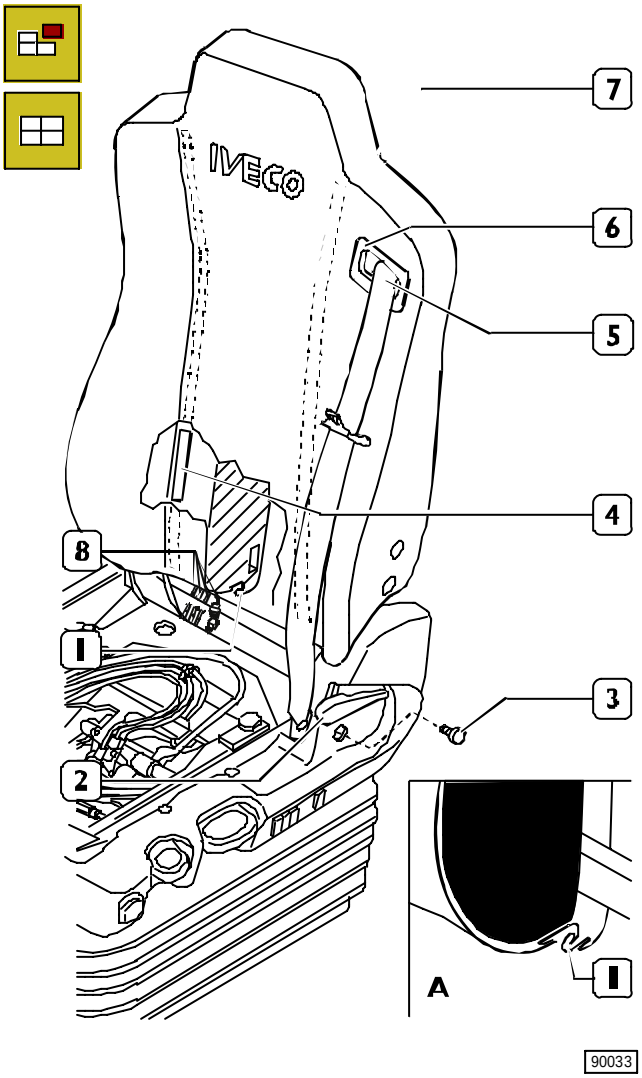
### Refitting

- For fitting, carry out the steps performed for removal in reverse order.

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## Removing - refitting the back upholstery

Figure 142




### Removing

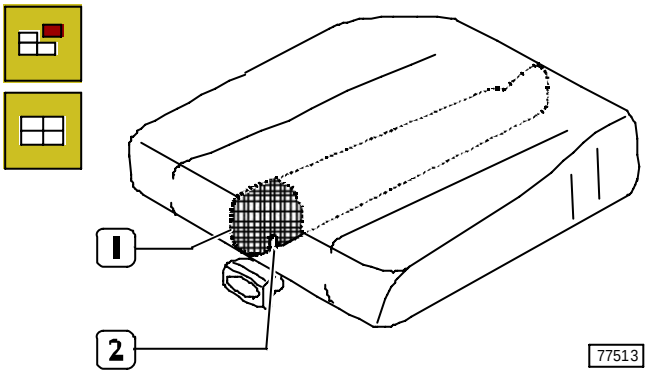
- Remove the seat cushion, as described above.
- Take off the three hoses and electric connection (1).
- Unhook the C-sections (1) (box A).
- Lift the lever (2) and unscrew the screw (3) fixing the seatbelt.
- Take off the facing (6).
- Lift the back upholstery (7) upwards off the fixing tapes (4) (Velcro),
- Extract the seatbelt through the opening (5).
- Remove the upholstery (7) from the seat.

### Refitting

- For fitting, carry out the steps performed for removal in reverse order.

## Removing - refitting the cushion upholstery

Figure 143




### Removing

- Remove the seat cushion, as described above.
- Free the upholstery of the cushion of the seat (1) from the edging (2) passing along the perimeter of the seat bottom.

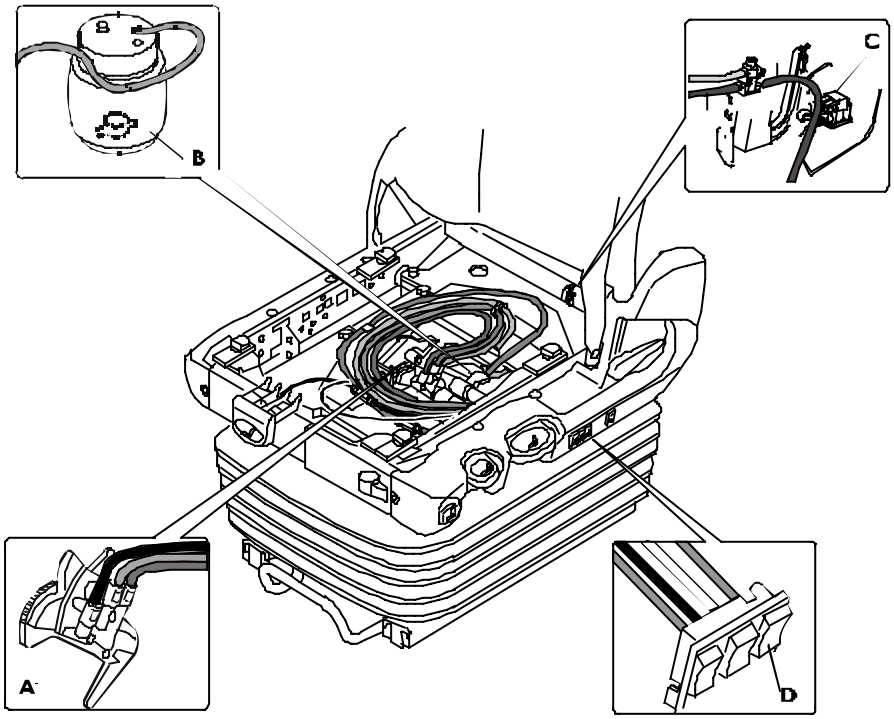
### Refitting

- For fitting, carry out the steps performed for removal in reverse order.

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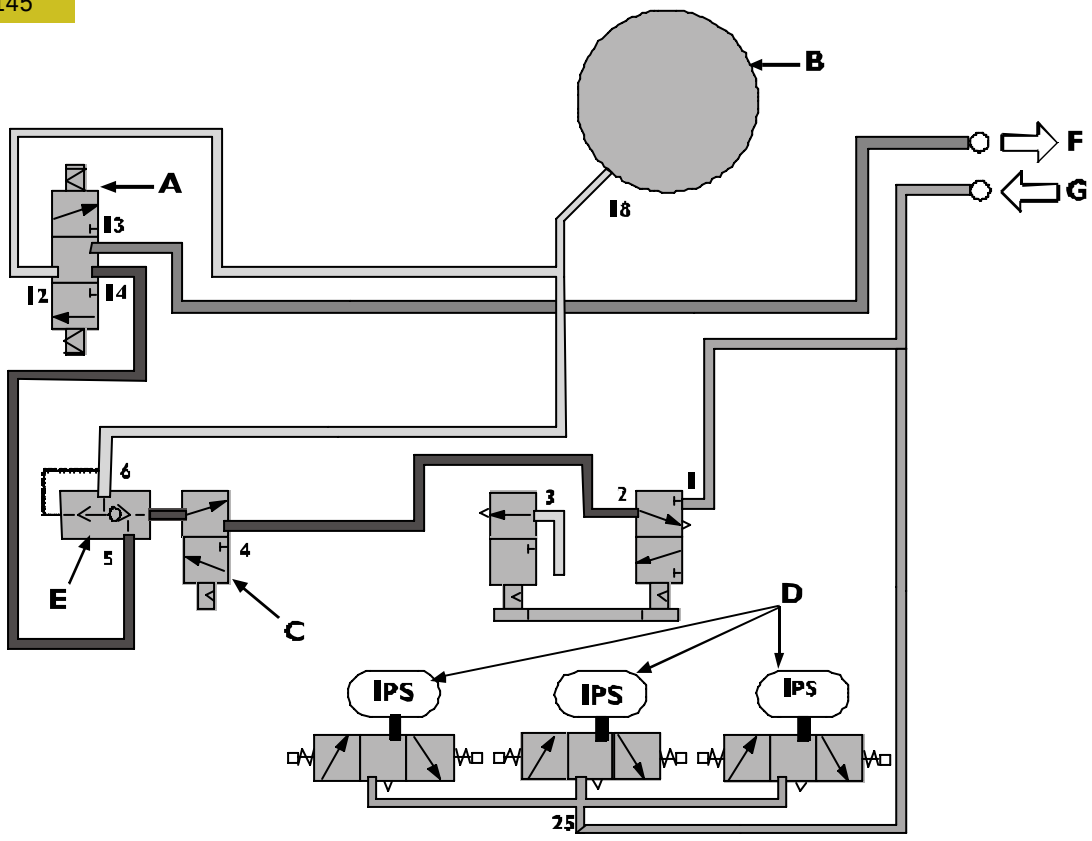
## DRIVER'S SEAT PNEUMATIC DIAGRAM

Figure 144




90034

Figure 145



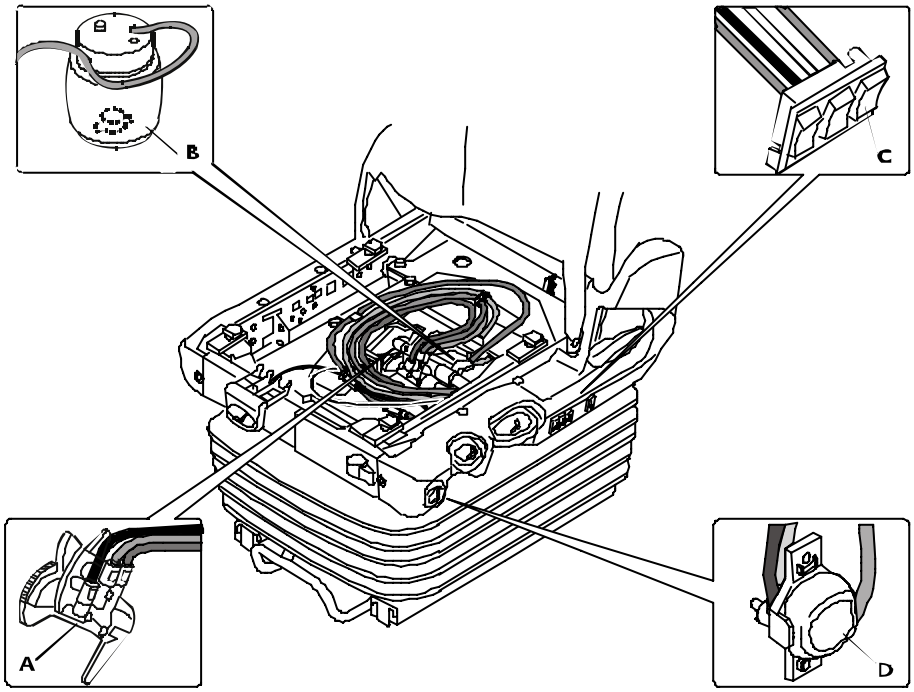

90035

A.Height adjusting valve - B. Pneumatic suspension - C. Magnetic valve for fast lowering - D. IPS valves - E. Selector - F. Foul air - G. Entering air

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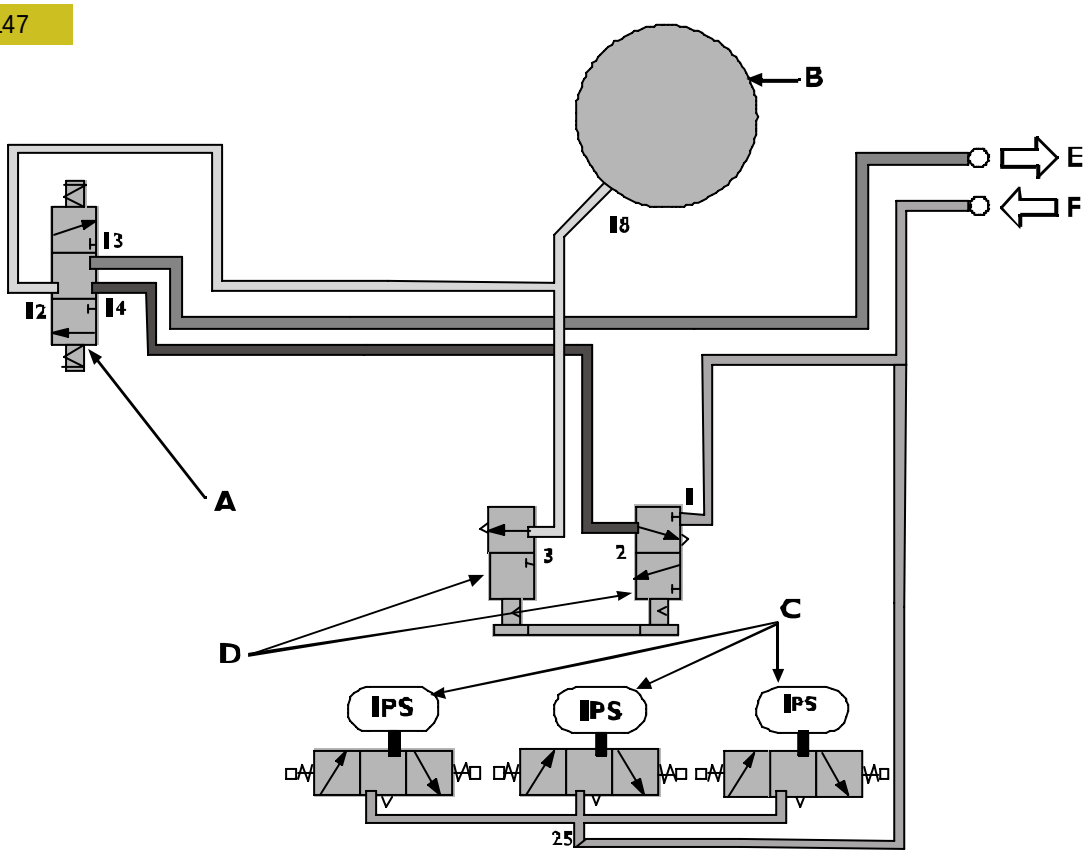
## PASSENGER'S SEAT PNEUMATIC SCHEME

Figure 146




90036

Figure 147




90037

A. Height adjusting valve - B. Pneumatic suspension - C. IPS valves - D. Fast lowering switch - E. Foul air - F. Entering air

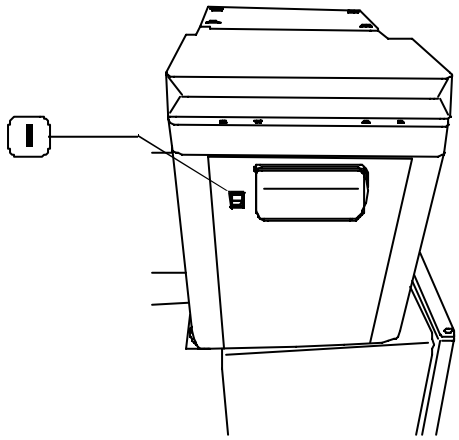
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# CABIN REFRIGERATOR

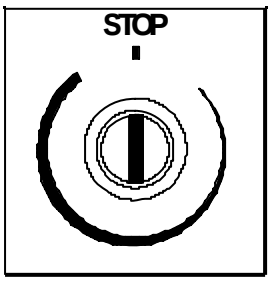
## Preliminary checks

If the fridge does not work or its inner temperature is not enough, check the following conditions prior to making any replacement or maintenance work:

Figure 148




86980




86981

OFF position

- control unit supply voltage equal to 24.1 V;
- switch (1) ON (orange warning lamp ON);
- the thermostat must be not in OFF position (see figure);
- the protection fuse available on the dashboard electric panel must not be blown;
- the space around the refrigerator must be free enough to ensure ventilation.

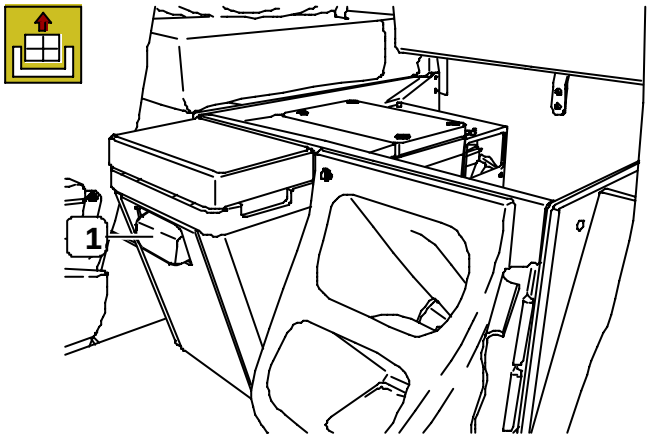
**NOTE** A compressor protection device is available for cabin tilting, whereby the installed refrigerator stops working, for safety reasons, if the vehicle (either stationary or running) is tilted by more than 15°.

**NOTE** The refrigerator may run down the battery when the engine is not working. When the battery level falls too low, the refrigerator will switch off automatically. Correct refrigerator operation is ensured only when the engine is running.

## Removal

- Detachment is accomplished by tilting over the cabin, removing the sound-proofing panel below, and taking off the two refrigerator fastening screws.

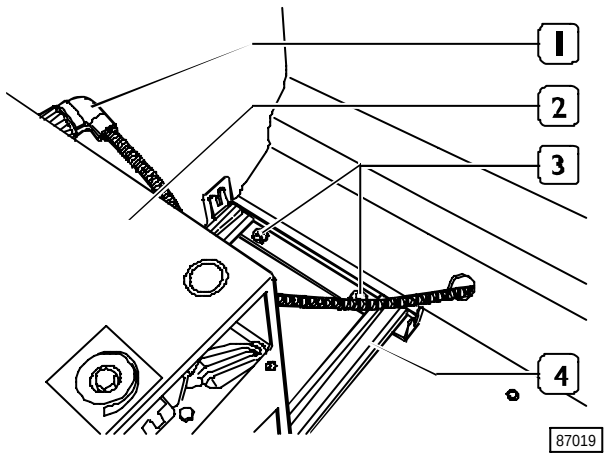
Figure 149




87018

- When the cabin has been lowered, make the refrigerator slide forward by acting on handle (1).

Figure 150




87019

- Disconnect electric connection (1).
- Remove screws (3).
- Take off refrigerator (2) with its respective guide (4).

## Refitting

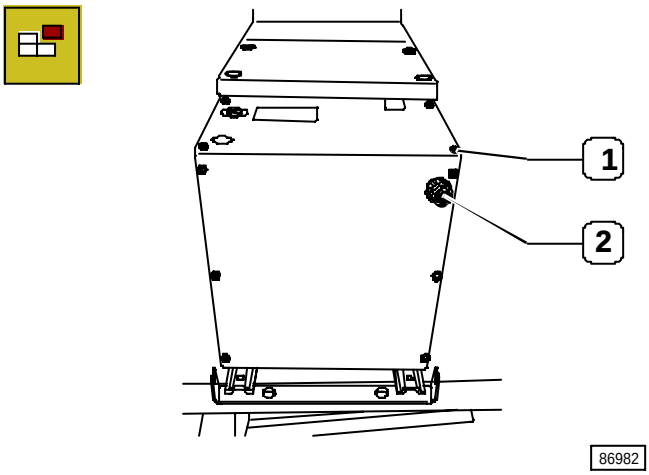
Refitting is carried out by reversing the order of removing operations.

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## OVERHAULING

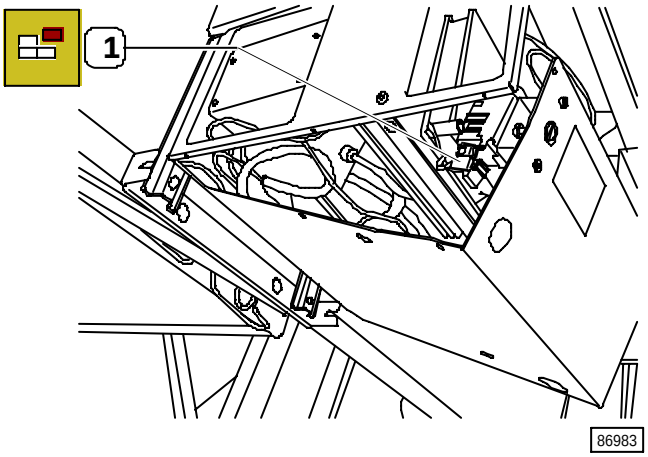
### Removing

Figure 151




Remove screws (1). Take threaded ring (2) out of the connector.

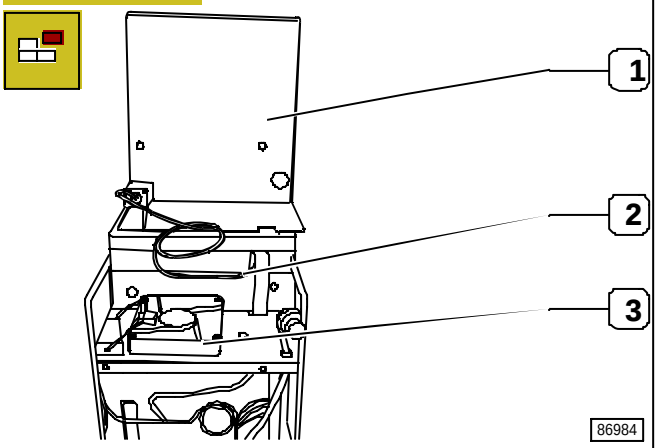
Figure 152




Remove connection (1) from the thermostat.

### Fan removing

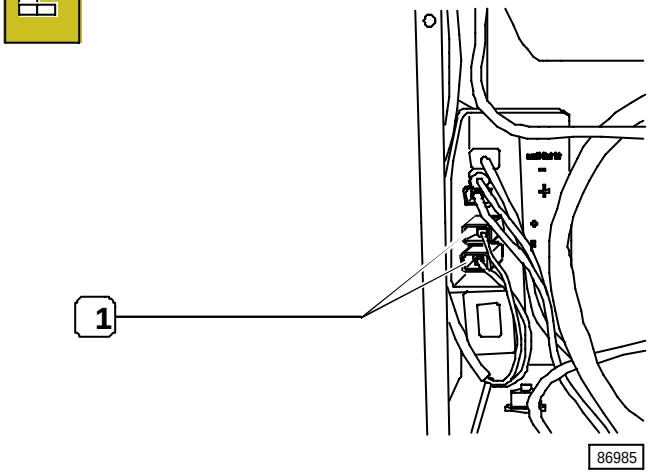
Figure 153




Overturn rear protection (1) as shown on the figure, taking care not to apply tensile stress to the thermostat probe (2).

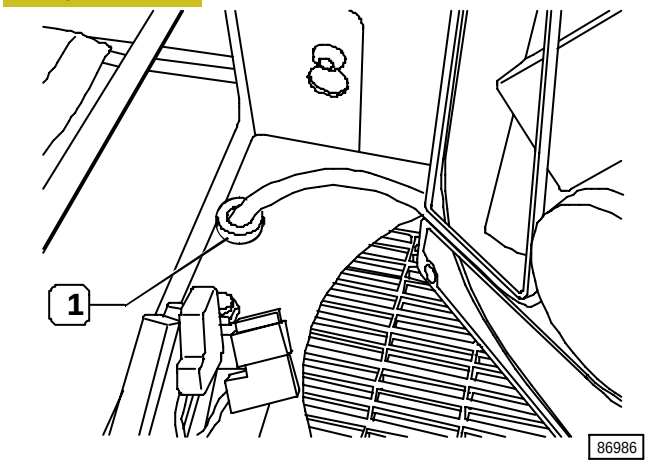
The fan can be removed by taking out screws (3).

Figure 154




Remove electric connection (1) from the control unit, taking care not to pull the cables.

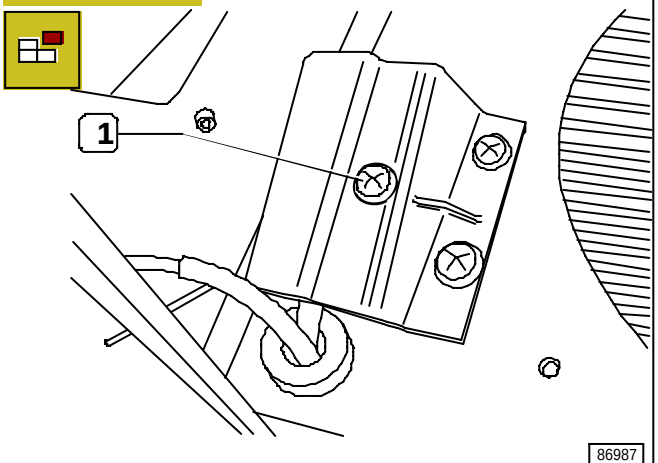
Figure 155




Use a screwdriver to take out core hitch (1), then take out the cables one at a time.

### Removing the antitipping probe with electronic circuit on the control unit

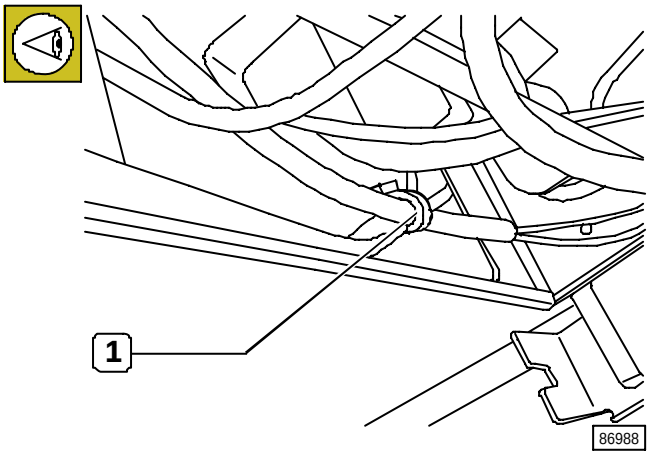
Figure 156




Remove screw (1).

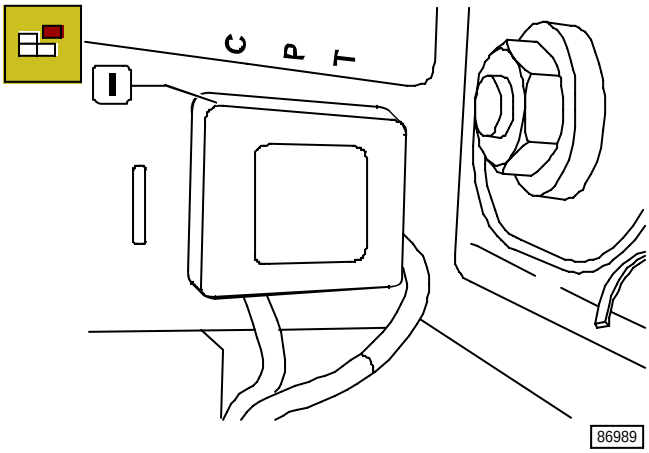
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Figure 157




Cut the plastic strap (1) joining the wiring on the electronic control unit front part.

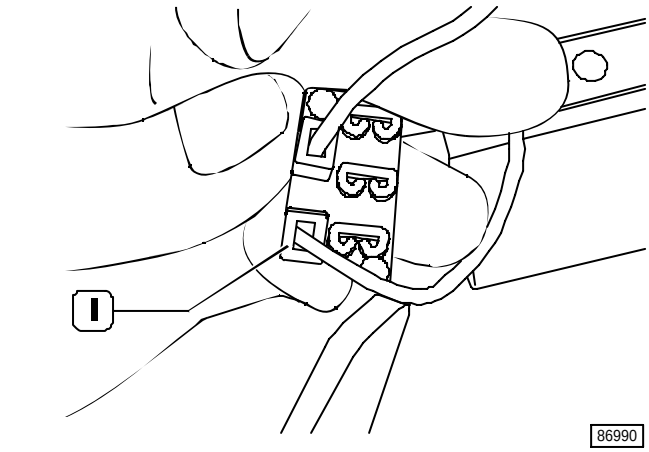
Figure 158




Take non-tilting probe circuit (1) out of the compressor's electronic control unit.

**NOTE** Do not use blunt tools which could damage the circuit inner face.

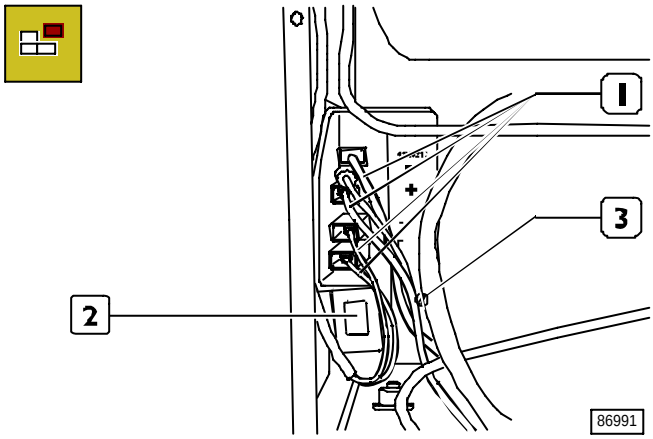
Figure 159




Take off the connector (1) to which the probe cable is secured. Now, the probe can be taken out through the core hitch, thus avoiding connector crawling.

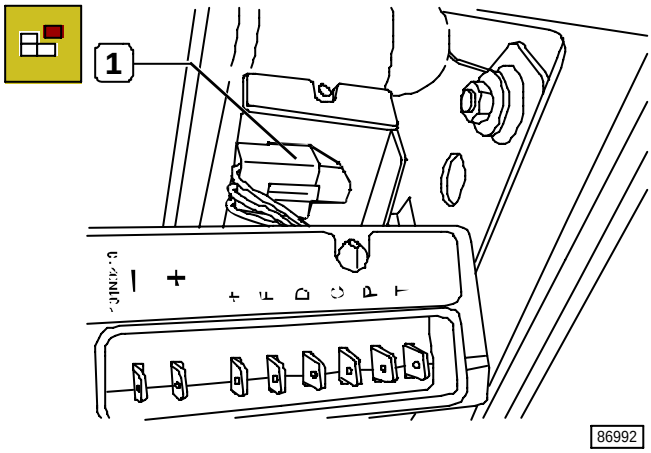
## Electronic control unit disassembling

Figure 160




Disconnect all electric cables (1) from the control unit. Take out electronic circuit (2). Remove screw (3).

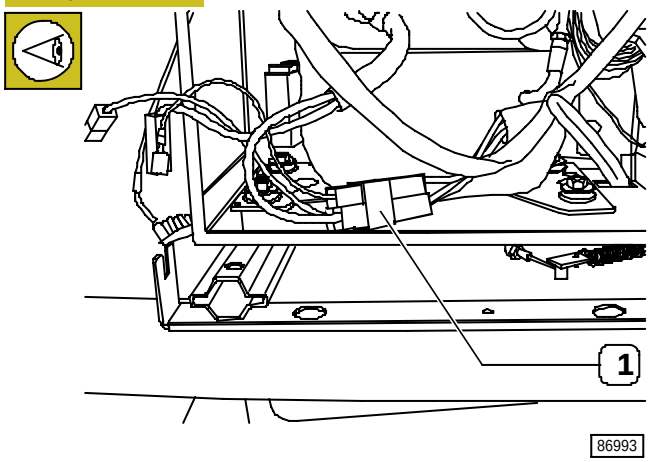
Figure 161




Move the control unit aside, then take connector (1) out of the compressor.

### Checks

Figure 162




Check proper tightening of connector (1) for connection with the front switch.

### Refitting

Assembling is carried out by reversing the order of disassembling operations.

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## CAB AIR-CONDITIONING

### General

The purpose of the air-conditioning system is to make the cab comfortable as regards the following parameters:

- temperature and relative humidity of outside air;
- temperature and relative humidity in the cab.

The system subjects the air to thermodynamic transformations that affect its temperature, relative humidity and purity. This is accomplished by:

- ventilation, or introducing air taken from the outside (therefore with the temperature and humidity of the surrounding environment) into the cab;
- air-conditioning, or cooling and de-humidifying the air, with the possibility of heating it afterwards as preferred so as to change the temperature and humidity in the cab.

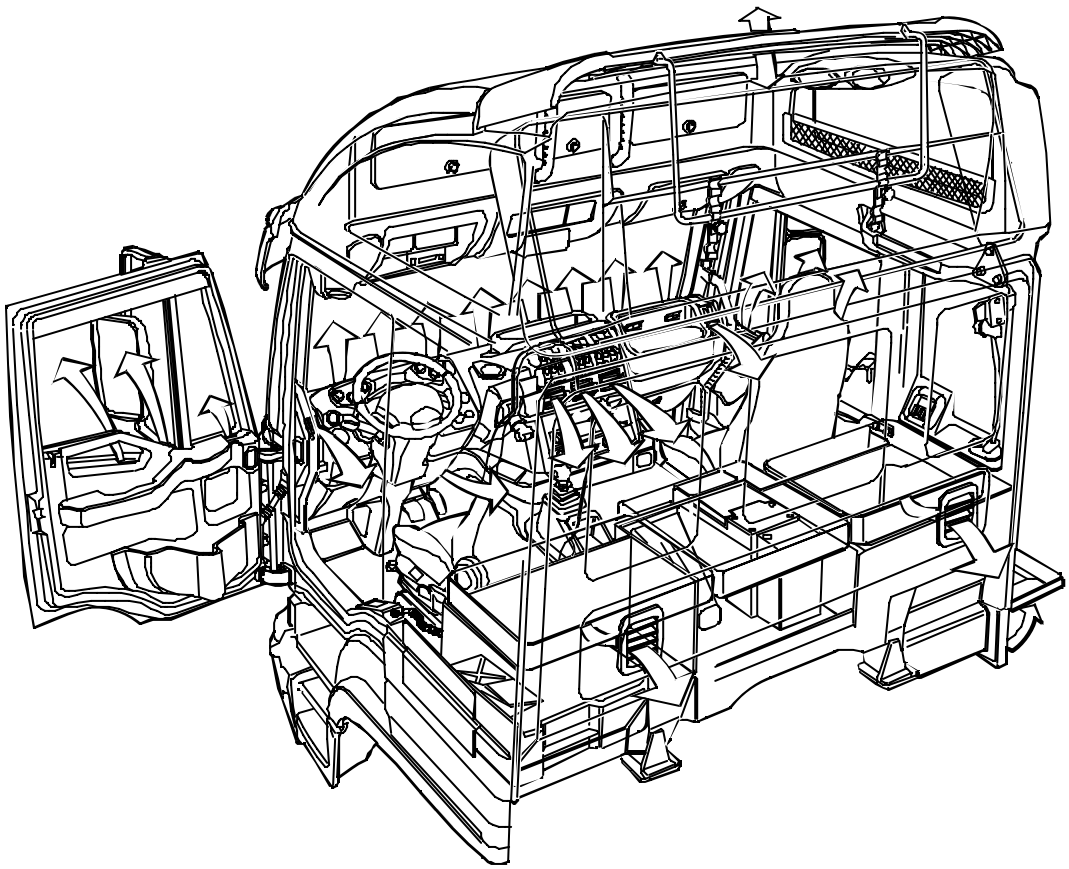
## VENTILATION

### Description

Ventilation is the function of drawing in fresh air from the outside, cleaned of pollen and dust by a special filter, or recycling the air in the cab.

This system is composed of a shell, designed to house the electric fan unit, air ducts, fresh air intake and recycled air intake. The electric fan has several speeds to draw in and circulate large masses of air.

Figure 163



85701

CAB INTERNAL VENTILATION DIAGRAM

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## AIR-CONDITIONING AND HEATING

### Description

This is accomplished by integrating an air-conditioning and a heating system.

This integration makes it possible to change the temperature and humidity in the cab.

### Air-conditioning

Air-conditioning is accomplished by taking advantage of the high capacity of some gases to lower temperature considerably in their phase of expansion, thereby making it possible to absorb heat from the cab.

This condition is obtained by two different levels of pressure (high, when the refrigerant fluid is in its liquid state, and low, when the fluid is in its gaseous state) that are established and maintained during operation of the system.

### Heating

Heating is accomplished by a radiator, in the heater unit, in which the engine coolant circulates.

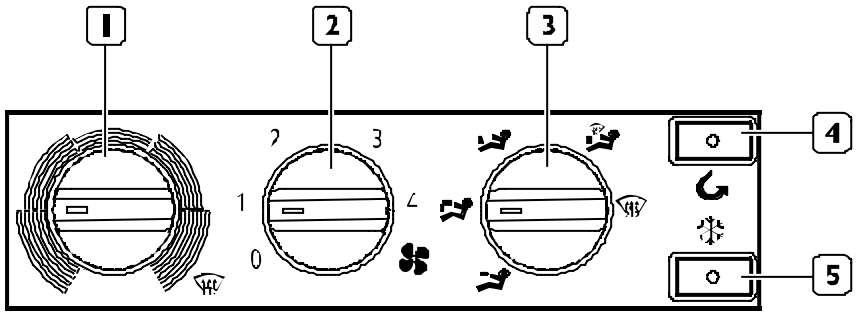
Special doors allow air to pass through the radiator only when the heating function is activated.

The main components of the air-conditioning and heating system comprise:

- compressor;
- condenser;
- the dehumidifier filter (incorporated in the condenser);
- three-level pressure switch;
- expansion valve;
- evaporator;
- heater/fan unit;
- pollen filter.

### Air-conditioning controls assembly

Figure 164




85702

### Manual

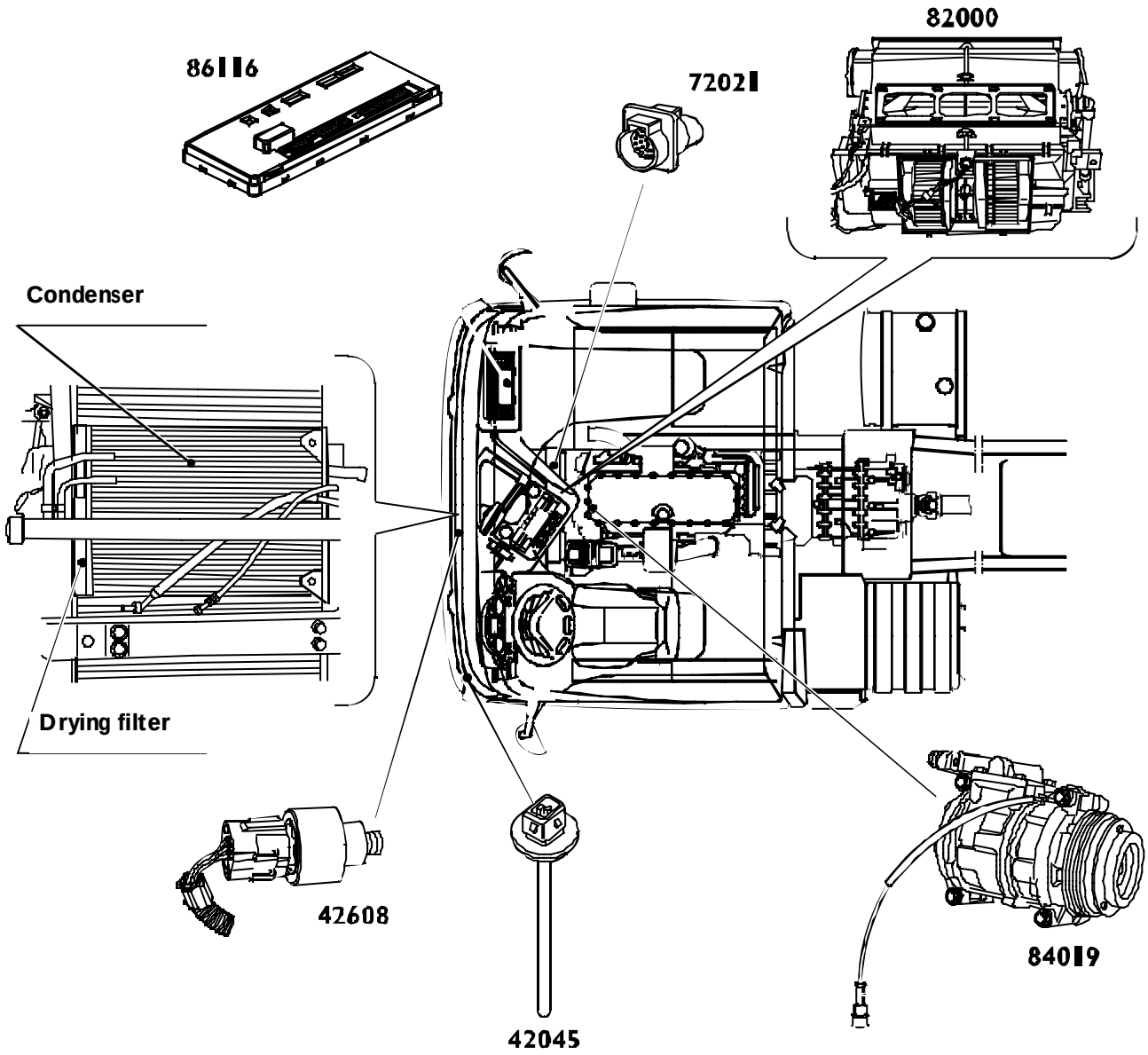
### Heating and ventilation

1. Air temperature control knob, with extreme positions to cut in the HI and LO functions (max and min air temperature / turn to the left for fresh air – turn to the right for warm air).
2. Electric fan knob with relative working speeds and operation selection;
   - off (0);
   - manual operation (1-2-3-4).
3. Air inlet control knob:
   - face zone air;
   - face and feet zone air;
   - feet zone air;
   - feet and windshield zone air;
   - windshield zone air.
4. Switch to turn on air recirculation: it prevents air flowing in from outside.
5. Switch to turn on the air-conditioner.

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## COMPONENT LAYOUT (WEBASTO AIR CONDITIONER)

Figure 165



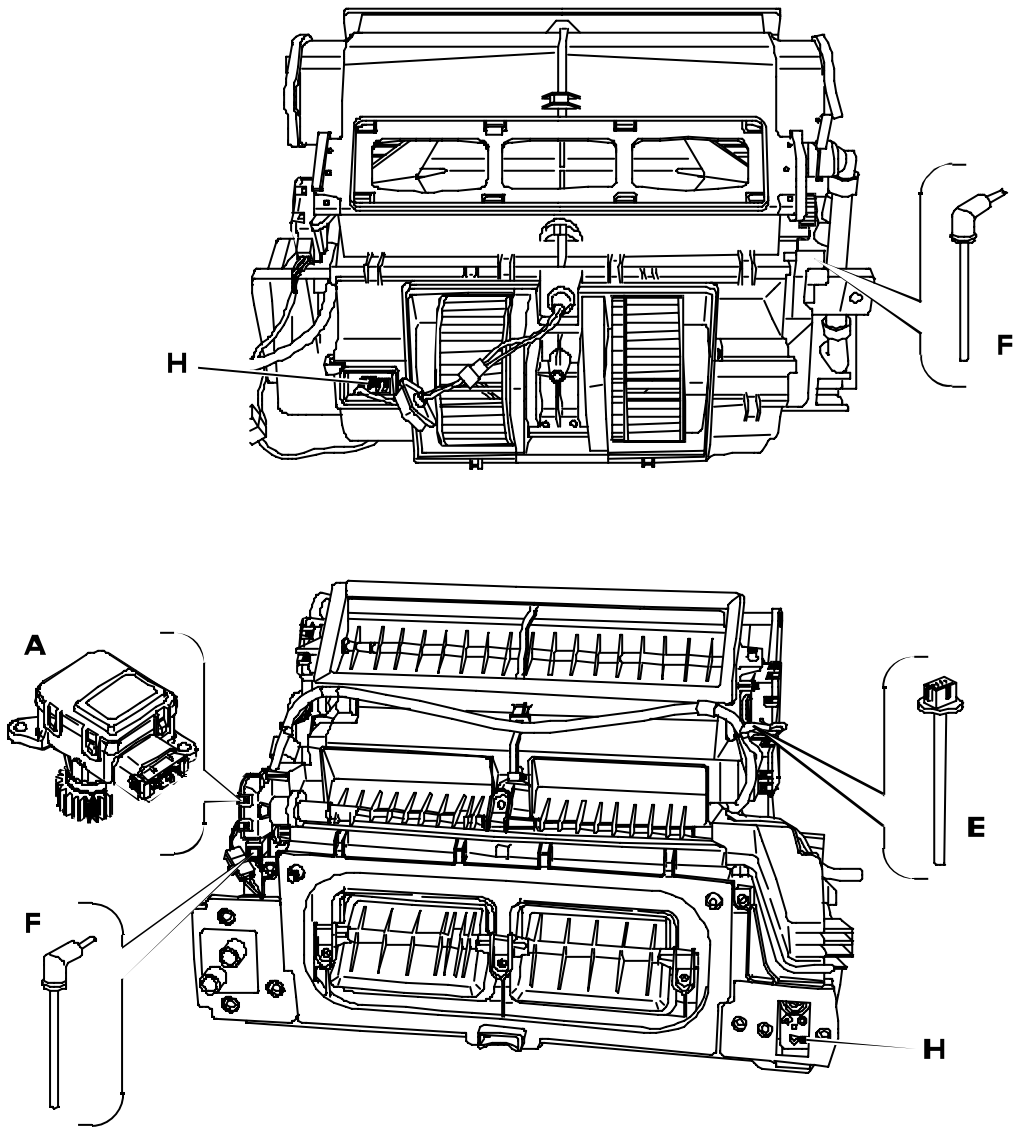

Legend

42045 Outside temperature transmitter
82000 Heater assembly
42608 Coolant pressure switches
25332 Compressor insertion remote control switch
84019 Compressor
86116 Body Computer
72021 30-pin diagnosis connector

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## HEATER ASSEMBLY COMPONENT LAYOUT (WEBASTO)

Figure 166

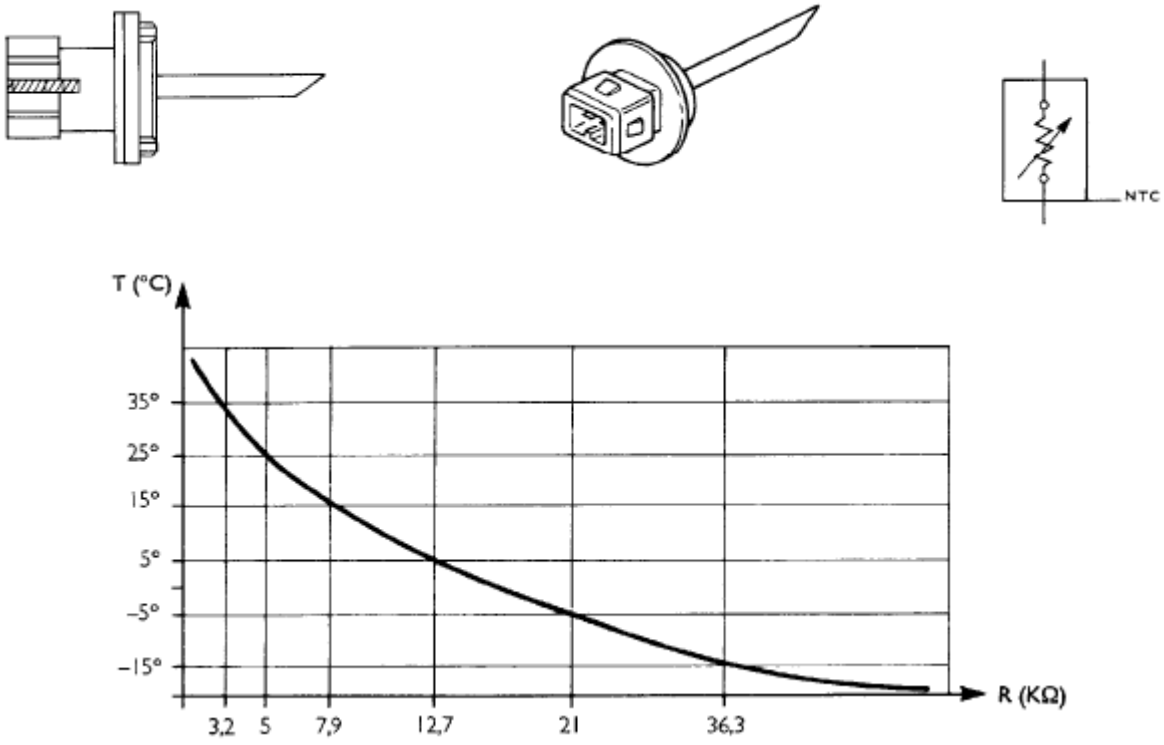



A. Recirculation geared motor (Ric) - E. Evaporator temperature sensor - F. Blown air temperature sensor - G. Modulates blower control - H. Expansion valve.

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## Outside temperature sensor

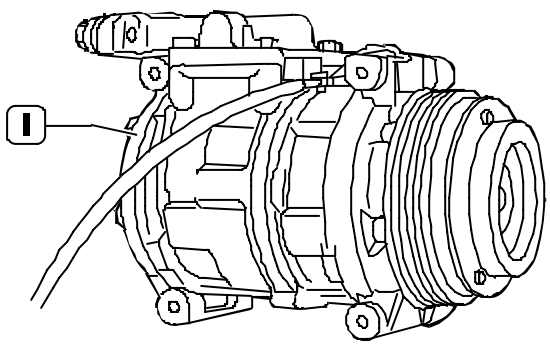
Figure 167




Positioned on the front of the vehicle (driver's side) so as to be affected by a temperature closer to reality.

## Compressor

Figure 168

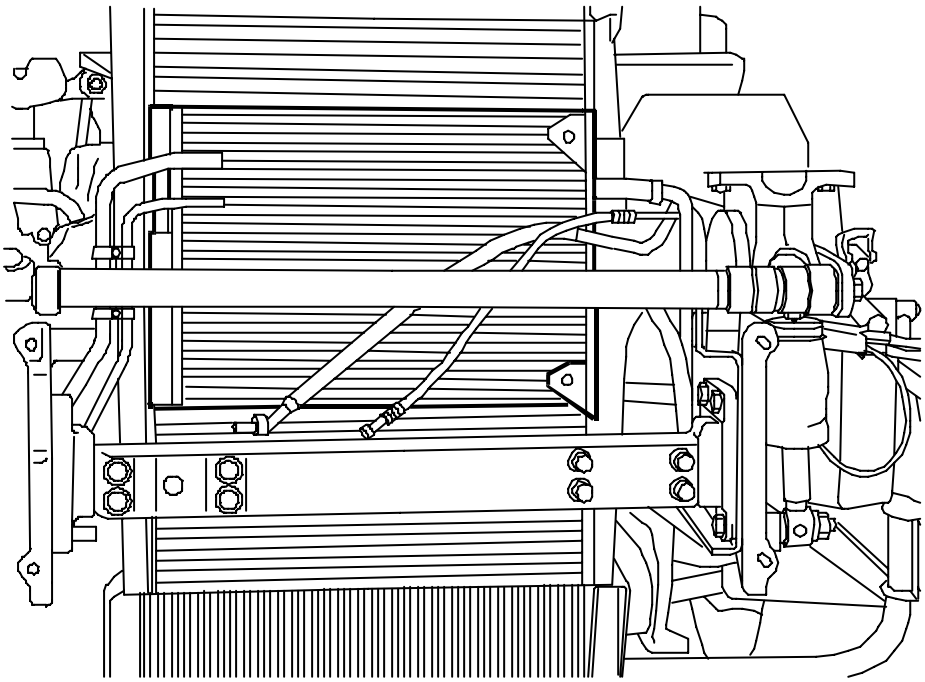



The compressor is situated in the engine bay between the radiator fan and the alternator.

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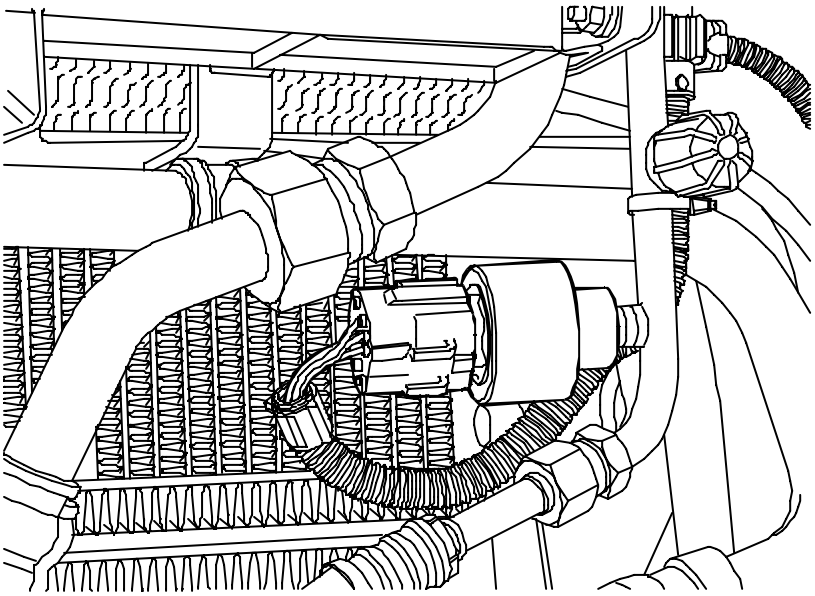
## Condenser and safety pressure switches

Figure 169

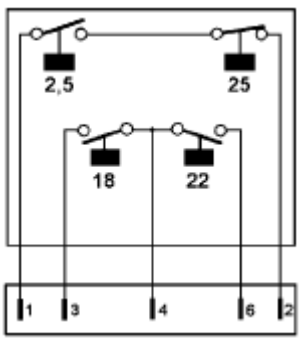


77245

Figure 170



74247




77560

The dehumidifier filter is integrated in the condenser that is found on the front of the vehicle.

The refrigeration system uses R134a fluid highlighted on the plate on its casing.

The safety pressure switch assembly with four levels is fitted on the condenser outlet pipe.

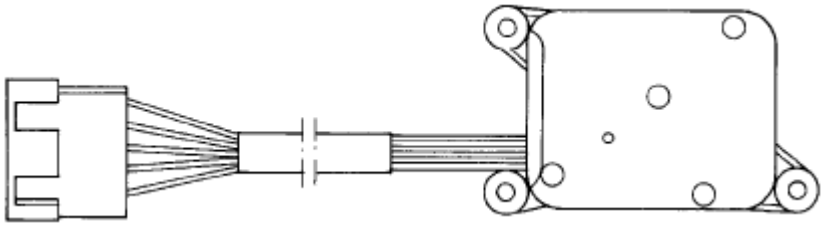
The two pressure switches, which are of the N/C and N/O type, make it possible to keep the pressure in the system constant from a minimum of 2.5 (N/O) to a maximum of 25 bars (N/C); with values outside this range the system is deactivated.

Whereas, the two pressure switches of the N/O type are used to disconnect the engine cooling fan coil when the system pressure is in the interval 18 ÷ 22 bars. This is accomplished by an earth signal that the two pressure switches supply to the Body Computer control unit.

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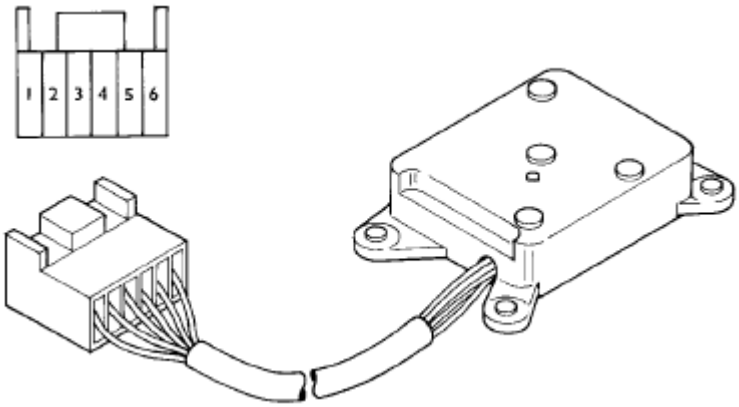
## Stepper motors

Figure 171

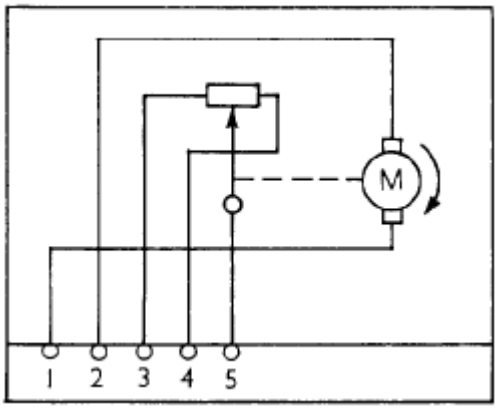


77571

Figure 172




77572




77573

Pin-out

| PIN | CABLE COLOUR | SIGNAL |
|---|---|---|
| 1 | White | +/- 24V |
| 2 | Purple | +/- 24V |
| 3 | Blue | 0V |
| 4 | Orange | 0 ÷ 5V |
| 5 | Green | + 5V |
| 6 | --- | Free |

The recirculation reduction unit is located on Heater/Conditioner unit.

It is directly activated by the electronic central unit with rated voltage (24 V) and it has 20 to 40 mA absorption.

Maximum absorption, on arriving at end of stroke, reaches 200 mA at power supply put off by the central unit.

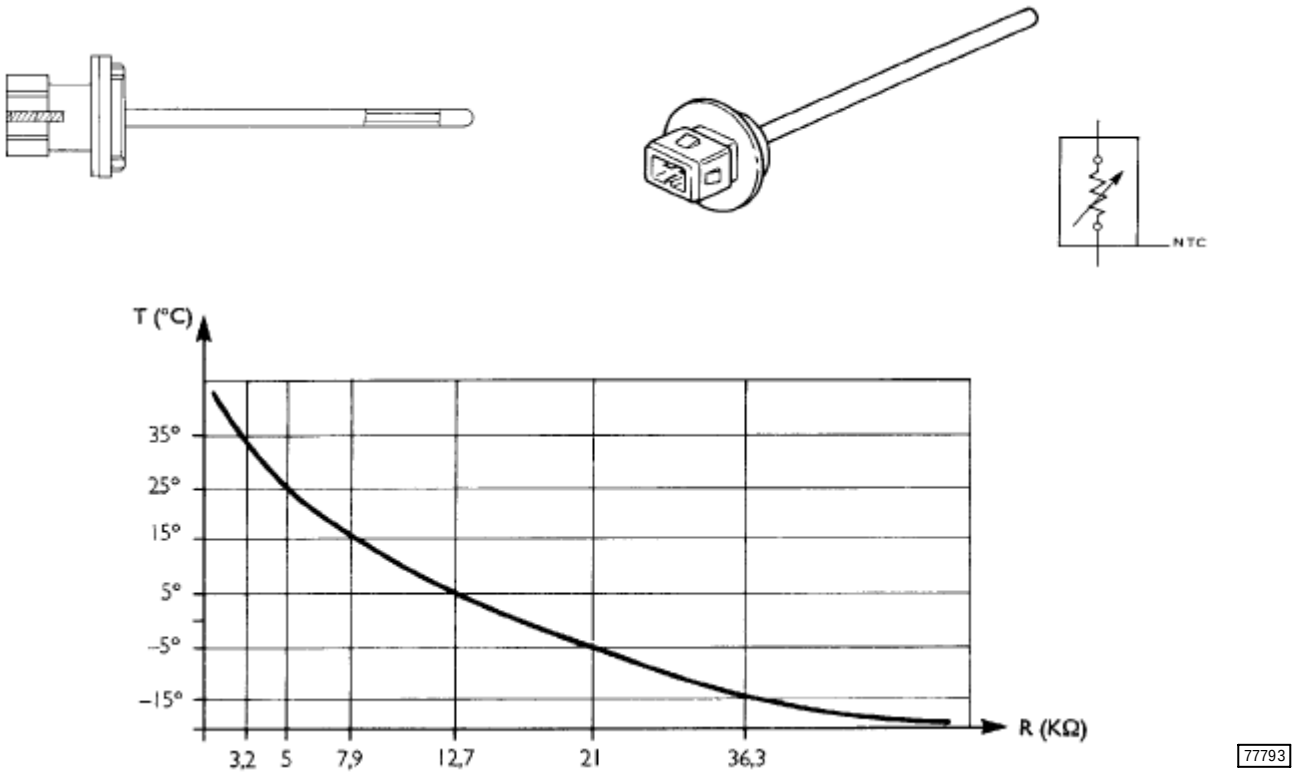
The potentiometer it is provided with is used for return signal and, on first power on, the central unit detects and stores end of stroke values used to split operation range.

N.B. If the reduction unit is being replaced, it is NECESSARY to RESET system.

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## Evaporator temperature sensor

Figure 173




The sensor inside the evaporator causes the compressor to turn on and off, allowing temperatures from 2°C (off) to 3.5°C (on) for VALEO and from 5°C (off) to 10°C (on) for WEBASTO.

The figure shows the same characteristics of the outside temperature sensor except for the connection.

## Expansion valve

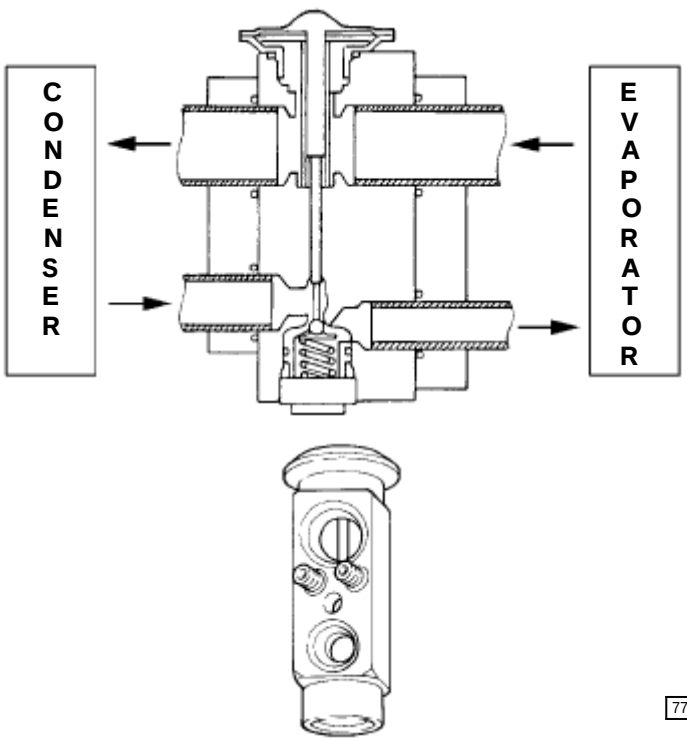
Figure 174

The expansion valve is the type with a block, its job is to lower the pressure of the fluid at the outlet of the condenser (and therefore of the filter) to a pre-set value so that the same fluid, circulating in the evaporator, can be drawn up by the compressor in a totally gaseous form.

It is therefore possible to state that the expansion valve fulfils three basic functions:

- METERING
- MODULATING
- CHECKING

This is fitted on the Heater/Air-conditioner assembly near the blower control module.



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# ADDITIONAL AIR HEATER SYSTEM (on request)

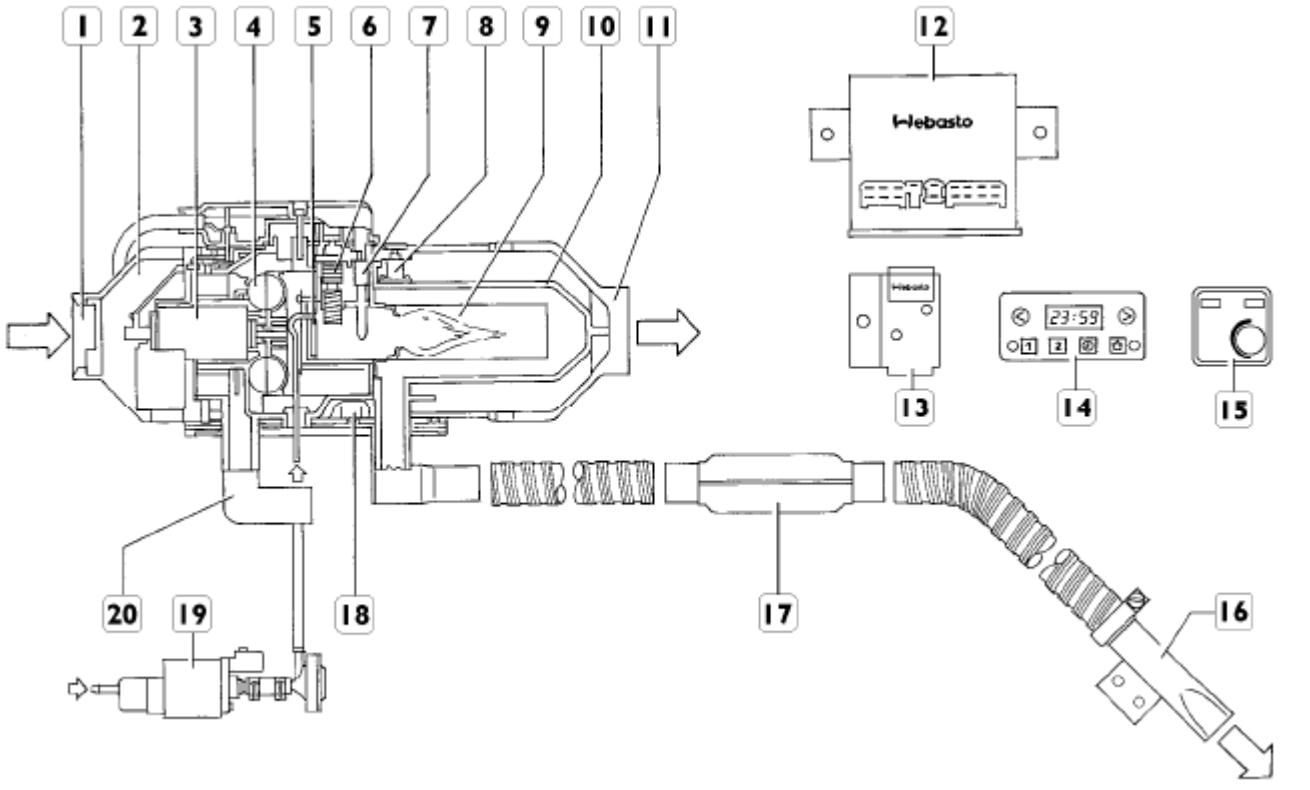
## Description

The auxiliary heater works independently of the engine.
Its function is to heat the cabin only.
The heater is connected to the vehicle fuel tank and electric system, and is located in the cabin.

## Operation

Switch-on and switch-off can be done by means of digital timer (4) or ambient thermostat (5).
Upon switching on, the warning lamp lights up and combustion chamber (9) preheating is started.
After approximately 30 seconds, pump (19) sucks the fuel from the tank and sends it to felt (5) which acts as an evaporator.
At the same time, fan (4) sucks, through pipe (20), the external air and sends it, through passage (18), to felt (5), where air is mixed with the fuel.
Heating plug (6) triggers mix burning.
During combustion, the flame licks exchanger (10). Fan (2) sucks cold air from intake (1) and sends it to exchanger (1) which heats, by yielding heat, the air sent to the cabin.
When combustion is over, photoresistor (7) cuts off heating plug (6) by means of control unit (12).
When the temperature exceeds the required value, a signal sent by ambient thermostat (15) causes reduced-power resistor (13) to come into operation: such resistor acts on the heater by reducing the revs number of engine (3) and the fuel pump rate.
Burnt gas are finally eliminated through silencer (17) and exhaust pipe (16).

Figure 175




PARTS MAKING UP THE AUXILIARY AIR-TYPE HEATER

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## FAULT DIAGNOSIS

### Troubleshooting
### Introduction

Diagnosis, i.e. locating the troubles that cause operation faults in the system, makes it possible to identify, by analyzing the fault found, the causes and, therefore, ensure prompt and safe repair so as to restore the system to full efficiency.
Below is the troubleshooting guide for faults mainly of mechanic and hydraulic nature which cannot be recognized by the electronic control unit.
As regards the fault mainly of electric and electronic nature, use the IVECO electronic diagnosis instruments "Modus - E.A.SY. - IT 2000", by connecting the instrument to the diagnosis takeoff and following the instructions step by step, as displayed by the instrument itself.

| Visible Failure | Possible cause | Repair action |
|---|---|---|
| System does not work | Inefficient electric system | Check the electric system. |
| | Compressor pulling belt not in normal working conditions and inefficient | Check the belt: if it is too loose or stretched, adjust it or, if necessary, replace it. |
| | Inefficient electromagnetic clutch coil. | Check whether the coil receives current. Replace the coil, if necessary. |
| | Inefficient system fittings and pipes. | Check and replace, if necessary, defective parts. |
| | Incorrect distance (play) between the front disc and the electromagnetic clutch. | Check the distance (play). Disconnect the compressor and adjust the distance, if necessary. |
| | Inefficient compressor. | Drain the system as described in the relevant chapter; disconnect the compressor and replace it. |
| Noisy system | Low compressor oil level. | Drain and refill the system as described in the relevant chapter. |
| | Lack of cooling fluid in the system. | Drain and refill the system as described in the relevant chapter. |
| | Incorrect distance (play) between the front disc and the electromagnetic clutch. | Check the distance (play). Disconnect the compressor and adjust the distance, if necessary. |
| | Low amount of coolant in the system (green sight glass). | Drain and refill the system as described in the relevant chapter. |
| | System is not leak-proof. | Use leak-detector 99051147 to check the system and the compressor; remedy the cooling fluid leaks (if any). |
| | Electromagnetic clutch does not work properly. | Check the clutch electric connections. Replace the electromagnetic clutch, if necessary. |
| | Humidity in the system. | Drain and refill the system as described in the relevant chapter. |

*(Continue)*

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| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Unusual noise with clutch engaged | Loose compressor fastenings. | Check and tighten to torque the screws and bolts fastening the compressor |
| | Inefficient electromagnetic clutch. | Check whether the fault is due to mechanic or electric causes, then act accordingly. |
| | Low compressor oil level. | Drain and refill the system as described in the relevant chapter. |
| | Inefficient compressor. | Drain the system and refill the compressor. |
| Unusual noise with disengaged clutch or vibrations | Incorrect distance (play) between the front disc and the electromagnetic clutch pulley. | Check the distance (play). Disconnect the compressor and adjust the distance, if necessary. |
| | Inefficient electromagnetic clutch supply electric system. | Check the electric system. |
| Insufficient cooling | Humidity in the system. | Drain and refill the system as described in the relevant chapter. |
| | High discharge pressure and normal sucking pressure due to the presence of air in the system. | Drain the cooling fluid, replace the drying filter, deaerate the system, then refill, as described in the relevant chapter. |
| | High discharge pressure and low sucking pressure with presence of water or ice on the drying filter or on the pipes from the condenser outlet to the expansion valve. | Drain the cooling fluid, eliminate the throttling or replace the faulty component, deaerate the system, then refill, as described in the relevant chapter. |
| | Normal discharge pressure and low/high sucking pressure due to incorrect electromagnetic clutch engagement/disengagement. | Change the trinary pressure gauge. |
| The heater goes to block | Inefficient electric system. | Check the electric system and replace defective parts. |
| | Irregular electric voltage. | (Operating voltage 19.5V ± 5%). Charge the battery. |
| | Incorrect operation of the heating plug. | Check the electric connections, the control unit and the plug, then act on faulty parts. |
| | Incorrect operation of the metering pump after 30 seconds' preheating. | Check the electric system, the control unit and the metering pump, then act on faulty parts. |
| | Incorrect operation of the burning unit. | Check the burning unit and the electric system. |
| | The heating plug is switched off within the safety time. | Check and replace, if necessary, the photoresistor. |
| | Efficient thermal limiter. | Check the thermal limiter. |

*(Continue)*

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| Visible Failure | Possible cause | Repair action |
|---|---|---|
| The fume exhaust pipe gets hot (heater combustion) | Incorrect operation of the metering pump. | Check and replace, if necessary, the pump. |
| | Poor fuel pipe seal. | Verify that the fuel pipe does not leak or is not throttled. |
| | Incorrect fuel connection. | Check the connection. |
| Heater gets stucked after brief combustion | Incorrect operation of the metering pump. | Check the pump rate. |
| | Incorrect $CO_2$ value. | Check the $CO_2$ value and replace the burner, if necessary. |
| | Inefficient, reduced power resistor. | Inefficient electric system. |
| Irregular operation of the measuring valve (after 30 seconds of pre-incandescence) | Inefficient photoresistor. | Check the electric cables and verify whether short-circuit occurs. |
| | Incorrect operation of the metering pump. | Check and replace if necessary. |
| | Inefficient thermal limiter. | Check and replace if necessary. |
| | Inefficient safety switch. | Check current flow and replace, if necessary. |
| Heating plug won't ignite | Inefficient electric system. | Check for breaks in electric cables and fittings. |
| | Inefficient heating plug. | Check and replace, if necessary, the plug. Check the ambient thermostat. |
| | Inefficient control unit. | Check the control unit. |
| Heater does not yield enough heat | Heater not running at full capacity. | Switch set to "reduced power" position. |
| | Ambient thermostat not set to the desired temperature. | Adjust the ambient thermostat. |
| | Inefficient electric system. | Check the electric system. |
| Incorrect $CO_2$ (Carbon dioxide) value | Incorrect assembly of fuel pump. | Verify that the fuel pump is positioned on the chassis with an inclination of 30° relative to the horizontal plane and with the power cables facing upwards. |
| | Inefficient silencer and fume exhaust pipe. | Clean and verify that they are not clogged. Replace them, if necessary. |
| | Dirty heat exchanger. | Check and clean the heat exchanger. |
| | Inefficient evaporating felt. | Check and replace, if necessary, the felt. |
| | Incorrect metering pump rate. | Check the pump rate and adjust the $CO_2$ value. |

*(Continue)*

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| Visible Failure | Possible cause | Repair action |
|---|---|---|
| Heater is switched off during operation due to a failure | Inefficient safety switch. | Check the safety switch. |
| | Inefficient photoresistor. | Check and replace, if necessary, the photoresistor. |
| | Incorrect heater operating temperature. | Check the ambient thermostat and the combustion air circuit. |
| | Incorrect fastening of heater to the support. | Check the fastening bolts and tighten them to torque. |
| | Incorrect combustion. | Check and troubleshoot. |
| | Incorrect operation of the metering pump. | Check and replace, if necessary, the pump. |
| | Inefficient combustion air circuit. | Check the combustion air circuit. |

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## MAIN DATA

| | | | | | |
|---|---|---|---|---|---|
| Cooling fluid | | | Type | | R 134 A |
| Amount of the system cooling fluid | | | | | |
| VEHICLE | COMPRESSOR | R134 COULANT QUANTITY PROVIDED FOR IN SYSTEM | COULANT QUANTITY CONTAINED IN THE PIPINGS (150 cm length) THAT ARE USED FOR RECHARGING | COULANT TOTAL QUANTITY TO BE SET ON CHARGING TOOL | OIL QUANTITY TO BE ADDED INTO SYSTEM AT EACH ND 8 TYPE CHARGING |
| TRAKKER AT/AD | DENSO 10 PA 17 | 700 g | 200 g for low pressure pipe, 200 g for high pressure pipe | 1000 g | 40 g |

| | | |
|---|---|---|
| COMPRESSOR | | NIPPONDENSO |
| Type | | 10 PA 17 |
| Number of cylinders | | 10 |
| Bore | mm | 29.5 |
| Stroke | mm | 6 |
| Revs number:<br>max.<br>min. | <br>rpm<br>rpm | <br>9000 |
| Coolant | | R 134 a (ecology) |
| Type of oil | | ND 8 |
| | | |
| ELECTROMAGNETIC CLUTCH | | |
| Revs number:<br>max.<br>min. | <br>rpm<br>rpm | <br>9000 |
| Disengaging torque | kgm | 4 |
| Rated voltage | V | 24 |
| Minimum engagement voltage | V | 7.5 |
| Play between front disc and pulley | mm | 0.4 ÷ 0.8 |

## AUXILIARY HEATER

| | | |
|---|---|---|
| Air-type heater with burner | | Eberspächer |
| Type | | D3L |
| Rated voltage | | 24V |
| Calorific yield:<br>full capacity<br>reduced capacity | <br>KW (Kcal/h)<br>KW (Kcal/h) | <br>3.2<br>1.0 |
| Permitted max. temperature at heater air inlet | | + 40°C |
| Heating air flow rate at 0.5 mbar:<br>full capacity<br>reduced capacity | <br>$m^3$ /h<br>$m^3$ /h | <br>160<br>65 |

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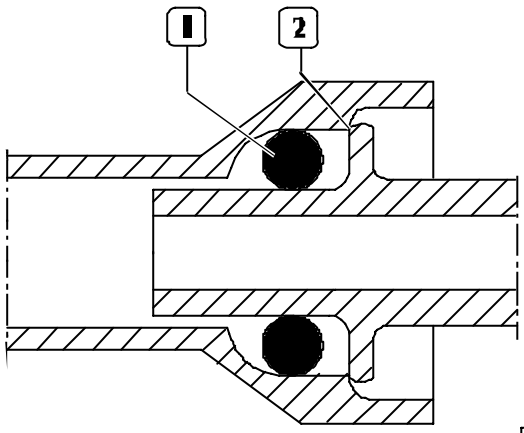
## GENERAL WARNINGS

Make sure that replacement parts (filter, condenser, evaporator, pipes and fittings) are supplied complete with the protection caps against dirt and moisture.
These caps must be removed only when the part is ready to be installed.

Compressors – and, sometimes, exchangers and filters, too – are delivered with slight internal pressurization, to prevent moisture penetration.
Verify that gas escapes when the protection cap is opened: this will prove that the component has been stored correctly.

Make sure that the pipe connections, both to one another and to other components, are made so as to ensure perfect tightness of the system. Cooling fluid leaks do not only cause system stoppage, but also fast compressor wear.
Therefore, you should check the presence of the seal ring on the fitting male portion: moisten with oil, the same used for the system (bear in mind, in any case, that it differs according to the type of coolant), and avoid, when assembling, making cuts or burrs between the coupling surfaces, which cause gas leaks.
Follow the instructions below.

Figure 176




Manually and carefully insert the male portion into the fitting female drill until collar (2) comes into contact with the corresponding metal seat in the female.
Such contact ensures mechanic support to the pipe: seal ring (1) pressed between the internal cylindrical portion and the drill provides hydraulic seal.
Do not use oversized-diameter or twin seal rings: they temporarily perform hydraulic seal, yet prevent the contact between the metal seats, causing, after a short period, fitting loosening and gas leaks.

**NOTE** When disconnecting the system pipes, plug the pipes and the coolant passages (if any), so as to avoid possible moisture or dirt penetration inside the system. This can badly affect correct operation of the system.

## TIGHTENING TORQUES

| DESCRIPTION | TORQUE | |
|---|---|---|
| | Nm | kgm |
| GAS PIPES FITTINGS | | |
| 5/8'' - 18 UNF | 15.9 | 1.6 |
| 3/4'' - 18 UNF | 15.9 | 1.6 |
| 1'' - 14 UNF | 29.8 | 3 |

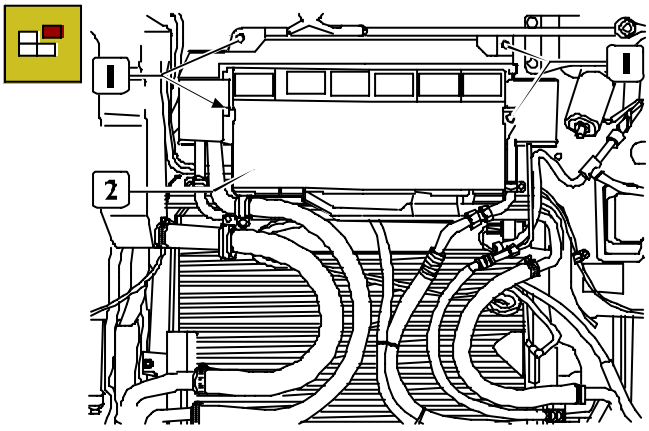
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## REPAIR OPERATIONS

### 553210 HEATER

### Removal

Figure 177

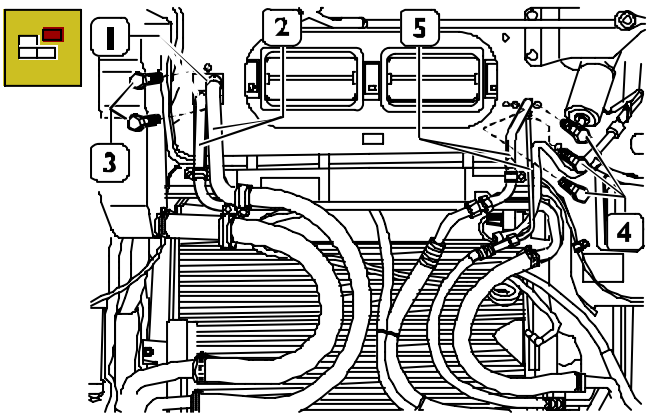



77122

For disconnecting heater assembly, it is needed to:

- For vehicles with air conditioner:
  position the key of ignition block to "Key On" position and switch air temperature to "LOW".
- For vehicles without air conditioner:
  from the inside of the cab, turn the knob for adjusting cab heating temperature so as to completely open engine coolant tap.
- partially drain engine coolant.
- detach the fascia covering (552211).
- Lift the radiator cowling.
- Unscrew the fixing screws (1) and separate the pollen filter cover (2) to access the underlying fasteners.

Figure 178




77123

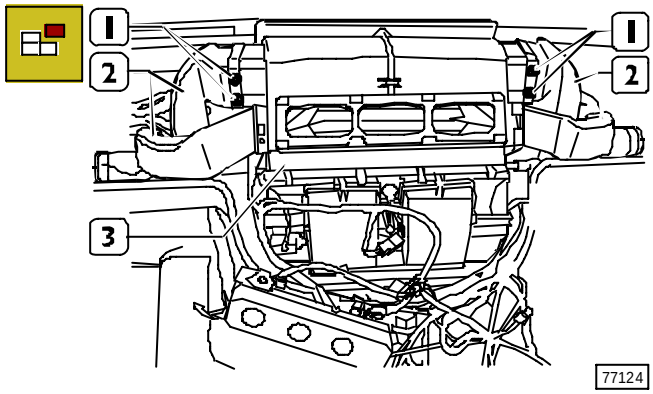
If the cab is provided with air conditioner, blow gas off cab air conditioning system, as described in relating chapter.

**NOTE** This operation must be carried out only by authorized, qualified skilled personnel.

**NOTE** Seal air conditioning system pipings to prevent moisture or impurities from entering the system.

- Unscrew screws (4) securing low and high pressure piping (5).
- Remove screws (3) near water pipings.
- Screws (3) near the water pipes.
- Apply special plugs on the high and low pressure pipes and on the expansion valve.

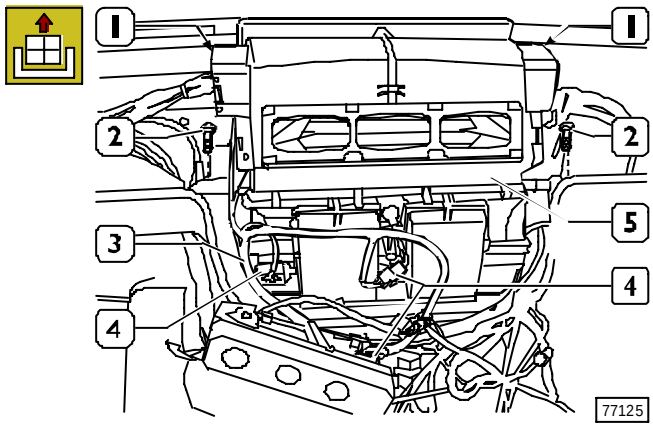
Figure 179




77124

- Working from inside the cab, unscrew the screws (1) fixing the air ducts (2) to the heater (3).
- Disconnect the air ducts (2) from the heater (3).

Figure 180




77125

- Unscrew the screws (2) fixing the heater (5) to the cross member on the cab.
- Detach the clamps (1) of the wiring bundles.
- Disconnect the connectors (4) and detach the relative electric wiring (3).
- Detach the heater (5) from the vehicle.

### Refitting

For reconnection, invert operations described for disconnection, observing following warnings:

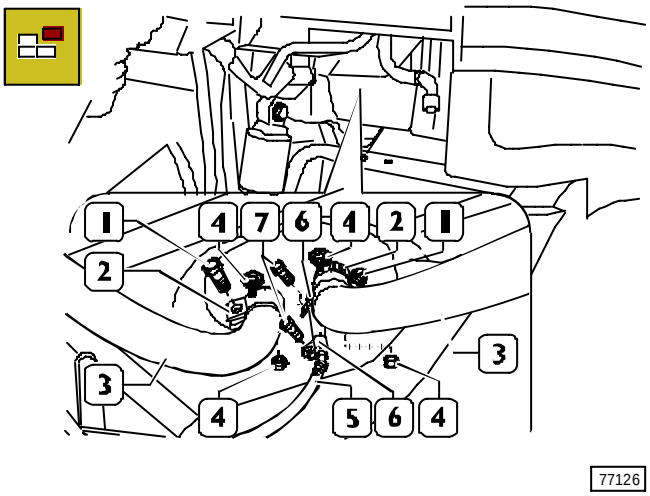
- tighten nuts or screws at prescribed torque;
- the engine coolant is at the right level;
- the system and components involved in the described procedure work properly.
- if present, fill air conditioner system as described in relating chapter

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## 507570 ADDITIONAL AIR HEATER SYSTEM

### Removal

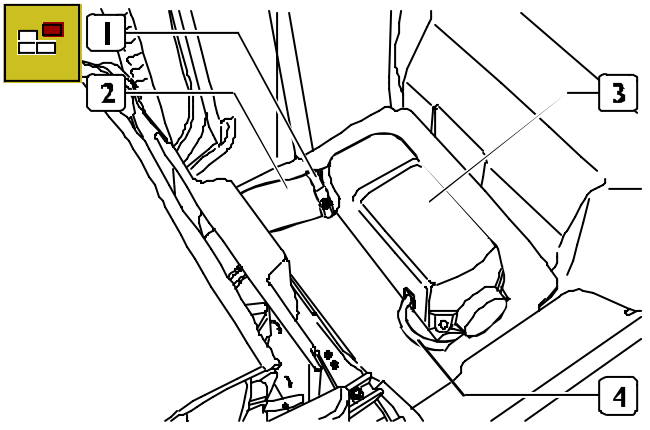
Figure 181




77126

- Lift the radiator cowling.
- Tilt up the cab.
- Unscrew the screws (7) of the clamps (6) and disconnect the fuel pipe (5).
- Unscrew the screws (1).
- Disconnect the clamps (2) and detach the inlet and outlet pipes (3).
- Unscrew the nuts (4) fixing the additional heater to the floor of the cab.
- Lower the cab.
- Close the radiator cowling.
- Operate from inside the cab, advance passenger seat and tilt back rest.

Figure 182




99140

- Disconnect the electrical connection (4).
- Loosen clamp (1) and release piping (2) from heater (3).
- Disconnect additional heater (3) from the cab.

### Refitting

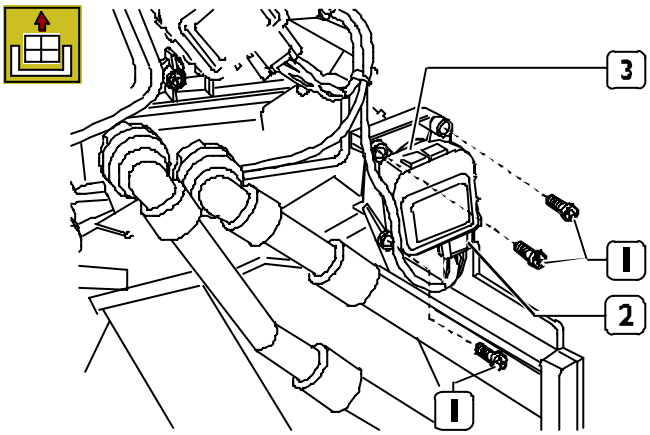
Refit by carrying out the procedures described for removal in reverse order.

**NOTE** To perform interventions on below described components, it could be necessary, owing to difficult access to components, to take off the coatings of dashboard (Op. 552211) and heater (Op. 553210).

## 553153 AIR RECIRCULATION DOOR CONTROL MOTOR

### Removal

Figure 183




77131

- Take off object holder box, unscrew securing screws, remove the Body Control and put aside as in Figure 90.
- Disconnect the power supply connector (2).
- Unscrew the fixing screws (1).
- Detach the air recirculation door control motor (3).

### Refitting

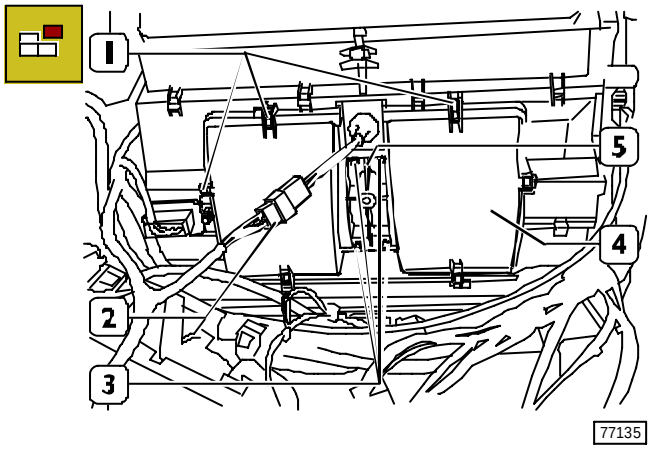
Refit by carrying out the procedures described for removal in reverse order.

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## 553212 ELECTRIC FAN

### Removal

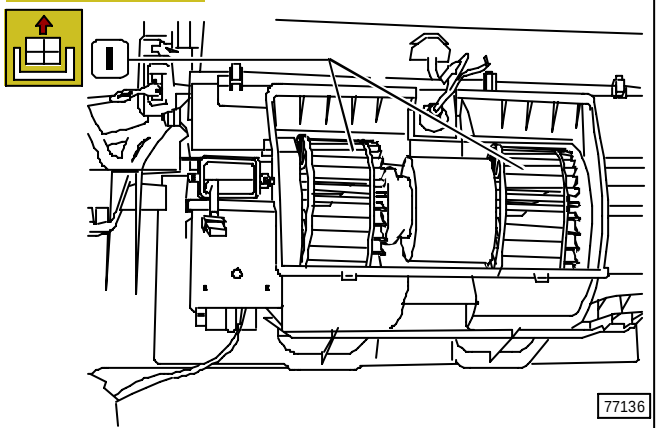
Figure 184




Perform the removal procedure:

- Central instrument panel (OP. 553710).
- Disconnect the connector (2).
- Take off the fixing clips (1), unscrew the screws (3) and detach the covers (4) and (5).

Figure 185




- Detach the electric fan (1) from its seat.

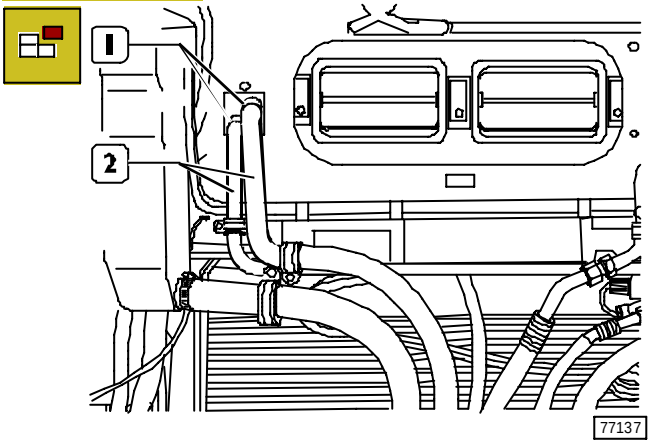
### Refitting

Refit by carrying out the procedures described for removal in reverse order.

## 553215 HEATER RADIATOR

### Removal

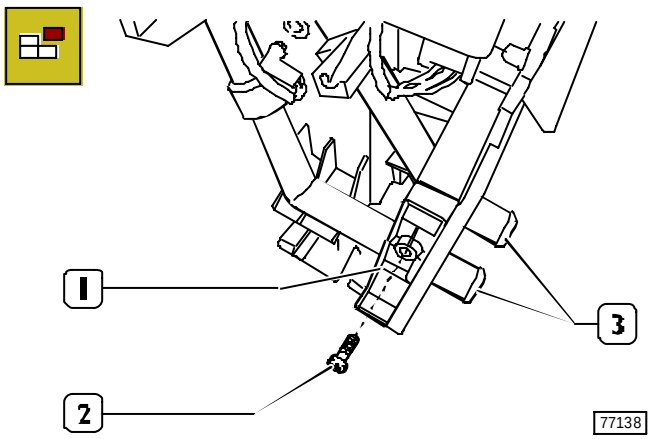
Figure 186




Before proceeding to detach the heater radiator, it is necessary to:

- For vehicles with air conditioner:
  position the key of ignition block to Key On" position and switch air temperature to "LOW".
- For vehicles without air conditioner:
  from the inside of the cab, turn the knob for adjusting cab heating temperature so as to completely open engine coolant tap.
- Partially drain engine coolant.
- Detach the pollen filter and cover (Figure 195).
- Detach Body Control as indicated on Figure 90.
- Detach the bottom covering of the fascia on the passenger side.
- Detach two passenger air openings.
- Detach the air delivery pipe from the central body to the rh door opening.
- Disconnect the retaining clamps (1) and separate the water pipes (2).

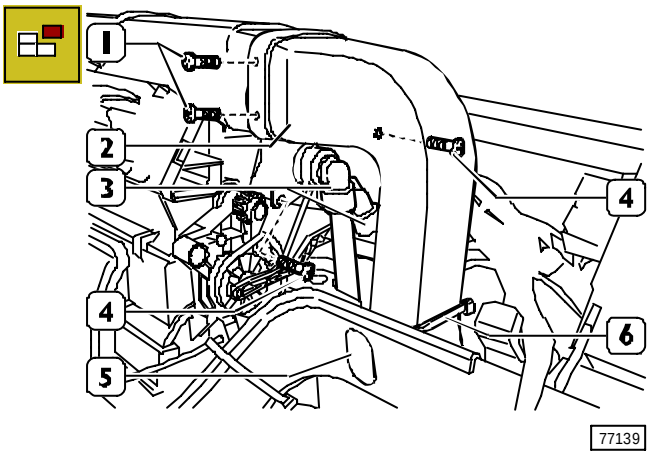
Figure 187




- Operating through the control unit compartment at the bottom of the fascia covering, unscrew the screw (2) fixing the clevis (1) and free the heater water pipes (3).

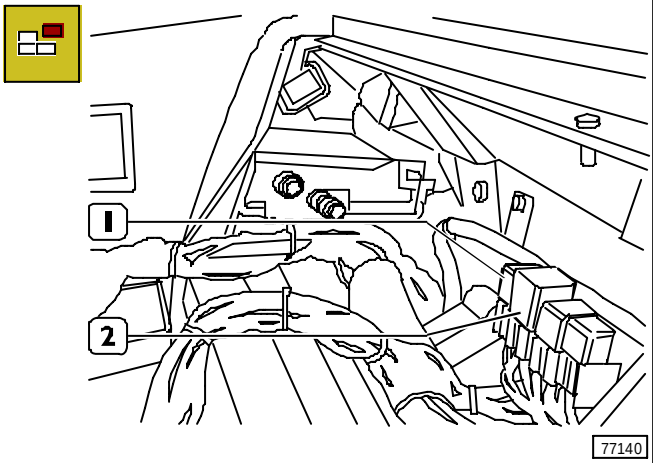
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Figure 188



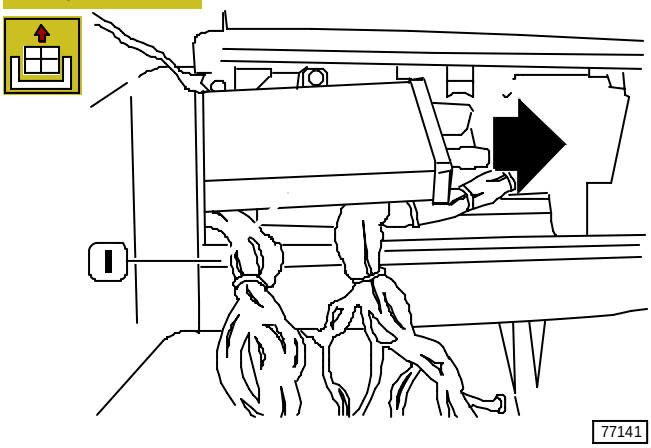

- Detach the connectors (1), (2) indicated to facilitate the outflow from the heater radiator.
- Take off the clips and detach the pipe (3).
- Unscrew the screws (4) fixing the radiator to the heater.

Figure 189




- Detach the connectors (1), (2) indicated to facilitate the outflow from the heater radiator.

Figure 190




- Extract the heater radiator (1) with due caution from the glove compartment bay.

## Refitting

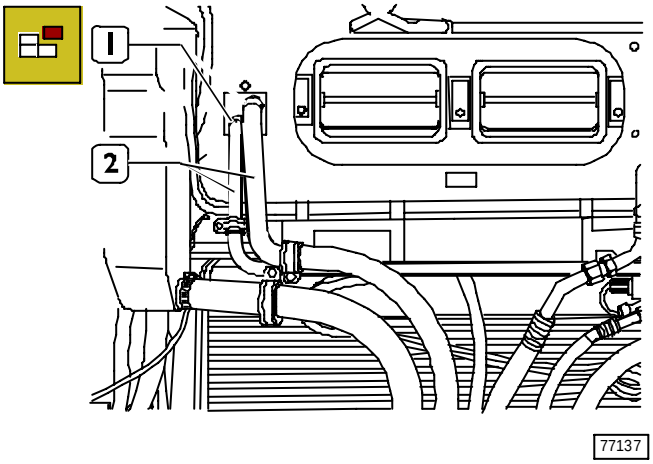
For reconnection, invert operations described for disconnection, observing following warnings:

- tighten nuts or screws at prescribed torque;
- the engine coolant is at the right level;
- the system and components involved in the described procedure work properly.

## 553216 TAP

### Removal

Figure 191

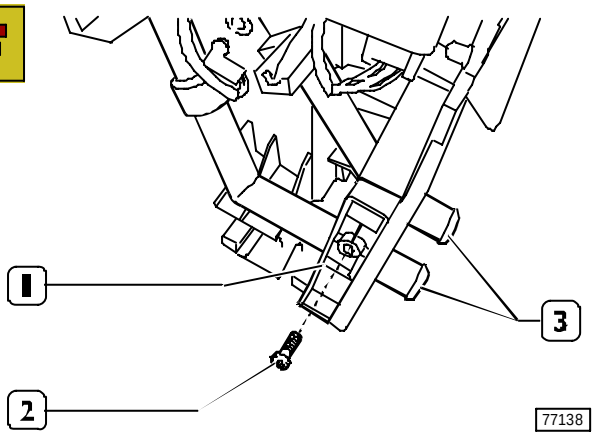



Before proceeding to detach the heater radiator, it is necessary to:

- For vehicles with air conditioner:position the key of ignition block toKey On" position and switch air temperature to "LOW".
- For vehicles without air conditioner:
  from the inside of the cab, turn the knob for adjusting cab heating temperature so as to completely open engine coolant tap.
- Partially drain engine coolant.
- Detach the pollen filter and cover (Figure 195).
- Detach Body Control as indicated on Figure 90.
- Detach the bottom covering of the fascia on the passenger side.
- Detach two passenger air openings.
- Detach the air delivery pipe from the central body to the rh door opening.
- Disconnect the retaining clamps (1) and separate the water pipes (2).

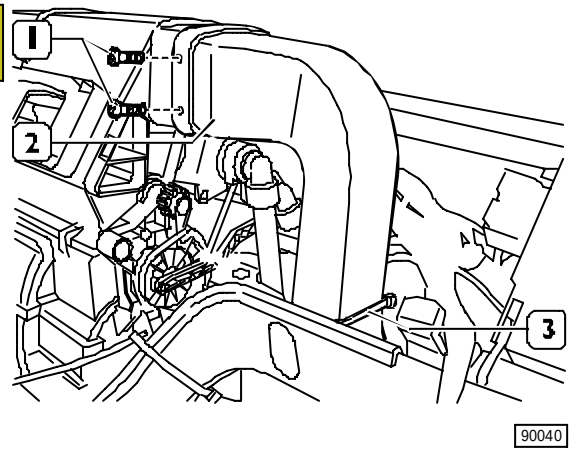
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Figure 192



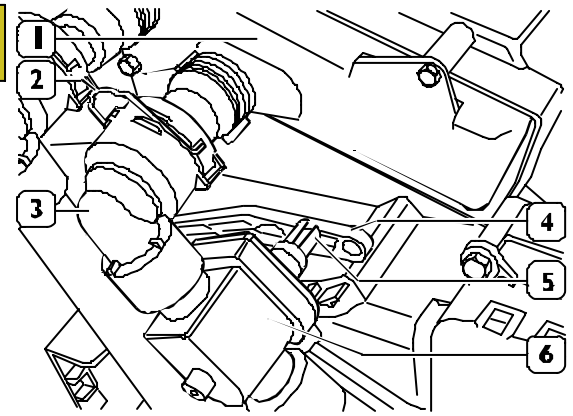

- Operating through the control unit compartment at the bottom of the fascia covering, unscrew the screw (2) fixing the clevis (1) and free the heater water pipes (3).

Figure 193




- Unscrew screws (1), take off pressure button, and cut check strap (3) and take off the piping for air duct (2).

Figure 194




- Lift fastener (2) and disconnect piping (3) from radiator (1). By special pliers, press fins (5) and disconnect tie rod (4). Remove screws and take tap (6) off the heater.

## Refitting

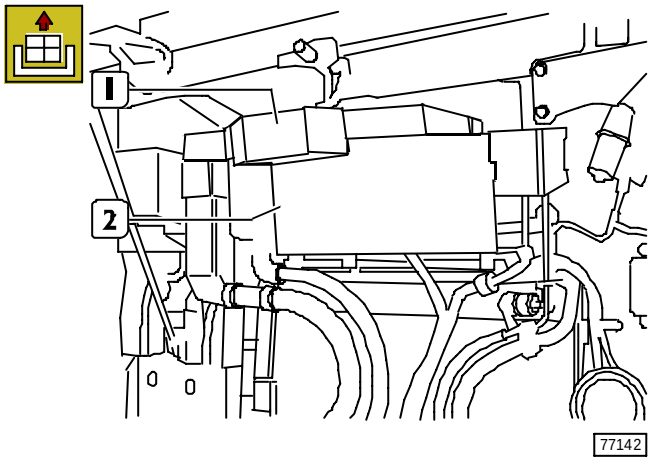
Refit by carrying out the procedures described for removal in reverse order.

- tighten nuts or screws at prescribed torque;
- the engine coolant is at the right level;
- the system and components involved in the described procedure work properly.

## 553261 POLLEN FILTER

### Removal

Figure 195




- Lift the cowling, lift cover (1) and remove anti-pollen filter (2).

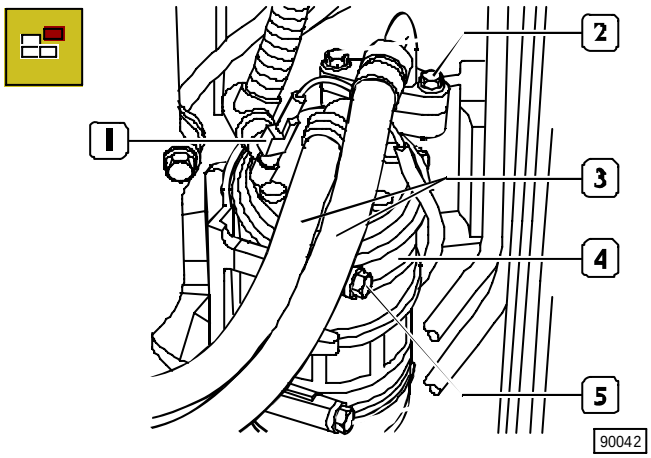
### Refitting

Refit by carrying out the procedures described for removal in reverse order.

## 553239 AIR-CONDITIONER COMPRESSOR

### Removal

Figure 196




- Discharge the air-conditioning system by following the procedure described under the relevant heading.
- Working from under the vehicle, unscrew the fixing screws (2) and remove the inlet and outlet pipes (3) from the compressor.

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**NOTE** Seal air conditioning system pipings to prevent moisture or impurities from entering the system.

- Loosen the automatic tightener and take off the compressor belt.
- Disconnect the power supply connector (1, Figure 196).
- Unscrew the fixing screws (5, Figure 196).
- Take compressor (4, Figure 196) off the engine.

### Refitting

Replace the sealing gasket.

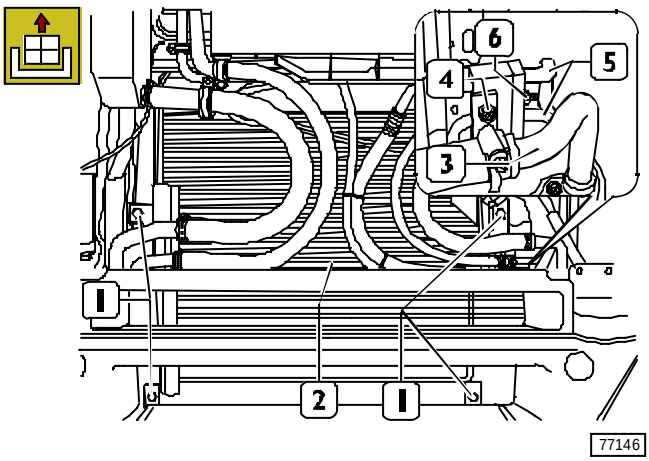
Tighten the fastening screws and the adapters to the specified torque.

Fill air conditioner system as described in relating chapter.

## 553232 AIR-CONDITIONER CONDENSER

### Removal

Figure 197




77146

- Lift the cowling and bleed air-conditioning system observing the procedure that is described in relating chapter.
- Unscrew the nut (6) and detach the condenser pipes (5).
- Unscrew the nut (4) fixing the pipe bracket (3).
- Unscrew the fixing screws (1) and remove the condenser (2) from the vehicle.

### Refitting

Replace the sealing gasket.

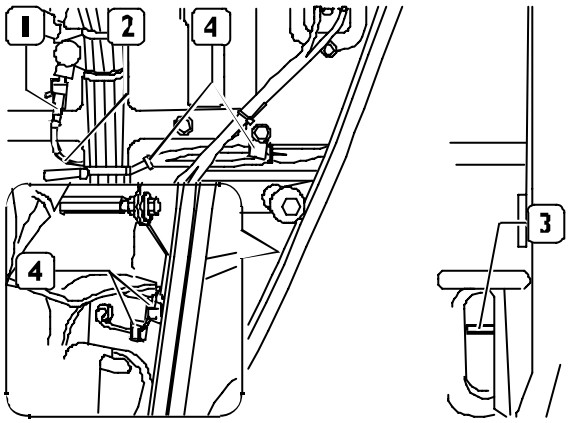
Tighten the fastening screws and the adapters to the specified torque.

Fill air conditioner system as described in relating chapter.

## 553242 OUTSIDE AIR TEMPERATURE SENSOR

### Removal

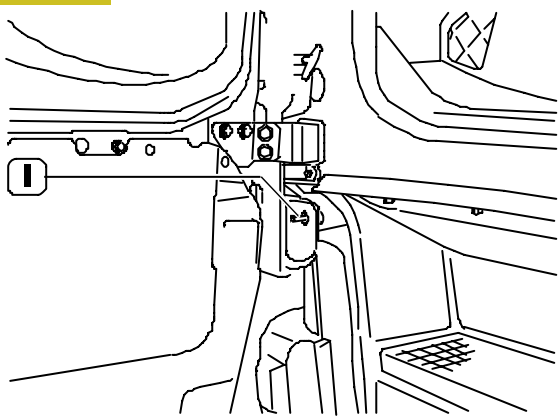
Figure 198




77147

- Lift the radiator cowling and disconnect the connector (1) and free the wiring (2) of the sensor (3) from the retaining clamps (4).

Figure 199




77148

- Detach the outside air temperature sensor (1) from its seat.

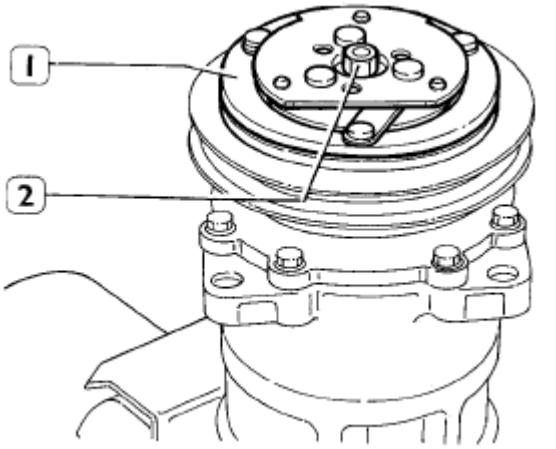
### Refitting

Refit by carrying out the procedures described for removal in reverse order.

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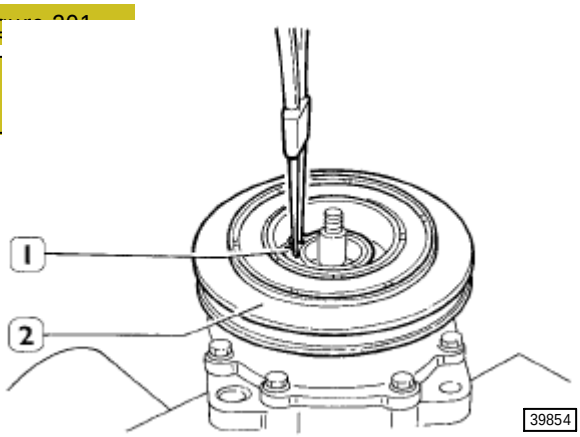
## 543921 REPLACING THE ELECTROMAGNETIC CLUTCH

Figure 200



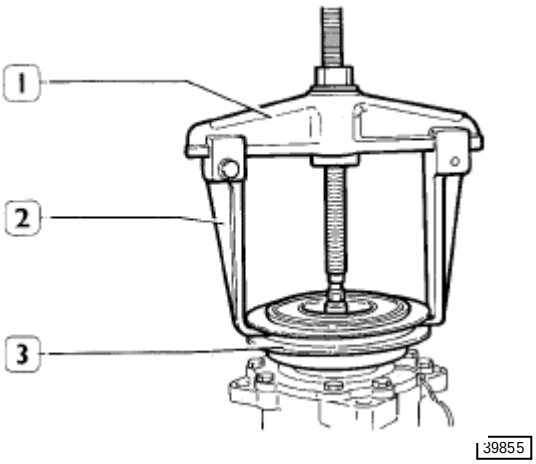

Stop front disc (1) rotation, then unscrew retaining nut (2) and remove the spacer below.

Figure 201



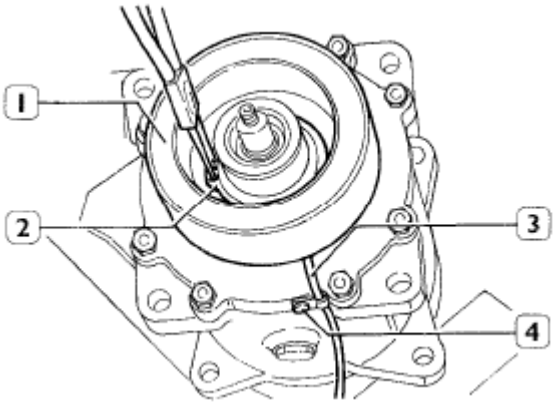

Use special rounded-tip pliers to remove pulley (2) retaining snap ring (1).

Figure 202



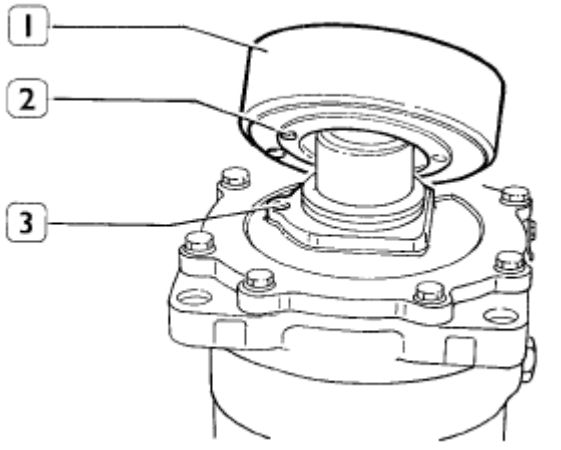

Use extractor 99341001 (1), equipped with brackets 99341009 (2), to take out pulley (3).
Remove the plate fastening screw with the envelope from the compressor.

Figure 203




Loosen screw (4), thus releasing magnetic coil (1) supply electric cable (3).
Use special rounded-tip pliers to remove retaining snap ring (2) and take off magnetic coil (1).

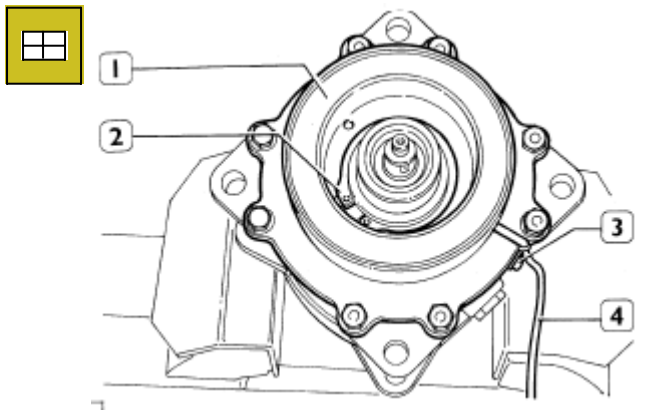
Figure 204




Place the new magnetic coil (1) in position, so that centering pin (2) engages into the respective hole (3).

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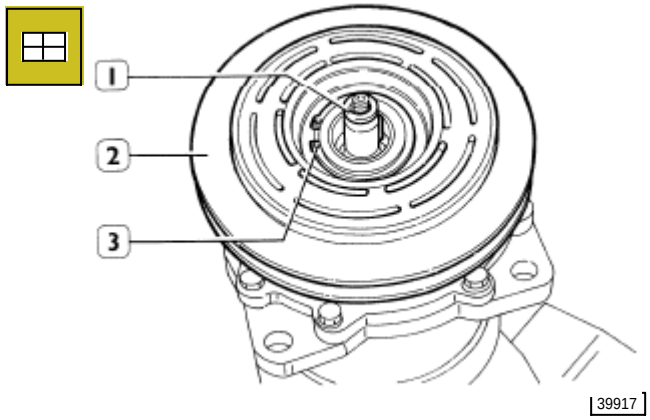
Figure 205




39916

Fit retaining snap ring (2). Tighten screw (3), then secure coil (1) supply electric cable (4) to the compressor body.

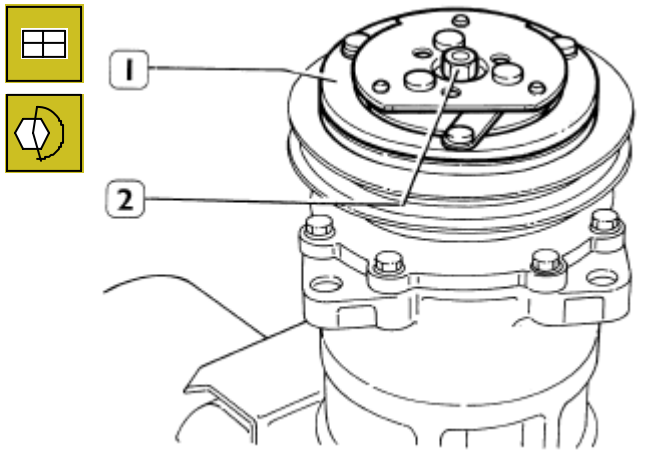
Figure 206




39917

Mount pulley (2), then retaining snap ring (3) and adjusting shim (1).

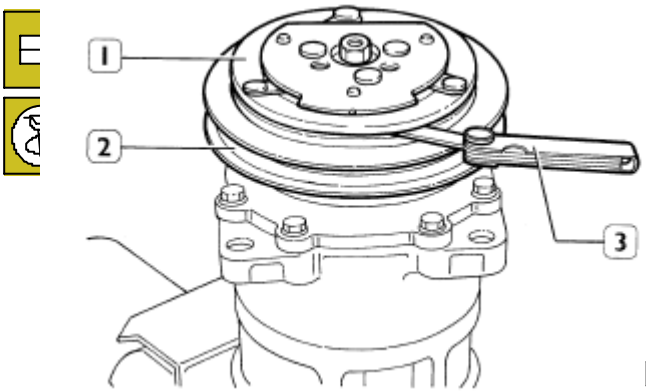
Figure 207




39852

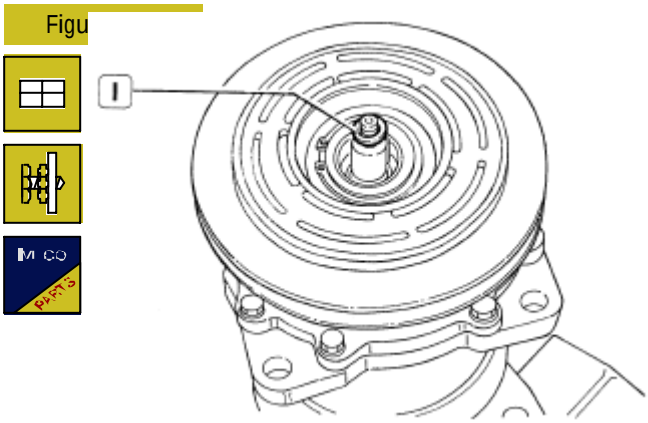
Mount front disc (1), stop rotation, then tighten retaining nut (2) to a torque of 35 ÷ 40 Nm (3,5 ÷ 4 Kgm).

Figure 208




Check, by means of a thickness gauge (3), that the play between front disc (1) and pulley (2) is 0.4 ÷ 0.8 mm.

Figu




39920

If the clearance between the front disc and the pulley does not correspond to the prescribed value, remove the front disc and replace the adjusting ring (1) with one having the suitable thickness.

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## PROCEDURE FOR DRAINING AND RECHARGING AIR CONDITIONING SYSTEMS WITH RECHARGING STATION 99305146 AND RECOVERY OF R134A COOLANT

This station has been made to be used on all air-conditioning/ heating systems for motor vehicles using R134A gas.

By connecting the station to a refrigerating system the gas it contains can be recovered, cleaned and made ready to be reloaded into the system or be transferred to an external container. In addition, it is possible to see the amount of oil taken from the system, restore it and "empty" the system.

To be operative, the station needs to absorb approximately 3 kg of refrigerant.

For prompt use it is advised to have at least 2 kg of refrigerant in the filler cylinders and to keep the station as level as possible.

**NOTE** This procedure does not describe the phases of loading and unloading refrigerant to and from external and internal containers or maintenance. Therefore, please refer to the operating and maintenance manual of the appliance.

The station is composed of:

1 control panel;

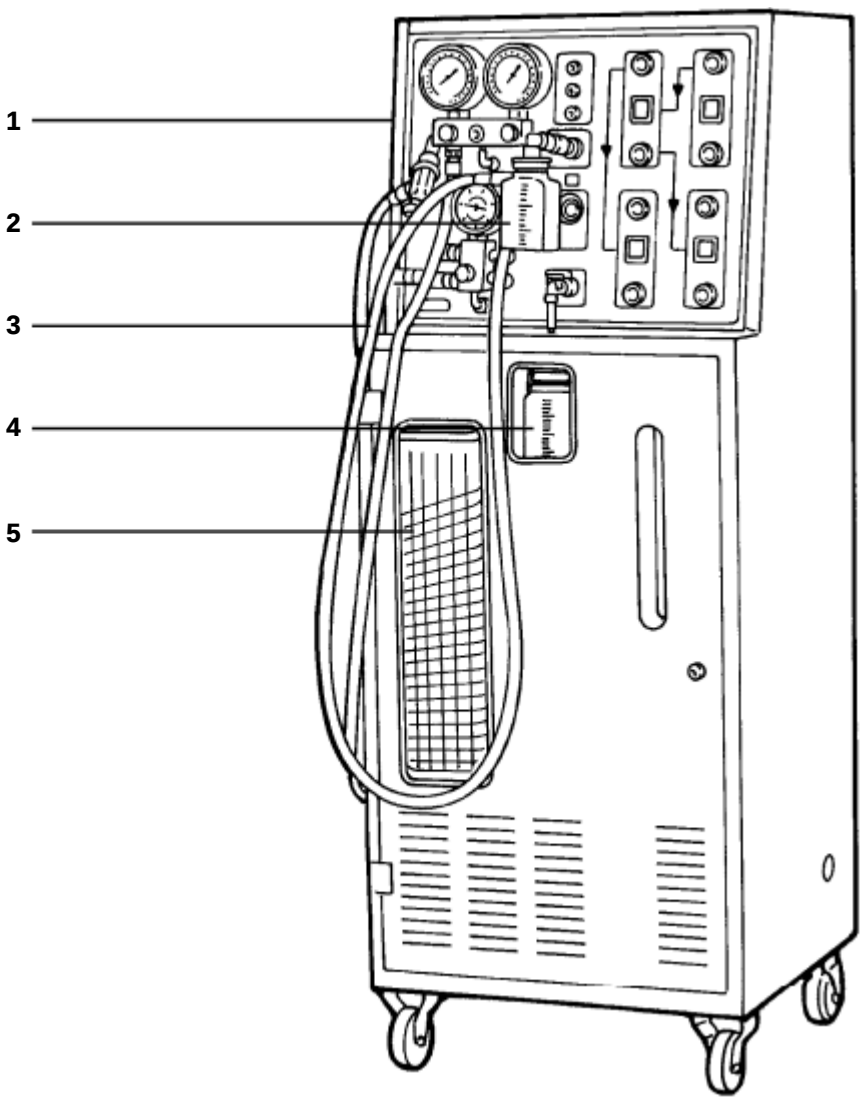
2 container to restore any oil recovered when unloading;

3 flexible hoses;

4 container to collect any oil recovered from the system;

5 filler cylinder with graduated scale revolving.

Figure 210



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## SAFETY STANDARDS

This station is exclusively for professionally trained operators who must be familiar with refrigerating systems, refrigerant gases and the damage pressurized equipment can cause, therefore:

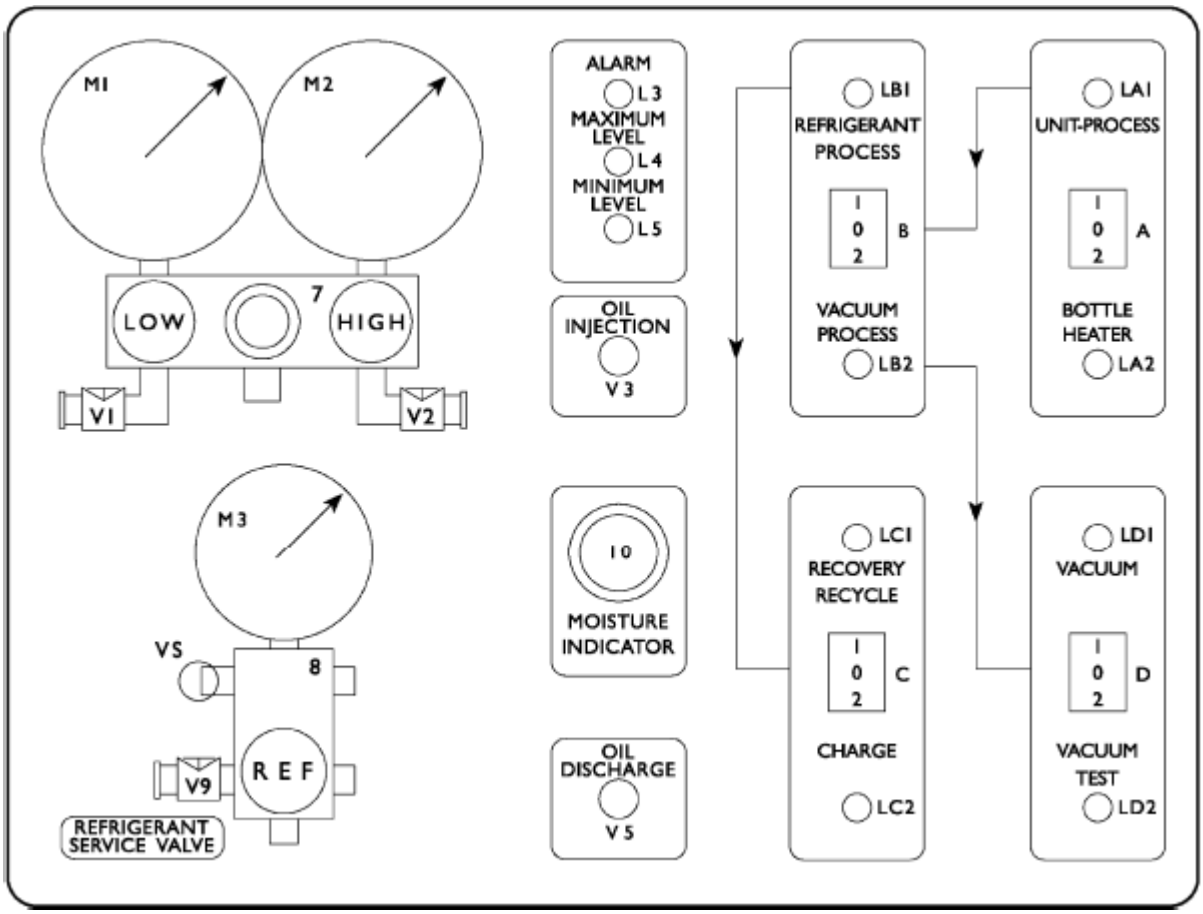
- always wear gloves and goggles when working with refrigerant gases. Contact of refrigerant liquid with the eyes can cause blindness;
- avoid all contact with skin (low boiling point -30°C can cause frostbite);
- never inhale the vapours of refrigerant gases;
- before connecting the station with a system or external container, check that all the valves are closed;
- before disconnecting the station, check that the cycle is over and all the valves are closed. This will prevent dispersing refrigerant gas into the atmosphere;
- never expose the unit or operate it in acidic or wet environments or close to open containers of inflammable substances;
- the unit must operate in places with good ventilation;
- never alter the settings of the safety valves and control systems;
- never use bottles or other storage containers that are not approved and are not fitted with safety valves;
- never load any container over 80% of its maximum capacity;
- never leave the unit powered if it is not to be used immediately. Cut off the mains power supply when it is not planned to use the equipment.

The station is equipped with special fittings to avoid contamination with systems using R12. Do not attempt to adapt this unit for use with R12.

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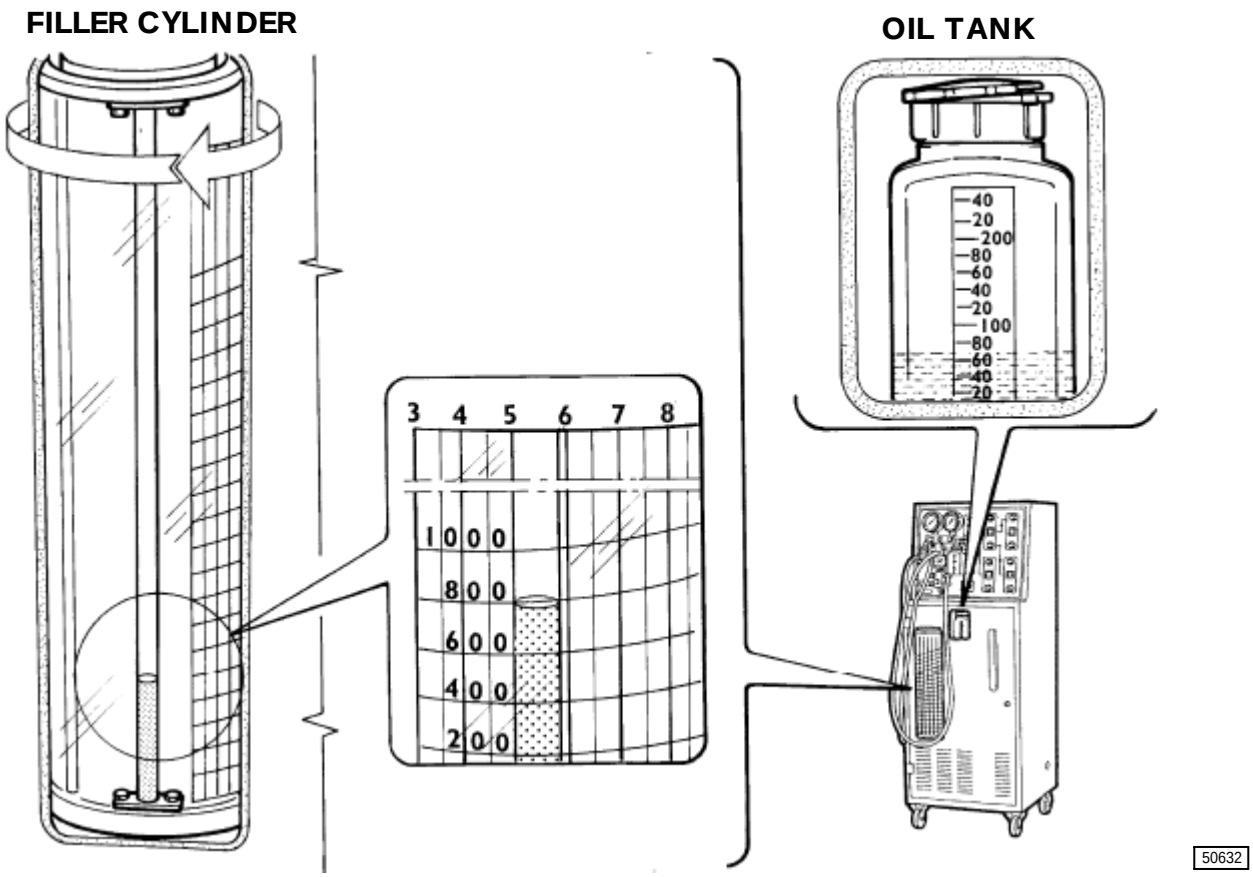
## CONTROL FASCIA

Figure 211




50634

Figure 212




50632

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Control fascia diagram legend

| | |
|---|---|
| M1 | Low pressure gauge |
| M2 | High pressure gauge |
| M3 | Filler cylinder pressure gauge |
| LOW | Low-pressure valve |
| HIGH | High-pressure valve |
| REF | Refrigerant filler and drain valve |
| V1 | Valve on low-pressure pipe |
| V2 | Valve on high-pressure pipe |
| V3 | Oil injection valve for A/C system |
| V5 | Oil drainage valve |
| V9 | A/C system washing refrigerant service valve |
| 10 | Moisture indicator |
| VS | Safety and drainage valve |
| L3 | Alarm warning light |
| L4 | Maximum level warning light |
| L5 | Minimum level warning light |
| A | Unit process / bottle heater switch |
| LA1 | Unit process indicator light |
| LA2 | Bottle heater indicator light |
| B | Refrigerant process / vacuum process switch |
| LB1 | Refrigerant process indicator light |
| LB2 | Vacuum process indicator light |
| C | Recovery recycle cycle / Filling switch |
| LC1 | Recovery recycle cycle indicator light |
| LC2 | Filling indicator light |
| D | Vacuum / vacuum test switch |
| LD1 | Vacuum indicator light |
| LD2 | Vacuum test indicator light |

Filler cylinder legend

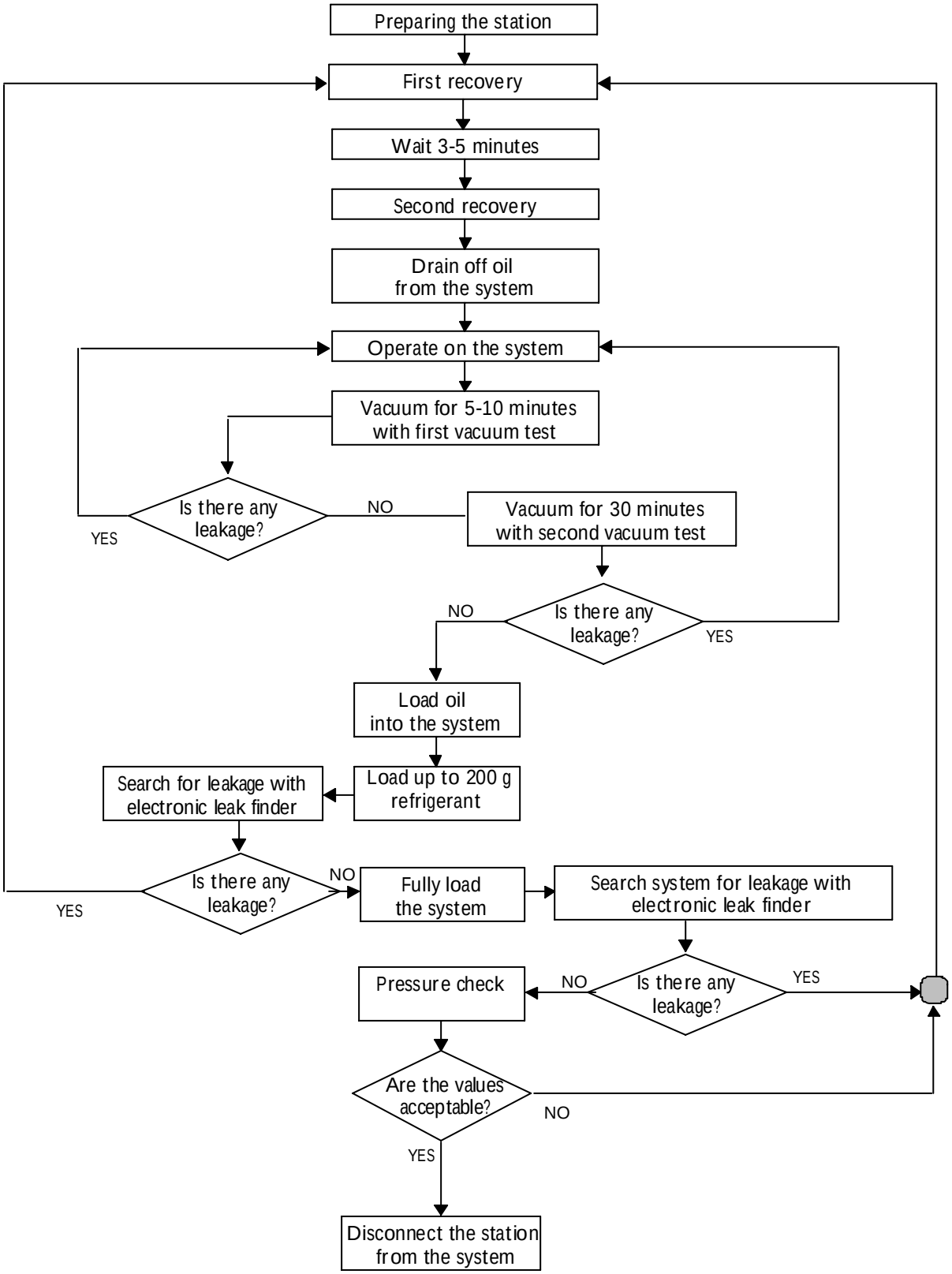
1 Pressure values in bar (vertical lines, revolving top cylinder).

2 Weight of load in grams (oblique lines, revolving top cylinder) 50 g division between lines.

3 Tank level viewer (internal cylinder).

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## OPERATION FLOW CHART



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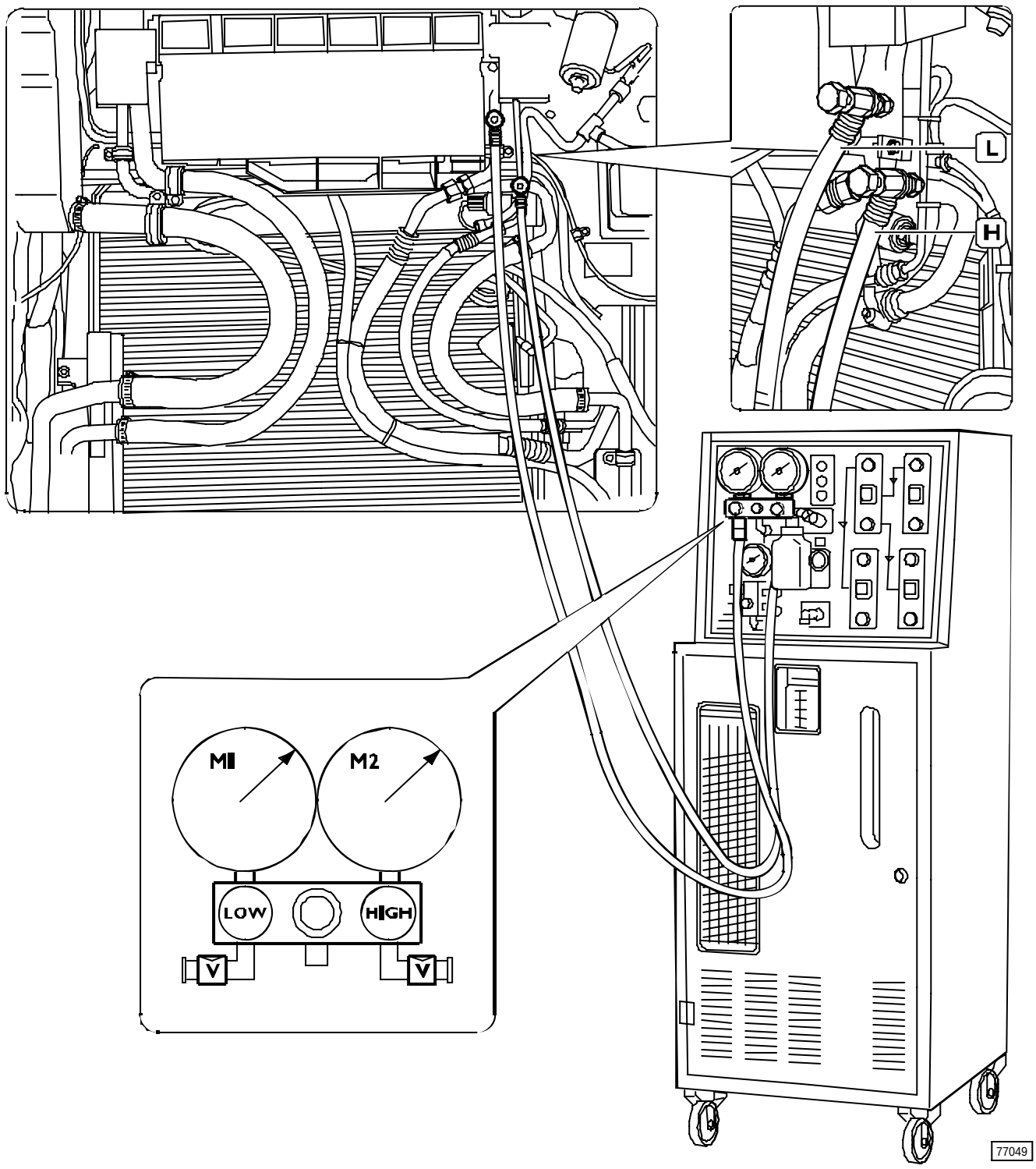
## RECOVERING REFRIGERANT FROM THE VEHICLE SYSTEM

Before starting to disconnect the pipes from the air-conditioner, check whether it is possible to do the repairs without discharging the gas.

If this is not possible, the following operations must be carried out:

- connect the pipe marked HIGH under the pressure gauge to the evaporator inlet (the inlet is the one on the pipe with a smaller diameter (H) connecting the drier filter with the evaporator);
- connect the pipe marked LOW under the pressure gauge to the evaporator outlet (the outlet is the one on the pipe with a larger diameter (L) connecting the evaporator with the drier);
- open the valves V1 and V2;
- open the LOW and HIGH cocks;

Figure 213



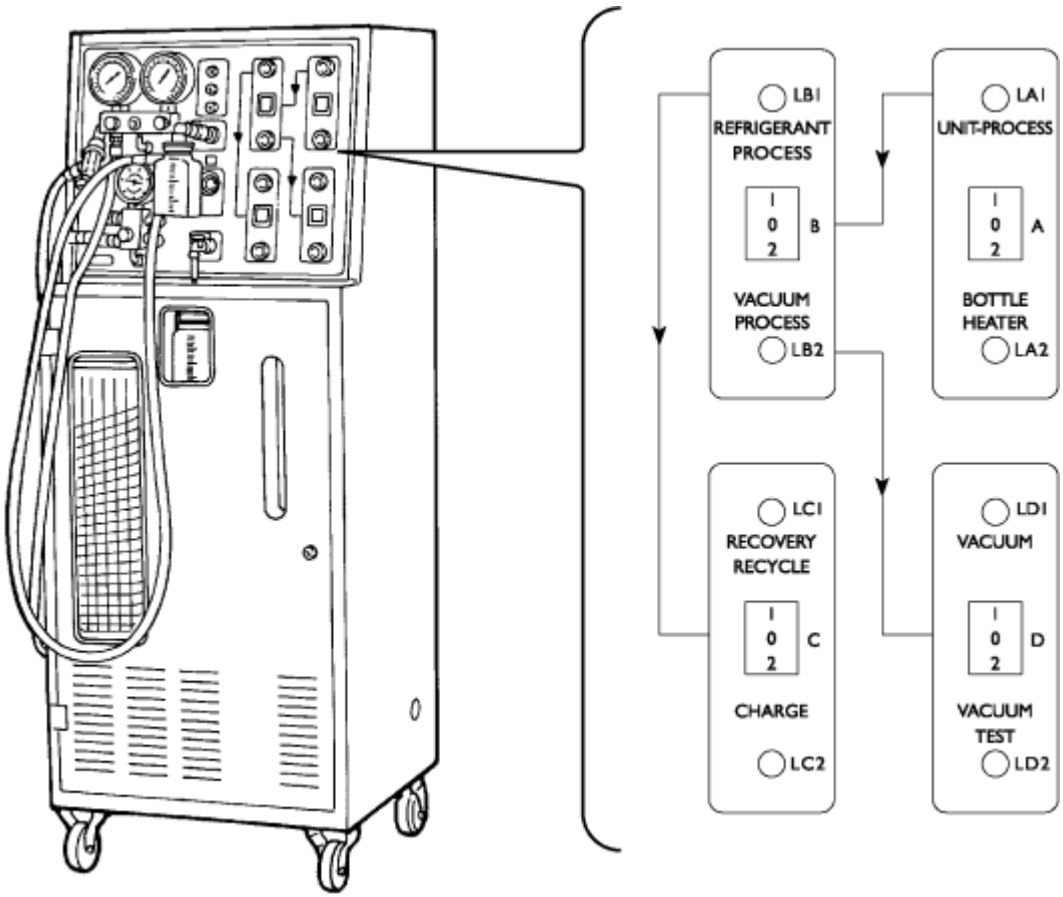
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- connect the station to the electricity mains (220 V - 50 Hz);
- press the switch A (Process Unit) onto position 1. The respective indicator light LA1 will come on;
- press the switch B (Refrigerant Process) onto position 1;
- the respective indicator light LB1 will come on;
- press the switch C (Recovery Recycle) onto position 1. The recovery and recycling operation will start automatically. The respective indicator light LC1 will come on to signal the operation in progress.
  On completing this operation the unit will automatically stop and the indicator light LC1 go out. Wait for a few minutes so that any pockets of refrigerant at low pressure remaining in the system can increase their pressure, by absorbing heat, and be able to be recovered. The station will automatically repeat the recovery cycle if the above conditions occur;
- put the switches A, B and C back onto position 0;
- close the V1, V2, LOW and HIGH valves.

**NOTE** If the refrigerant reaches the maximum level (maximum level indicator light L4 on), the recovery cycle must be stopped immediately by pressing switch C onto position 0 and transferring the refrigerant from the filler cylinder to a suitable external bottle.

- Continue the operations following the instructions given on the following pages.

Figure 214




50636

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## CREATING A VACUUM IN THE SYSTEM

This operation should be carried out if all the repairs have been performed and the system components have been properly refitted. This operation is the phase prior to refilling, therefore proceed as follows:

**NOTE** Do not run the vacuum cycle when there is even minimal pressure in the station or system.

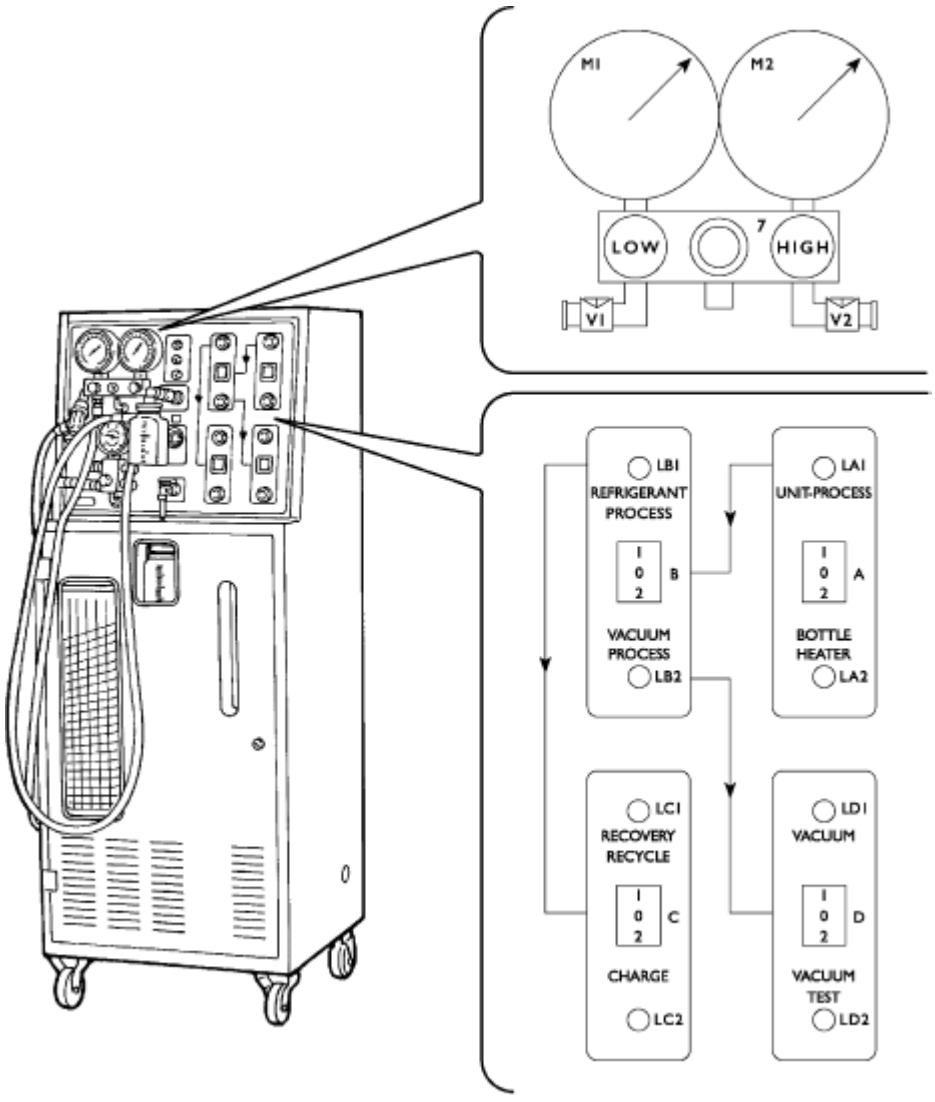
- connect the pipes to the specific system connections and open the V1-V2/LOW and HIGH valves;
- press the switch A (Process Unit) onto position 1. The respective indicator light LA1 will come on;
- press the switch B (Vacuum Process) onto position 2. The respective indicator light LB2 will come on;
- press the switch D (Vacuum) onto position 1. The system will automatically start being evacuated and the respective indicator light LD1 will come on to signal the operation in progress.

After a few minutes of operation (10 at most) if the system has no leaks the indicator light LD2 VACUUM TEST will also come on. From this time on, evacuation should be continued for at least two hours to obtain a good evacuation;

**NOTE** The indicator light LD2 vacuum test fails to come on if there is a leak. Stop evacuation, eliminate the leak and repeat the evacuation procedure.

- at the end of the time programmed for evacuation, press the switch D (vacuum test) onto position 2 and leave the system in this state for 3-5 minutes. The indicator light LD2 VACUUM TEST is on if the system has a good seal. The indicator light LD2 VACUUM TEST goes out if there is a leak. Eliminate the leak and repeat the evacuation cycle;
- put the switches D and B back onto position 0 and proceed with the following phase.

Figure 215



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It is possible that at the end of each recovery cycle the station may have recovered lubrication oil from the compressor, which should be drained off into a specific graduated container (1).

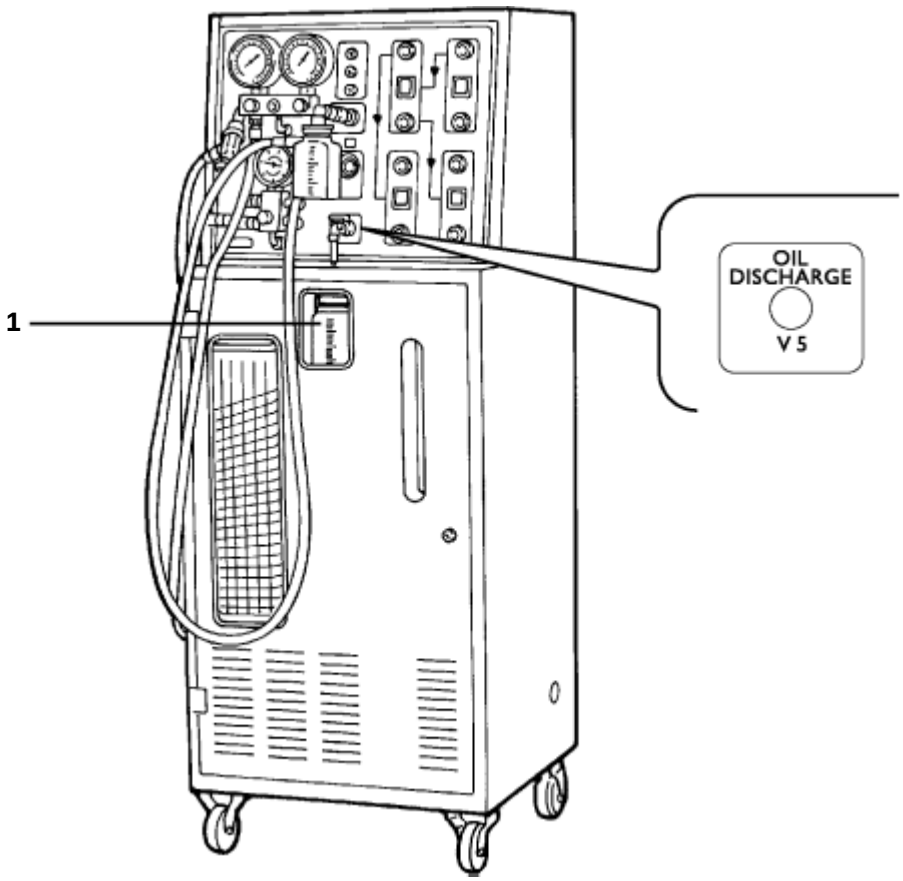
1 Slowly open the valve V5 (Oil Discharge).

2 When all the oil has been discharged into the container (1) close the valve V5.

3 Quantify and record the amount of oil discharged.

4 Eliminate the recovered oil correctly.
This oil cannot be reused.
The same amount of new oil as has been removed must be added to the system.

Figure 216



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## RESTORING OIL IN THE SYSTEM

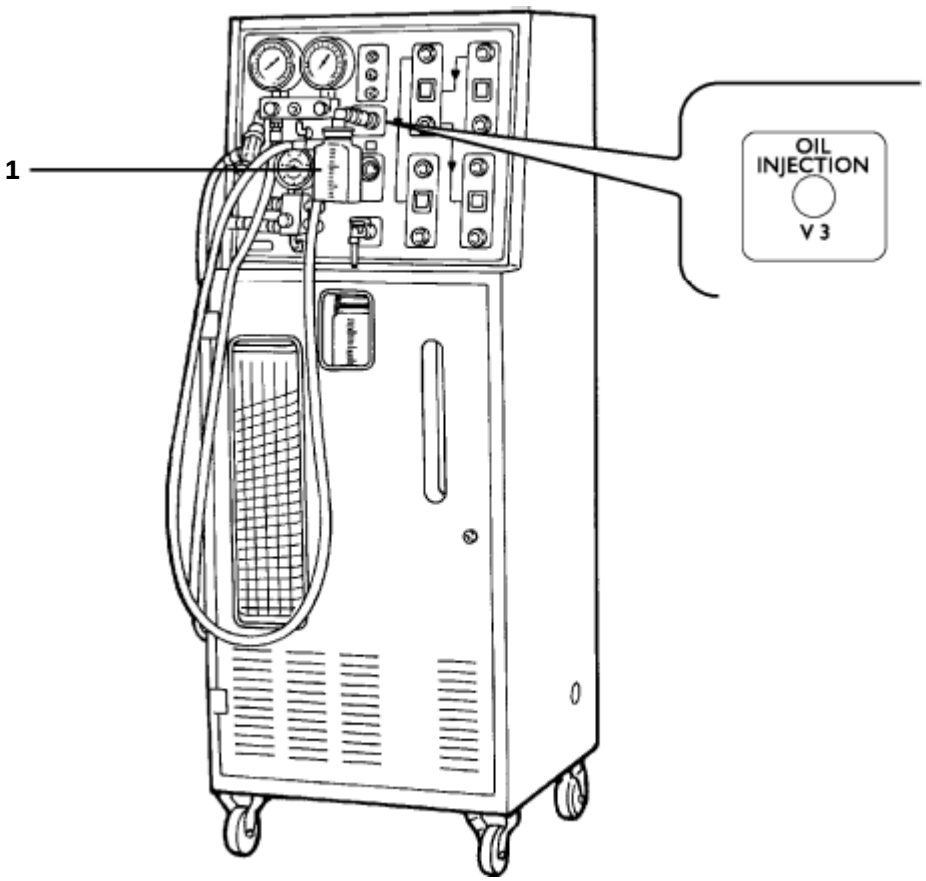
If during the recovery and recycle phase, oil from the system has been removed, it must now be replenished:

- take the metering device supplied with the right amount of lubricant for the system concerned, or previously measured;
- connect the metering device (1) to the lubricant injection valve V3;
- open the valve V3 and then carry out the system vacuum phase for a few moments;
- open the valve mounted on the metering device container (1). The oil will be drawn into the system;
- close the valve V3 and the valve on the metering device container when the required quantity of lubricant has been drawn in;
- disconnect the metering device (1) from the injection valve V3 and fit the protective cap back on;

**NOTE** Keep the oil containers well sealed in order to avoid contamination. In particular, remember that oil is extremely hygroscopic:

- never open the oil injection valve V3 if the system has positive pressure;
- oil should only be injected with a vacuum in the system;
- the oil level must never fall under the suction pipe (air would get into the system).

Figure 217



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## FILLING THE SYSTEM WITH REFRIGERANT

Before refilling, it is wise to be aware of some important rules:

- know the quantity of refrigerant to use (it is normally written on an adhesive plate affixed on the vehicle);
- the filler cylinder is equipped with a minimum level check that prevents introducing incondensable gas into the system.
  This is why the last approx. 600 g of refrigerant it contains cannot be used;
- therefore, before filling, check that the cylinder contains a sufficient quantity for filling (maximum quantity that can be used 3800 g);
- if the pressure inside the filler cylinder indicated on the pressure gauge (2) is greater than as required, which can be seen on the filler cylinder window approx. 10 bar max, discharge the excess pressure through the valve (1) on the pressure gauge assembly to bring it down to the right level, reading the value on the pressure gauge.

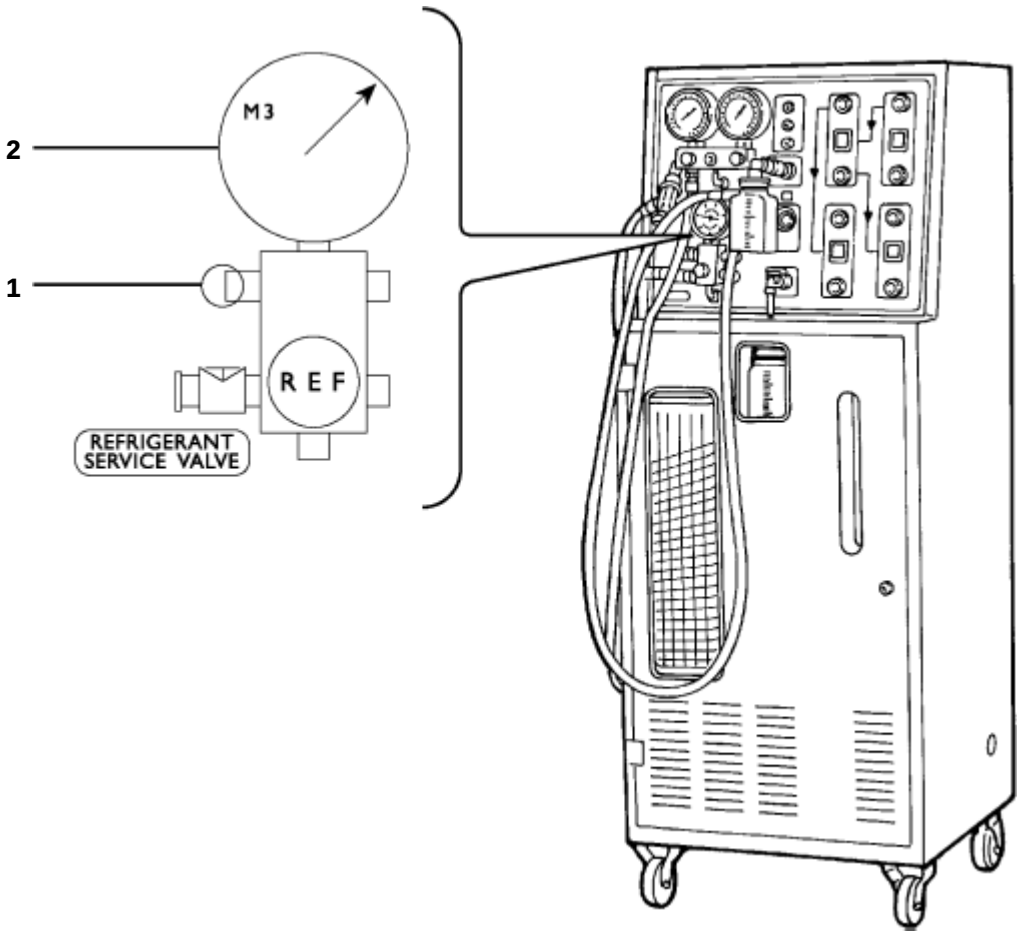
**NOTE** To transfer refrigerant from an external bottle to the filler cylinder and vice versa, refer to the equipment manual.

Considering that the amount of refrigerant depends on its pressure, to know the actual weight it is necessary to turn the outside of the filler cylinder so the line of the diagram matches the level viewer. In this way we can know the exact quantity of refrigerant in the cylinder (starting weight).

When calculating the weight of the refrigerant, in addition to the 600 g that cannot be used, remember to increase the load by approximately 100 g (this is the weight of refrigerant contained in the station-system connecting pipes). The right quantity of refrigerant to introduce into the system will therefore be given by: 600 g + 100 g + (quantity referred to the system capacity).

Always check before filling that the indicator on the "console" shows the refrigerant contains no moisture, in which case the indicator will be bright green. If this is not so, replace the filters in the station as instructed in the equipment manual.

Figure 218



Aquila Trucks Centres

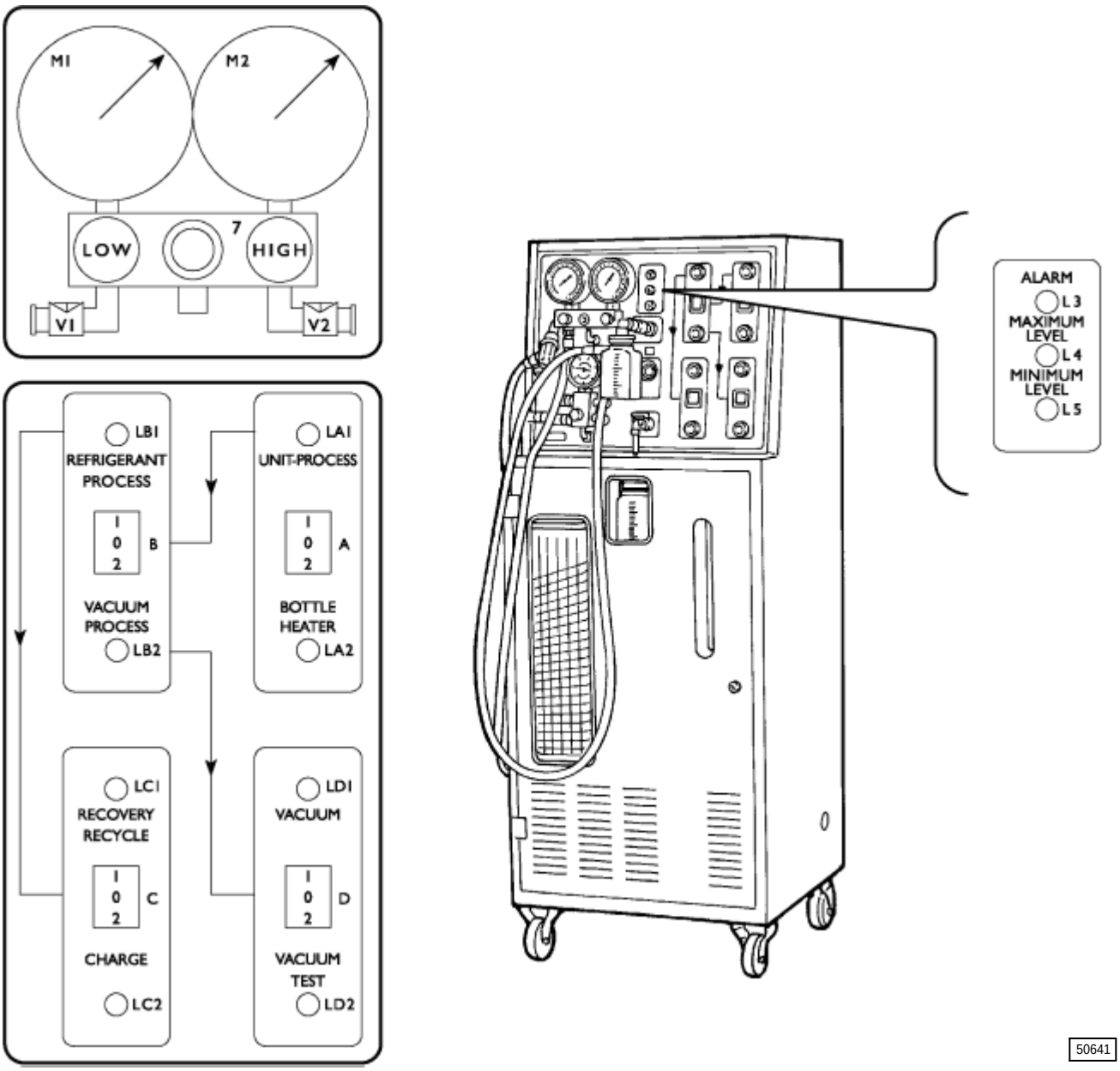
When the cylinder contains the necessary quantity for filling (both pipes must already be connected to the system connectors since the vacuum operation has already been performed), proceed as follows:

- close the LOW valve, keep the HIGH and V1 - V2 valves open;
- press the switch B (Refrigerant process) onto position 1, the indicator light LB1 will come on;
- press the switch C (Charge) onto position 2, the respective indicator light LC2 will come on and refrigerant will flow from the station into the system;

**NOTE** When filling, if the level of refrigerant in the cylinder falls under the required quantity the system will stop and the Minimum Level indicator light (L5) will come on.

- having loaded 200 ÷ 500 g of refrigerant, depending on the size of the system, stop filling by moving the switch C (Charge) onto position 0;
- check the system is properly sealed with the electronic leak finder;
- complete filling the system until the pre-calculated residual weight in the cylinder is reached;
  (Residual weight = Total weight - System capacity weight)
- complete filling, move the switches C - B and A onto position 0 (A had been moved for the vacuum).
  Check again there is no leakage;
- close the HIGH valve.

Figure 219



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## CHECKING THE PRESSURES IN THE SYSTEM

After filling, leave the pipes connected and carry out the following check:

- close the HIGH and LOW valves, V1 and V2 open;
- turn on the engine, switch on the air-conditioner and check on the pressure gauges M1 and M2 that the pressures correspond, normally: low pressure no less than 1 bar, high pressure 15 ÷ 18 bar, depending on the system specifications.

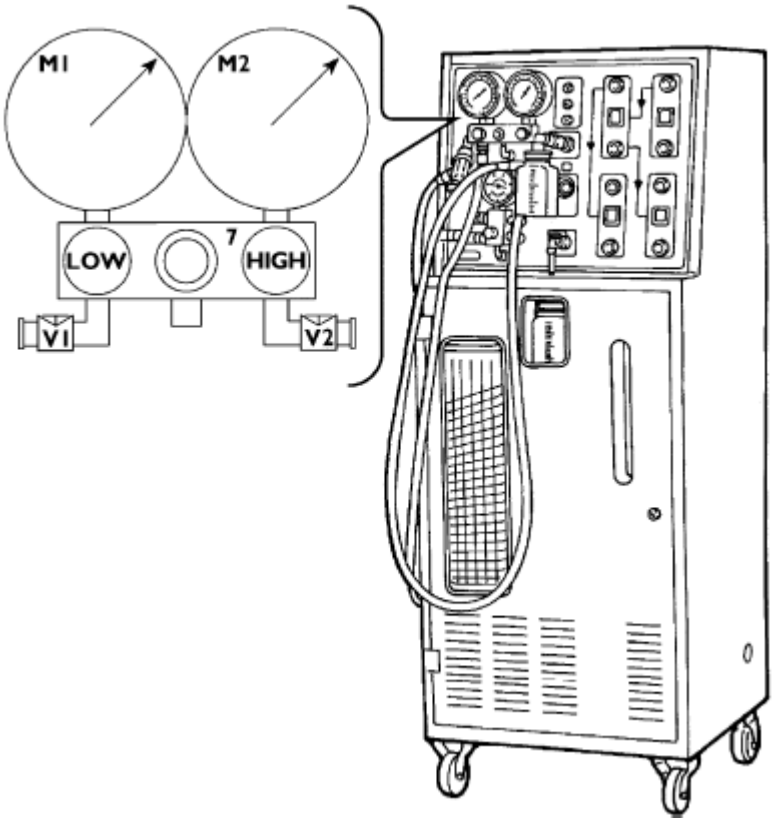
## OPERATIONS PRIOR TO DISCONNECTING THE STATION FROM THE SYSTEM

Always observing the above safety rules, carry out the following operations:

- check that all the valves are closed: LOW - HIGH, V1 - V2;
- disconnect the pipes of valves V1 - V2 and put the caps back onto the system valves;
- Check the system again with the leak finder.

**NOTE** Normally, with the air-conditioner switched on, air should come out of the vents at a temperature lower than 5°C and after a period of operation to stabilize the temperature of the ducts.

Figure 220




50642

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# PROCEDURE FOR DRAINING AND RECHARGING AIR CONDITIONING SYSTEMS WITH RECHARGING STATION 99305148 AND RECOVERY OF R134A COOLANT

This station has been made to be used on all air-conditioning/ heating systems for motor vehicles using R134A gas.

By connecting the station to a refrigerating system the gas it contains can be recovered, cleaned and made ready to be reloaded into the system or be transferred to an external container. In addition, it is possible to see the amount of oil taken from the system, restore it and "empty" the system.

## Main components

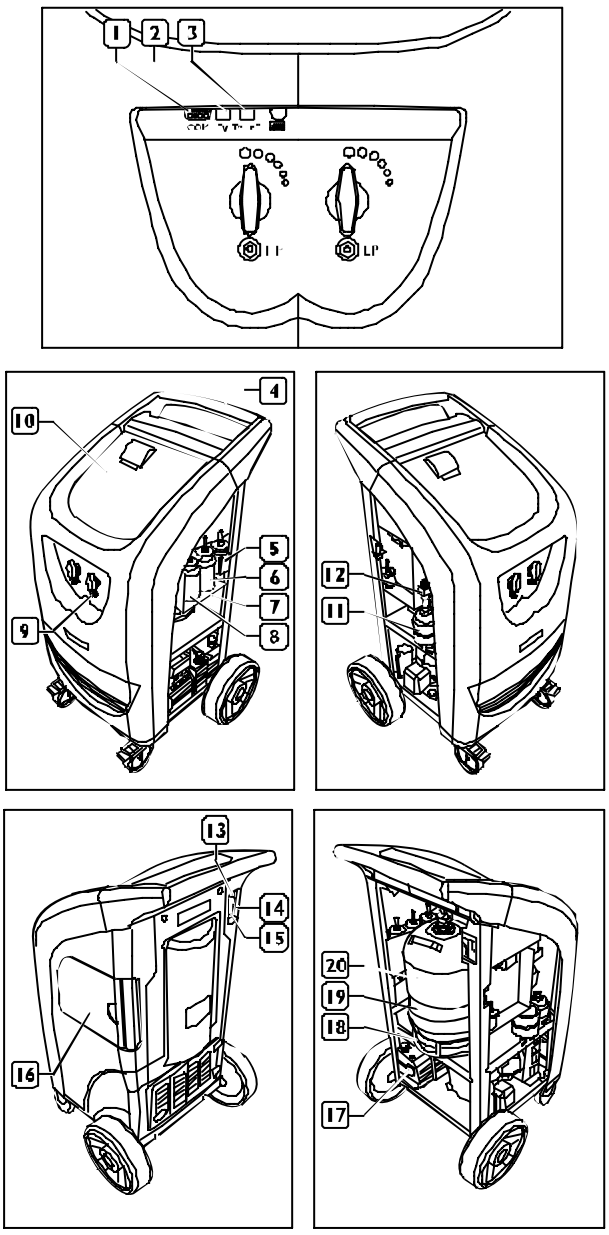
To be operative, the station needs to absorb approximately 3 kg of refrigerant.

For prompt use it is advised to have at least 2 kg of refrigerant in the filler cylinders and to keep the station as level as possible.

**NOTE** This procedure does not describe the charge/drain phases of coolant from internal/external tanks an dit does not provide indications on maiintenance interventions required.

For these operations, please refer to the equipment supplier use and maintenance manual.

Figure 221




115615

1.Serial port - 2. TV temperature probe connector - 3. Electrical probe connector - 4. Handle - 5. Tracer container - 6. New fluid container - 7. Fluid scales - 8. Used fluid container - 9. Taps - 10. Control console - 11. Dehydrating filters - 12. Moisture gauge - 13. Master switch - 14. Fuse - 15. Electric plug socket - 16. Fluid container flap - 17. Vacuum pump - 18. Electronic scale - 19. Heater coil - 20. Cylinder

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## SAFETY STANDARDS

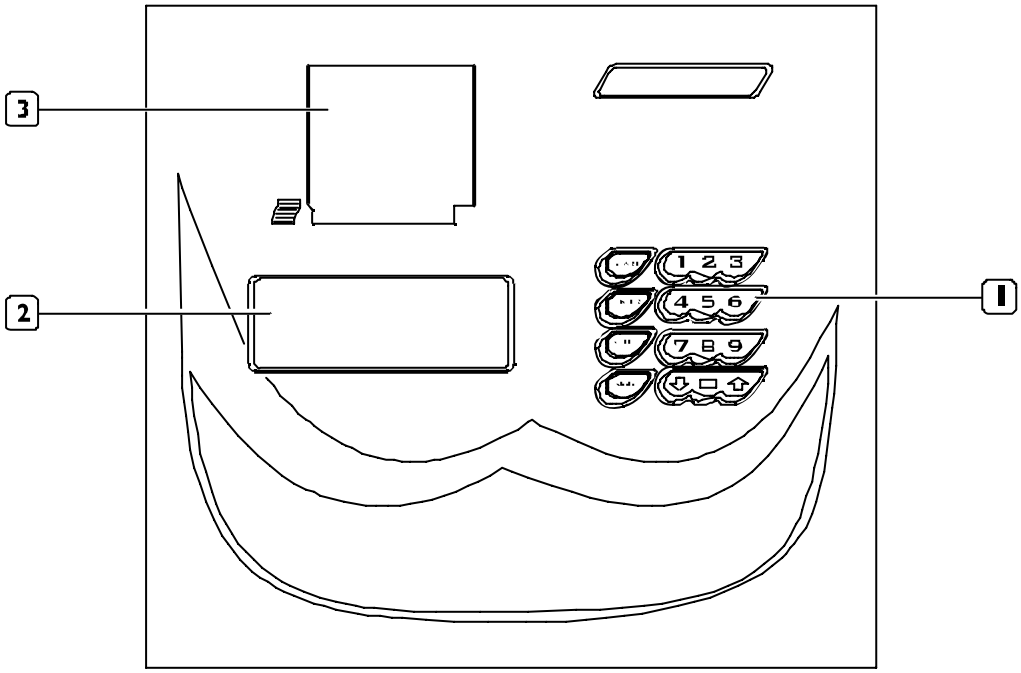
This station is exclusively for professionally trained operators who must be familiar with refrigerating systems, refrigerant gases and the damage pressurized equipment can cause, therefore:

- always wear gloves and goggles when working with refrigerant gases. Contact of refrigerant liquid with the eyes can cause blindness;
- avoid all contact with skin (low boiling point -30°C can cause frostbite);
- never inhale the vapours of refrigerant gases;
- before connecting the station with a system or external container, check that all the valves are closed;
- before disconnecting the station, check that the cycle is over and all the valves are closed. This will prevent dispersing refrigerant gas into the atmosphere;
- never expose the unit or operate it in acidic or wet environments or close to open containers of inflammable substances;
- the unit must operate in places with good ventilation;
- never alter the settings of the safety valves and control systems;
- never use bottles or other storage containers that are not approved and are not fitted with safety valves;
- never load any container over 80% of its maximum capacity;
- never leave the unit powered if it is not to be used immediately.
  Cut off the mains power supply when it is not planned to use the equipment;
- always connect the pipe with the RED machine quick coupling to the A/C system high pressure branch.
  Always connect the pipe with the BLUE machine quick coupling to the A/C system low pressure branch.
  Keep the connection pipes far away from moving or rotating objects or parts (cooling fan, alternator etc.).
  Keep the connection pipes far away from hot items or parts (engine exhaust pipes, radiator etc.);
- always fill the A/C system with the amount of fluid recommended by the manufacturer.
  Never exceed this amount. Always check the fluid level before each operation.
  Always add the correct amount of fluid.
  Check the electric mains is 220-240V/50Hz before connecting the machine to the mains;
- the cylinder must be filled to 80% of maximum capacity to leave a gas reserve to absorb any pressure increases.
  Never touch the internal cylinder taps.
  Dispose of fluid extracted from the A/C system and vacuum pump in special waste fluid containers.
  Change the filters at the required intervals using only filters recommended by the manufacturer.
  Only use fluids recommended by the manufacturer.
  Never swap the vacuum pump fluid with air conditioning system fluid.
  Any guarantees on the machine will be null and void if the above safety rules are not complied with.

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## CONTROL PANEL

Figure 222




1. Keypad - 2. Alphanumeric LCD - 3. Printer

### Keypad functions

STOP: Use this key to stop the current operation (recovery - drain fluid - empty - add fluid - fill).
Press the START key again to start again from the previous point.
The horn is switched off if the STOP key is pressed during an alarm, an error or at the end of an operation.
ENTER: This key confirms the procedure or operation flashing on the LCD.

↓: This key is used to move from one procedure to another or from one operation to another, from top to bottom.

↑: This key is used to move from one procedure to another or from one operation to another, from bottom to top.

START: This key activates the confirmed procedure or operation.

**NOTE** Press START only when requested to by the LCD).

### Emergency warning light panel

HIGH PRESSURE ALARM: is displayed and emits an acoustic signal when fluid pressure in the circuit exceeds 17.5 bars.
The recovery operation is automatically halted.

CYLINDER FULL ALARM: displayed and emits an acoustic alarm when more than 80% of the maximum capacity is present in the cylinder, i.e. 9.5 kg.
RECOVERY operation is automatically halted (to cancel this alarm, one or more A/C systems must be charged before recovering more coolant).

CYLINDER EMPTY ALARM: displayed and emits an acoustic alarm when too little coolant is present inside the cylinder.

NEW FLUID CONTAINER ALARM: displayed and emits an acoustic alarm when the volume of new fluid drops below approximately 50 $cm^3$.

USED FLUID CONTAINER FULL ALARM: displayed and emits an acoustic alarm when the volume of used fluid drops exceeds approximately 200 $cm^3$.

LEAKS IN A/C SYSTEM ALARM: displayed and emits an acoustic alarm after the first 10 minutes of vacuum if there are leaks in the A/C system.

**NOTE** Detection of micro-leaks cannot be guaranteed.

SERVICE ALARM: displayed and emits an acoustic alarm when 150 kg of coolant are recovered.
To deactivate, replace the filters and vacuum pump fluid.
Together with the filters, a code will be sent to eliminate the alarm.

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## PRELIMINARY CHECKS

Check that the switch (13, Figure 221) is in position 0.
Check that all the machine taps are closed.
Connect the machine to the mains and turn on.
Check that the pump fluid level gauge indicates at least half full.
If the level is low, fuel must be added.

Check the additional fluid container (6, Figure 221) contains at least 100 $cm^3$ of fluid.
Check the machine LCD to ensure the cylinder contains at least 3 kg of coolant.
If not, refill the internal cylinder using an external cylinder with appropriate coolant.

## AUTOMATIC PROCEDURE

All the operations are carried out automatically in the automatic procedure: recovery and recycling, fluid drain, vacuum, addition of new fluid and refilling.
The amount of gas recovered, recovered fluid, vacuum time, fluid added and the amount of gas injected are printed automatically at the end of each individual operation.

Connect the hoses to the A/C system using the quick couplings, taking care to connect the BLUE hose to the low pressure branch and the RED hose to the high pressure branch.
If the system is equipped with a single high or low pressure quick coupling, only connect the relevant quick coupling.

Check that the high and low taps are closed.
Turn on the vehicle engine and air conditioner for 5-10 minutes, keeping the passenger compartment fan running at maximum speed.
Turn off the vehicle engine.

The instrument has a four-row display with up to 20 characters per row.
The selected item flashes on the option menus.
It is indicated between inverted commas in this manual.

AUTOMATIC PROCEDURE
ASSISTED PROCEDURE
NEXT MENU
AVAILABILITY XXXX G

⇓

ENTER

⇓

VACUUM XX MIN
AUTOMATIC FLUID
FLUID XX CC
FILLING XXXX G

Follow the automatic procedure, i.e. press ENTER when the message "Automatic procedure" flashes on the LCD.

< VACUUM XX MIN. >
AUTOMATIC FLUID
FLUID XX CC
FILLING XXXX G

⇓

2

⇓

0

⇓

< VACUUM 20 MIN. >
AUTOMATIC FLUID
FLUID XX CC
FILLING XXXX G

Enter the vacuum time or confirm the previous time. Simply press ENTER to confirm the previous time. Use keys 0-...-9 to set a new time.

< VACUUM 20 MIN. >
AUTOMATIC FLUID
FLUID XX CC
FILLING XXXX G

⇓

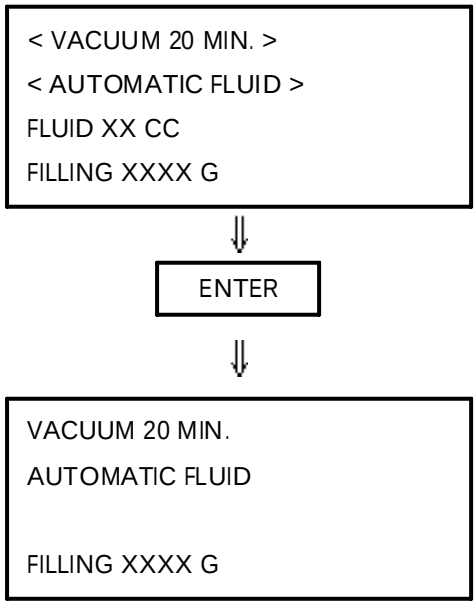
ENTER

⇓

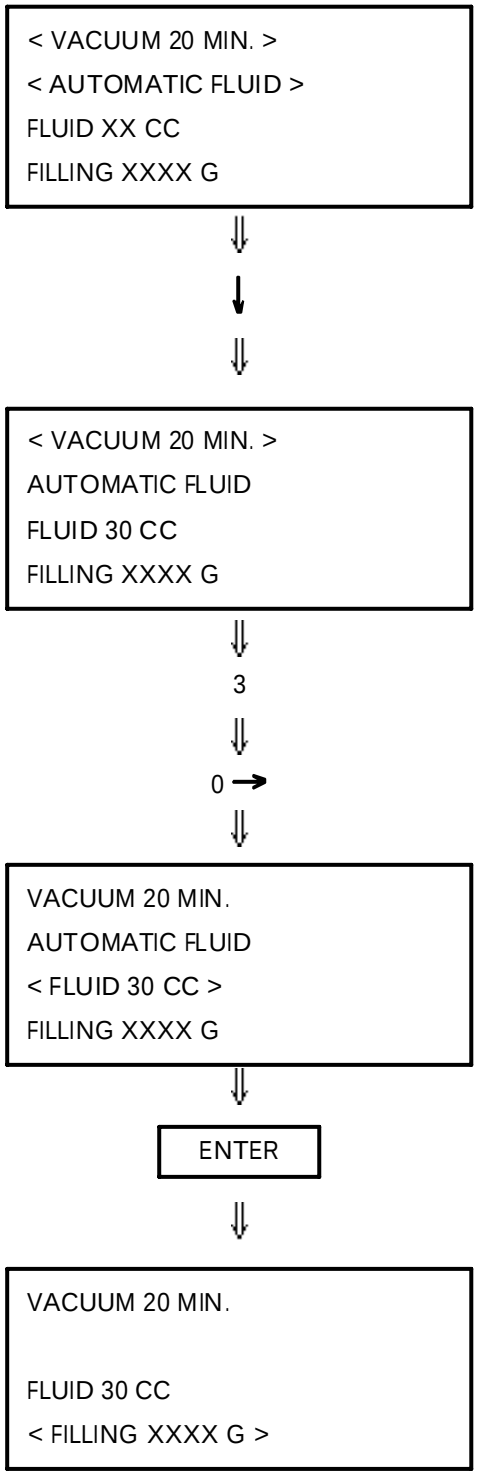
VACUUM 20 MIN.
< AUTOMATIC FLUID >
FLUID XX CC
FILLING XXXX G

Once the vacuum time has been confirmed, the message "Automatic fluid" begins to flash.
Press ENTER to confirm.

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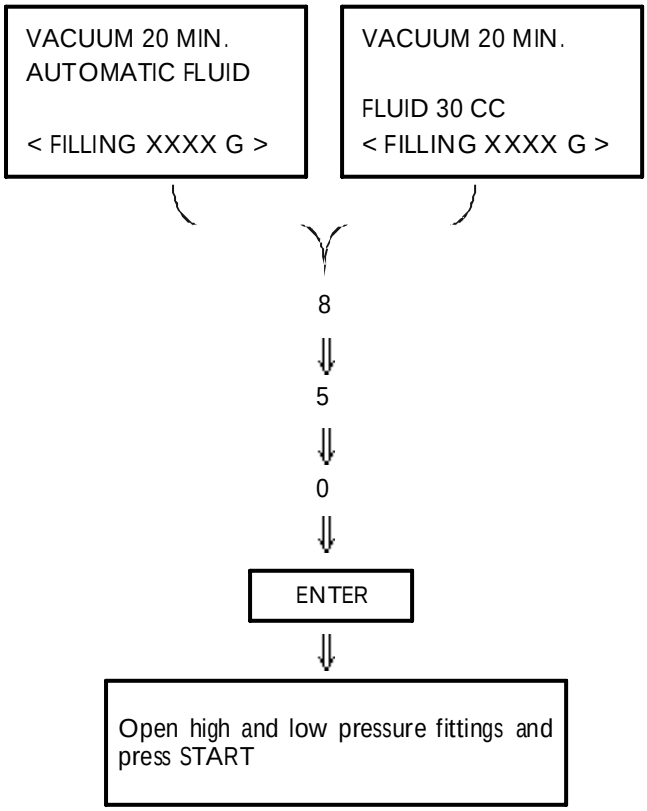



If the automatic fluid is confirmed, the system automatically adds the amount of fluid removed during recovery after the vacuum stage.




If you need to add a quantity of fluid other than the quantity drained after recovery, set as follows: once the vacuum time has been confirmed, the message "Automatic fluid" begins to flash.
Press the ↓ key to move to the message "Fluid xx cc", enter the volume of fluid you wish to be added automatically after the vacuum using the keys 0-... 9 and press ENTER.

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Once the fluid has been confirmed, the message "Filling xxxx g" begins to flash. Set the quantity of coolant in g you wish to add to the A/C system.
For example, if the quantity is 850 g, press the keys 8, 5 and 0 "Filling 850 g".
After setting the quantity, confirm with ENTER.

Open the machine high and low pressure fittings and press the START key.

If a gas analyser is installed, the machine tests the purity of the air conditioning system coolant.
If the coolant is sufficiently pure, recovery begins.
If the A/C system does not achieve the required level of purity, the machine runs a second test.
If the second test fails, the machine displays the alarm message "A/C system contains contaminated coolant".

Contaminated coolant cannot be recovered because it would contaminate the coolant inside the machine cylinder.

During the recovery stage, the system displays the amount of coolant recovered in g.
Once recovery is complete, the machine stops draining and automatically displays the spent fluid removed from the A/C system during recovery.

The fluid drain operation lasts 3 minutes. If some pockets of coolant remaining in the A/C system after this operation cause the pressure to increase, the machine automatically begins to recover the coolant.
After draining, the vacuum operation begins automatically for the preset time. After the first 10 minutes, a check is run for A/C system leaks (attention: if vacuum time is < 10 minutes, the machine will not check for leaks in the A/C system).
If leaks are found in the A/C system, the machine automatically stops and displays the "leaks in A/C system" alarm (detection of microleaks is not guaranteed).

If the A/C system seal is effective, the machine will continue with the vacuum operation.
Once the vacuum stage is complete, new fluid is added automatically according to the amount of fluid drained or according to the volume set by the operator.
At the end, the system automatically switches to refilling and adds the set amount.

Once the refilling operation is complete, close the machine high and low pressure fittings and turn on the A/C system to check the pressures.
During the pressure check, the machine displays "Press ENTER to print a pressure graph".
To obtain a print-out, press ENTER. A pressure graph may be printed for other checks by pressing the START key.
After the pressure check, the machine displays the message "Disconnect the HP fitting and open HP-BP".
Now disconnect the quick coupling only from the A/C system (turn the engine off if necessary) and open the high and low pressure taps with the A/C system running so that the A/C system drains off the coolant in the pipes.

After approximately one minute, remove the machine low pressure fitting from the vehicle A/C system and turn off the engine.
Set the master switch (13, Figure 221) to 0.

**NOTE** The automatic procedure may be run even if the A/C system is empty. In this case, the system begins directly from the vacuum operation.

If the A/C system only has one high pressure quick coupling, set the filling quantity to +150g.

## ASSISTED PROCEDURE

In the assisted procedure, each operation may be carried out individually apart from the recycling recovery stage, which is followed automatically by the spent fuel drain stage and the vacuum for the set time.

The amount of gas recovered, recovered oil, vacuum time, oil added and the amount of gas injected are printed automatically at the end of each individual operation.

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Recycling recovery

Connect the hoses to the A/C system using the quick couplings, taking care to connect the BLUE hose to the low pressure branch and the RED hose to the high pressure branch.
If the system is equipped with a single high or low pressure quick coupling, only connect the relevant quick coupling.
Turn on the vehicle engine and air conditioner for 5-10 minutes, keeping the passenger compartment fan running at maximum speed.
Turn off the vehicle engine.
Follow the assisted procedure, i.e. press ENTER when the message "Assisted procedure" flashes on the LCD.

If following the assisted procedure, press ENTER when the message "Recycling recovery" flashes on the LCD.
Open the machine high and low pressure fittings and press the START key.

If a gas analyser is installed, the machine tests the purity of the air conditioning system coolant.
If the coolant is sufficiently pure, recovery begins. If the A/C system does not achieve the required level of purity, the machine runs a second test.
If the second test fails, the machine displays the alarm message "A/C system contains contaminated coolant".

Contaminated coolant cannot be recovered because it would contaminate the coolant inside the machine cylinder.

During the recovery stage, the system displays the amount of coolant recovered in g.
Once recovery is complete, the machine stops draining and automatically displays the spent fluid removed from the A/C system during recovery.
The fluid drain operation lasts 3 minutes.
If some pockets of coolant remaining in the A/C system after this operation cause the pressure to increase, the machine automatically begins to recover the coolant.

Vacuum

Connect the hoses to the A/C system using the quick couplings, taking care to connect the BLUE hose to the low pressure branch and the RED hose to the high pressure branch.
If the system is equipped with a single high or low pressure quick coupling, only connect the relevant quick coupling.
Follow the assisted procedure, i.e. press ENTER when the message "Assisted procedure" flashes on the LCD.
To select vacuum, press ENTER when the message "Vacuum xx min" flashes on the LCD.

Set the vacuum time only if you wish to change the previously set time.
Press ENTER to confirm.
Open the machine high and low pressure fittings and press START.
At this point, the vacuum operation begins for the preset time.
After the first 10 minutes, a check is run for A/C system leaks (attention: if vacuum time is < 10 minutes, the machine will not check for leaks in the A/C system). Leaks are found in the A/C system, the machine automatically stops and displays the "leaks in A/C system" alarm (detection of microleaks is not guaranteed); in this event, use leak detector 99305147.
If the A/C system seal is effective, the machine will continue with the vacuum operation.

Adding new fluid

This operation may be carried out exclusively following a vacuum operation and before refilling.
Follow the assisted procedure, i.e. press ENTER when the message "Assisted procedure" flashes on the LCD.
Select the fluid, i.e. when the message "Fluid xx cc" flashes on the LCD.
Set the volume of new fluid to be added in $cm^3$.
Press ENTER to confirm.
Open at least one of the two machine high or low pressure valves and press START.

Filling A/C systems

Follow the assisted procedure, i.e. press ENTER when the message "Assisted procedure" flashes on the LCD.
Select refilling, i.e. when the message "Refilling xxxx g" flashes on the LCD.
Set the amount you wish to add to the A/C system in grams (if an A/C system contains 740g press keys 7, 4 and 0.
To check, ensure the message "Filling 740g" is displayed).
Press ENTER to confirm.

Press the START key and open the machine high pressure tap (if the A/C system only has one low pressure fitting, open the machine low pressure tap).
Once the refilling operation is complete, close the machine high and low pressure fittings and turn on the A/C system to check the pressures.
During the pressure check, the machine displays "Press ENTER to print a pressure graph".
To obtain a print-out, press ENTER.
A pressure graph may be printed for other checks by pressing the START key.
After the pressure check, the machine displays the message "Disconnect the HP fitting and open HP-BP".
Now disconnect the quick coupling only from the A/C system (turn the engine off if necessary) and open the high and low pressure taps with the A/C system running so that the A/C system drains off the coolant in the pipes.

After approximately one minute, remove the machine low pressure fitting from the vehicle A/C system and turn off the engine.
Set the master switch (13, Figure 221) to 0.
If the A/C system only has one high pressure quick coupling, set the filling quantity to +150g (this is the amount that may remain in the high pressure pipe).

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## LEAK FINDER FOR AIR-CONDITIONING SYSTEMS WITH HFC R134A (99305147)

Tool L-780A makes it possible to identify leakage of HFC 134A gas from the system extremely accurately in the order of 3.3 g a year with the switch on maximum sensitivity.

This instrument requires no settings, the operator only needs to select the desired sensitivity.

The instrument warns the operator of any gas leakage with a buzzer and a LED that flashes in proportion to the concentration of gas.

In addition, the LED indicates the battery is flat if it goes out.

Operating temperature is between 0 C and 50°C.

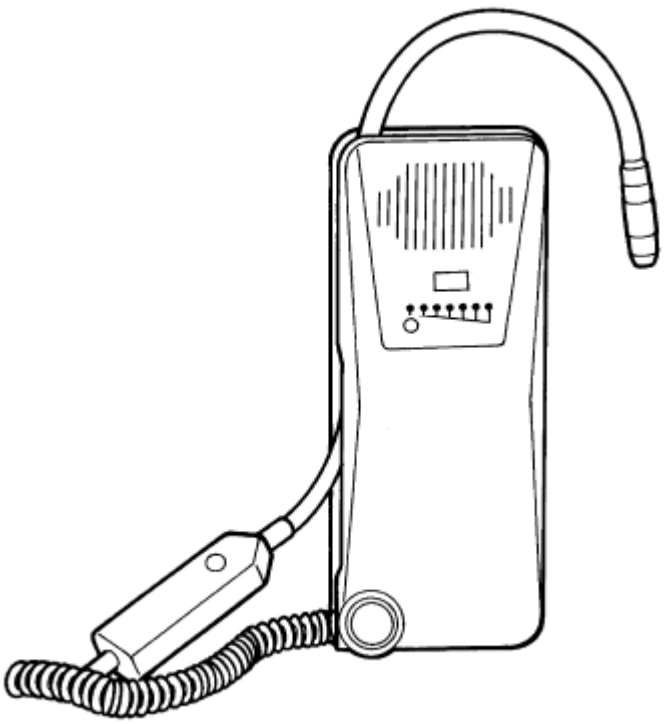
The instrument is equipped with a flexible probe to reach particularly difficult fittings or parts.

The two levels of sensitivity are:

- low sensitivity = 16.5 g/year;
- high sensitivity = 3.3 g/year.

**NOTE** Before checking vehicles, wait for the engine to cool, the hot parts can falsify the test.

Figure 223



50643

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## 5001 CHASSIS FRAME

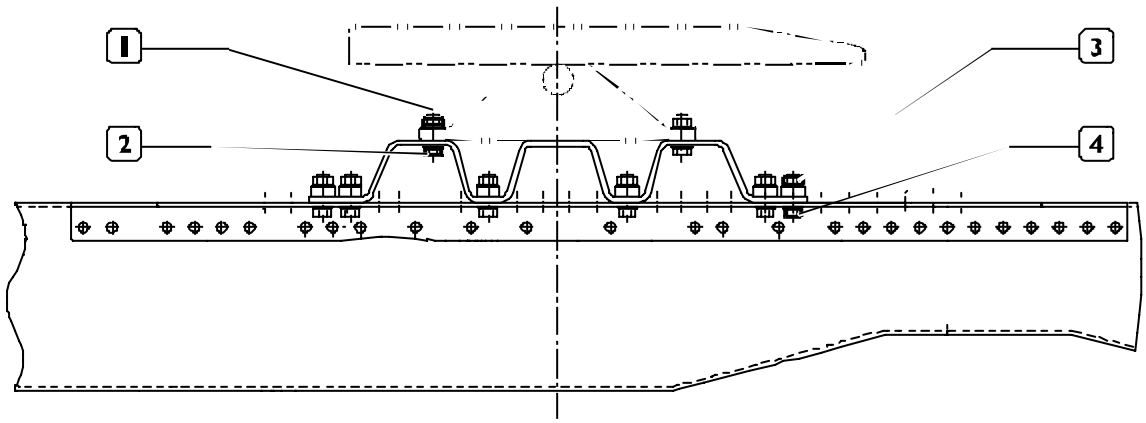
Double bottle neck high resistance steel chassis.

Dimensions

| | | |
|---|---|---|
| Inner distance between side members: | | 1016 mm (front)<br>836 (middle)<br>756 mm (rear) |
| Note: Indicated distances are independent of thickness. | | |
| Side member section inner height | | 289 mm (front)<br>199 mm (rear) |
| Side member thickness: | 6.7 mm | (180W, 190/260/340W, 400IT/WT, 440T, 260/380B) |
| | 7.7 mm | (380T/W/B, 410T/W/B, 720T/WT) |

## TIGHTENING TORQUES

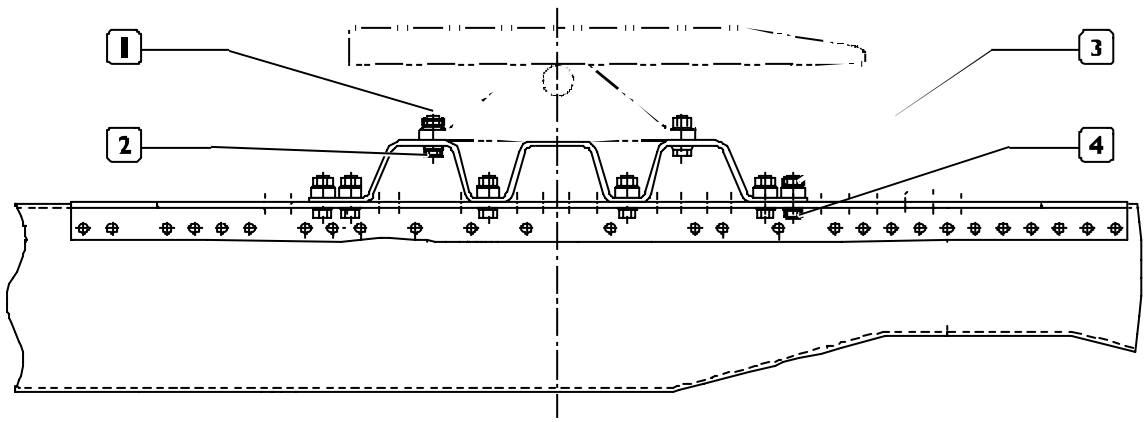
Figure 224




90317

SEMITRAILER FIFTH WHEEL MOUNTING SCHEME

Figure 225




90318

SEMITRAILER PLATE AND FIFTH WHEEL MOUNTING SCHEME

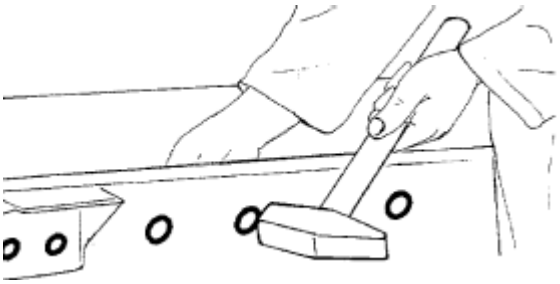
| DESCRIPTION | TORQUE | |
|---|---|---|
| | Nm | Kgm |
| Screw with M16x1.5 flange securing fifth wheel to chassis or plate | 238 ± 26 | 23.8 ± 2.6 |
| Nut with M16x1.5 flange securing fifth wheel to chassis or plate | 310.5 ± 33.5 | 31 ± 3.3 |
| Nut with M16x1.5 flange securing plate to chassis | 310.5 ± 33.5 | 31 ± 3.3 |
| Screw with M16x1.5 flange securing plate to chassis | 238 ± 26 | 23.8 ± 2.6 |

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## REPAIRS
## CHECKS

Inspect the chassis frame, checking its alignment.
If even at this stage you detect any deformation you then need to free the relevant part of the chassis frame to help make an exact measurement.
Before the test you need to check all the parts that, with their imperfections, affect the exact measurements (for example, tyre pressure, weak or broken leaf springs, etc.).

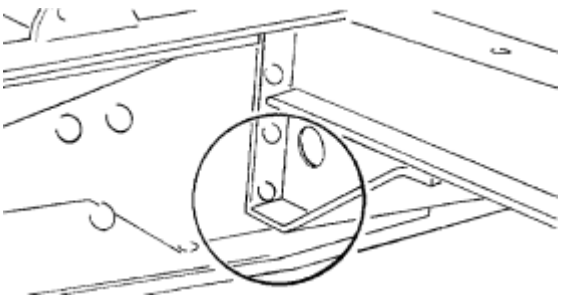
Figure 226



17344

Check the rivets by striking their heads with a mallet and touching the opposite side with your fingers.
Mark any loose rivets with paint to help identify them during the repair work.

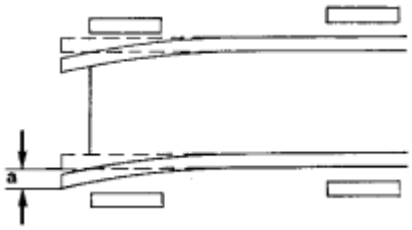
Figure 227



17345

Carefully check for any peeling or cracking all over the chassis frame, paying special attention to joints under great strain, such as: chassis frame cross members, brackets, mounts of leaf springs and chassis frame structural members.
Mark any peeled or cracked points straight away.

Figure 228




17347

Laterally permissible curvature of chassis frame
"a" = 3 mm/m.

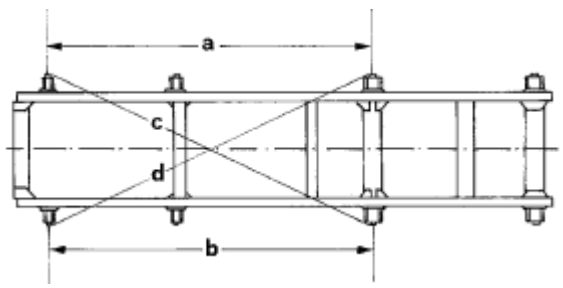
Figure 229




17348

Permissible curvature of chassis frame
"b" = 1 mm/m
Maximum 10 mm.

Figure 230




17349

Permissible difference between "a" and "b" = 3 mm.
With diagonal measurement between "c" and "d" = 6 mm.

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## Measuring the bend of the chassis frame downwards or upwards

Figure 231

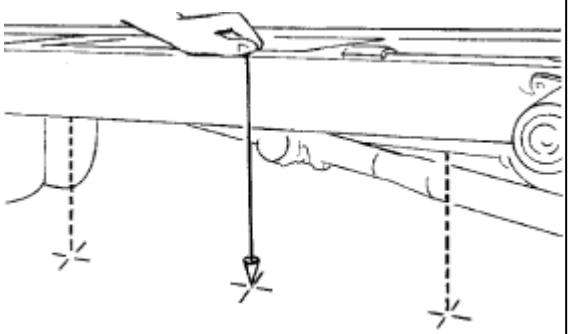



17350

Permissible torsion on the chassis frame
"b" = 1 mm each side.

## Measuring the side bend of the chassis frame

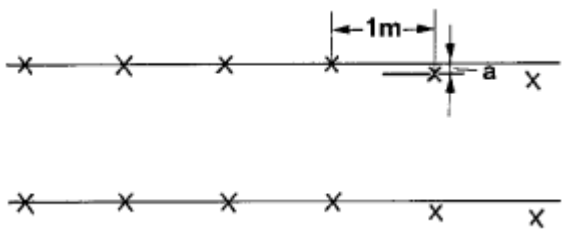
Figure 232



17351

To measure the side bend of the chassis frame you need to plumb the supporting surfaces starting with the two structural members at an interval of approximately 1 m.
The points obtained in this way need to be marked accurately on the floor.

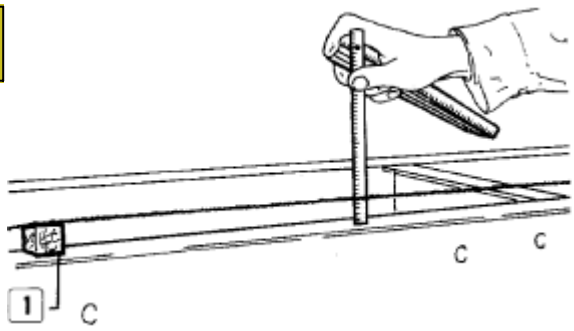
Figure 233




17352

To use the plumbed points you need to stretch out a string passing through the marked points in a line.
The points outside the line indicate the start and extent of the actual deformation (a).

Figure 234

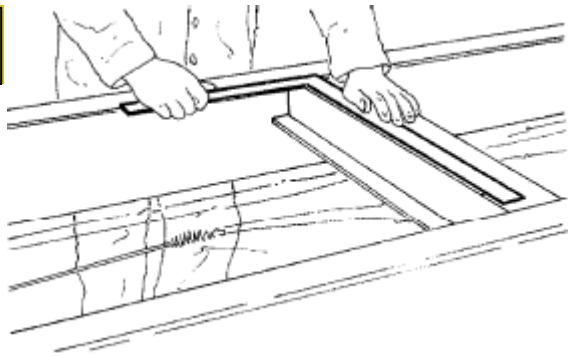



17353

Take two shims (1) of such a size that a string can be stretched along the full length from the straight portion of the bottom or top waist on the structural member of the chassis frame.
Measure the distance of the structural member from the string at 1-metre intervals. A different string distance indicates the position and extent of an actual bend in the structural member.

## Measuring the movement of the chassis frame

Figure 235

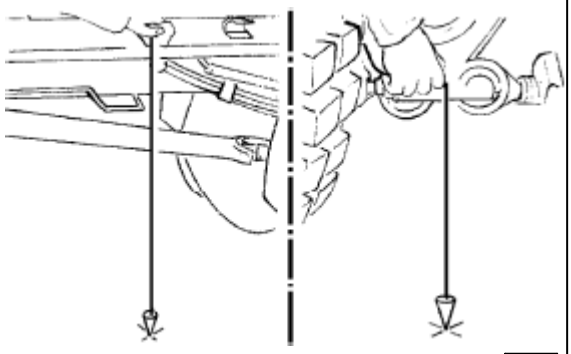


17354

A movement of the chassis frame can be measured by means of a set square.
To do this, place the set square at 90° to the structural member of the chassis frame and check the squareness of the cross members of the chassis frame.

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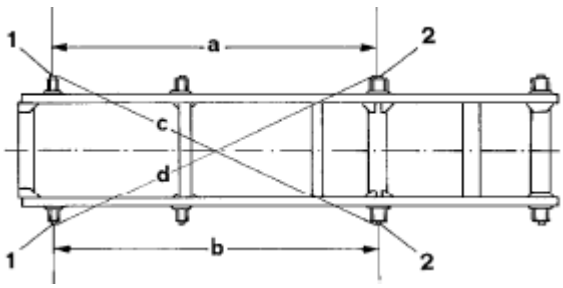
Figure 236



17355

A movement in the position of the axes can be checked by making a diagonal measurement. To do this, plumb the centre of the front mount of the front suspension and the centre of the front support of the rear leaf spring on the flat supporting surface, on both sides.

Figure 237

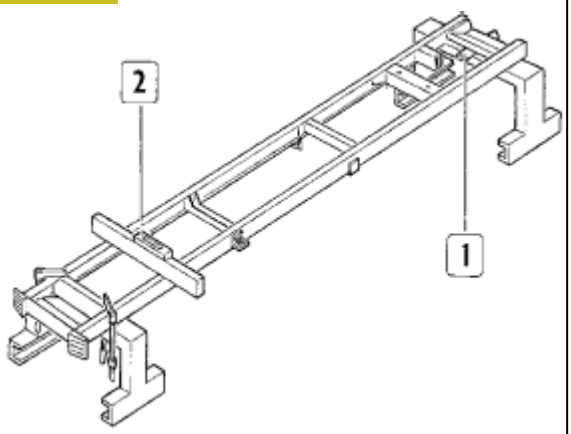



17356

Firstly compare the distance of the points "a" and "b". Then make the diagonal measurement (distance "c" and "d") from point (2) in front to the right to point (2) behind to the left and the opposite.

## Measuring the torsion of the chassis frame

Figure 238




17357

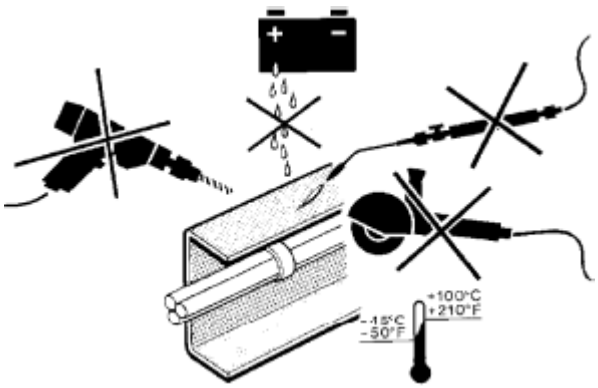
A slight torsion can only be measured with the chassis frame freed of the cab and mechanical assemblies.
To do this check, proceed as follows:

- Set the chassis frame on two stands.
- Using two clamps, secure one side of the chassis frame to the stand.
- Position the other side of the chassis frame, in a central position under the rear cross member, on the knee of an L-shaped iron (1).
- Set a rule crosswise and put a spirit level (2) on this, checking the reading.

At each check point you will need to have the same reading or the chassis frame is out of shape.

## PRECAUTIONS

Figure 239

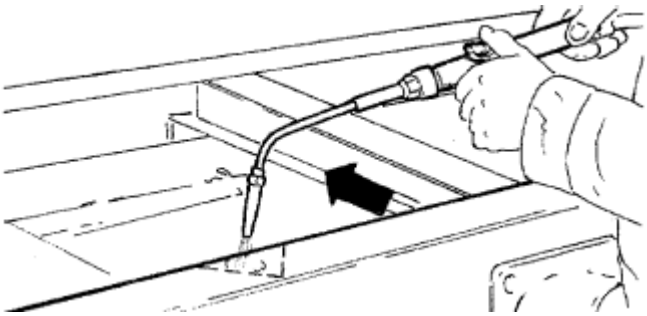



17358

During the work of welding, drilling, grinding, cutting near brake system piping, especially if this is made of plastic, and electric cables, take the appropriate precautions to protect them, contemplating their removal if required. All the parts of the chassis frame subject to reconditioning will need to be protected against oxidation and corrosion.
This protection and painting will need to be done carefully on all the parts concerned, as per any relevant instructions, methods and precautions of the paint manufacturers.

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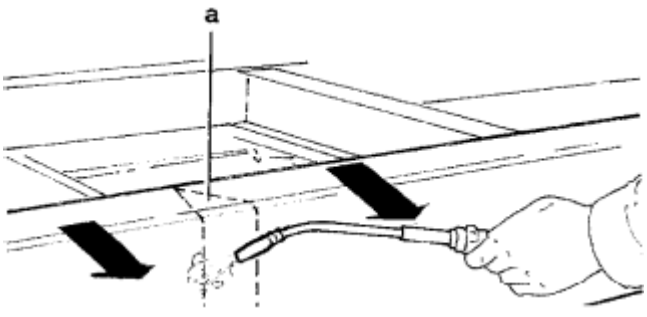
Figure 240



17359

The chassis frame is reconditioned by wedge heating the relevant part with a blowpipe.
During this operation the metal needs to turn cherry red, which corresponds to a temperature of 600 - 680ºC.
The heated points must undergo no further heating.
Let the treated parts cool slowly without using any water, compressed air or the like.

Figure 241

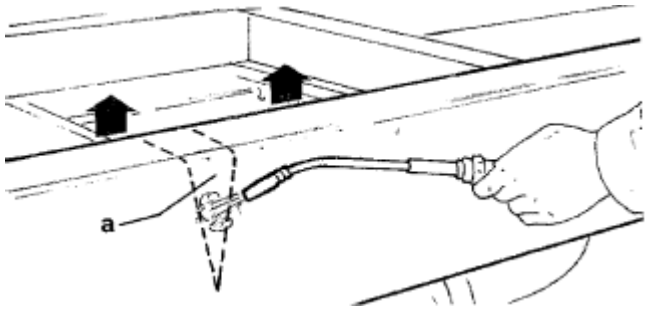



17360

Straighten the side bend of the chassis frame with wedge heating on the top and bottom waist of the part concerning the chassis frame.
The tip of the heating wedge has to lie in the direction of the required bend.

If the base (a, Figure 44) of the two heating wedges is in the top plate of the structural member, then the plate also needs to be heated, but last.

Figure 242



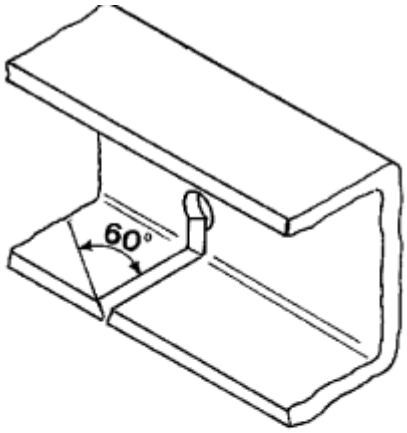

17361

Straighten the sag in the chassis frame downwards or upwards with wedge heating on the top plate of the structural member.
In the case of downward bending, the base (a) of the heating wedge is at the bottom. In the case of upward bending, do the opposite.
The relevant bottom or top waist of the structural member has to be heated last in the area of the base of the heating wedge.

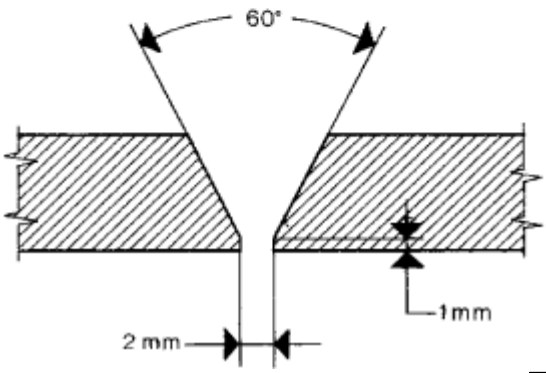
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## Welds on the chassis frame

Figure 243




7362

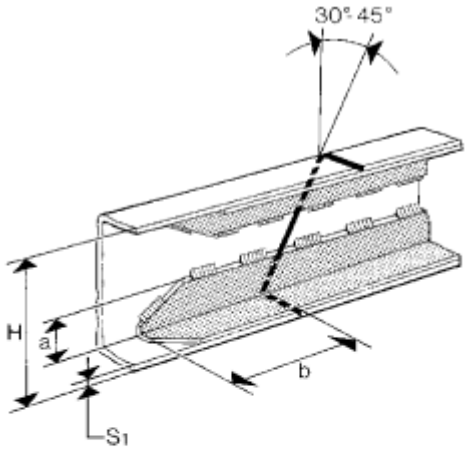



17363

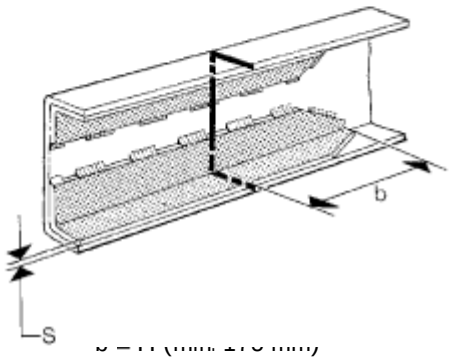
Before starting work, disconnect the negative battery terminal and connect the earth of the welding machine straight onto the piece to weld. Plastic pipes will need to be protected or removed.
Welds will have to be made solely by skilled, trained personnel, with suitable equipment and in workmanlike fashion.
Strip and deoxidize the parts to weld. At the point of breakage, on the inside of the structural member and along the full length of the relevant section, make a V bevel of 60°.

No cuts are permitted on the structural members at areas of changes in profile or at points with a high concentration of stresses; additionally, the line of separation must not concern the holes already in the structural member.

Figure 244




17364




S ≒ (0.8 ÷ 1) Sl

17365

Here we give the operating instructions for proper welding:

a) Heat all around the area to weld (except for QST E 420 material). Do the arc welding with several passes, using thoroughly dried basic electrodes, or MIG-MAG procedures with suitable filler material. Do not overcharge with current. The weld must have no edge cuts or dross.

b) Start back welding as specified in point (a).

c) Leave the structural members to cool slowly and evenly. It is not permissible to use jets of air or other means.

d) Grind off the excess material.

e) Apply steel corner strengthening, with the same specifications as the steel used in the chassis frame. The approximate minimum dimensions are given in the above illustrations. They are to be fixed solely on the vertical rib of the structural member and it is possible to use bead welding, dummy spots, screws or rivets. The cross section and length of the weld bead, the number and distribution of the dummy spots, screws or rivets must be suited to transmit the bending and cutting moments of the section. On completing the work, the part involved in welding must be effectively protected with rust proofing.

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SECTION 15

# Programmed maintenance


| | Page |
|---|---|
| DIAGRAM OF POINTS FOR CHECKS AND/OR MAINTENANCE OPERATIONS | 3 |
| MAINTENANCE SERVICES CHART | 5 |
| PROGRAMMED MAINTENANCE WITH HOUR INTERVALS (FOR VEHICLES USED IN QUARRIES AND CONSTRUCTION SITES) | 5 |
| CHECKS AND/OR MAINTENANCE OPERATIONS | 6 |
| - Hour interval schedule for quarries and construction site vehicles and off-road vehicles | 6 |
| TIMED OPERATIONS | 7 |
| - Plan with hour interval for quarry and building yard vehicles and for off-road vehicles | 7 |
| CHECKS AND/OR MAINTENANCE OPERATIONS (PLAN WITH HOUR INTERVALS) | 8 |
| M1 SERVICE | 8 |
| M2 SERVICE | 11 |
| M3 SERVICE | 14 |
| TIMED OPERATIONS WITH HOUR INTERVALS | 15 |
| T1 SERVICE | 15 |
| T2 SERVICE | 15 |
| T3 SERVICE | 16 |
| T4 SERVICE | 17 |
| T5 SERVICE | 17 |
| T6 SERVICE | 17 |
| T7 SERVICE | 18 |
| T8 SERVICE | 18 |
| PROGRAMMED MAINTENANCE WITH KM INTERVALS (For vehicles used on the road for medium and long distances) | 19 |
| CHECKS AND/OR MAINTENANCE OPERATIONS | 20 |
| - Schedule with km intervals for vehicles used on the road for medium and long distances | 20 |

https://truckmanualshub.com/

Aquila Trucks Centres

Page

EXTRA PLAN/TIMED OPERATIONS . . . . . 21

- Plan with kilometer intervals for road use vehicles over middle to long runs . . . . . 21

CONTROL AND/OR MAINTENANCE INTERVENTIONS (PLAN WITH KM INTERVALS) . . . . . 22

M1 SERVICE . . . . . 22

M2 SERVICE . . . . . 25

M3 SERVICE . . . . . 29

EXTRA PLAN/TIMED OPERATIONS (PLAN WITH KM INTERVALS) . . . . . 29

EP1 SERVICE . . . . . 29

EP2 SERVICE . . . . . 31

T1 SERVICE . . . . . 31

T2 SERVICE . . . . . 32

T3 SERVICE . . . . . 32

T4 SERVICE . . . . . 32

T5 SERVICE . . . . . 32

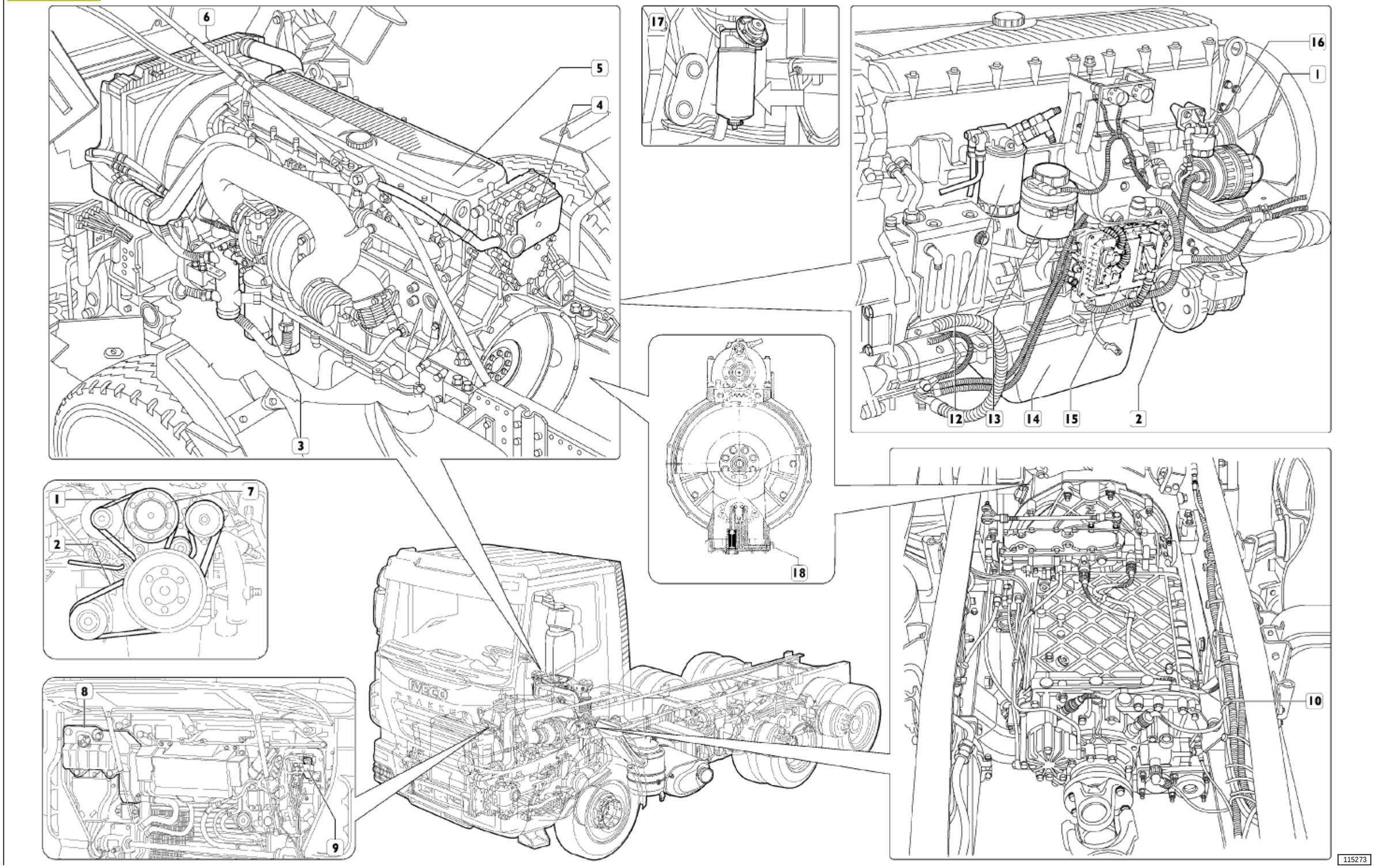
T6 SERVICE . . . . . 33

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## DIAGRAM OF POINTS FOR CHECKS AND/OR MAINTENANCE OPERATIONS

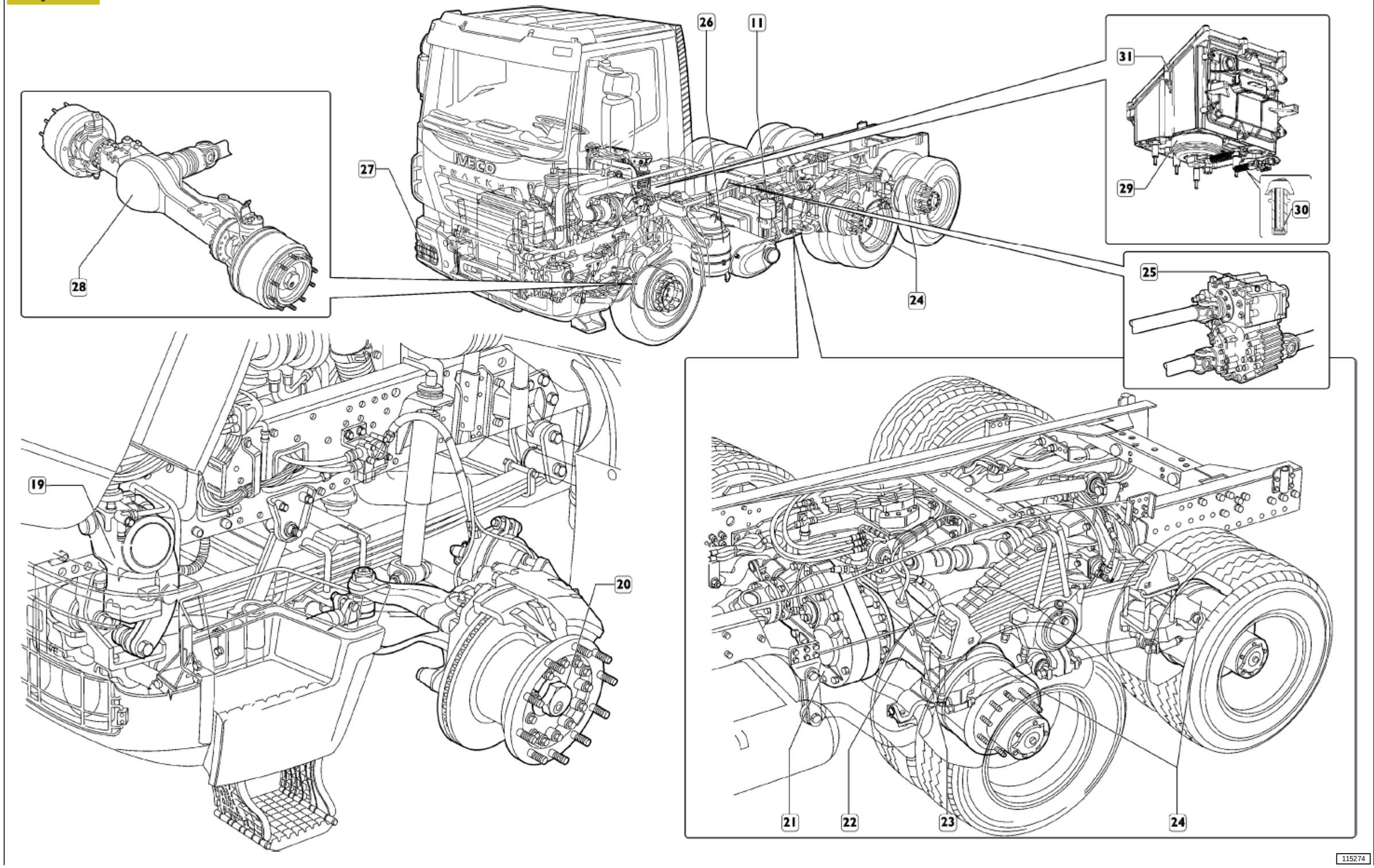
Figure 1



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## DIAGRAM OF POINTS FOR CHECKS AND/OR MAINTENANCE OPERATIONS

Figure 2




115274

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## MAINTENANCE SERVICES CHART

The Extra Plan operations (designated with the letters EP) are complementary to standard services.
They are maintenance operations to be carried out at regular time or mileage intervals and concern optional components that are not present on all models.
Important! The correlation between kilometres and months only applies in cases where the distance travelled by the vehicle corresponds roughly to the specified average annual mileage. This is indicated only in order to suggest a hypothetical maintenance programme,. Note that the time intervals specified for Extra Plan operations are to be adhered to regardless of the actual mileage covered.

The kilometre frequency for engine lubrication is in relation to a percentage of sulphur in diesel of under 0.5%.
NOTE: If using diesel with a percentage of sulphur above 0.5%, the oil-change frequency has to be halved.

Use engine oil: ACEA E4 (URANIA FE 5 W 30) - ACEA7 (URANIA LD7)

## PROGRAMMED MAINTENANCE WITH HOUR NTERVALS (FOR VEHICLES USED IN QUARRIES AND CONSTRUCTION SITES)

- ACEA E4 lubricants classified as ACEA E6 cannot be used according to the change intervals established for class ACEA E4. They shall be changed according to the time intervals established for lubricants ACEA E2, i.e. every 400 hours.
- If class ACEA E7 (Urania LD7) engine oil is used, the engine oil and filters must be changed every 800 hours.
- If class ACEA E2 (Urania Turbo) engine oil is used, the engine oil and filters must be changed every 400 hours.
- In the event of very low annual operating time or anyway below 1000 hours/year, the engine oil and the filters shall be changed every 12 months.
- In the event of operating time below 1000 hours/year, the oil of the rear axles, distributor, transmission, etc. shall be changed at least every 2 years.
- The filter dryer of the pneumatic system must in any case be renewed every year.
- In the case of very low annual mileage, general greasing must be carried out at least once a year.

To schedule the work, keep to the following chart:

| OILS | SERVICES | | | EXTRA PLAN PROGRAMMED OPERATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Engine ACEA E4 (1) Urania FE5W30 | M1 | M2 | M3 | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 |
| | Every 1000 hours | Every 1500 hours | Every 3000 hours | Multipower every 800 hours | Gearbox oil and filter + Intarder (2) | Every 3 months | Every year before winter | Every year before summer | Every year | Every 2 years | Every 3 years |

(1) IVECO suggests the use of these lubricants to raise the vehicle "fuel economy". The new vehicle is already equipped by IVECO with these types of lubricants, suitable also for cold climates (minimum temperature down to -30°). The change intervals depend on the use of these oils.

(2) See note at page 7.

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## CHECKS AND/OR MAINTENANCE OPERATIONS
### Hour interval schedule for quarries and construction site vehicles and off-road vehicles

| Type of operation | | M1 | M2 | M3 |
|---|---|---|---|---|
| References figure 1/2 | Engine | | | |
| 14 | Change engine oil | • | | • |
| 3 | Replace engine oil filter | • | | • |
| 12 | Replace fuel filter | • | | • |
| 1-2 | Replace miscellaneous drive belts | • | | |
| 13 | Replace or clean hydraulic steering system filter | • | | • |
| 15 | Check-up of engine EDC system via MODUS, IT 2000 or E.A.SY. | | • | • |
| 5 | Check valve clearance and adjust if necessary | | • | • |
| 16 | Replace variable geometry turbocharger VGT air filter | | • | • |
| 1 | Replace engine auxiliary member drive belt | | | • |
| 2 | Replace air-conditioner compressor drive belt | | | • |
| 7 | Checking fan electromagnetic joint clutch wear (if applicable) | • | | • |
| | Chassis and mechanical assemblies | | | |
| 17 | Replace fuel pre-filter | • | | • |
| 10 | Check efficiency and clean gearbox oil bleeds | • | | • |
| 9 | Check clutch fluid level | • | | • |
| 11 | Replace pneumatic system drier filter | • | | • |
| • | Grease the VGT control lever | | • | • |
| | Chassis and mechanical assemblies | | | |
| 28 | Check efficiency and clean drive axle oil bleeds (for 4x4, 6x6, 8x8 vehicles) | • | | • |
| 25 | Clean divider oil bleeds between axles | • | | • |
| 23 | Clean axle oil bleed | • | | • |
| • | General greasing | • | | • |
| 28 | Change drive axle oil (for 4x4, 6x6, 8x8 vehicles) | | • | • |
| • | Change front side reduction gear oil (for 4x4, 6x6, 8x8 vehicles) | | • | • |
| 22 | Change axle oil | | • | • |
| 20 | Change front wheel hub oil (for 4x2, 6x4, 8x4 vehicles) | | • | • |
| 21 | Change transmission assembly oil (for 6x4, 6x6, 8x8 vehicles) | | • | • |
| 25 | Change transfer box oil (for 4x4, 6x6, 8x8 vehicles) | | • | • |
| 19 | Control of the guide and support fixture | | • | • |
| 29-30 | AdBlue system filter and pre-filter change | | • | • |
| | Cab and electric appliances | | | |
| 27 | Check headlight adjustment | | • | • |
| 31 | AdBlue system test with EASY, MODUS or IT2000 | • | • | • |
| | Miscellaneous | | | |
| • | Handling operations (1) | • | • | • |
| • | Functional testing on road | • | • | • |
| • | Cabin tilting / opening / closure of cowling | • | • | • |

(1) Vehicle and tooling handling activity in the workshop.

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## TIMED OPERATIONS

### Plan with hour interval for quarry and building yard vehicles and for off-road vehicles

| | | |
|---|---|---|
| T1 | | Every 800 hours |
| | | Simultaneously with a maintenance service |
| | 534501 | Replacing total power take-off (Multi-power) oil |
| T2 | | Every 1200 hours, gearboxes supplied with mineral oil (1)<br>Every 2400 hours, ZF 9 S 1310 gearboxes supplied with synthetic oil (2)<br>Every 3600 hours, ZF EUROTRONIC gearboxes supplied with synthetic oil (3) |
| | | Together with maintenance operations |
| | 530105 | Change oil and filter of ZF transmission + Intarder |
| | 530105 | Change gearbox oil |
| T3 | | Every 3 months |
| | 553261 | Checking anti-pollen filter (4) condition |
| | 506011 | Washing radiator guard grid |
| T4 | | Every year - before Winter |
| | | Possibly, and simultaneously with a maintenance service |
| | 506019 | Checking coolant density |
| | 773130 | Replacing additional heater fuel filter |
| T5 | | Every year - before Summer |
| | | Possibly, and simultaneously with a maintenance service |
| | 506010 | Checking possible radiator clogging |
| T6 | | Every year |
| | | Possibly, and simultaneously with a maintenance service |
| | 505100 | Replacing the cartridge and cleaning air filter container (5) |
| | 540450 | Replacing blow-by filter |
| T7 | | Every 2 years |
| | | Possibly, and simultaneously with a maintenance service |
| | 506010 | Replacing engine coolant |
| T8 | | Every 3 years |
| | | Possibly, and simultaneously with a maintenance service |
| | 505292 | Replacing oil and draining clutch hydraulic control |

1) ZF Ecosplit gearboxes supplied with mineral oil, in the event of very low annual operating time change the oil every year

(2) ZF New Ecomid gearboxes supplied with synthetic oil, in the event of very low annual operating time change the oil every 2 years

(3) ZF Eurotronic gearboxes supplied with synthetic oil, in the event of very low annual operating time change the oil every 3 years

(4) In case of low runs, perform filters replacement once a year, at every start of Spring.

(5) Early air filter clogging is generally caused by environmental conditions; for this reason, air filter must be replaced when relating warning from special sensor is issued independently of relevant prescription, which must be anyhow observed in lack of specific indications.

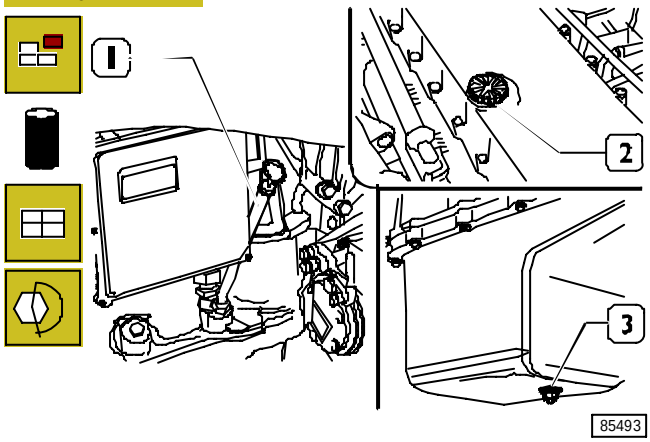
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## CHECKS AND/OR MAINTENANCE OPERATIONS (PLAN WITH HOUR INTERVALS)

### M1 SERVICE

### 542710 Change engine oil

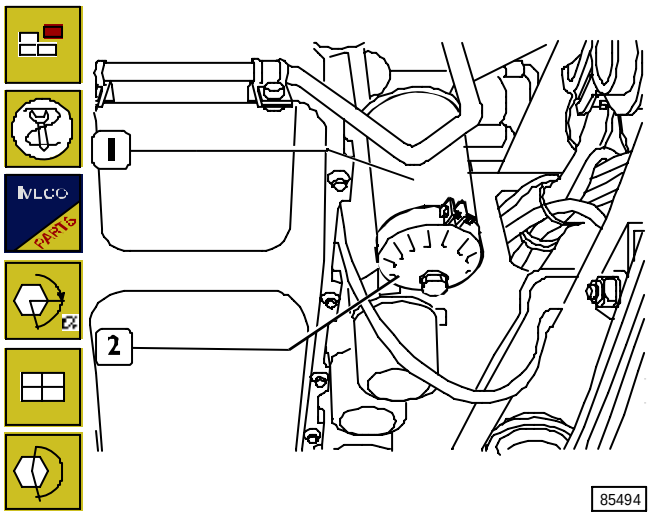
Figure 3




Take out the oil level dipstick (1).
From underneath the vehicle, remove the soundproofing guard.
Unscrew the plug (3) from the oil sump and drain the engine oil off into a specific container.
Screw the plug back on under the sump and tighten it to the required torque.
Fill in with the prescribed oil quantity and quality (see the CAPACITIES table in the GENERAL INFORMATION section) from the tie rod cover pipe union (2).

### 543420 Replace engine oil filters

Figure 4




Drain the oil as described in point "Changing engine oil."

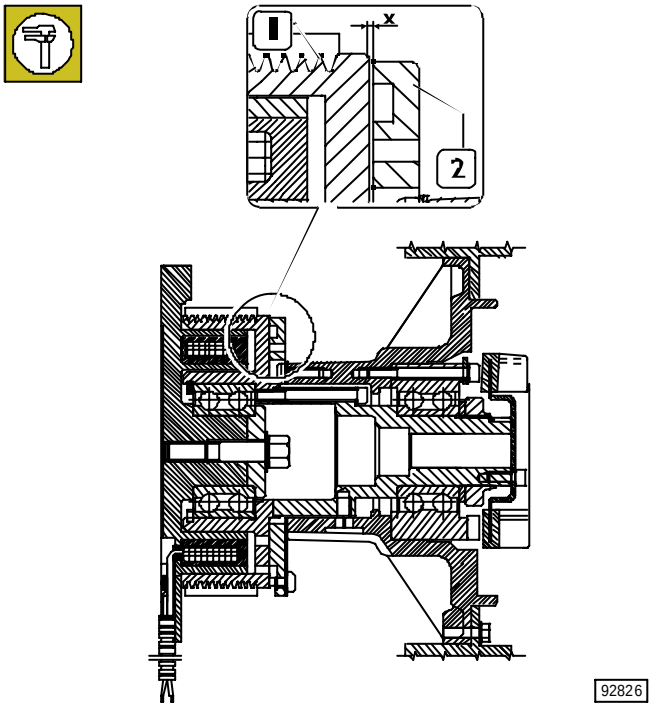
Remove the oil filter (1) with tool 99360314 (2).

**NOTE** Before refitting the new cartridges, moisten the seal with engine oil.

Screw the oil filters (1) on by hand to bring them into contact with the mount and then tighten by 3/4 of a turn to the prescribed torque and proceed as described in point "Changing engine oil."

### 543450 Check electromagnetic coupling clutch wear

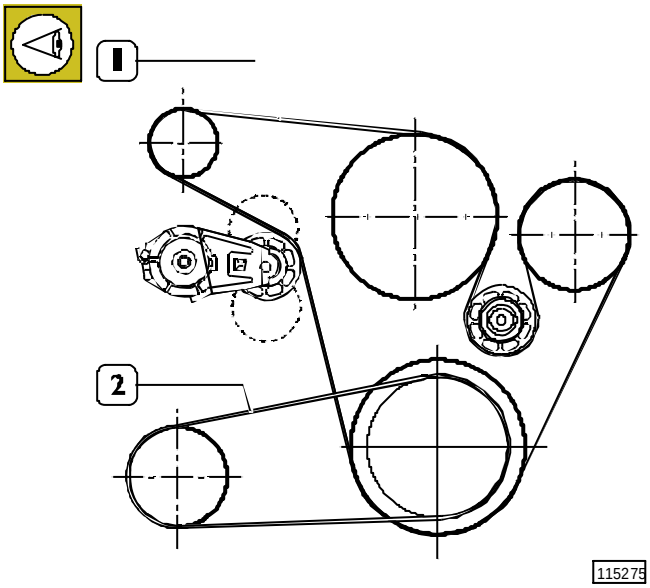
Figure 5




Using a feeler gauge, check the gap between the anchor assembly (2) and the pulley (1), it must be no greater than 2.5 mm.

### 540843/543934 Check miscellaneous drive belts

Figure 6

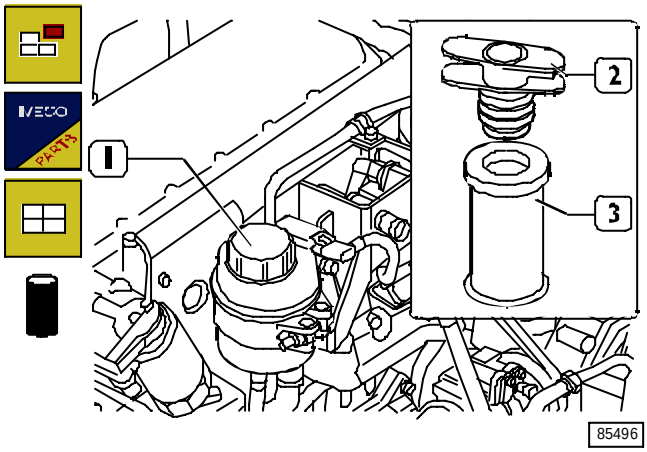



Visually check that the belts (1-2) are neither worn nor deteriorated; if they are, change them as described in the M3 service.

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## 544221 Replace or clean hydraulic steering system filter

Figure 7




Before taking off the cover (1), thoroughly clean the tank.

This will prevent foreign impurities from coming into contact with the oil of the hydraulic system.

Take the cover (1) off the tank and take out the oil filter (3).

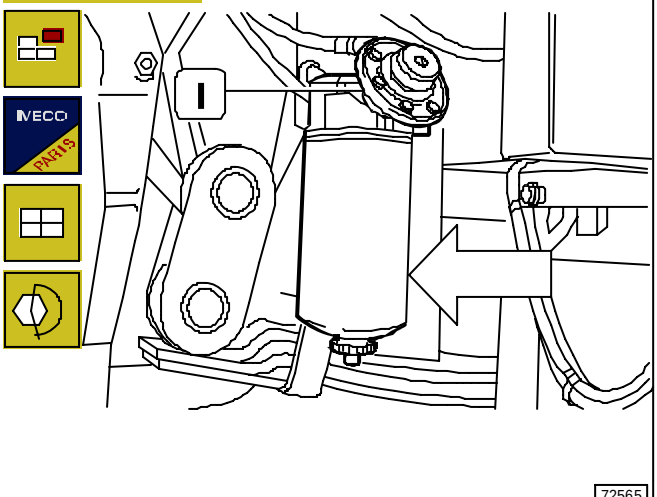
Remove the coupling device (2) from the oil filter (3) and replace the filter.

Take off the plug (1) (after unhooking the transmitter) of the hydraulic power steering tank and check that with the engine running and the wheels travelling in a straight line, the oil level reaches the top reference mark on the dipstick.

With the engine stationary and wheels in a straight line, the oil level has to exceed the top reference mark of the dipstick by 1 or 2 cm; if necessary, top up the level by taking off the cover (1).

## 507210 Replace pre-filter

Figure 8

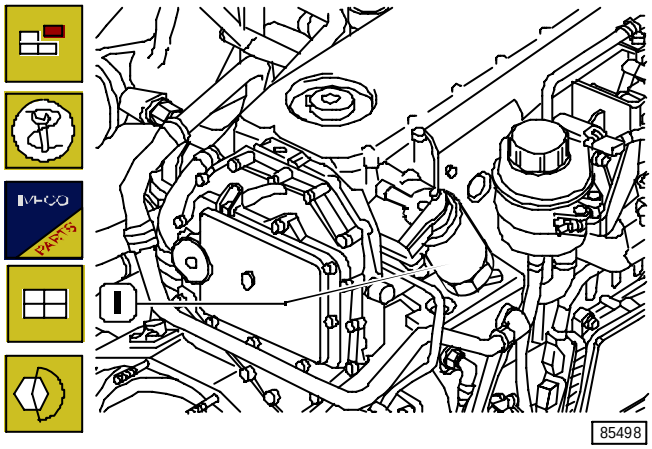



Unscrew the pre-filter (1) and replace it.
Before refitting the new cartridge, moisten the seal with diesel or engine oil. Screw the cartridge on by hand until it is in contact with the mounting and then tighten by 3/4 of a turn to the required tightening torque.

When replacing the cartridge, it must not have been pre-filled. This is to prevent impurities getting into circulation that could damage the injector/pump system components. Bleed the air from the fuel circuit as described on the previous pages.

## 542093 Replace fuel filter

Figure 9

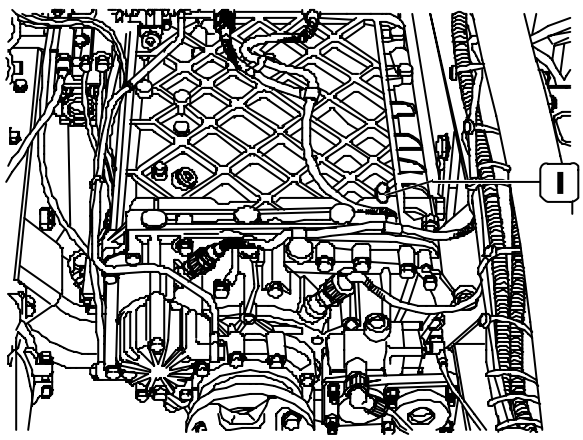



Remove the fuel filter (1) with tool 99360314.
Before refitting the new cartridge, moisten the seal with diesel or engine oil.
Screw the new one on by hand, taking care to check that the rubber seal and the mating surface are clean and in a perfect state of repair. Screw the cartridge on by hand until it is in contact with the mounting and then tighten by 3/4 of a turn to the required tightening torque.

Bleed the air from the supply system as described in the following paragraph.

## 530105 Clean gearbox oil breather (ZF 9/16S gearboxes)

Figure 10

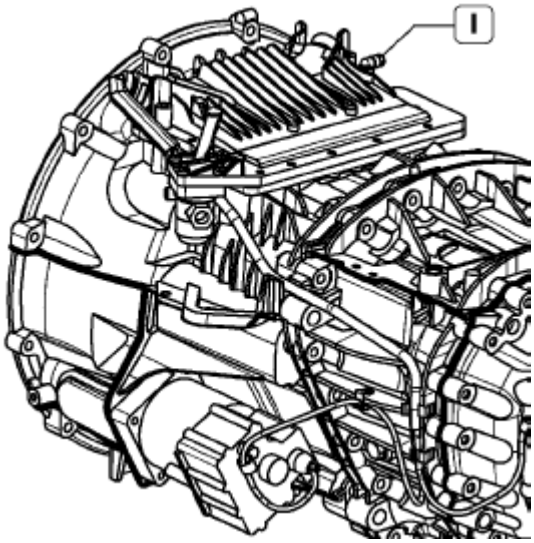



Remove the oil vapour breather (1) and clean it thoroughly. Then fit it back on, checking it is in the right position, and tighten it to the required torque.

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**(ZF 12AS gearboxes)**

Figure 11

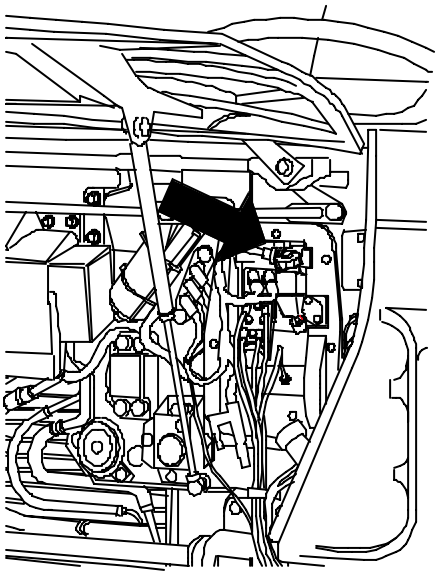



115277

Remove the oil vapour breather (1) and clean it thoroughly. Then fit it back on, checking it is in the right position, and tighten it to the required torque.

## 505292 Check clutch fluid level (Excluding vehicles with EuroTronic gearbox)

Figure 12



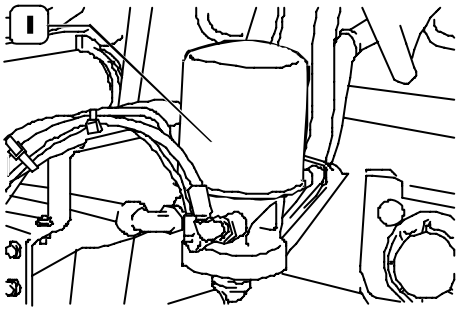
98879

Check the level of the clutch fluid. Top it up if it is too low (see the fluids table in the GENERAL section).

The clutch fluid is poisonous and corrosive: if you accidentally come into contact with it, wash immediately with water and a neutral soap.

## 503447 Replace pneumatic system drier filter

Figure 13



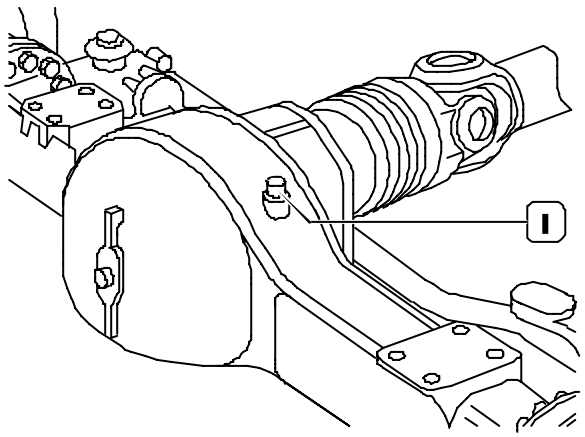

72569

Discharge the pressure from the compressed air system.

Unscrew the drier filter (1) and replace it. Tighten it to the required torque, checking there is no air leakage when pressure is restored.

## 522810 Cleaning engine front axle oil (for versions 4x4/ 6x6/ 8x8 only)

Figure 14



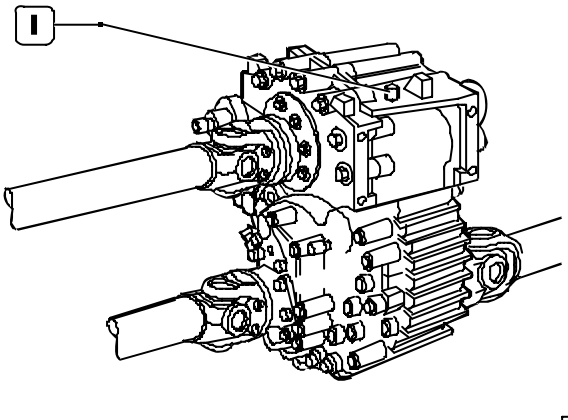

72574

Remove the oil vapour breather (1) and clean it thoroughly. Fit it back on, checking it is in the right position, and tighten it to the required torque.

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## 505401 Clean oil breather on transfer box (with hours intervals)

Figure 15

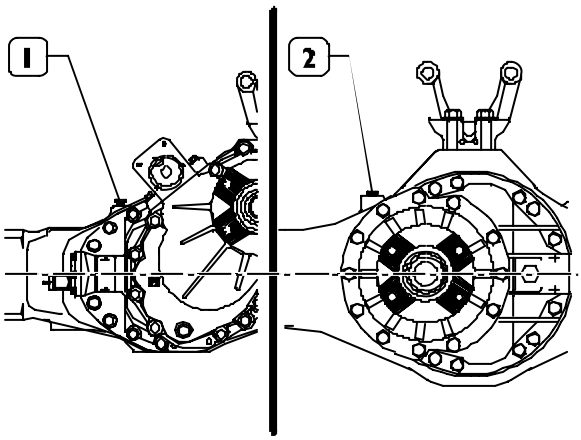



72575

Remove the oil vapour breather (1) and clean it thoroughly. Fit it back on, checking it is in the right position, and tighten it to the required torque.

## 525013 Clean oil breather on axles

Figure 16




72576

Remove the oil vapour breathers (1) from the middle axle and (2) from the rear axle and clean them thoroughly. Fit them back on, checking they are in the right position, and tighten them to the required torque.

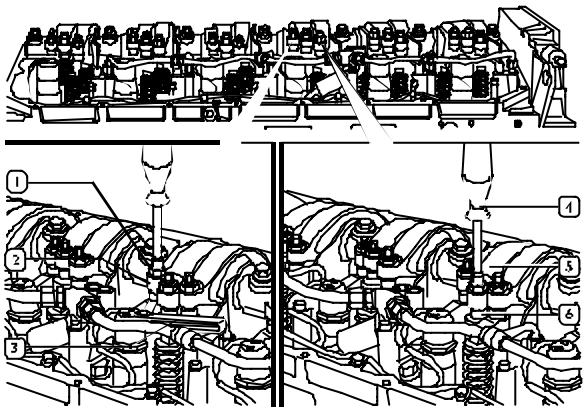
- **General greasing**
- **Handling operations**
- **Functional on road testing**
- **Tilting the cab, opening/closing the front grille**
- **Check AdBlue system using EA.SY. MODUS or IT2000**

## M2 SERVICE

- **Check-up on EDC system with MODUS, IT2000 or E.A.SY.**
- **Check AdBlue system using EA.SY. MODUS or IT2000**

## 540613 Check valve clearance and adjust if necessary

Figure 17

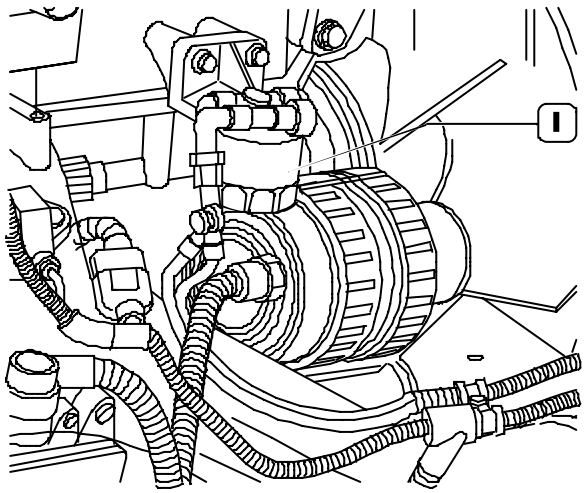



86835

To perform these operations correctly, proceed as described under the relevant heading in the "ENGINE" section.

## 542406 Replace variable geometry turbocharger (VGT) valve air filter (Cursor Engine)

Figure 18




72577

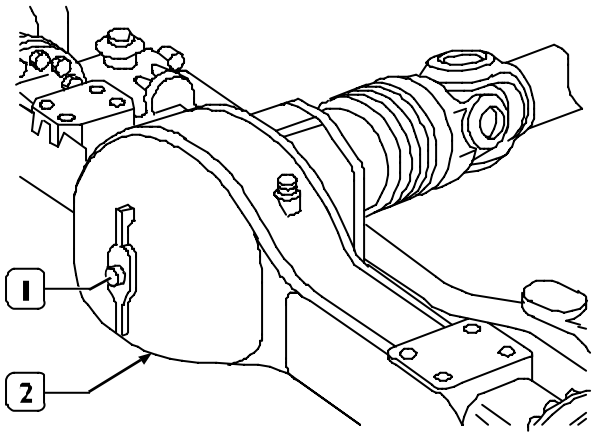
**NOTE** In versions with Cursor 8 engine the filter is assembled on the chassis.

Using a suitable tool, unscrew the filter (1) and replace it. Before fitting the new cartridge, moisten the seal with diesel or engine oil. Screw it on by hand until it is in contact with the mounting and then tighten by 3/4 of a turn to the required tightening torque.

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## 522810 Change drive axle oil (4x4, 6x6, 8x8 versions only)

Figure 19

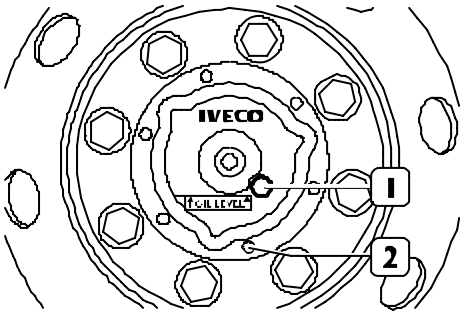



72580

- With the axle warm, take off the plug (2) and drain the oil into a specific container.
- Pour in fresh oil through the hole closed by the plug (1) (see under the FLUIDS heading of the GENERAL section).
- Clean the oil vapour breather.
- Tighten the plugs to the required torque.

## 522870 Change front side reduction gear oil (4x4, 6x6, 8x8 versions only)

Figure 20



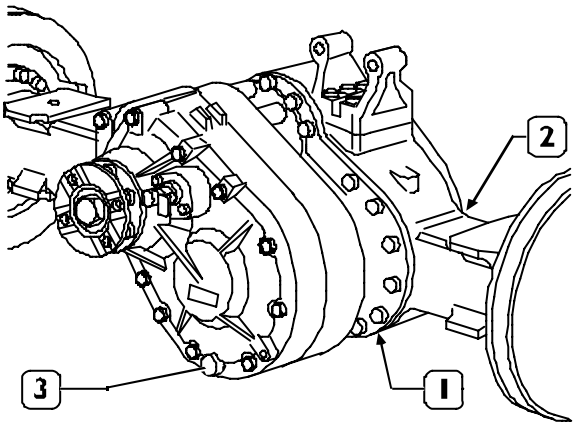

72581

Change the oil as follows:
- Set the plug (1) as shown in the figure and the "OIL LEVEL" line exactly horizontal.
- Open the screw (2) and drain off the oil into a specific container.
- Pour in fresh oil through the hole closed by the plug (1) (see SPECIFICATIONS AND DATA in the "REAR AXLE" section).
- Before screwing the plug (1) and screw (2) back on, spread sealant paste on them and tighten them to the required torque.

## 525110/525010 Change axle oil

Transmission and middle axle

Figure 21

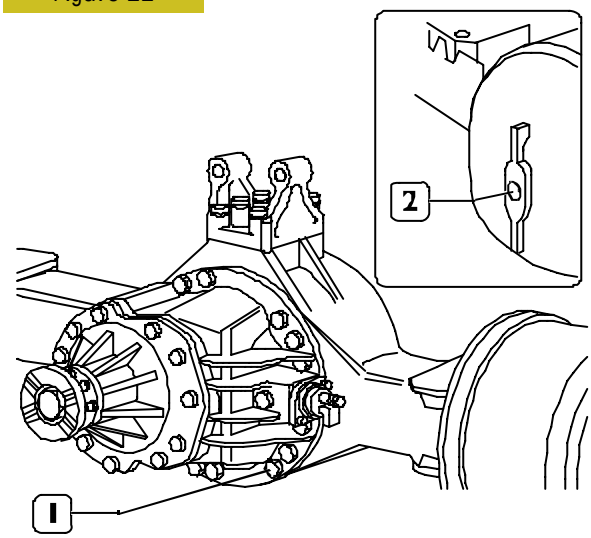



72582

- With the axle warm, unscrew the plugs (1) and (3) and drain off the spent oil into a specific container.
- Screw the plugs back on and pour in fresh oil through the hole closed by the plug (2) (for the quantity, see under the FLUIDS heading of the GENERAL section).
- Clean the oil vapour breather.
- Tighten the plugs to the required torque.

Rear axle

Figure 22



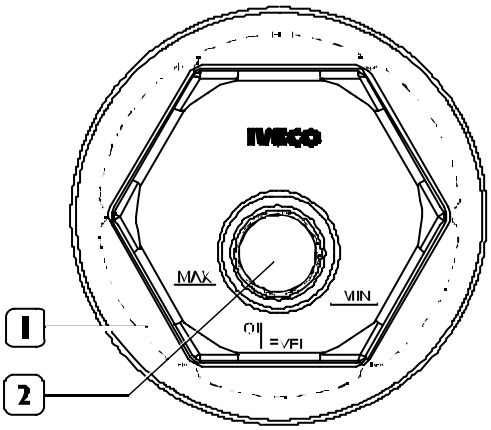

72583

- With the axle warm, unscrew the plug (1) and drain off the oil into a specific container.
- Pour in fresh oil through the hole closed by the plug (2) (see under the FLUIDS heading of the GENERAL section).
- Clean the oil vapour breather of the axle.
- Tighten the plugs to the required torque.

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## 520620 Change front wheel hub oil (4x2, 6x4, 8x4 versions only)

Figure 23




Proceed as follows:

- remove plug (1) and suck oil with suitable syringe;
- fill the wheel hub with new oil (for the quantity and type of oil, see CHARACTERISTICS AND DATA in the "AXLES" section.

Oil level is checked through plug (2) slide with max and min writings on cover (1) in horizontal position.

## 505401 Change transmission assembly oil (6x4, 6x6, 8x8 versions only)

See the procedures for changing the transmission and middle axle oil described above.

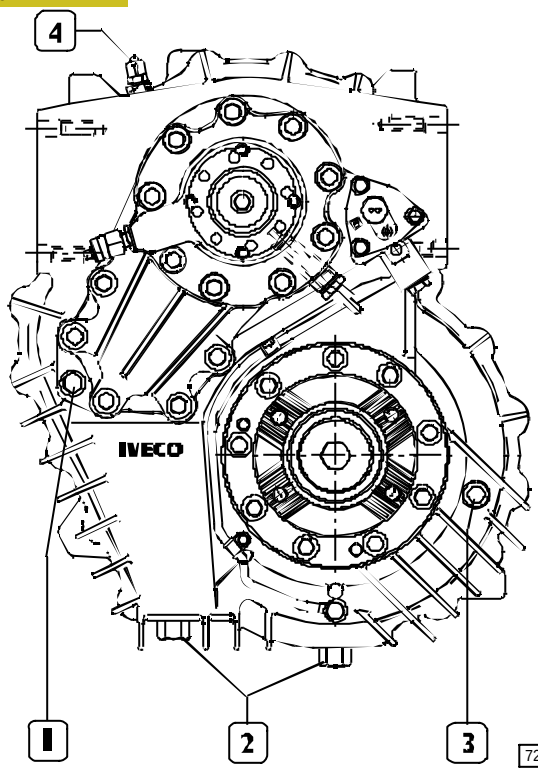
## ■ Replace AdBlue filter and prefilter

In order to carry out these operations correctly, proceed as described in the relevant chapter of section "ENGINE".

## ■ Grease the VGT control lever

## 505401 Change reduction gear - divider oil (4x4, 6x6, 8x8 versions only)

Figure 24

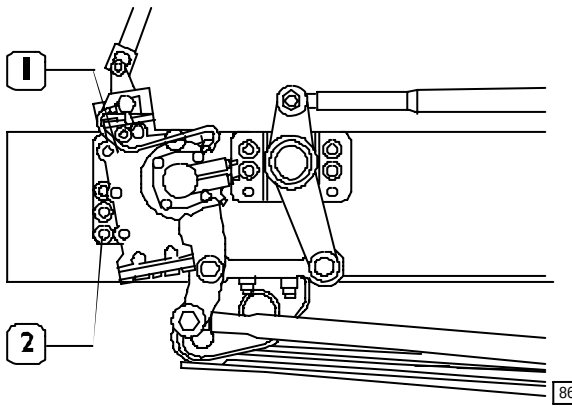



- With hot distributor, slacken the drain plugs (2) and drain the oil in a suitable container.
- Tighten the plugs (2) to torque 60 Nm x TC 1800, 78 Nm x TC 2200 and clean the oil breather (4).
- Remove the plugs (1 and 3), fill through the plug hole (1) the prescribed quantity and type of oil, see chapter GENERALITIES in the "AXLE" section.

Filling is correct when the oil reaches the plug hole (3). Drive in the plugs (1 and 3) and tighten them to the prescribed torque.

## 501401 Check steering box fixing and mounting

Figure 25

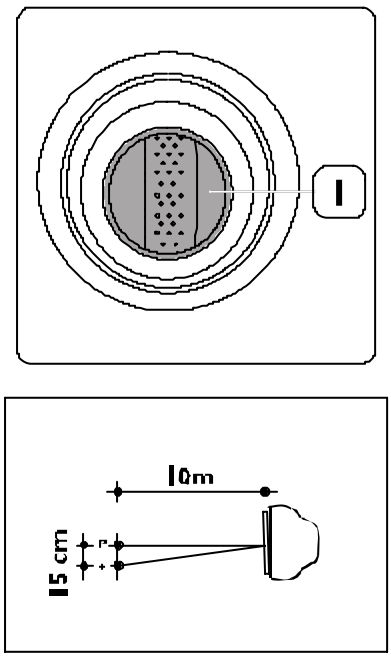



Check that the fastenings of the steering box (1) and mounting (2) are tightened to the required torque.

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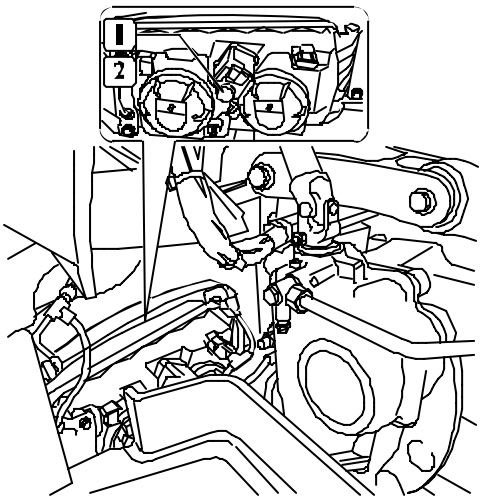
## 760044 Check headlight adjustment

Figure 26




- Place unloaded vehicle, with tyres at prescribed pressure, on flat ground, facing a light colour wall located at 10 metre distance.
- Mark two crosses on the wall corresponding to the centres of the two headlights.
- By using control (1), position headlights with inclination zero. Inclination can be displayed on CLUSTER display unit.

Figure 27




- Tilt the cab and turn on the low beam. The distance between the crosses and the points P, which correspond to the angle of the headlights, has to be 15 cm.
- Adjust light beam according to horizontal and vertical directions by operating on screws (1and 2).

- **Handling operations**
- **Functional testing on road**
- **Cabin tilting / opening / closure of front grille**

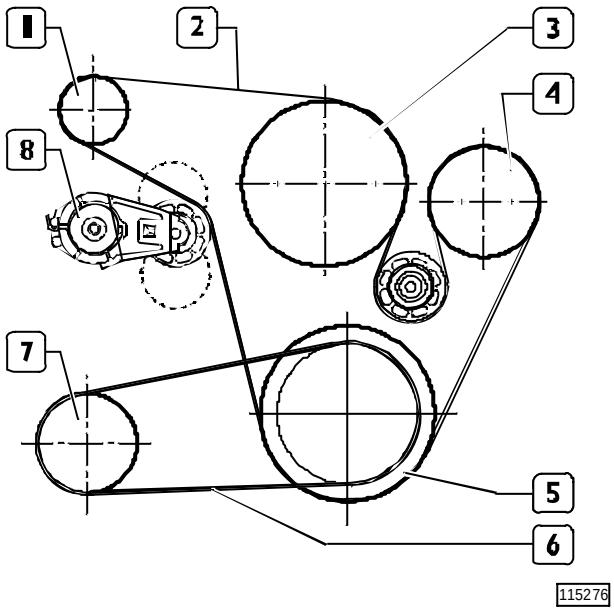
## M3 SERVICE

**NOTE** The M3 service comprises the operations of the M1 and M2 services plus the ones listed here.

## 543411 Replace auxiliary member drive belt

## 543910 Replace air-conditioner compressor drive belt

Figure 28




ASSEMBLY DIAGRAM OF BELTS FOR FAN - WATER PUMP - ALTERNATOR AND AIR-CONDITIONER COMPRESSOR

1. Alternator - 2. Drive belt - 3. Fan - 4. Water pump - 5. Crankshaft - 6. Spring belt - 7. Air-conditioner compressor - 8. Drive belt automatic tensioner

In order to carry out these operations correctly, proceed as described in the relevant chapter of section "ENGINE".

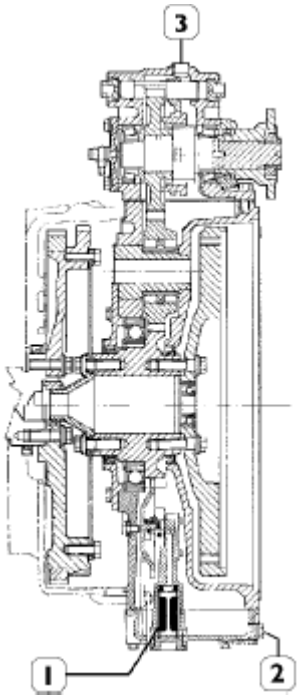
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## TIMED OPERATIONS WITH HOUR INTERVALS

### T1 SERVICE

#### 534501 Change "Multipower" total power take-off oil (if applicable)

Figure 29




72589

Set the vehicle horizontal and stop the engine.
Position a suitable container to collect the oil.

- Unscrew the drain plug (2).
- Unscrew the filter (1) and clean it thoroughly.

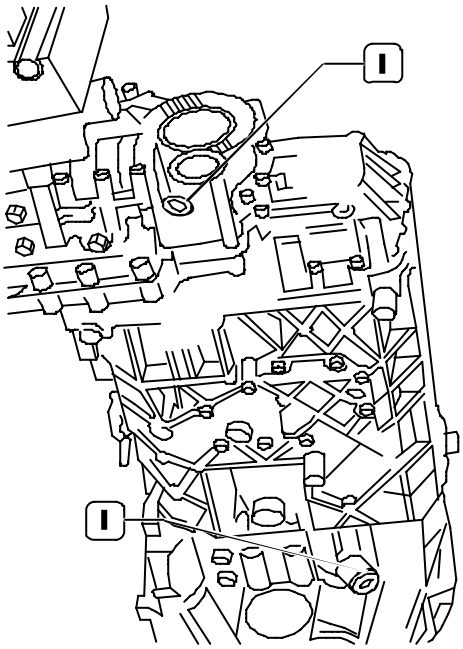
To restore the oil level, screw the filter (1) and drain plug (2) back on to the required torque, checking the state of the seals.
Replace them if they have deteriorated. Then:

- Unscrew the plug (3) and add the required amount of oil (see FLUIDS in GENERAL INFORMATION).
- Screw the plug back on to the required torque.

### T2 SERVICE

#### 530105 Change oil and filter of ZF 16 S gearbox + Intarder

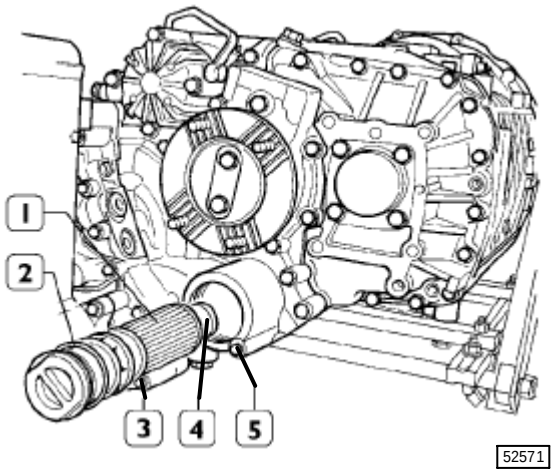
Figure 30




72570

- With the gearbox warm, take off the plugs (1) and drain the oil into a specific container.

Figure 31




52571

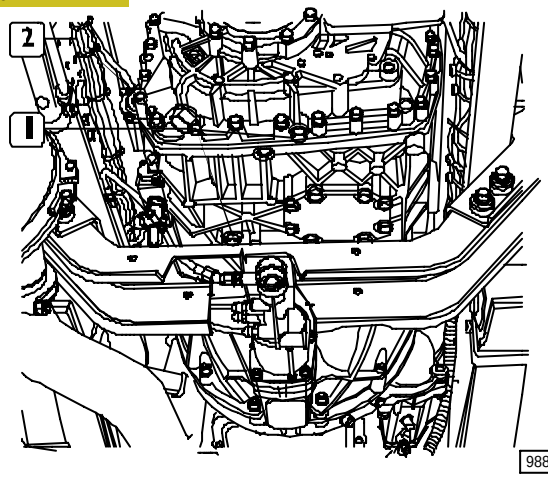
Remove the oil filter as follows:

- unscrew the screw (5) fixing the filter;
- take off the cover and filter (1);
- remove the cover from the filter and replace it. Take care not to lose the magnetic pad (4) on the outer edge of the filter, as it has to be repositioned on the new filter;
- check the state of the o-ring (2) and replace it, if necessary;
- grease the o-ring (3) inserted in the assembly opening of the new filter;
- couple the new filter with its cover and insert it into its seat as far as it will go. Secure the screw (5).

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## 530105 Change gearbox oil (ZF mechanical gearboxes)

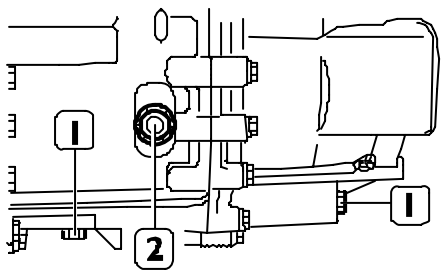
Figure 32




- With the gearbox warm, take off the plug(s) (1) and drain the oil into a specific container.
- The oil should be drained off taking care not to dirty the cross member beneath as it is near the outlet on some types of gearbox.
- It is therefore wise to use a tool to convey the oil away.
- Pour in fresh oil through the hole closed by the plug (2) (for the quantity, see under the FLUIDS heading of the GENERAL section).
- Tighten the plugs to the required torque.

### (ZF 12AS gearbox)

Figure 33

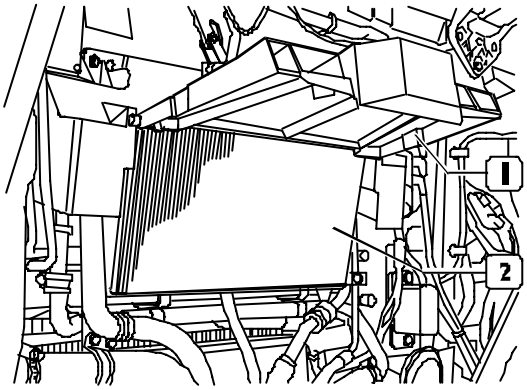



- With the gearbox warm, take off the plug(s) (1) and drain the oil into a specific container.
- The oil should be drained off taking care not to dirty the cross member beneath as it is near the outlet on some types of gearbox.
- It is therefore wise to use a tool to convey the oil away.
- Pour in fresh oil through the hole closed by the plug (2) (for the quantity, see under the FLUIDS heading of the GENERAL section).
- Tighten the plugs to the required torque.

## T3 SERVICE

## 553261 Checking anti-pollen filter condition

Figure 34




Check the state of clogging of the pollen filter (2).
Anti-pollen filter can be accessed by lifting front cowling and under door (1).

**NOTE** Excessive clogging of the pollen filters can cause a reduction in the flow rate of air into the cab and therefore less ventilation. This will be highlighted especially by a significant reduction in the efficiency of the windscreen defrosting function.

## 506011 Wash radiator grille

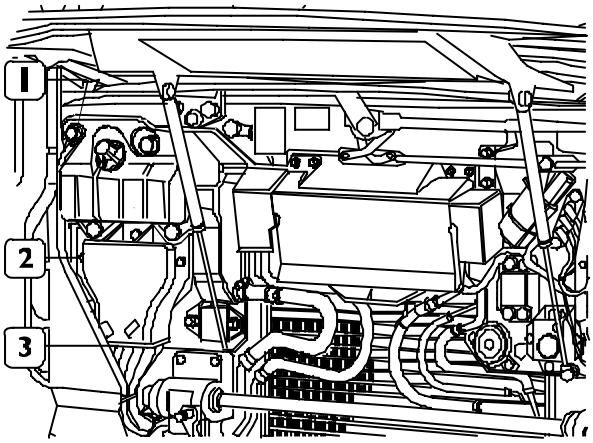
Lift the cab radiator cowling and carefully clean the radiator grille.

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## T4 SERVICE

### 506019 Check percentage of antifreeze in the engine coolant

Figure 35




98881

The plug (1) must never be taken out for any reason whatsoever.
With the engine warm, the cooling system is in overpressure, therefore take care when taking off the cap (2).

Take off the cap (2) and draw off a sample of the coolant from the expansion tank (3) with the densimeter 99395858.

Depending on the temperature of the liquid, check the percentage of antifreeze in the liquid on the scale of the instrument. The percentage has to be higher than 40% and must not exceed 50%.

If necessary, restore the percentage of antifreeze, bearing in mind that the liquid needs to be replaced every 2 years.

For vehicles fitted with an additional heater, the percentage of antifreeze must never exceed 50%.

### 773130 Replacing additional heater fuel filter

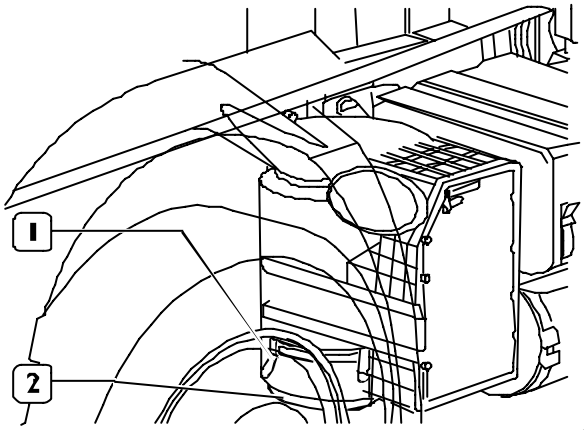
## T5 SERVICE

### 506010 Checking possible radiator clogging

## T6 SERVICE

### 505100 Replacing air filter cartridge in dry conditions and cleaning the container

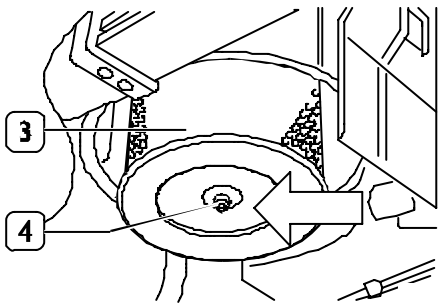
Figure 36




72590

- Unhook the clamps (1) (or, depending on the version, unscrew the nut) and take off the bottom cover (2).

Figure 37




72591

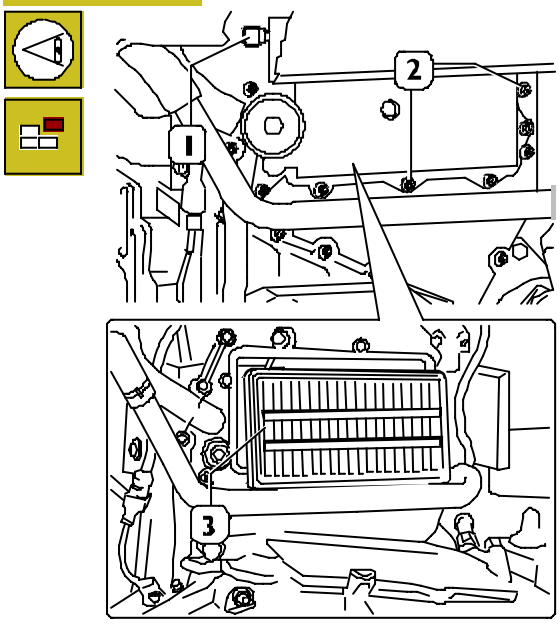
- Unscrew the nut (4) and take out the cartridge of the filter (3).

Before fitting the new cartridge, clean its housing thoroughly.

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## 540450 Replacing engine blow-by filter

Figure 38




- Unscrew the screws (2), take off the casing, take out the filter (3) and replace it with a new one. The filter works in a single direction, so you need to mount it with the two strengthening bars in view as shown in the figure.

## T7 SERVICE
## 506010 Changing engine coolant

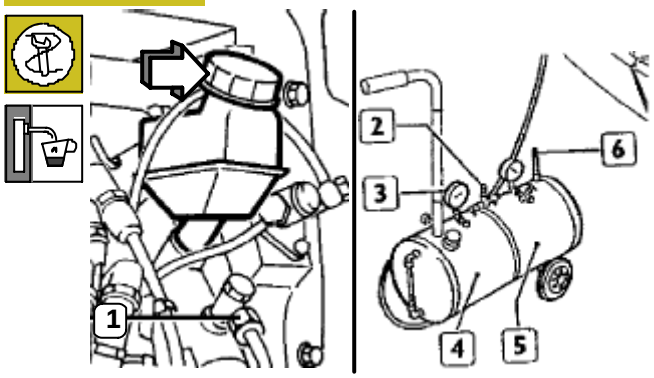
Perform procedure described in relating paragraph in section "ENGINE".

## T8 SERVICE
## 505292 Change the clutch fluid and make air bleeding (only versions with mechanical transmission)

Drain off the clutch control fluid and change it (see Fluids table in GENERAL section).

The clutch fluid is poisonous and corrosive: if you accidentally come into contact with it, wash immediately with water and a neutral soap.

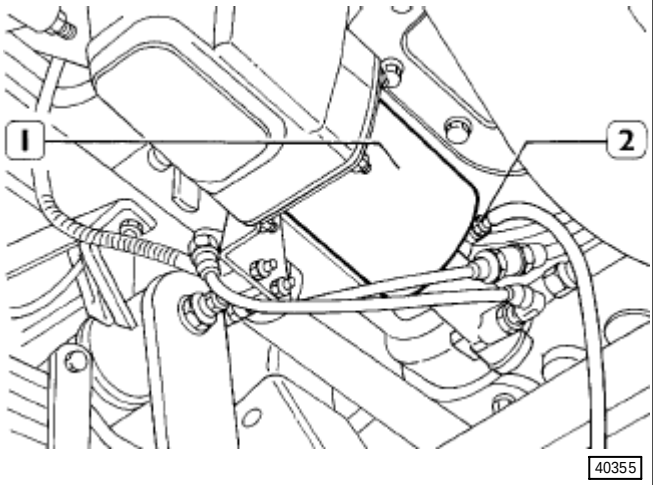
Figure 39




After changing the fluid, bleed the hydraulic clutch control system.
Use the air bleeding tool 99306010 as follows:

- charge reservoir (5) with compressed air;
- fill reservoir (4) with Tutela TRUCK DOT SPECIAL fluid
- replace the cap (⇒) of the clutch fluid reservoir with one of the caps supplied with the tool 99306010 and connect the pipe to the cap.

Figure 40




- Attach a plastic tube to the bleed screw (2) on the slave cylinder (1) and immerse the opposite end of the tube in a container containing Tutela TRUCK DOT SPECIAL fluid, unscrew the bleed screw (1) by one full turn, open the valve (2) (see Figure 39) until a pressure reading of 1 to 1.2 bar is obtained on the pressure gauge (3);
- when the clutch fluid flowing through the tube is uniform and free of air bubbles, close the bleed screw and discharge the air from the reservoir (5) through valve (6).

**NOTE** Whenever the clutch fluid is changed, it will also be necessary to bleed the clutch master cylinder by loosening the fitting (1, Figure 39) before bleeding the clutch servo.

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## PROGRAMMED MAINTENANCE WITH KM INTERVALS
## (For vehicles used on the road for medum and long distances)



- ACEA E4 lubricants classified as ACEA E6 cannot be used according to the change intervals established for class ACEA E4. They shall be changed according to the time intervals established for lubricants ACEA E2, i.e. every 400 hours.
- If class ACEA E7 (URANIA LD7) engine oil is used, the engine oil and filters must be changed every 80,000 km.
- If class ACEA E2 (URANIA TURBO) engine oil is used, the engine oil and filters must be changed every 40,000 km.
- In the event of very low distances travelled per year or anyway below 100,000 km/year, the engine oil and the filters must be changed every 12 months.
- If using diesel with a percentage of sulphur above 0.5%, the oil-change frequency has to be halved.
- In the event of very low distances travelled per year, the oil of the rear axles, distributor, transmission, etc. must be changed at least every 2 years.
- The filter dryer of the pneumatic system must in any case be renewed every year.
- In the case of very low annual mileage, general greasing must be carried out at least once a year.

To schedule the work, keep to the following chart:

| OILS | SERVICES | | | EXTRA PLAN | | PROGRAMMED OPERATIONS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Engine ACEA E4 (1) Urania FE5W30 | **M1** | **M2** | **M3** | **EP1** | **EP2** | **T1** | **T2** | **T3** | **T4** | **T5** | **T6** |
| | Every 100,000 km | Every 150,000 km | Every 300,000 km | Change gearbox oil (2) | Every 240,000 km | Every 6 months | Every year before winter | Every year before summer | Every years | Every 2 years | Every 3 years |

(1) IVECO suggests the use of these lubricants to raise the vehicle "fuel economy". The new vehicle is already equipped by IVECO with these types of lubricants, suitable also for cold climates (minimum temperature down to -30°). The change intervals depend on the use of these oils.

(2) See note at page 7.

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## CHECKS AND/OR MAINTENANCE OPERATIONS

**Schedule with km intervals for vehicles used on the road for medium and bng distances**

| Type of operation | | M1 | M2 | M3 |
|---|---|---|---|---|
| References figure 1/2 | Engine | | | |
| 14 | Change engine oil | • | | • |
| 3 | Replace engine oil filter | • | | • |
| 12 | Replace fuel filter | • | | • |
| 4 | Blow-by filter replacement | | • | • |
| 1-2 | Check miscellaneous drive belts | • | | • |
| 13 | Replace or clean hydraulic steering system filter | • | | • |
| 15 | Check-up of engine EDC system via MODUS, IT 2000 or E.A.SY. | | • | • |
| 5 | Check valve clearance and adjust if necessary | | • | • |
| 16 | Replace variable geometry turbocharger VGT air filter | | • | • |
| 7 | Checking fan electromagnetic joint clutch wear (if applicable) | • | | • |
| • | Grease the VGT control lever | | • | • |
| | Chassis and mechanical assemblies | | | |
| 17 | Replace fuel pre-filter | • | | • |
| 10 | Check efficiency and clean gearbox oil bleeds | • | | • |
| 9 | Check clutch fluid level | • | | • |
| 11 | Replace pneumatic system drier filter | • | | • |
| | Chassis and mechanical assemblies | | | |
| 28 | Check efficiency and clean drive axle oil bleeds (for 4x4, 6x6, 8x8 vehicles) | • | | • |
| 25 | Check efficiency and clean divider oil bleeds between axles | • | | • |
| 23 | Check efficiency and clean axle bleed | • | | • |
| • | General greasing | • | | • |
| 28 | Change drive axle oil (for 4x4, 6x6, 8x8 vehicles) | | • | • |
| • | Change front side reduction gear oil (for 4x4, 6x6, 8x8 vehicles) | | • | • |
| 22 | Change axle oil | | • | • |
| 20 | Change front wheel hub oil (for 4x2, 6x4, 8x4 vehicles) | | • | • |
| 21 | Change transmission assembly oil (for 6x4, 6x6, 8x8 vehicles) | | • | • |
| 25 | Change transfer box oil (for 4x4, 6x6, 8x8 vehicles) | | • | • |
| 19 | Check steering box and mounting | | • | • |
| 29-30 | AdBlue system filter and pre-filter change | | • | • |
| 26 | Engine air filter change (dry cartridge) (1) | | • | • |
| | Cab and electric appliances | | | |
| 27 | Check headlight adjustment | | • | • |
| 31 | Ad Blue system test with EASY, MODUS or IT2000 | • | • | • |
| | Miscellaneous | | | |
| • | Handling operations (2) | • | • | • |
| • | Functional testing on road | • | • | • |
| • | Cabin turning / opening / closure of cowling | • | • | • |

(1) Early clogging of the air cleaner is generally due to environmental conditions. For this reason it needs to be replaced when signalled by the sensor irrespective of the guidelines that anyhow have to be observed if there are no specific instructions otherwise.

(2) Vehicle and tooling handling activity in the workshop.

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## EXTRA PLAN/TIMED OPERATIONS

### Plan with kilometer intervals for road use vehicles over middle to long runs

| | | |
|---|---|---|
| EP1 | | Every 120000 km, gearboxes supplied with mineral oil (1)<br>Every 240000 km, ZF 9 S 1310 gearboxes supplied with synthetic oil (2)<br>Every 360000 km, ZF EUROTRONIC gearboxes supplied with synthetic oil (3) |
| | | possibly, simultaneously with a maintenance service |
| | 530105 | Replacing gearbox oil and filter (only gearboxes ZF + Intarder) |
| | 530105 | Change gearbox oil |
| EP2 | | Every 240.000 Km |
| | | possibly, simultaneously with a maintenance service |
| | 543411 | Replace water pump belt and alternator |
| | 543910 | Replace conditioner compressor control belt |
| T1 | | Every 6 months - In particular, at every start of Spring |
| | | and, possibly, simultaneously with a maintenance service |
| | 506011 | Washing radiator guard grid |
| | 553261 | Checking anti-pollen filter (4) condition |
| T2 | | Every year - before Winter |
| | | Possibly, and simultaneously with a maintenance service |
| | 506019 | Checking coolant density |
| | 773130 | Replacing additional heater fuel filter |
| T3 | | Every year - before Summer |
| | | Possibly, and simultaneously with a maintenance service |
| | 506010 | Checking possible radiator clogging |
| T4 | | Every year |
| | | Possibly, and simultaneously with a maintenance service |
| | 534501 | Replacing total power take-off (Multi-power) oil |
| T5 | | Every 2 years |
| | | Possibly, and simultaneously with a maintenance service |
| | 506010 | Replacing engine coolant |
| T6 | | Every 3 years |
| | | Possibly, and simultaneously with a maintenance service |
| | 505292 | Replacing oil and draining clutch hydraulic control |

(1) ZF Ecosplit gearboxes supplied with mineral oil, in the event of very low annual operating time change the oil every year

(2) ZF New Ecomid gearboxes supplied with synthetic oil, in the event of very low annual operating time change the oil every 2 years

(3) ZF Eurotronic gearboxes supplied with synthetic oil, in the event of very low annual operating time change the oil every 3 years

(4) Early air filter clogging is generally caused by environmental conditions; for this reason, air filter must be replaced when relating warning from special sensor is issued independently of relevant prescription, which must be anyhow observed in lack of specific indications.

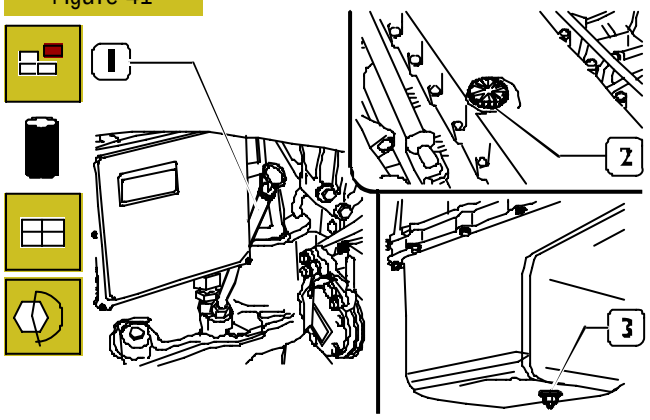
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# CONTROL AND/OR MAINTENANCE INTERVENTIONS (PLAN WITH KM INTERVALS)

## M1 SERVICE

### 542710 Change engine oil

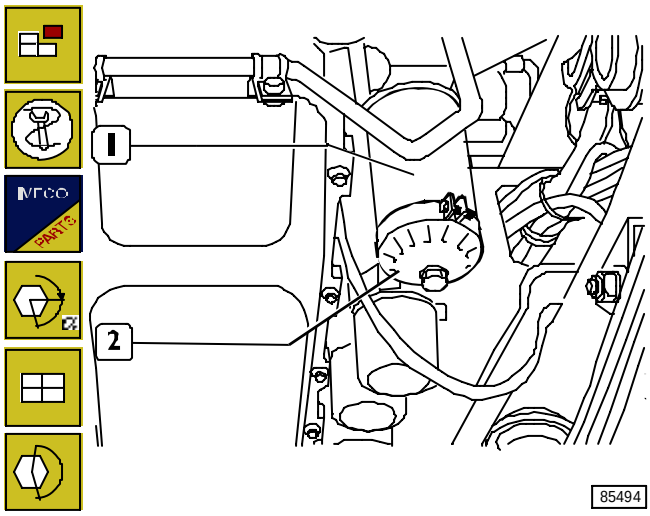
Figure 41




Take out the oil level dipstick (1).
From underneath the vehicle, remove the soundproofing guard.
Unscrew the plug (3) from the oil sump and drain the engine oil off into a specific container.
Screw the plug back on under the sump and tighten it to the required torque.
Fill in with the prescribed oil quantity and quality (see the CAPACITIES table in the GENERAL INFORMATION section) from the tie rod cover pipe union (2).

### 543420 Replace engine oil filters

Figure 42




Drain the oil as described in point 14. "Changing engine oil."

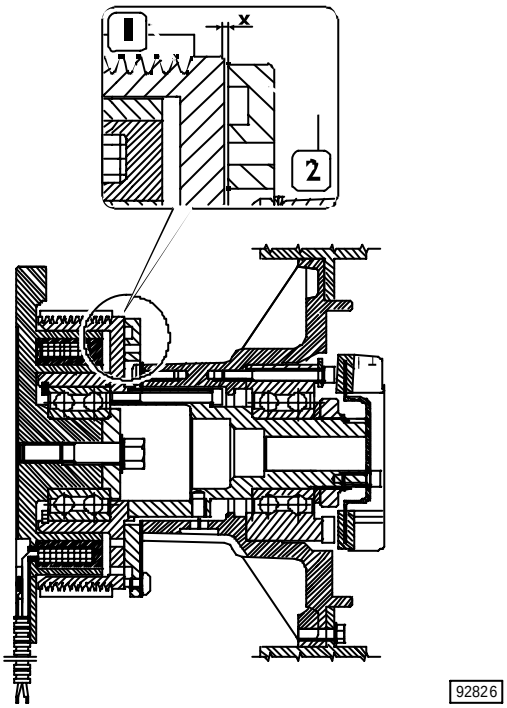
Remove the oil filter (1) with tool 99360314 (2).

**NOTE** Before refitting the new cartridges, moisten the seal with engine oil.

Screw the oil filters (1) on by hand to bring them into contact with the mount and then tighten by 3/4 of a turn to the prescribed torque and proceed as described in point 14. "Changing engine oil."

### 543450 Check electromagnetic coupling clutch wear

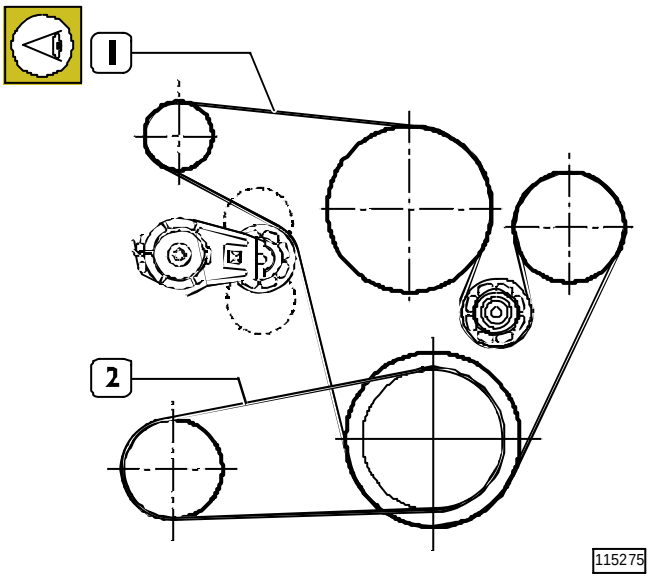
Figure 43




Using a feeler gauge, check the gap between the anchor assembly (2) and the pulley (1), it must be no greater than 2.5 mm.

### 540843/543934 Check miscellaneous drive belts

Figure 44

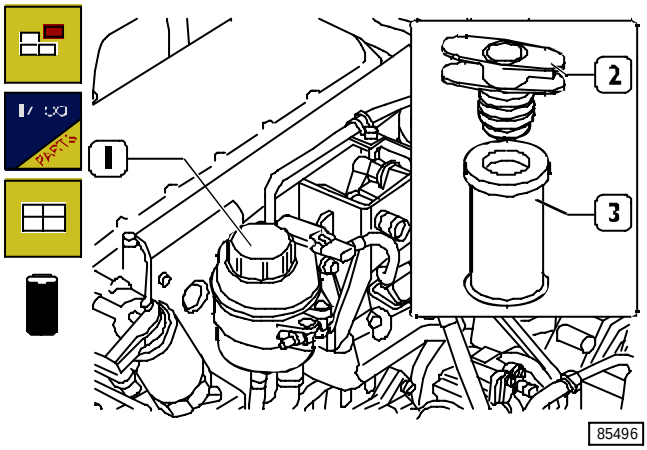



Visually check that the belts (1-2) are neither worn nor deteriorated; if they are, change them as described in the EP2 service.

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## 544221 Replace or clean hydraulic steering system filter

Figure 45




Before taking off the cover (1), thoroughly clean the tank.

This will prevent foreign impurities from coming into contact with the oil of the hydraulic system.

Take the cover (1) off the tank and take out the oil filter (3).

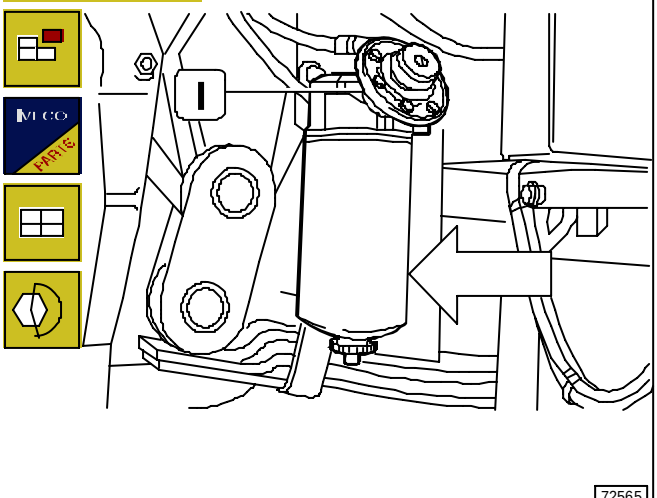
Remove the coupling device (2) from the oil filter (3) and replace the filter.

Take off the plug (1) (after unhooking the transmitter) of the hydraulic power steering tank and check that with the engine running and the wheels travelling in a straight line, the oil level reaches the top reference mark on the dipstick.

With the engine stationary and wheels in a straight line, the oil level has to exceed the top reference mark of the dipstick by 1 or 2 cm; if necessary, top up the level by taking off the cover (1).

## 507210 Replace pre-filter

Figure 46

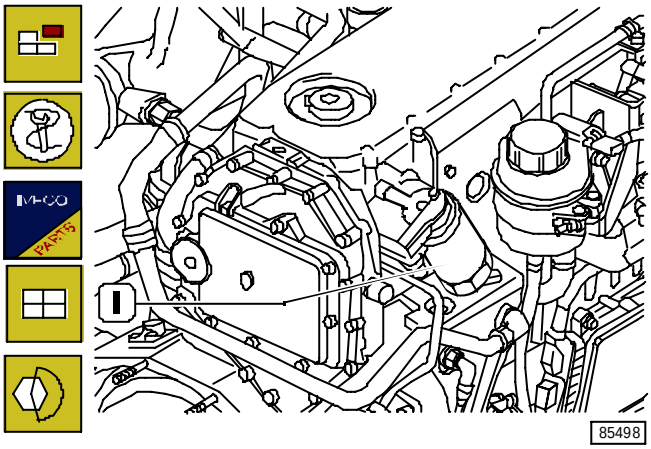



Unscrew the pre-filter (1) and replace it.
Before refitting the new cartridge, moisten the seal with diesel or engine oil. Screw the cartridge on by hand until it is in contact with the mounting and then tighten by 3/4 of a turn to the required tightening torque.

When replacing the cartridge, it must not have been pre-filled. This is to prevent impurities getting into circulation that could damage the injector/pump system components. Bleed the air from the fuel circuit as described on the previous pages.

## 542093 Replace fuel filter

Figure 47

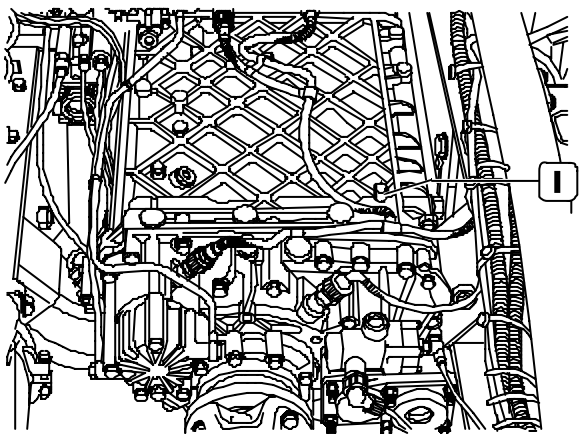



Remove the fuel filter (1) with tool 99360314.
Before refitting the new cartridge, moisten the seal with diesel or engine oil.
Screw the new one on by hand, taking care to check that the rubber seal and the mating surface are clean and in a perfect state of repair. Screw the cartridge on by hand until it is in contact with the mounting and then tighten by 3/4 of a turn to the required tightening torque.

Bleed the air from the supply system as described in the following paragraph.

## 530105 Clean gearbox oil breather (ZF 9/16S gearboxes)

Figure 48

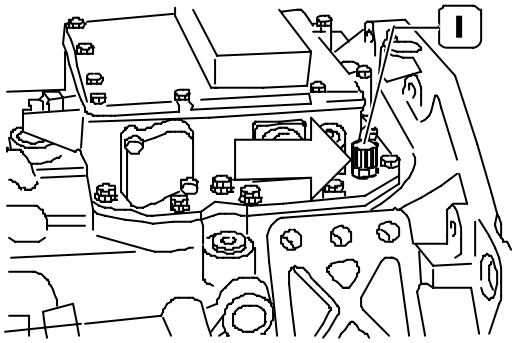



Remove the oil vapour breather (1) and clean it thoroughly. Then fit it back on, checking it is in the right position, and tighten it to the required torque.

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**(ZF 12AS gearboxes)**

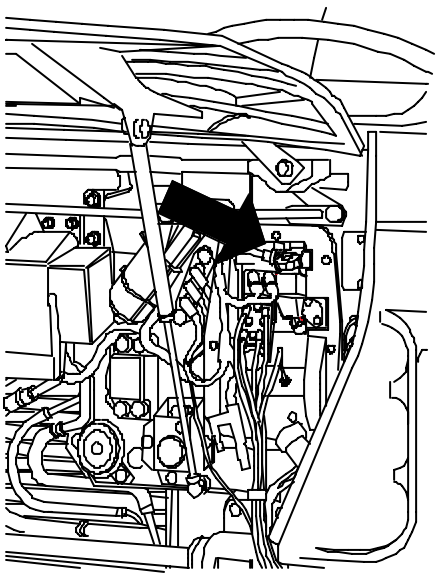
Figure 49




Remove the oil vapour breather (1) and clean it thoroughly. Then fit it back on, checking it is in the right position, and tighten it to the required torque.

## 505292 Check clutch fluid level (Excluding vehicles with EuroTronic gearbox)

Figure 50

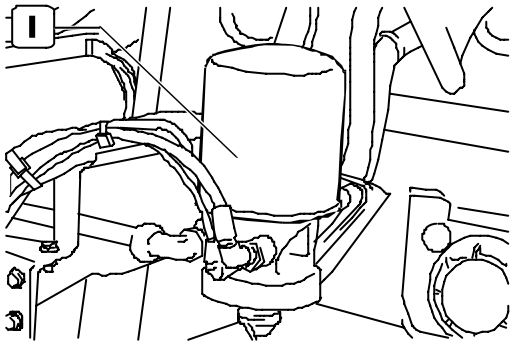



Check the level of the clutch fluid. Top it up if it is too low (see the fluids table in the GENERAL section).

The clutch fluid is poisonous and corrosive: if you accidentally come into contact with it, wash immediately with water and a neutral soap.

## 503447 Replace pneumatic system drier filter

Figure 51

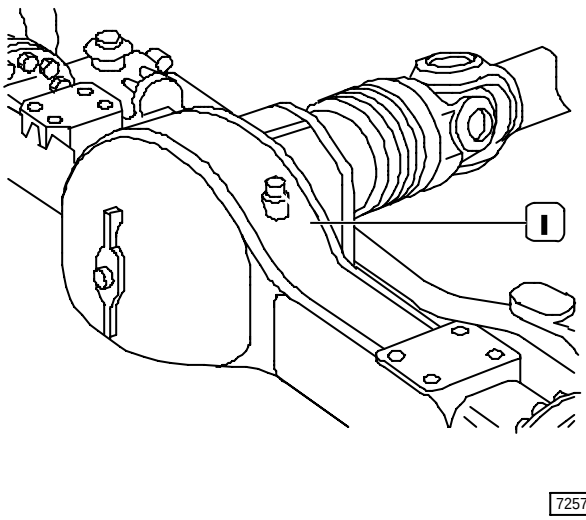



Discharge the pressure from the compressed air system.

Unscrew the drier filter (1) and replace it. Tighten it to the required torque, checking there is no air leakage when pressure is restored.

## 522810 Cleaning engine front axle oil (for versions 4x4/ 6x6/ 8x8 only)

Figure 52

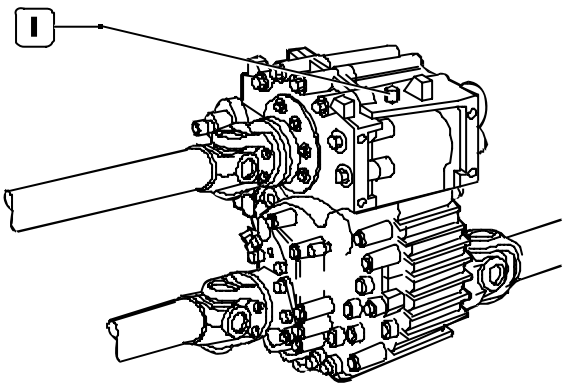



Remove the oil vapour breather (1) and clean it thoroughly. Fit it back on, checking it is in the right position, and tighten it to the required torque.

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### 505401 Clean oil breather on transfer box between axles (with hours intervals)

Figure 53

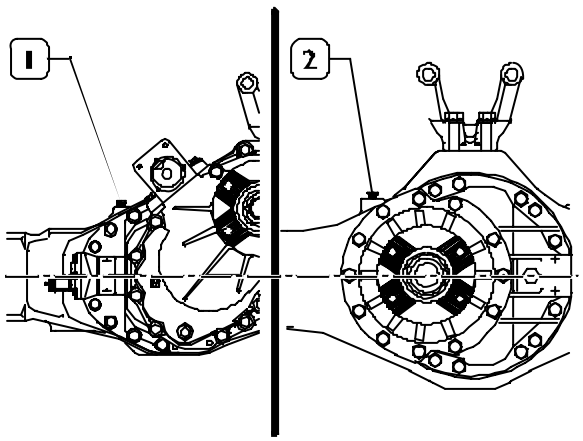



72575

Remove the oil vapour breather (1) and clean it thoroughly. Fit it back on, checking it is in the right position, and tighten it to the required torque.

### 525013 Clean oil breather on axles

Figure 54




72576

Remove the oil vapour breathers (1) from the middle axle and (2) from the rear axle and clean them thoroughly. Fit them back on, checking they are in the right position, and tighten them to the required torque.

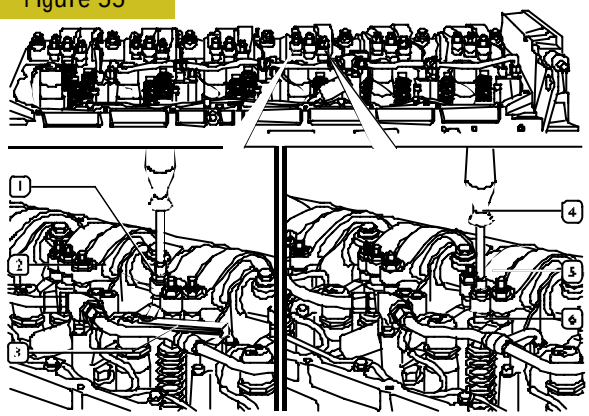
- **Test AdBlue system using EA.SY., MODUS or IT 2000**
- **General greasing**
- **Handling operations**
- **Functional on road testing**
- **Tilting the cab, opening/closing the front grille**

## M2 SERVICE

- **Check-up on EDC system with MODUS, IT2000 or E.A.SY.**

### 540613 Check valve clearance and adjust if necessary

Figure 55

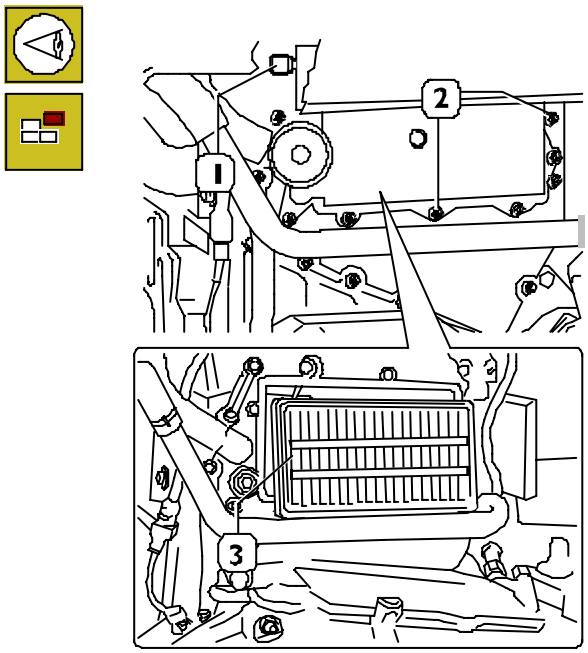



86835

To perform these operations correctly, proceed as described under the relevant heading in the "ENGINE" section.

### 540450 Replace the blow-by filter

Figure 56



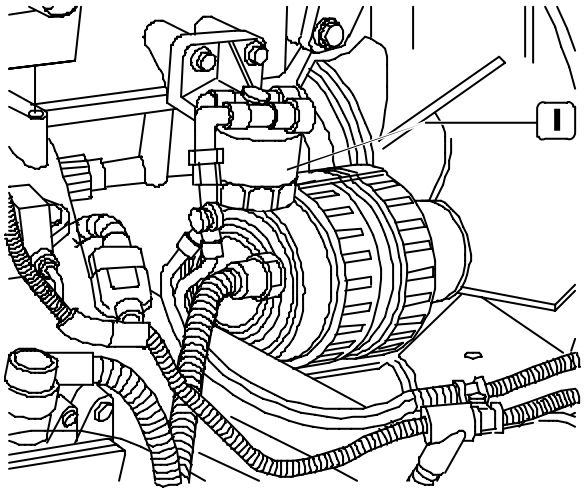

72563

- Unscrew the screws (2), take off the casing, take out the filter (3) and replace it with a new one. The filter works in a single direction, so you need to mount it with the two strengthening bars in view as shown in the figure.

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## 542406 Replace variable geometry turbocharger (VGT) valve air filter

Figure 57



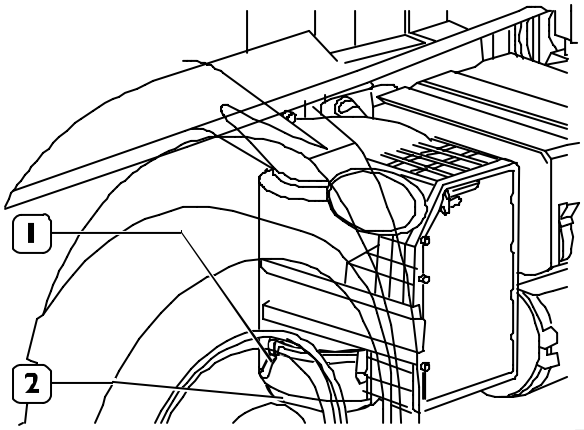

72577

**NOTE** In the CURSOR 8 versions the filter is mounted on the frame.

Using a suitable tool, unscrew the filter (1) and replace it. Before fitting the new cartridge, moisten the seal with diesel or engine oil. Screw it on by hand until it is in contact with the mounting and then tighten by 3/4 of a turn to the required tightening torque.

## 505100 Replacing air filter cartridge in dry conditions and cleaning the container

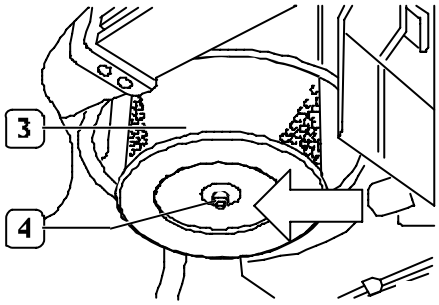
Figure 58




72590

- Unhook the clamps (1) (or, depending on the version, unscrew the nut) and take off the bottom cover (2).

Figure 59




72591

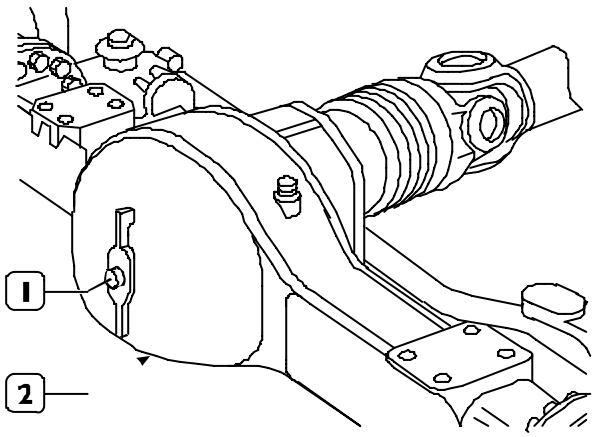
- Unscrew the nut (4) and take out the cartridge of the filter (3).

Before fitting the new cartridge, clean its housing thoroughly.

## ■ Grease the VGT control lever

## 522810 Change drive axle oil (4x4, 6x6, 8x8 versions only)

Figure 60



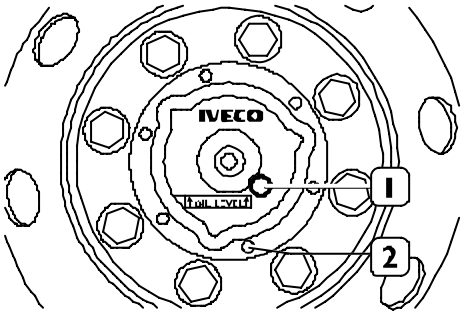

72580

- With the axle warm, take off the plug (2) and drain the oil into a specific container.
- Pour in fresh oil through the hole closed by the plug (1) (see under the FLUIDS heading of the GENERAL section).
- Clean the oil vapour breather.
- Tighten the plugs to the required torque.

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## 522870 Change front side reduction gear oil (4x4, 6x6, 8x8 versions only)

Figure 61




72581

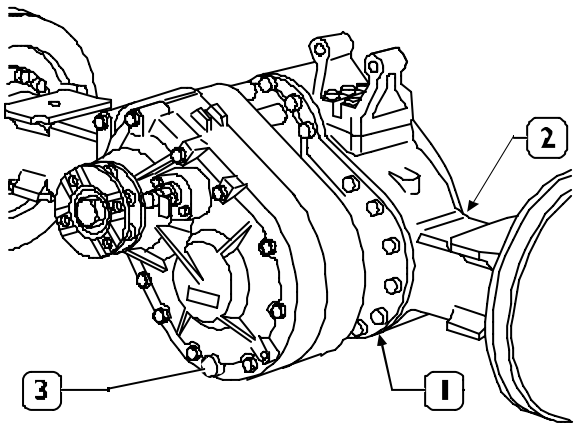
Change the oil as follows:

- Set the plug (1) as shown in the figure and the "OIL LEVEL" line exactly horizontal.
- Open the screw (2) and drain off the oil into a specific container.
- Pour in fresh oil through the hole closed by the plug (1) (see SPECIFICATIONS AND DATA in the "REAR AXLE" section).
- Before screwing the plug (1) and screw (2) back on, spread sealant paste on them and tighten them to the required torque.

## 525110/525010 Change axle oil

Transmission and middle axle

Figure 62

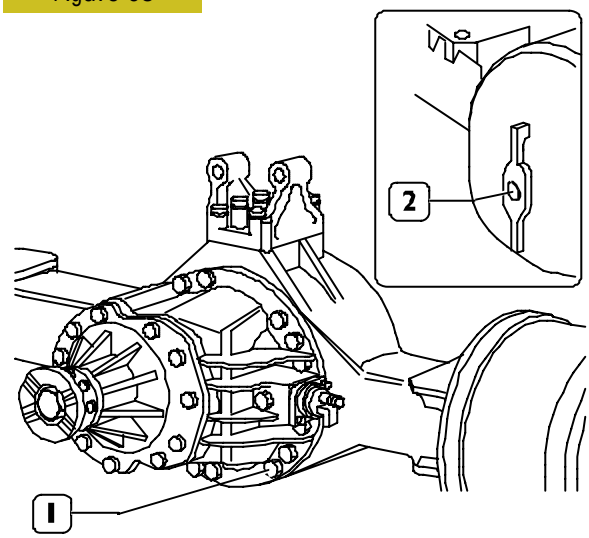



72582

- With the axle warm, unscrew the plugs (1) and (3) and drain off the spent oil into a specific container.
- Screw the plugs back on and pour in fresh oil through the hole closed by the plug (2) (for the quantity, see under the FLUIDS heading of the GENERAL section).
- Clean the oil vapour breather.
- Tighten the plugs to the required torque.

Rear axle

Figure 63

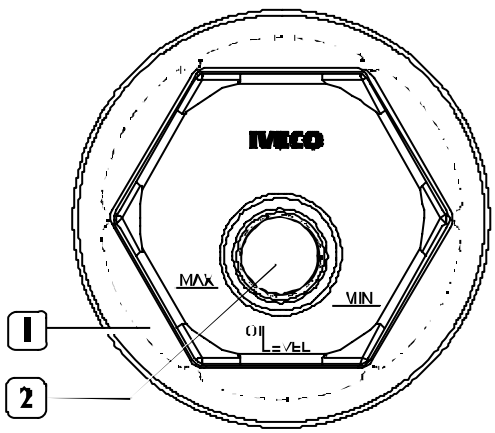



72583

- With the axle warm, unscrew the plug (1) and drain off the oil into a specific container.
- Pour in fresh oil through the hole closed by the plug (2) (see under the FLUIDS heading of the GENERAL section).
- Clean the oil vapour breather of the axle.
- Tighten the plugs to the required torque.

## 520620 Change front wheel hub oil (4x2, 6x4, 8x4 versions only)

Figure 64




79068

Proceed as follows:

- remove plug (1) and suck oil with suitable syringe;
- fill the wheel hub with new oil (for the quantity and type of oil, see CHARACTERISTICS AND DATA in the "AXLES" section.

Oil level is checked through plug (2) slide with max and min writings on cover (1) in horizontal position.

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## 505401 Change transmission assembly oil (6x4, 6x6, 8x8 versions only)

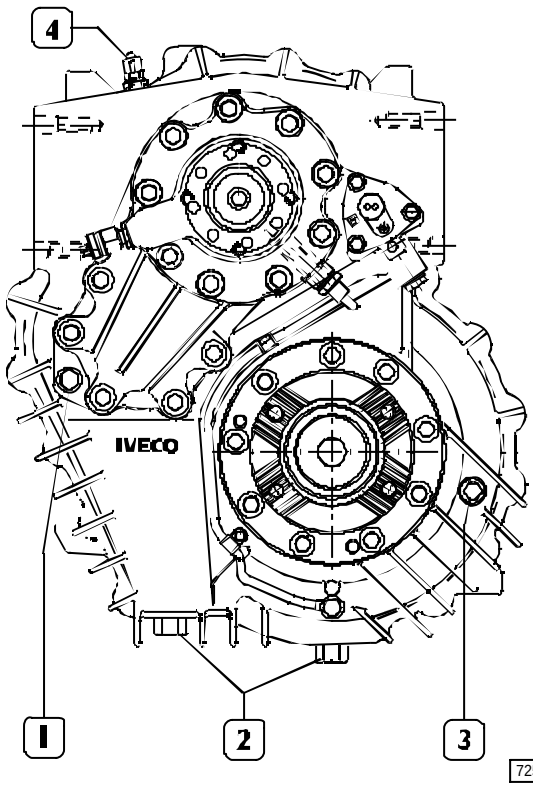
See the procedures for changing the transmission and middle axle oil described above.

## ■ Replace AdBlue filter and prefilter

In order to carry out these operations correctly, proceed as described in the relevant chapter of section "ENGINE".

## 505401 Change transfer box oil (6x4, 6x6, 8x8 versions only)

Figure 65



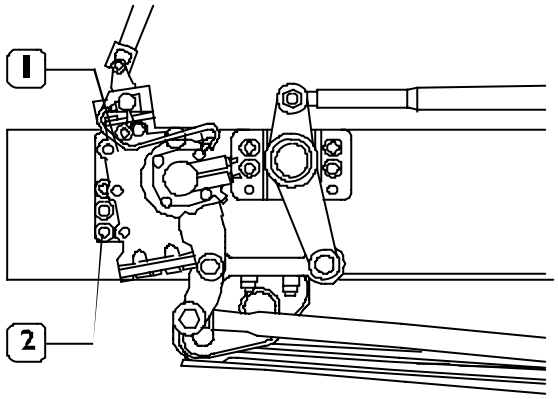

72584

- With hot distributor, slacken the drain plugs (2) and drain the oil in a suitable container.
- Tighten the plugs (2) to torque 60 Nm x TC 1800, 78 Nm x TC 2200 and clean the oil breather (4).
- Remove the plugs (1 and 3), fill through the plug hole (1) the prescribed quantity and type of oil, see chapter GENERALITIES in the "AXLE" section.

Filling is correct when the oil reaches the plug hole (3). Drive in the plugs (1 and 3) and tighten them to the prescribed torque.

## 501401 Check steering box fixing and mounting

Figure 66

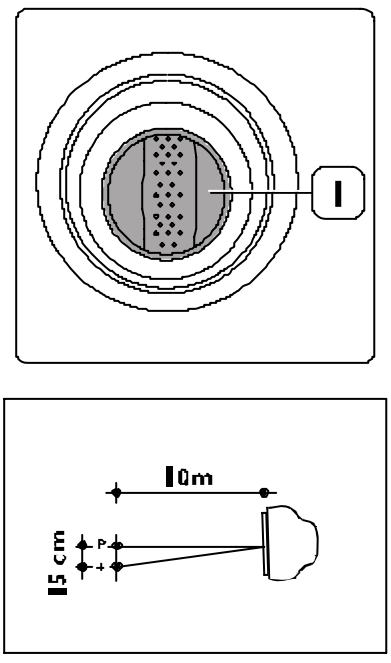



86836

Check that the fastenings of the steering box (1) and mounting (2) are tightened to the required torque.

## 760044 Check headlight adjustment

Figure 67

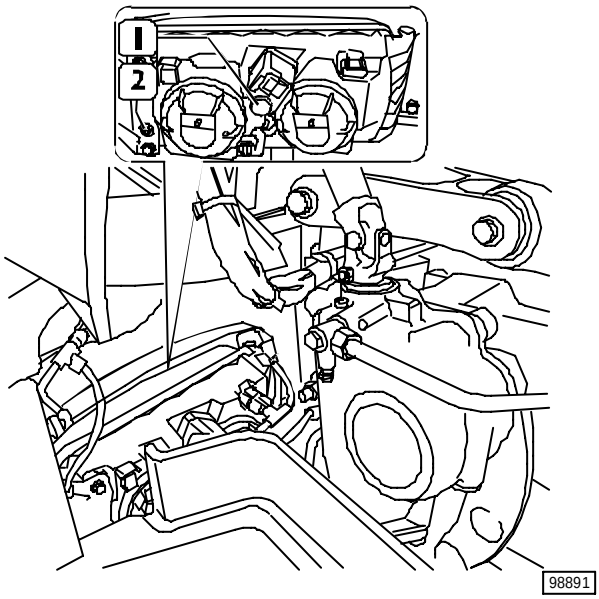



98882

- Place unloaded vehicle, with tyres at prescribed pressure, on flat ground, facing a light colour wall located at 10 metre distance.
- Mark two crosses on the wall corresponding to the centres of the two headlights.
- By using control (1), position headlights with inclination zero. Inclination can be displayed on CLUSTER display unit.

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Figure 68




- Tilt the cab and turn on the low beam. The distance between the crosses and the points P, which correspond to the angle of the headlights, has to be 15 cm.
- Adjust light beam according to horizontal and vertical directions by operating on screws (1and 2).

■ **Handling operations**
■ **Functional testing on road**

## M3 SERVICE

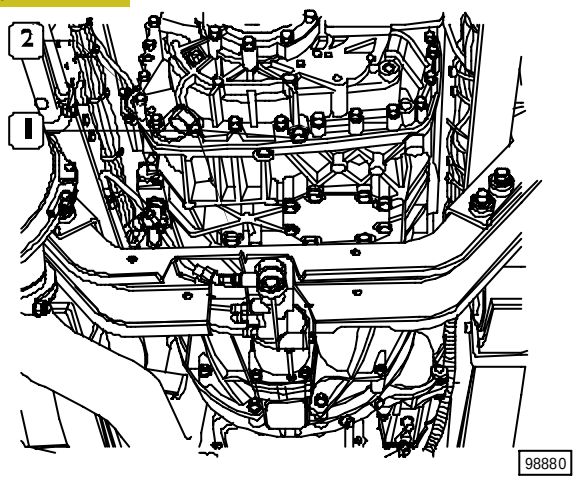
**NOTE** The M3 service comprises the operations of the M1 and M2 services.

## EXTRA PLAN/TIMED OPERATIONS (PLAN WITH KM INTERVALS)

## EP1 SERVICE

### 530105 Change gearbox oil (ZF mechanical gearboxes)

Figure 69

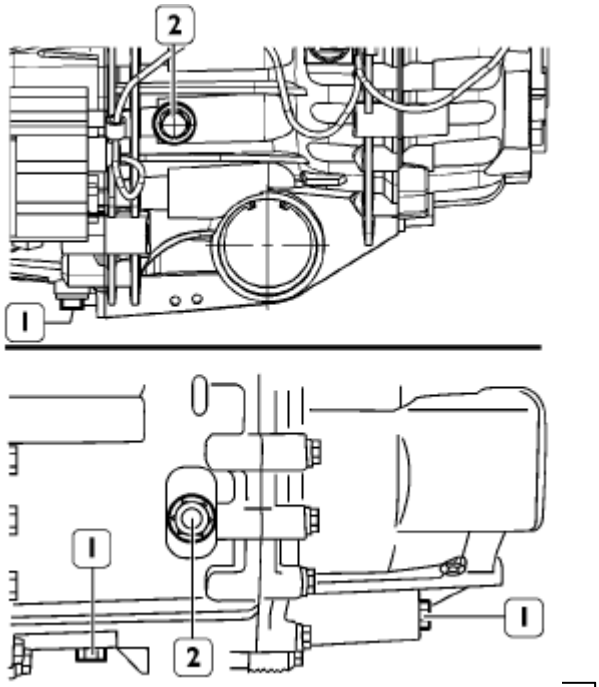



- With the gearbox warm, take off the plug(s) (1) and drain the oil into a specific container.
- The oil should be drained off taking care not to dirty the cross member beneath as it is near the outlet on some types of gearbox.
- It is therefore wise to use a tool to convey the oil away.
- Pour in fresh oil through the hole closed by the plug (2) (for the quantity, see under the FLUIDS heading of the GENERAL section).
- Tighten the plugs to the required torque.

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**(ZF 12AS gearboxes)**

Figure 70

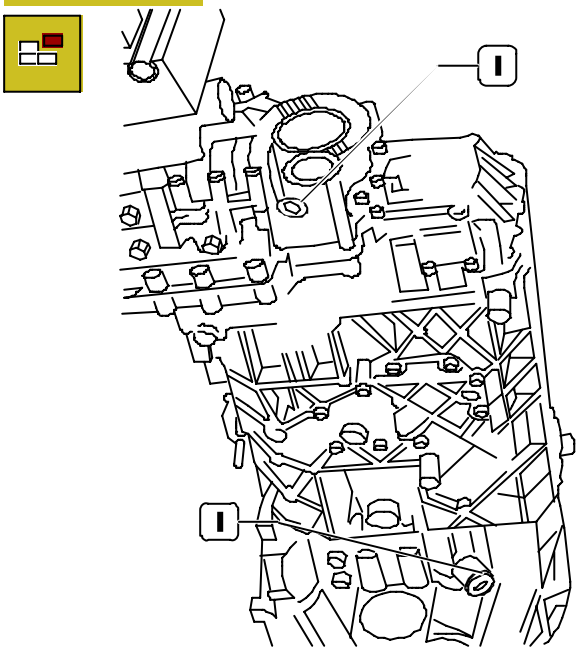



5278

- With the gearbox warm, take off the plug(s) (1) and drain the oil into a specific container.
- The oil should be drained off taking care not to dirty the cross member beneath as it is near the outlet on some types of gearbox.
- It is therefore wise to use a tool to convey the oil away.
- Pour in fresh oil through the hole closed by the plug (2) (for the quantity, see under the FLUIDS heading of the GENERAL section).
- Tighten the plugs to the required torque.

## 530105 Replace oil and filter of ZF16 S gearbox + Intarder

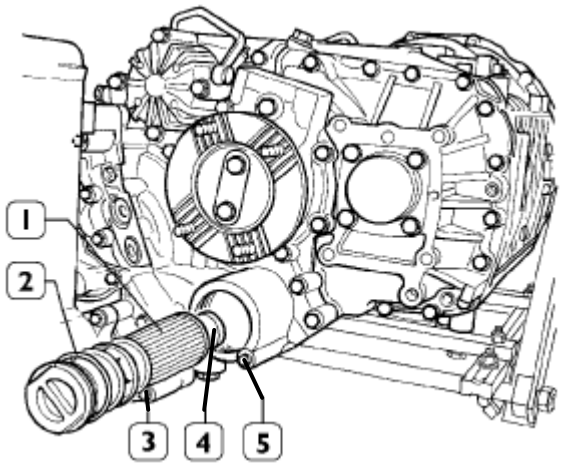
Figure 71




72570

- With the gearbox warm, take off the plugs (1) and drain the oil into a specific container.

Figure 72




52571

Remove the oil filter as follows:

- unscrew the screw (5) fixing the filter;
- take off the cover and filter (1);
- remove the cover from the filter and replace it. Take care not to lose the magnetic pad (4) on the outer edge of the filter, as it has to be repositioned on the new filter;
- check the state of the o-ring (2) and replace it, if necessary;
- grease the o-ring (3) inserted in the assembly opening of the new filter;
- couple the new filter with its cover and insert it into its seat as far as it will go. Secure the screw (5).

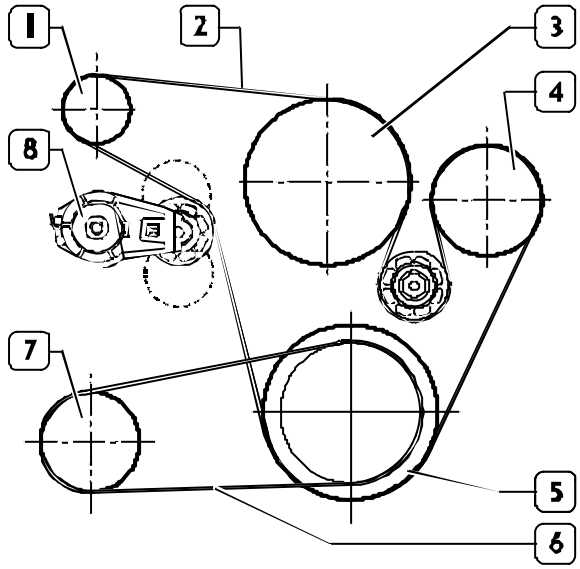
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## EP2 SERVICE

### 543411 Replace water pump belt and alternator

### 543910 Replace air-conditioner compressor drive belt

Figure 74




ASSEMBLY DIAGRAM OF BELTS FOR FAN - WATER PUMP - ALTERNATOR AND AIR-CONDITIONER COMPRESSOR

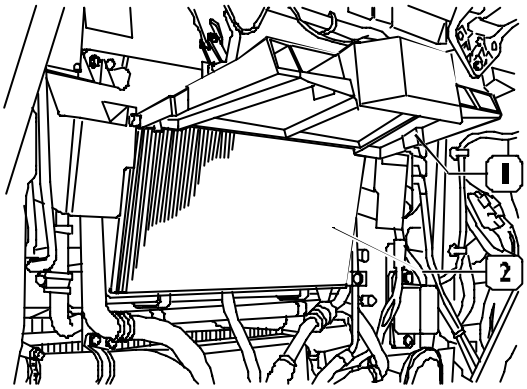
1. Alternator - 2. Drive belt - 3. Fan - 4. Water pump - 5. Crankshaft - 6. Spring belt - 7. Air-conditioner compressor - 8. Drive belt automatic tensioner

In order to carry out change operations correctly, proceed as described in the relevant chapter of section "ENGINE".

## T1 SERVICE

### 553261 Checking anti-pollen filter condition

Figure 73




Check the state of clogging of the pollen filter (2).
Anti-pollen filter can be accessed by lifting front cowling and under door (1).

**NOTE** Excessive clogging of the pollen filters can cause a reduction in the flow rate of air into the cab and therefore less ventilation. This will be highlighted especially by a significant reduction in the efficiency of the windscreen defrosting function.

### 506011 Wash radiator grille

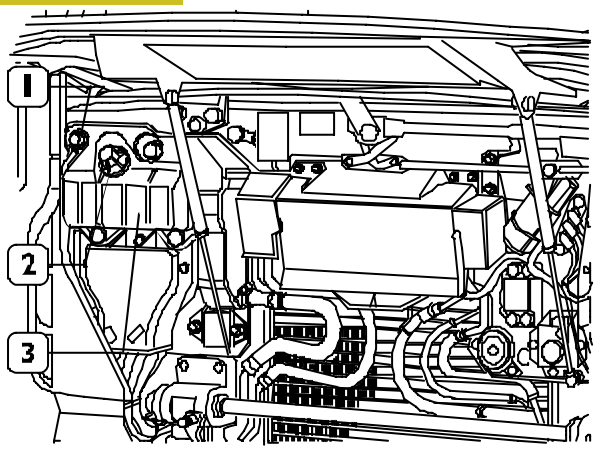
Lift the cab radiator cowling and carefully clean the radiator grille.

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## T2 SERVICE

### 506019 Check percentage of antifreeze in the engine coolant

Figure 75




The plug (1) must never be taken out for any reason whatsoever.
With the engine warm, the cooling system is in overpressure, therefore take care when taking off the cap (2).

Take off the cap (2) and draw off a sample of the coolant from the expansion tank (3) with the densimeter 99395858.

Depending on the temperature of the liquid, check the percentage of antifreeze in the liquid on the scale of the instrument. The percentage has to be higher than 40% and must not exceed 50%.

If necessary, restore the percentage of antifreeze, bearing in mind that the liquid needs to be replaced every 2 years.

For vehicles fitted with an additional heater, the percentage of antifreeze must never exceed 50%.

### 773130 Replacing additional heater fuel filter

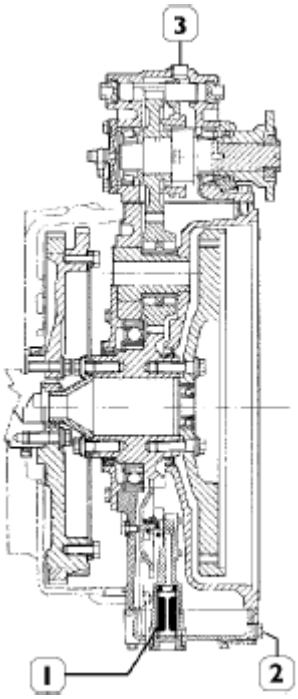
## T3 SERVICE

### 506010 Checking possible radiator clogging

## T4 SERVICE

### 534501 Change "Multipower" total power take-off oil (if applicable)

Figure 76




Set the vehicle horizontal and stop the engine.
Position a suitable container to collect the oil.
- Unscrew the drain plug (2).
- Unscrew the filter (1) and clean it thoroughly.

To restore the oil level, screw the filter (1) and drain plug (2) back on to the required torque, checking the state of the seals.
Replace them if they have deteriorated. Then:
- Unscrew the plug (3) and add the required amount of oil (see FLUIDS in GENERAL INFORMATION).
- Screw the plug back on to the required torque.

## T5 SERVICE

### 506010 Changing engine coolant

Perform procedure described in relating paragraph in section "ENGINE".

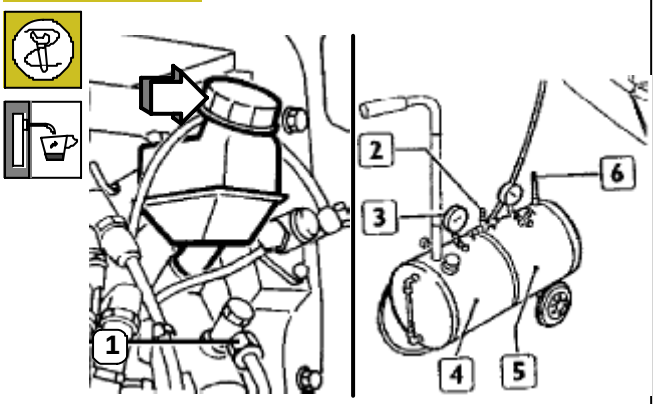
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## T6 SERVICE
## 505292 Change the clutch fluid and make air bleeding (only versions with mechanical transmission)

Drain off the clutch control fluid and change it (see Fluids table in GENERAL section).

The clutch fluid is poisonous and corrosive: if you accidentally come into contact with it, wash immediately with water and a neutral soap.

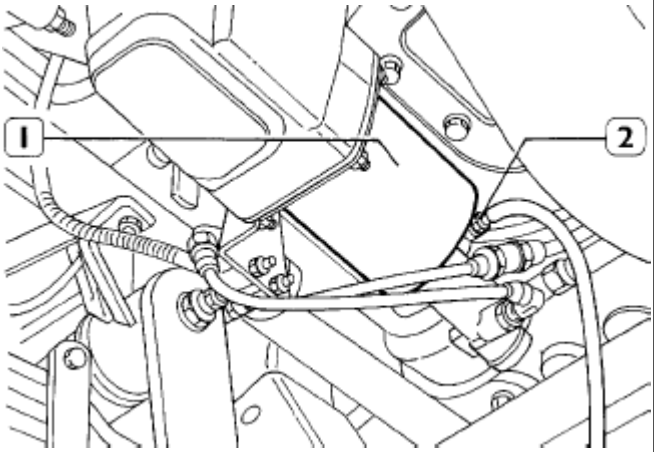
Figure 77




After changing the fluid, bleed the hydraulic clutch control system.
Use the air bleeding tool 99306010 as follows:

- charge reservoir (5) with compressed air;
- fill reservoir (4) with Tutela TRUCK DOT SPECIAL fluid
- replace the cap (⇒) of the clutch fluid reservoir with one of the caps supplied with the tool 99306010 and connect the pipe to the cap.

Figure 78




- Attach a plastic tube to the bleed screw (2) on the slave cylinder (1) and immerse the opposite end of the tube in a container containing Tutela TRUCK DOT SPECIAL fluid, unscrew the bleed screw (1) by one full turn, open the valve (2) (see Figure 77) until a pressure reading of 1 to 1.2 bar is obtained on the pressure gauge (3);
- when the clutch fluid flowing through the tube is uniform and free of air bubbles, close the bleed screw and discharge the air from the reservoir (5) through valve (6).

**NOTE** Whenever the clutch fluid is changed, it will also be necessary to bleed the clutch master cylinder by loosening the fitting (1, Figure 77) before bleeding the clutch servo.

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SECTION 16

# Electric/Electronic system


| | Page |
|---|---|
| GENERAL WARNINGS FOR ELECTRICAL/ ELECTRONIC COMPONENTS | 3 |
| COMPONENT CODE | 6 |
| MAIN CHANGES | 11 |
| CAN LINES | 12 |
| CAN LINE ASSEMBLY DRAWING | 17 |
| POWER NETWORK | 18 |
| GROUND POINTS | 19 |
| ELECTRICAL EQUIPOTENTIAL BRAID | 20 |
| ALTERNATOR | 23 |
| STARTER MOTOR | 25 |
| JUNCTION CONNECTORS | 27 |
| DIAGNOSIS CONNECTOR | 77 |
| BULKHEAD | 79 |
| CENTRAL INTERCONNECTING UNIT | 84 |
| FUSE | 85 |
| REMOTE SWITCHES | 87 |
| FUSE ASSEMBLY BODY CONTROLLER (IBC3) | 89 |
| SUPPLEMENTARY FUSES (70000) | 90 |
| INSTRUMENT BOARD | 92 |
| CENTRAL DASHBOARD CONTROLS | 93 |
| CONTROLS ON THE STEERING WHEEL | 94 |
| REARVIEW MIRRORS AND WINDOW REGULATOR CONTROL ADJUSTMENT | 95 |
| LEFT LIGHT CONTROL 54033 | 96 |
| ENGINE BRAKE CONTROL AND INTARDER | 99 |
| GEAR SELECTION FUNCTION | 100 |
| FUNCTION ENGAGING EMERGENCY MODE (LIMP HOME) | 102 |

https://truckmanualshub.com/
Aquila Trucks Centres


| | Page |
|---|---|
| CLUSTER | 104 |
| CLUSTER (PIN-OUT) | 107 |
| BODY CONTROLLER (IBC3) | 113 |
| BODY CONTROLLER | 115 |
| - Linking connectors | 115 |
| CHASSIS ELECTRONIC MODULE (M.E.T.) | 119 |
| D.D.M./P.D.M. | 121/1 |
| S.W.I. (STEERING WHEEL / STEERVATOR INTERFACE) | 122 |
| SPIRALED CONTACT | 125 |
| STEERING COLUMN (COMPONENT LOCATION) | 126 |
| B.M. (BED MODULE) | 130 |
| E.B.M. (EASY BED MODULE) | 131 |
| TACHOGRAPH | 133 |
| M.C. NET INTERFACE | 134/1 |
| INJECTION SYSTEM ASSEMBLY | 134/2 |
| ENGINE CONTROL UNIT OPERATION STRATEGIES | 134/4 |
| EDC (ECM) SYSTEMS | 135 |
| SYSTEM COMPONENTS | 139 |
| VCM (VEHICLE CONTROL MODULE) ELECTRONIC CONTROL UNIT | 163 |
| IMMOBILIZER | 166 |
| ABS-EBL | 168 |
| COMMON COMPONENTS | 171 |

| | Page |
|---|---|
| ECAS SUSPENSIONS | 178 |
| EUROTRONIC AUTOMATIC TRANSMISSION | 184 |
| LIMP - HOME | 189 |
| ELECTRONIC CENTER | 192 |
| TRANSMISSION ACTUATOR | 194 |
| CLUTCH ACTUATOR | 196 |
| INTARDER | 200 |
| EM (EXPANSION MODULE) ELECTRONIC CONTROL UNIT (PTO) | 206 |
| AUTOMATIC AIR CONDITIONER | 209 |
| MANUAL AIR CONDITIONER | 224 |
| HYDRONIC D 10 WATER HEATER | 228 |
| SCR (SELECTIVE CATALYTIC REDUCTION) SYSTEM - DENOX 2 | 235 |
| CENTRAL LOCKING WITH REMOTE CONTROL | 238 |
| DIAGNOSTIC | 240 |
| CIRCUIT CHARTS | 245 |

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## GENERAL WARNINGS FOR ELECTRICAL/ELECTRONIC COMPONENTS



Do not ever disconnect the batteries from the system with the engine running.
Do not start the engine without first having connected the batteries in a permanent manner.

- Before working on the vehicle, immobilise the wheels with chocks.
- Do not use fast chargers to start the engine. Engine starting can be performed either by means of separate batteries or by means of a special truck.
- Incorrect polarisation of the power supply voltage for the electronic control units (e.g. erroneous battery polarisation) may damage the components irreversibly.
- If you have to disconnect the batteries from the system, always disconnect the frame ground cable from the negative terminal of the batteries first.
- Before connecting the batteries to the system, make sure that the system is suitably insulated.
- Disconnect the batteries from the system before recharging them by means of an external unit.
- Disconnect the external recharging unit from the power mains before removing the unit's pliers from the battery terminals.
- At temperatures of over 80 °C (drier ovens), take down the ECU's.
- At the connection stage, tighten the flanged nuts of the connectors (temperature and pressure sensors, etc.) to he required torque. Check the exact polarity of the battery terminals when starting the engine by means of the auxiliary truck.
- Before working on the vehicle's electrical/electronic system disconnect the positive pole of the battery.
- Before disconnecting the connector from an electronic control unit, isolate the system.
- Do not cause sparks to check whether a circuit is live.
- Do not use a test bulb to check the continuity of a circuit. Only use the appropriate testing devices.
- Do not directly power the components associated with electronic control units with the nominal power rating of the vehicle.
- Make sure that the wirings of electronic devices (length, type of cable, location, grouping, connection of screen braiding, earthing, etc.) conform with the IVECO system and that they are carefully restored after repair or maintenance work. To avoid the possible malfunctioning of the electronic systems on board, the wirings of additional devices must follow a different path than that of the above-mentioned systems.
- Do not connect the negative terminals of additional systems to the negative terminals of electronic systems.
- In the event of electric welding on the vehicle, disconnect all the electronic control units and/or disconnect the power cable from the battery positive terminal and connect it to the frame earth.
- Connectors are viewed from the cable side.



Key storage procedures are affected by electromagnetic disturbances such as cell phones and the like.
Therefore, during key memorization:
1. Ensure there are no sources of disturbance in the cab or close to the keys.
2. Keys not inserted in the panel must be at a distance of at least 1 meter.

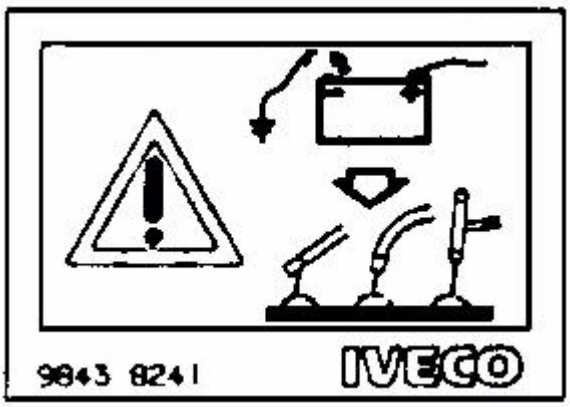


When working on electronic control units, plug connections and electrical connections to the components, measurements can be made only on suitable testing lines, by means of special plugs and plug-type bushes. Do not under any circumstances make use of improper devices such as metal wires, screwdrivers, clips and the like. In addition to the risk of causing a short circuit, this might damage plug-type connections and this would then give rise to contact problems.

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In order to prevent damage or short-circuiting of the on-board electronic control units, the following operations must be always carried out before starting any welding operation on the chassis.

- If electric welding has to be done on the vehicle,



112514

isolate the electric system as follows:

a) disconnect the power lead from the battery positive terminal and connect it to the chassis earth;

b) disconnect the power lead from the battery negative terminal;

c) disconnect the electronic control unit connectors, taking care to avoid touching the control unit connector pins.

- Moreover:

a) should it be necessary to carry out welding operations close to the control unit, remove it from its location.

b) whenever possible, earth the welding machine directly to the piece that has to be welded.

In the case of vehicles equippedwith a DTCO digital tachograph, do not disconnect the battery leads and then connect them by jumpers to reset the electronic systems.

This operation should be avoided, as it could cause permanent damage to the DTCO tachograph CARD or other on-board electronic systems.

To reset the electronic system without running risks, disconnect the vehicle battery and wait for 10 minutes.

It is strictly forbidden to carry out any modifications or connections to the electronic control unitwiring; in particular, the line interconnecting data between the control units (CAN line) must be considered as untouchable.

Diagnostic and maintenance operations can only be carried out by authorised personnel with IVECO approved equipment.

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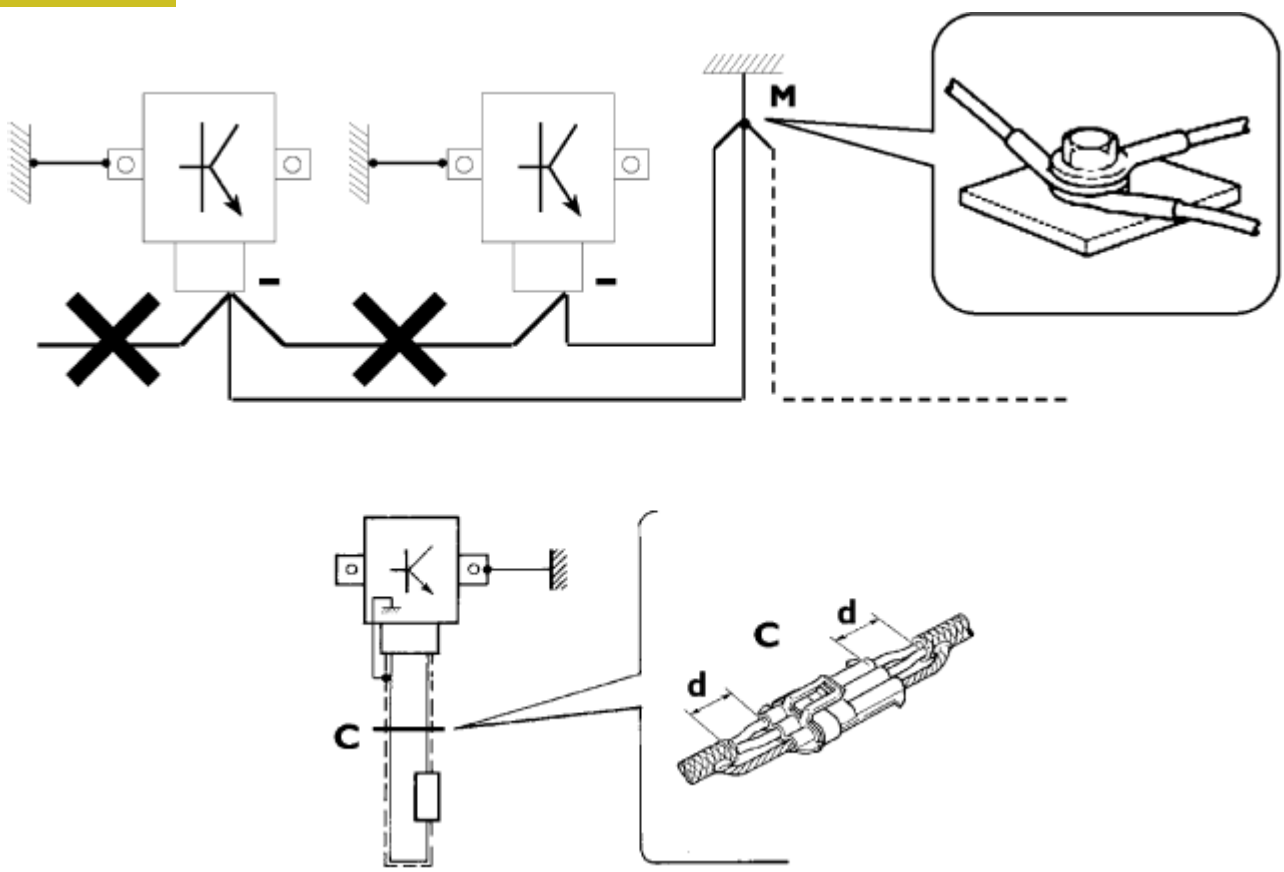
## Practical tips

The negative leads connected to a system grounding point must be as short as possible and connected to one another in "star" configuration; make sure that they are tightened in an orderly and adequate manner (Figure 1, ref. M).

Furthermore, for electronic components, the instructions to be followed very carefully are:

- ECU's must be connected to the system ground if they are provided with a case.
- ECU negative cables must be connected both to a system grounding point, such as for instance the dash compartment ground (with no "serial" or "chain" connections) and to the negative terminal(s) of the battery/batteries.
- Even though they are not connected to the system ground/battery negative terminals, analogue ground elements (sensors) must have excellent insulation. As a result, special care must be devoted to the eddy resistances of the cable terminals: oxidation, seam-folding defects, etc.
- The metal braid of shielded circuits must be in electrical contact at either end with system components.
- Only one end of the shielding braid must be connected to the system ground.
- In the presence of jointing connectors, the non-shielded portion, d, must be as short as possible in the proximity of the connectors (Figure 1).
- The cables must be arranged so as to run parallel to the reference plane, i.e., as close as possible to the frame/body structure.
- Additional electromechanical systems must be connected with the greatest care to the system ground and must not be placed alongside the cables of electronic components.

Figure 1




88039

SHIELDING BY MEANS OF A METAL BRAID OF A CABLE LEADING TO AN ELECTRONIC COMPONENT - C. CONNECTOR - d. DISTANCE ! 0.

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## COMPONENT CODE

| | |
|---|---|
| 03000 | Self-rectifying alternator with built in voltage regulator |
| 08000 | Starter Motor |
| 12015 | Motor for outside air intake door |
| 12023 | Window shade motor |
| 12032 | Cab hydraulic release pump motor |
| 20000 | Starter battery |
| 22000 | Horn |
| 22043 | Buzzer for warning that automatic transmission gear selector is not in regular position |
| 25010 | Contactor for additional high beam lamps engagement |
| 25200 | Relay for starter |
| 25201 | Relay, preheating |
| 25202 | Relay, G.C.R. energizing |
| 25203 | Relay, G.C.R. opening |
| 25204 | Relay, remote starting enablement, cab unlatched |
| 25205 | Relay, engine stopping |
| 25206 | Relay, rich mixture control |
| 25207 | Relay, alternator D+ earthing |
| 25208 | Relay, remote start enablement, gear engaged |
| 25209 | Relay for cutting off various components during starting stage |
| 25210 | Relay, starting enablement with transmission in neutral |
| 25211 | Relay with delayed opening contact for keeping G.C.R energized |
| 25212 | Relay with delayed closing contact for keeping RTE energized |
| 25213 | Relay for supply of users connected to ignition switch through battery positive |
| 25222 | Relay for allowing connection of thermal starter |
| 25306 | Contactor for electroheater control and windscreen defrost |
| 25310 | Relay for allowing connection of internal heating with power load inhibiting relay |
| 25322 | Relay for connection of auxiliary heater (1st speed) |
| 25325 | Contactor for engine water recycle open with engine running |
| 25327 | Relay for connection of air-conditioning system |
| 25332 | Relay for connection of air-conditioning system |
| 25337 | Contactor for engine water recycle close solenoid valve with additional heater on |
| 25351 | Electric trap opening contactor |
| 25352 | Electric trap closing contactor |
| 25544 | Topflap engine polarity reverse contactor for LD |
| 25545 | Topflap open/close comand contactor for LD |
| 25705 | Contactor for vehicle testing |
| 25722 | Cab hydraulic release pump switch (lowering) |
| 25723 | Cab hydraulic release pump switch (raising) |
| 25737 | Contactor for fan (Barufaldi) electromagnetic coupling engagement |
| 25740 | Headlamp washer enable contactor |
| 25805 | Contactor for horn control |
| 25818 | Contactor for heater windscreen control |
| 25866 | Relay for terminal 58 |
| 25874 | Relay for connection of power loads with engine running |
| 25897 | Relay for connection of side transmission power takeoff |
| 25898 | Relay for connection of rear transmission power takeoff |
| 25900 | General current relay |
| 25901 | Main current relay with automatic switch |
| 25903 | Contactor for EDC disengagement |
| 25924 | EDC connecting relay "Main Relay" |
| 30001 | Dipped and main beam headlamp with side light |
| 30010 | High beam headlamp |
| 30011 | Fog light |
| 30100 | Headlamp aiming control actuator |
| 32002 | Front direction indicator |
| 32010 | Rotary lamp |
| 33001 | Side direction indicator |
| 33004 | Side marker lamp |
| 34000 | Multifunctional rear light |
| 34011 | Trailer light |
| 35000 | Number plate light |
| 37000 | Front/rear dimensions light |
| 37001 | Front dimensions light |
| 39000 | Ceiling lamp for cabin inside lighting |
| 39003 | Courtesy light for steps |
| 39009 | Courtesy light for reading lights |
| 39017 | Courtesy light for adjustable cabin interior light |
| 39020 | Ashtray lamp |

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| | |
|---|---|
| 39030 | Cab side opening lighting lamp |
| 39030 | Cab side opening lighting lamp |
| 39034 | White and red internal light unit |
| 40011 | Electronic Tachograph |
| 40032 | Sender unit for tachometer and tachograph |
| 40046 | Inductive type chassis height sensor (rear axle) |
| 40047 | Inductive type chassis height sensor (front axle) |
| 42030 | Sender unit for engine oil pressure gauge |
| 42045 | Sender unit for outdoor temperature gauge |
| 42100 | Switch for front brake insufficient air pressure indication |
| 42101 | Switch for rear brake insufficient air pressure indication |
| 42102 | Switch signalling handbrake applied |
| 42108 | Switch for trailer retarder signal |
| 42111 | Switch signalling trailer braking system failure |
| 42116 | Switch for low air pressure indicator in EBS system |
| 42200 | Switch signalling pneumatic suspension system failure |
| 42351 | Switch signalling air filter blocked |
| 42374 | EDC clutch switch |
| 42379 | Switch for PTO engagement enable |
| 42381 | Drive axle RH pressure sensor (ECAS) |
| 42382 | Lift axle RH pressure sensor (ECAS) |
| 42389 | Air pressure sensor on third axle pneumatic lifting system |
| 42551 | Switch signalling oil filter blocked |
| 42608 | Coolant pressure signalling 3-switch assembly |
| 42622 | Circuit 2 hydraulic oil flow indicator switch |
| 42623 | Electric switch in front power steering engagement valve (ZF circ. 1,5) |
| 42624 | Electric switch in front power steering lock valve (ZF circ. 1,5) |
| 42700 | Fuel filter clogged indicator switch |
| 44031 | Fuel level gauge sender unit with reserver warning light contact |
| 44035 | Insufficient windscreen washer fluid level gauge control |
| 44036 | Insufficient radiator coolant level gauge control |
| 44037 | Insufficient power steering liquid level indicator ECU |
| 44043 | Engine oil level gauge sender unit |
| 47032 | Sender unit for engine oil temperature thermometer |
| 47041 | Water temperature transmitter for Retarder ECU |
| 47042 | Fuel temperature sensor |
| 47043 | Engine fan temperature sensor |
| 47113 | Thermometric switch for pre-filter and fuel oil sedimentation tank heating |
| 48035 | Engine rpm sensor |
| 48042 | Engine rpm sensor (on timing gear) |
| 48043 | Turbocharger speed sensor |
| 50003 | Electronic dashboard with microprocessor for instrument and indicator lamp display |
| 50005 | Multiplex instruments unit module |
| 52001 | Switch with built in indicator lamp for windscreen defrost heater |
| 52003 | Switch with built in indicator lamp for additional heater |
| 52005 | Switch with built in w/l for heated rear view mirrors |
| 52009 | Switch with built in w/l for trailer light |
| 52013 | Switch for internal aerators |
| 52024 | Switch with built in w/l for additional headlamps |
| 52029 | Central emergency control switch |
| 52035 | Switch with integral rotary headlamp engagement indicator lamp |
| 52044 | Switch for differential lock engagement |
| 52045 | Switch for front drive engagement |
| 52056 | Switch with built-in w/lamp for ASR cutout |
| 52057 | ABS cut out switch |
| 52059 | Automatic transmission speed selector |
| 52070 | Switch for engaging side power takeoff |
| 52071 | Switch for engaging rear power takeoff |
| 52090 | Suspension levelling switch (ECAS) |
| 52091 | Switch with integral indicator lamp for heater rear mirror engagement |
| 52092 | Switch for engine or cab heater |
| 52093 | Switch for tail hatch locking safety |
| 52094 | Switch for spot light |
| 52200 | Switch for electric or pneumatic horns |
| 52220 | Switch for tail hatch locking safety |
| 52300 | Switch for tail hatch locking safety |
| 52302 | Switch with built in w/l for hazard warning lights |
| 52304 | Switch for fog lights and rear fog lights inhibitor |
| 52307 | Switch for exterior lights |

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| | |
|---|---|
| 52312 | Switch controlling headlamp alignment adjustment |
| 52324 | Engine brake connecting switch |
| 52326 | White and red internal lights switch |
| 52502 | Ignition switch for services with starting |
| 52600 | Main current switch |
| 53006 | Switch for starting from engine compartment |
| 53007 | Switch for stopping engine from engine compartment |
| 53022 | Switch for front differential lock control |
| 53030 | Switch for controlling starting assistance |
| 53061 | Cab hydraulic release consensus switch |
| 53062 | Cab hydraulic release pump switch (lowering) |
| 53063 | Cab hydraulic release pump switch (raising) |
| 53068 | Unstable switch for idle position (n) with automatic transmission |
| 53069 | Unstable switch for reverse (r) with automatic transmission |
| 53070 | Unstable switch for forward gears (d) with automatic transmission |
| 53071 | Unstable switch for speed limiter with automatic transmission |
| 53300 | Switch for driver's side electric window |
| 53302 | Switch for passenger side electric window |
| 53303 | Push-button panel for sliding door opening device control |
| 53304 | Switch for axle pneumatic suspension control |
| 53305 | Switch for drive axle pneumatic suspension control |
| 53306 | Switch controlling sun roof motor |
| 53309 | Switch for 3rd axle raising system |
| 53311 | Switch for controlling window blind |
| 53315 | Switch with built in telltale to turn on foglights |
| 53316 | Current general contactor switch |
| 53501 | Switch signalling vehicle stopped |
| 53503 | Switch signalling reversing lights |
| 53504 | Front differential lock on indicator switch |
| 53506 | Four wheel drive engaged indicator switch |
| 53507 | Switch signalling reduced gears engaged |
| 53508 | Switch for antistarting with reduced gears |
| 53509 | Switch for switching on interior lights |
| 53510 | Switch for switching on step lights |
| 53511 | Switch signalling cabin unlatched |
| 53512 | Switch for antistarting engine device with handbrake off |
| 53521 | Switch for signalling longitudinal differential lock |
| 53538 | Tilted box indicator switch |
| 53547 | Switch for secondary signal from brake pedal to EDC ECU |
| 53565 | Brake pedal pressed indicator switch |
| 53567 | Switch for signalling side power takeoff engaged |
| 53568 | Switch for signalling rear power takeoff engaged |
| 53591 | Switch for signalling failure of the hydraulic circuit with auxiliary steering third axle |
| 53593 | Switch to light cab side opening lamp |
| 53593 | Tool compartment light switch |
| 53602 | Switch indicating incomplete sunshade closing |
| 53606 | Reed switch (control with magnet) on master clutch cylinder for synchronous protection of mechanical transmission, 70% compressed |
| 53607 | Reed switch (control with magnet) on clutch master cylinder for EDC |
| 53801 | Switch signalling Rockwell axle differential lock engaged |
| 53802 | Switch signalling Rockwell axle differential lock engaged (3rd axle) |
| 54030 | 4 function steering column switch unit |
| 54033 | 6 function steering column switch unit |
| 61011 | 3A 1-diode holder container |
| 61101 | 1 3A diode container |
| 61104 | Air braking system drier resistor |
| 61108 | Current limiter resistance for heater windscreen system |
| 61110 | Pre-filter and fuel oil sedimentation tank pre-heating resistor |
| 61121 | Resistance for engine preheating |
| 61126 | Termination resistor for CAN bus |
| 61137 | Current limiter resistor for additional engine water heater |
| 61147 | Resistor container for ACC (Adaptive Cruise Control) |
| 61150 | Urea filter outlet heater with SCR (Selective Catalytic Reduction) |
| 64000 | Electric windscreen washer pump |
| 65000 | Windscreen wiper unit |
| 66005 | Headlamp washer pump |
| 68000 | Radio equipment |
| 68001 | Speaker |

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| | |
|---|---|
| 68003 | Preamplifier |
| 68005 | Feeder 24 V 12 V |
| 68007 | City Band (C.B.) |
| 70000 | Fuse holder 6 (30 A) |
| 70001 | Fuse holder 8 |
| 70058 | 1-way 20A fuse carrier |
| 70066 | Fuse holder 1-way 1a for ADR |
| 70401 | Fuse holder 4-ways |
| 70402 | Fuse holder 4-ways |
| 70403 | Fuse holder 4-ways |
| 70601 | Fuse holder with 6 fuses |
| 70602 | Fuse holder with 6 fuses |
| 70603 | Fuse holder with 6 fuses |
| 70604 | Fuse holder with 6 fuses |
| 70605 | Fuse holder with 6 fuses |
| 72006 | 7-pin coupling for tractor/trailer ABS/EBS electric connection Coupling with 7 poles for electrical connection of trailer ABS |
| 72010 | 15-pole coupling for electrical connection to trailer |
| 72021 | 30-pole connector for the electrical connection to the diagnostic equipment located outside the vehicle |
| 72022 | 2-pole coupling for external engine start |
| 72025 | 2-pole 12 V connection for general power supply |
| 72026 | 2-pole 12 V connection for telephone |
| 72069 | 16-pole coupling for OBD (On Board Diagnose) |
| 78009 | Closed circuit to turbine solenoid valve |
| 78016 | Engine fan solenoid valve |
| 78050 | Engine brake solenoid valve |
| 78052 | ABS/EBS solenoid valve |
| 78053 | ASR solenoid valve |
| 78054 | Solenoid valve for engaging retarder |
| 78055 | Solenoid valve for retarder oil accumulator |
| 78057 | EBS front axle air pressure control proportional valve |
| 78058 | EBS trailer air pressure control proportional valve |
| 78059 | Duplex valve for EBS |
| 78060 | Solenoid valve to exclude third-axle braking with ASR |
| 78061 | Oversize solenoid valve for axle braking in case of EBS ECU failure |
| 78062 | ECAD regeneration solenoid valve (Electronic Controlled Air Dryer) |
| 78063 | ECAD bleed solenoid valve (Electronic Controlled Air dryer) |
| 78171 | Splitter control solenoid valve |
| 78182 | Solenoid valve for mechanical transmission synchronous protection |
| 78203 | Solenoid valve for pneumatic horns |
| 78205 | Solenoid valve for transverse differential lock |
| 78206 | Solenoid valve for longitudinal differential lock |
| 78208 | Solenoid valve for total PTO engagement on transmission |
| 78227 | Solenoid valve for radiator water recirculation |
| 78238 | Rear axle solenoid valve assembly for chassis alignment |
| 78239 | Front axle solenoid valve assembly for chassis alignment |
| 78243 | Rear axle electropneumatic distributor |
| 78245 | Solenoid valve for total PTO disengagement on transmission |
| 78247 | Solenoid valve for electronic injection |
| 78248 | Solenoid valve for variable geometry turbine order |
| 78249 | Solenoid valve for third axle pneumatic valve control |
| 78250 | Solenoid valve for 3rd axle lowering |
| 78251 | Solenoid valve for engaging transmission side power takeoff |
| 78252 | Solenoid valve for engaging transmission rear power takeoff |
| 78265 | Solenoid valve for axle transverse differential lock engagement |
| 78266 | Metering module solenoid valve with SCR (Selective Catalytic Reduction) |
| 78267 | Engine water circulation solenoid valve for urea tank heating with SCR (Selective Catalytic Reduction) |
| 80000 | Motor for right electric window |
| 80001 | Motor for left electric window |
| 82000 | Windscreen defrosting control unit |
| 82005 | Auxiliary air heater |
| 82010 | Air conditioning system control and indication ECU |
| 84000 | Water boiler |
| 84001 | Air burner |
| 84005 | Additional heater ECU |
| 84006 | Additional heater control and indication ECU |
| 84009 | Internal temperature sensor |
| 84010 | Metering device |

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| | |
|---|---|
| 84019 | Electromagnetic pulley |
| 85000 | Cigar lighter |
| 85001 | Cigar lighter outlet |
| 85003 | Heated rearview mirror (trailer) |
| 85004 | Heated rearview mirrot (wheel) |
| 85005 | Heated rearview mirror |
| 85006 | Electrically adjustable heated rear view mirror |
| 85007 | Wheel electrically adjustable heated rear view mirror |
| 85008 | Trailer electrically adjustable heated rear view mirror |
| 85009 | Front Heated rearview mirror |
| 85010 | Rear view mirror control |
| 85011 | Rearview selection and heated rearview mirror engagement control |
| 85023 | Electric latch |
| 85036 | Heated pneumatic seat (driver side) |
| 85038 | Heated pneumatic seat (passenger side) |
| 85065 | Remote control for aligning suspensions and raising 3rd axle |
| 85131 | Volumetric sensor |
| 85140 | Electronic control for SCR pumping module (Selective Catalytic Reduction) |
| 85141 | Catalyst outlet temperature sensor with SCR (Selective Catalytic Reduction) |
| 85142 | Level and urea tank temperature sensors with SCR (Selective Catalytic Reduction) |
| 85143 | Catalyst inlet temperature sensor with SCR (Selective Catalytic Reduction) |
| 85144 | NOX detection sensor with SCR |
| 85150 | EDC ECU |
| 85152 | Accelerator load sensor (EDC) |
| 85153 | Coolant temperature sensor (EDC) |
| 85154 | Turbofan air temperature sensor (EDC) |
| 85155 | Turbofan air temperature sensor (EDC) |
| 85156 | Turbo blower air temperature and pressure sensor for EDC |
| 85158 | Turbofan air temperature sensor (EDC) |
| 85159 | Temperature and ambient air pessure sensor for EDC |
| 85161 | Relative humidity combustion air and temperature sensors with EDC |
| 86002 | Sensors for front brake shoe wear |
| 86003 | Sensors for rear brake shoe wear |
| 86004 | Automatic transmission electronic control unit |
| 86013 | Sensor for signalling water in fuel filter |
| 86015 | Retarder electronic control unit |
| 86023 | Vehicle raising/lowering control unit Ecas |
| 86029 | Centralized door lock ECU |
| 86030 | Sensor detecting heat irradiation |
| 86038 | Centralized lube ECU |
| 86053 | Multiplex control and signal unit from bed positions |
| 86116 | Multiplex body computer control unit |
| 86119 | Multiplex driver door module ECU |
| 86053 | Multiplex control and indication ECU from stretchers |
| 86116 | Multiplex body computer ECU |
| 86117 | Multiplex front frame computer ECU |
| 86118 | Multiplex rear frame computer ECU |
| 86119 | Multiplex Driver Door Module ECU |
| 86120 | Multiplex passenger door module ECU |
| 86123 | Multiplex ECU for steering control shaft interfacing |
| 86124 | Cabin operation with Multiplex ECU |
| 86125 | ECU for VDI (Vehicle Data Interface) |
| 86126 | ECU for EM (Expansion module) |
| 86127 | ECU for DMI (Data Management Interface) |
| 86128 | M.E.T. chassis ECU |
| 86129 | ECU for MC-NET (Mobile Communication Network) |
| 86130 | Navigator ECU |
| 86131 | Telematic ECU |
| 86132 | VCM (Vehicle Control Module) ECU |
| 88000 | ABS ECU |
| 88001 | ABS/EBS system sensor |
| 88005 | EBS system ECU |
| 88006 | EBS rear axle air pressure control modulator |
| 88007 | Potentiometric sensor for front wheel shoe position indicator |
| 88008 | Potentiometric sensor for rear wheel shoe position indicator |
| 88010 | Rear axle brake application pressure sensor |
| 88011 | Potentiometric sensor for third axle skid wear signalling |
| 88012 | SAS sensor (= Steering Angle Sensor) for EBS |
| 88013 | ESC module (= Electronic Stability Control) for EBS |
| 89000 | Fridge |
| 89010 | Food warmer |

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## MAIN CHANGES

For vehicles with Euro 4 engine the electric/electronic system is subject to important variations.
In order to handle the increased complexity of Euro 4 operations demanded to the engine control system extra hardware and software resources, the VCM (Vehicle Computer Module) has been added so that vehicle functions can be reallocated on it, which up to Euro 3 had been carried out by the EDC engine control unit, therefore more development flexibility is available for vehicle functions. The immobilizer function has been also integrated on this unit.

The New Body Controller (IBC3) unlike the Body Computer (BC) distributes direct positives and key-locked, protected by external fuses (replaceable) or internal (resettable).In the chassis there is the MET control unit (chassis electronic module) which controls the chassis power devices, thus replacing the FFC and RFC control units.

For the automated transmission on the new Euro 4 vehicle range the gear selector has been removed. Its functions are carried out from the control pushbuttons located on the dashboard center panel combined with the power steering lever.

The EM control unit (Expansion Module) replaces the DMI (Data Management Interface). It controls the power takeoffs and makes it possible to implement complex applications and connections to different devices through the CAN-open line. It communicates with the other control units through the CAN DVB line.

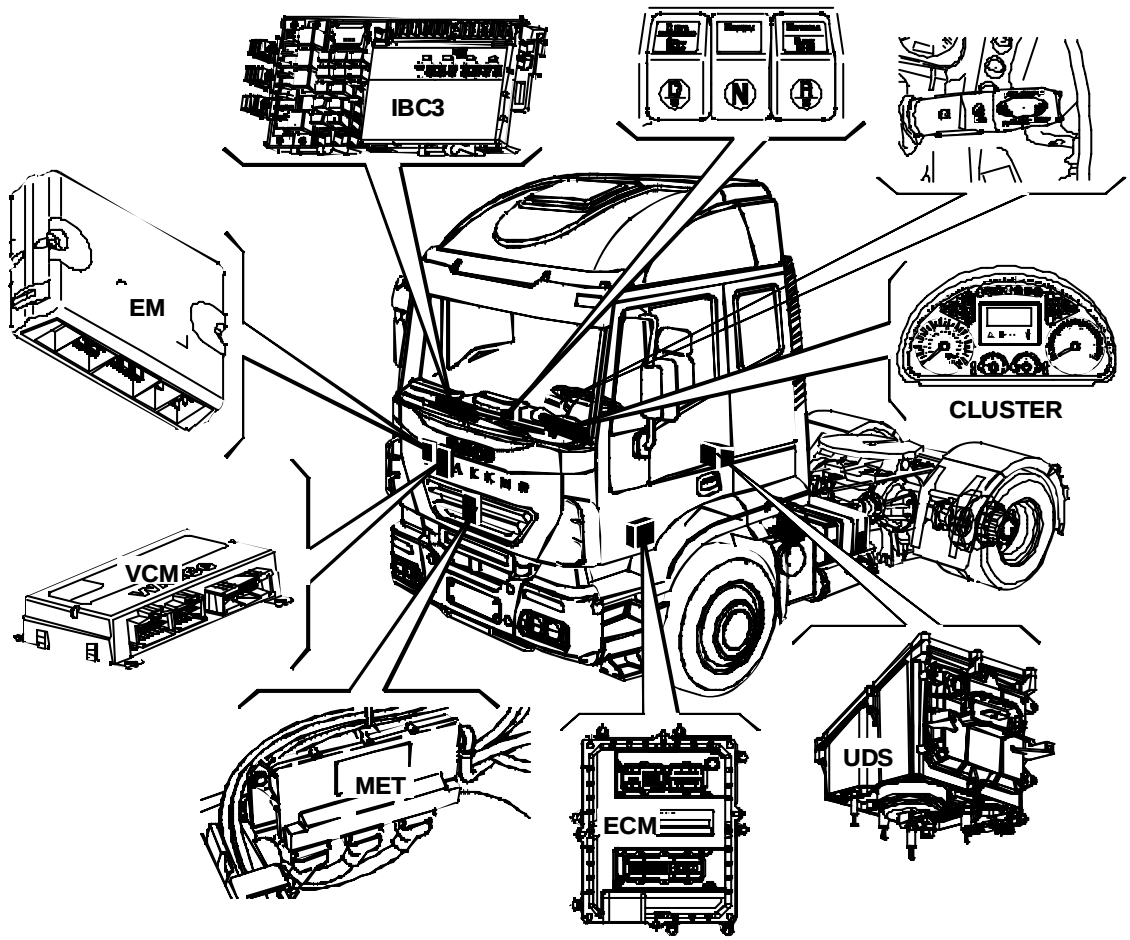
The SCR (Selective Catalytic Reduction) - Denox 2 is on the entire Average/Heavy Euro 4 Range with the Urea Dosing System (UDS) positioned on the lower side of the frame.
The ENGINE ECM (Engine Control Module) replaces EDC MS 6.2.

The new Cluster is monochrome with more functions compared to the previous one.

The introduction of the new units and the change of the previous ones require changes of the vehicle system structure.
The following CAN lines are on the VCM unit:

- VDB - Vehicle Data Bus
- ECB - Engine Control Bus
- FMB - Fuhrpark Management Bus

Figure 2



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## CAN LINES

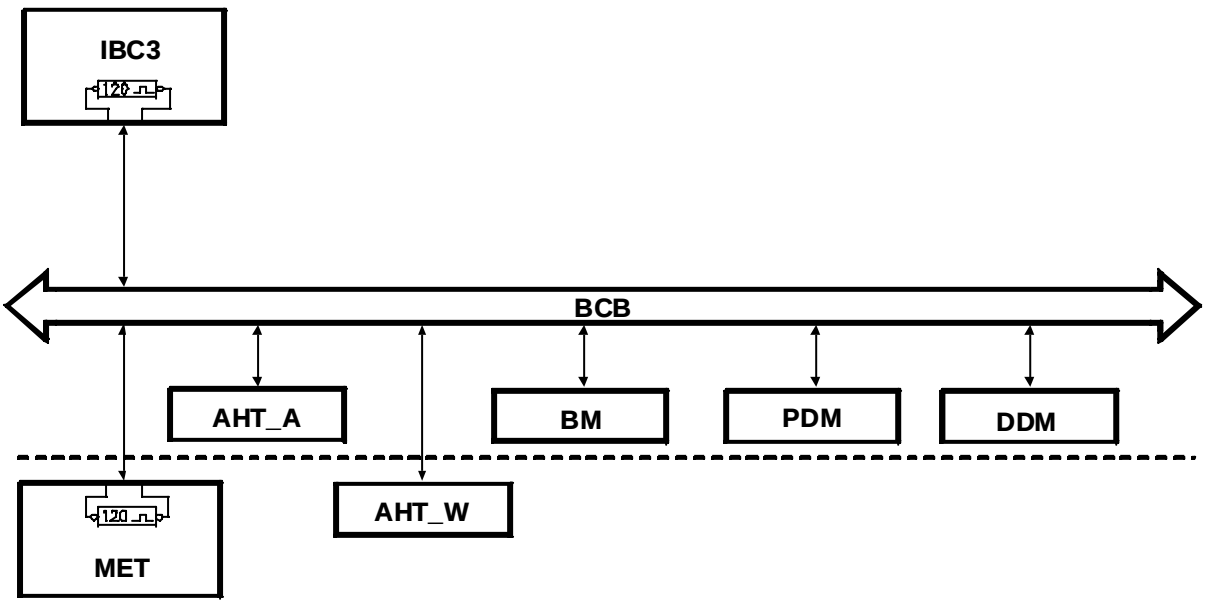
Dialogue between the Easy Mux system, vehicle systems, engine control unit, SCR system, radio and various setters is carried out by means of the CAN lines:

- BCB - Body Control Bus
- VDB - Vehicle Data Bus
- ECB - Engine Control Bus
- IDB - Infotainment Data Bus
- FMB - Fuhrpark Management Bus

### BCB (Body Control Bus) communication line

It enables the communication between the IBC3 and MET control units of the Easy Mux system and the other control units of the different services onboard.

Figure 3




Technical features 112585

- Data transmission speed 62.500 (BIT/SEC)
- Color of the wire Grey

List of Units

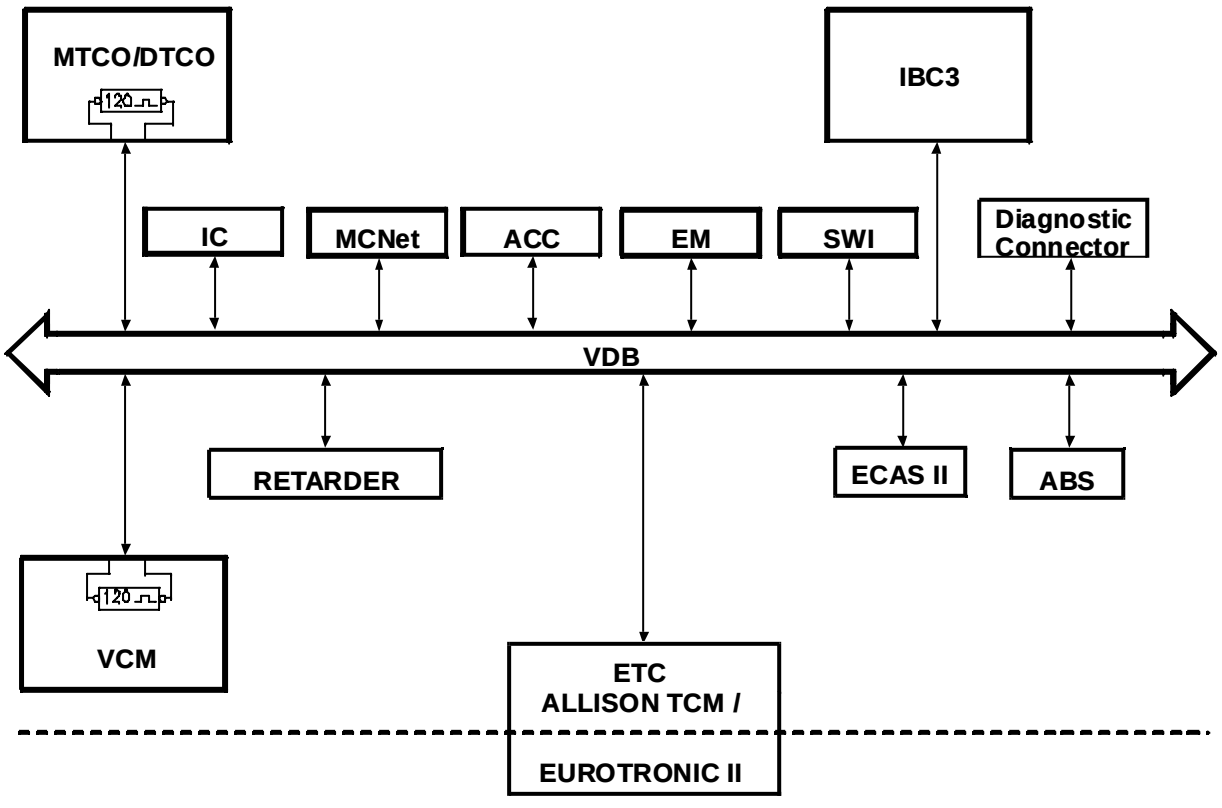
| Ref. | Description |
|---|---|
| IBC3 | Body Controller |
| DDM | Driver Door Module control unit |
| PDM | Passenger Door Module control unit |
| BM | Bed Module |
| MET | MET chassis control unit |
| AHT-A | Air heater |
| AHT-W | Water heater |

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## VDB (Vehicle Data Bus) Communication Line

Allows the electronic systems on the vehicle to dialogue. The units connected to it are: Eurotronic Transmission, Retarder, ABS, Ecas, Diagnosis connector, VCM, Tachograph, ACC, SWI, EM, (Mc Net).
This line also dialogues with the Cluster and the Body Computer.

Figure 4




Features

- Data transmission speed 250.000 (BIT/SEC)
- Color of the wire Black

List of Units

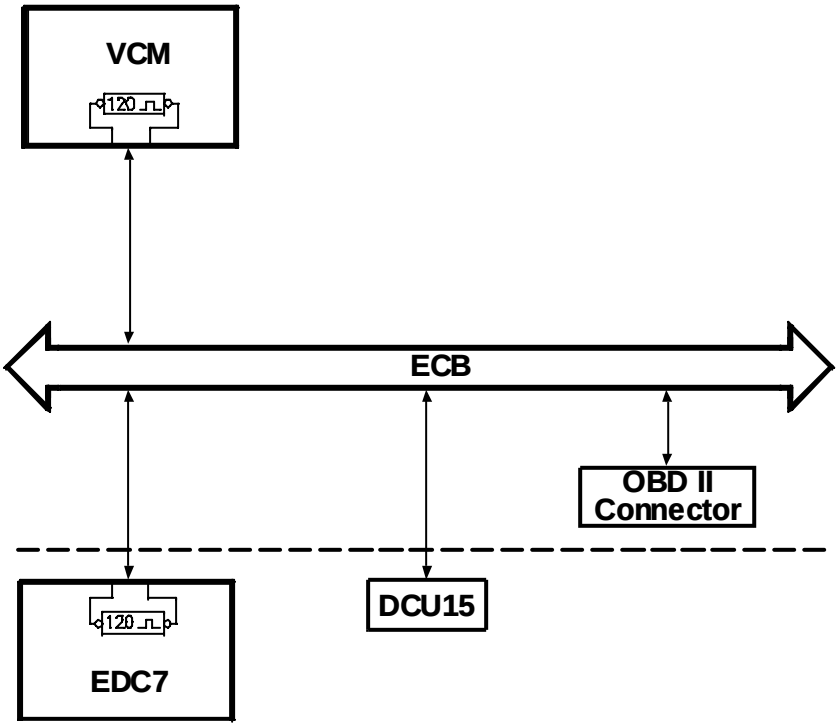
| Ref. | Description |
|---|---|
| MTCO | Tachograph |
| DTCO | Digital tachograph |
| VCM | Vehicle Control Module control unit |
| IC | Cluster |
| IBC3 | Body Controller |
| SWI | Steering Wheel Interface control unit |
| Diagnostic Connector | 30-pole diagnosis connector |
| ABS | ABS control unit |
| McNet | Electronic control unit for Mobile Communication Network |
| RETARDER | Intarder control unit |
| ECAS II | Air suspension contrl unit |
| EUROTRONIC II | Eurotronic II automatic gearbox control unit |
| ALLISON TCM | Allison automatic gearbox control unit |
| ACC | Radar ACC (Adaptive Cruise Control) control unit |

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## ECB (Engine Control Bus) communication line

Allows the units and the engine control sensors to dialogue together. The units connected to it are:: EDC, VCM, DCU15 and the OBD connector.

Figure 5




112280

Features

- Data transmission speed 250.000 (BIT/SEC)
- Color of the wire Yellow

List of Units

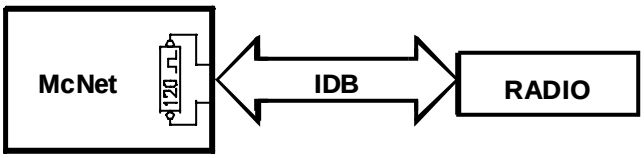
| Ref. | Description |
|---|---|
| VCM | Vehicle Control Module Unit |
| EDC7 | Engine control unit |
| DCU15 | SCR pumping module unit |
| OBD II Connector | 16 pole connector for OBD (onbord diagnose) |

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## I.D.B. (Infotainment Data Bus) communication line

Allows communication between the Cluster and the Radio. The messages sent are shown on the CLUSTER.

Figure 6




112586

Technical features

- Data transmission speed 100.000 (BIT/SEC)
- Color of the wire Blue

List of Units

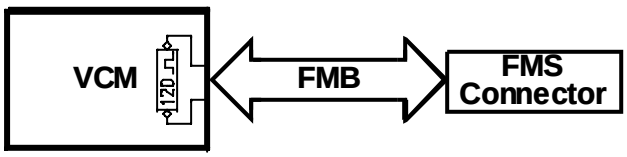
| Ref. | Description |
|---|---|
| Radio | Radio |
| McNet | Electronic control unit for Mobile Communication Network |

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## F.M.B. (Fuhrpark Managemant Bus) communication line

Allows communication between the different electronic systems (accessories) on the vehicle, , FMS (Telephone) connector and VCM unit.

Figure 7




112283

Technical features

- Data transmission speed 250.000 (BIT/SEC)
- Color of the wire White

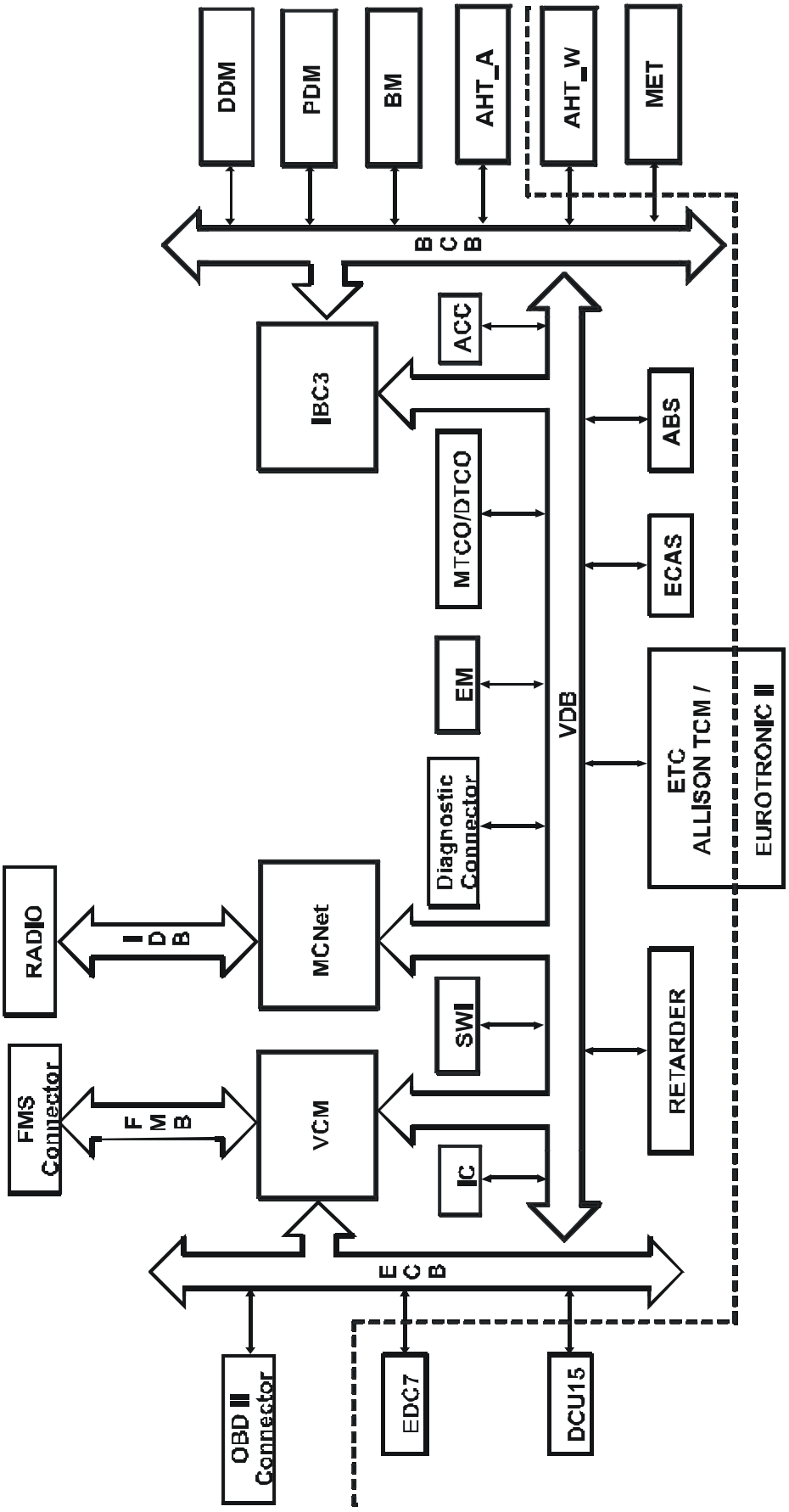
List of Units

| Ref. | Description |
|---|---|
| VCM | Vehicle Control Module Unit |
| FMS | Connector FMS |

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## CAN LINE ASSEMBLY DRAWING

Figure 8



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## POWER NETWORK

Never disconnect the batteries from the system with the engine running.
Before connecting the batteries to the system, make sure that the system is well insulated.
Disconnect the batteries from the system when charging them.

The purpose of the electric system is to generate, regulate, store and distribute the energy needed to make the vehicle components work.

For this reason the supply of the base electric system is ensured by a generator (28V - 60A -90A alternator) and two batteries, each with 12 V 170 Ah (opt 220 Ah) connected in series.

A mobile fuse holder containing a 20 Amp fuse is located close to the batteries. This fuse supplies:

- Fuse holder 70605/1
- Body Controller (A07)
- Refrigerator
- ACC presetting

This fuse is not present on the ADR version.

### Power cable section:

- battery direct cable = 16 $mm^2$
- fuse cables = 4 $mm^2$

Attain to what detected on the vehicle for the remaining sections.

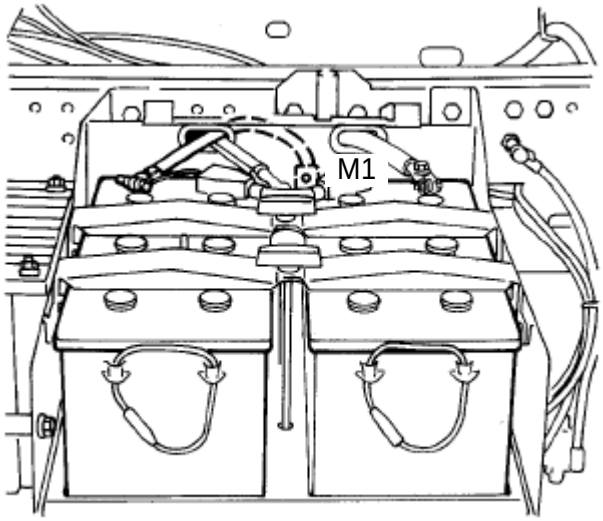
### Negative network

The batteries are connected to the frame ground with a brown 70 $mm^2$ cable, at ground point M1 on the left sidemember (Figure 9).

The starter motor is connected to the frame ground (M2) through a 70 $mm^2$ cable, fastened on the right sidemember near the actual motor.

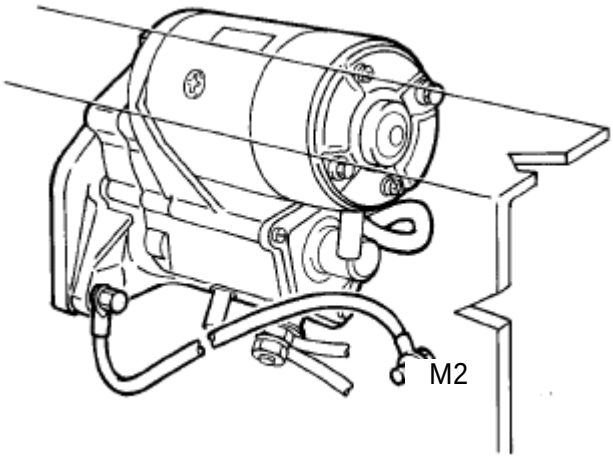
The same cable serves for connecting the whole engine unit to the frame ground.

Figure 9




GROUND POINT OF BATTERIES ON LEFT SIDEMEMBER

Figure 10



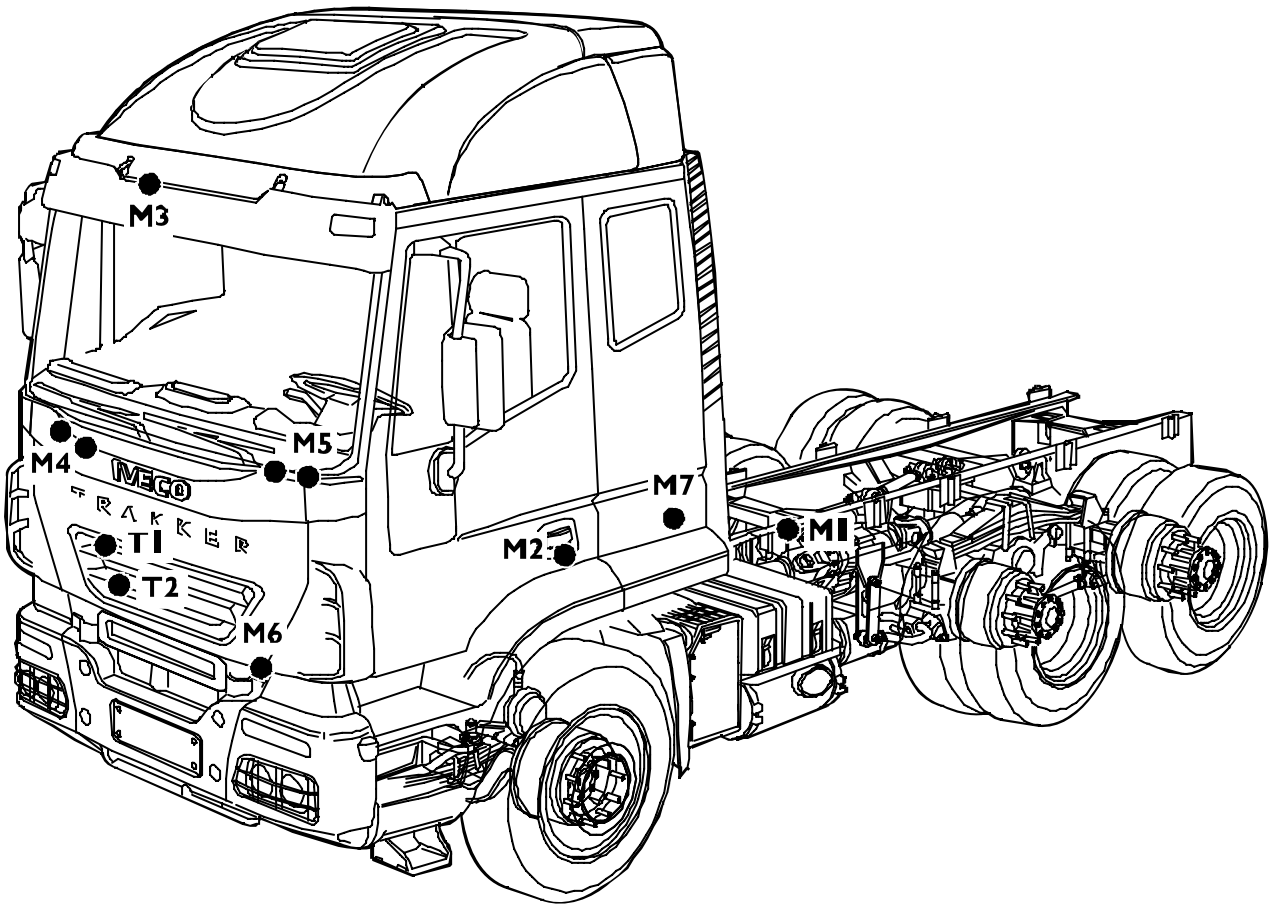

6632

STARTER MOTOR AND ENGINE GROUND POINT

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## GROUND POINTS

Figure 11




M1. Battery ground - M2. Starter motor ground - M3. Upper cab ground - M4. Right inner cab ground - M5. Left inner cab ground - M6. Front right frame ground - M7. Engine ground - T1 - T2. Equipotential braid

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## ELECTRICAL EQUIPOTENTIAL BRAID

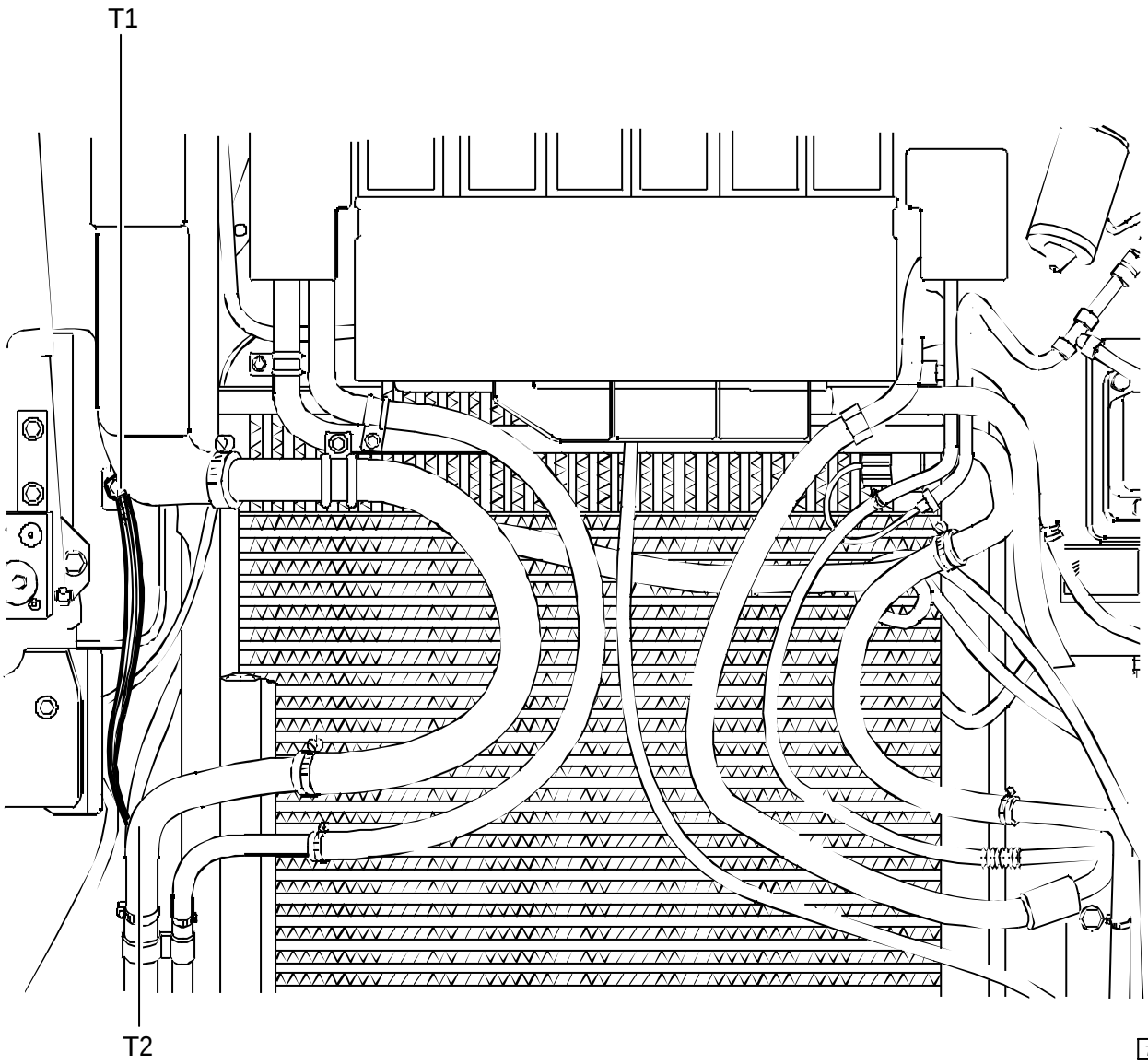
Though generally protected against the influence of on-board equipment voltage, electronic components nevertheless remain particularly sensitive electromagnetic compatibility issues, of different nature such as:

- generated by the vehicles
- external.

A suitable size flexible electrolytic copper braid has been provided on the vehicles to minimize these phenomena and return main cab and frame structures to the equipotential state.

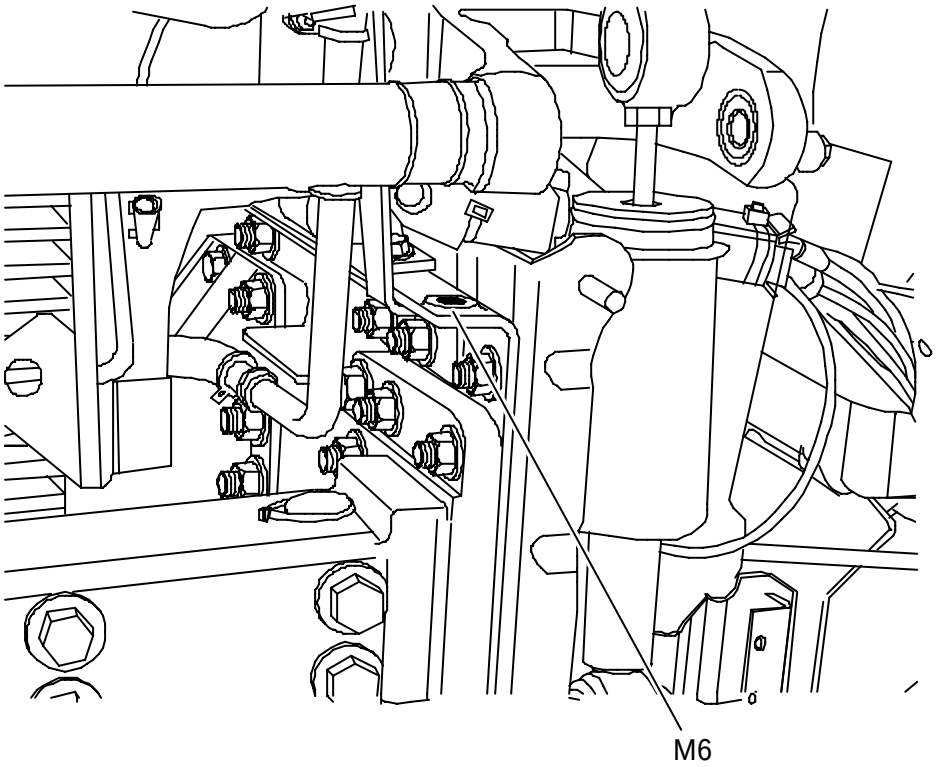
Check that the braid is properly attached to the frame and the cab, in the event of defective cab grounding.

Figure 12



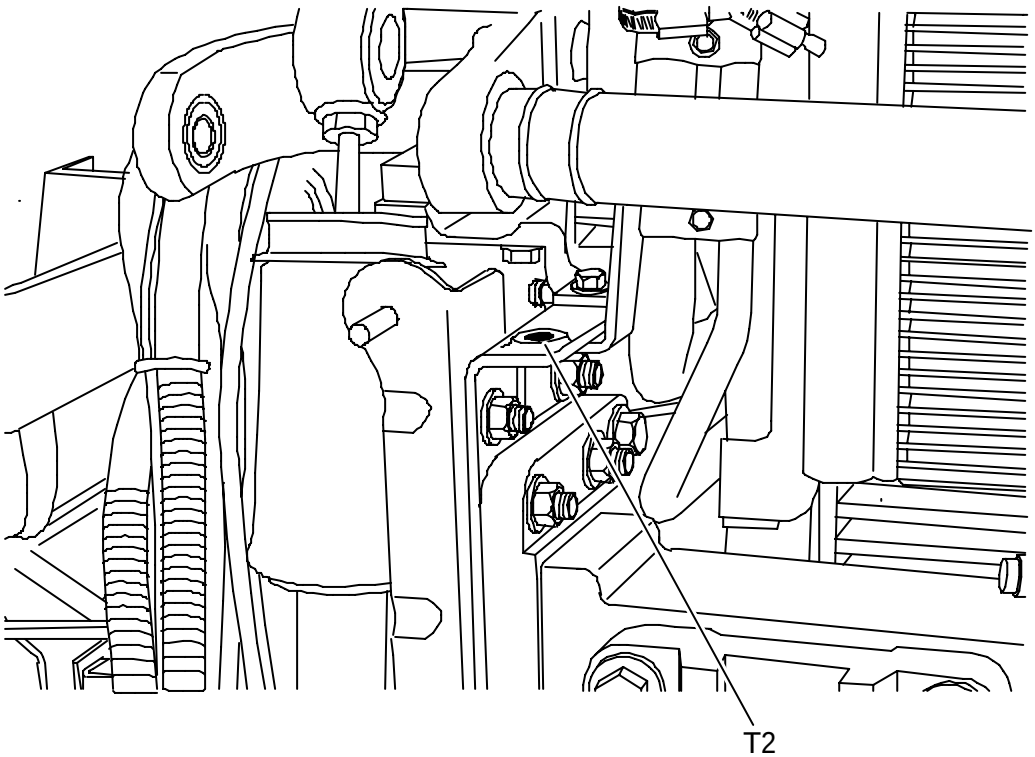
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Figure 13




GROUND POINT ON THE LEFT FRONT FRAME

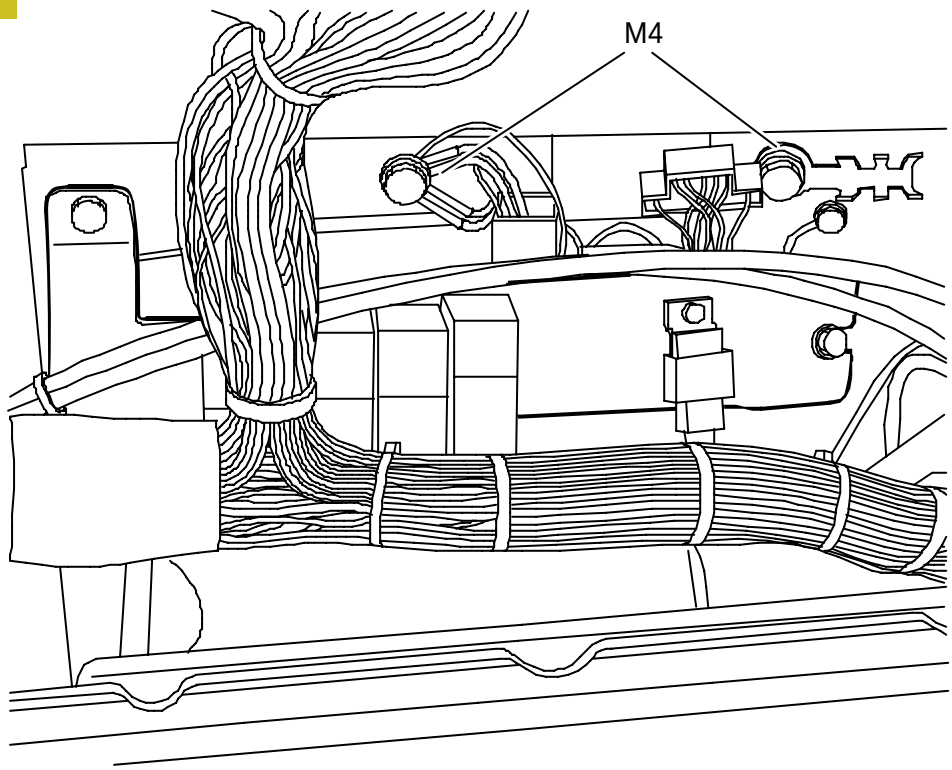
Figure 14




GROUND POINT ON THE RIGHT FRONT FRAME

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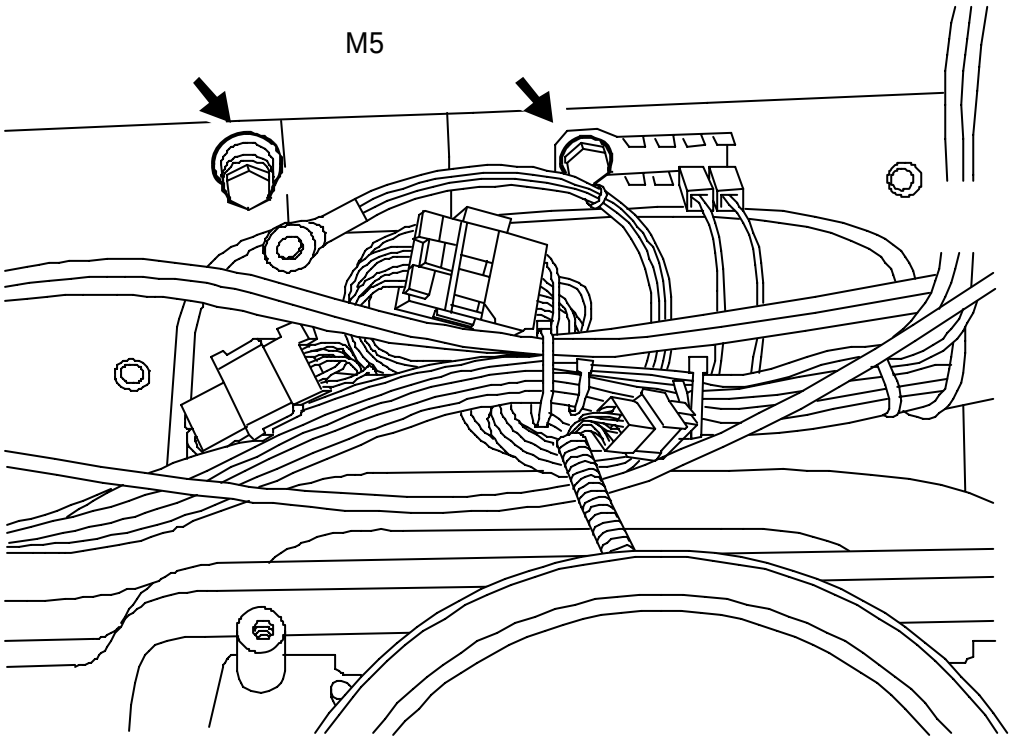
Figure 15




49849

GROUND POINT BEHIND THE BODY COMPUTER

Figure 16




73754

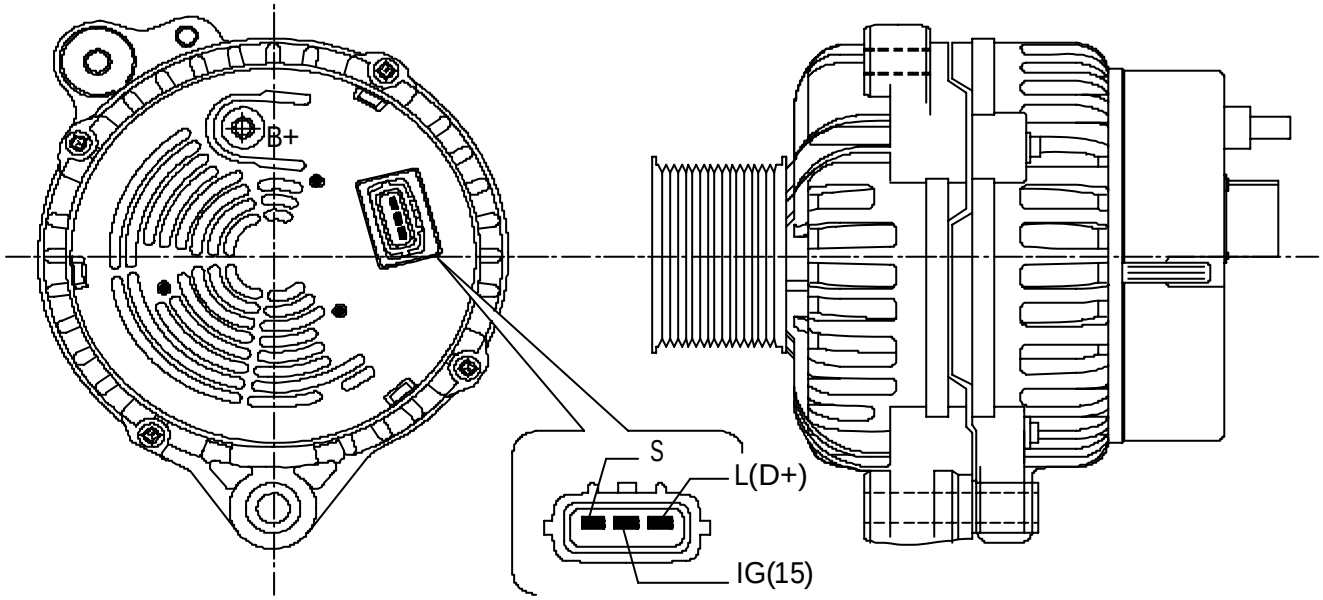
GROUND POINT BEHIND THE CLUSTER

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## 28 V - 40 A ÷ 90 A "BOSCH" ALTERNATOR

Figure 17

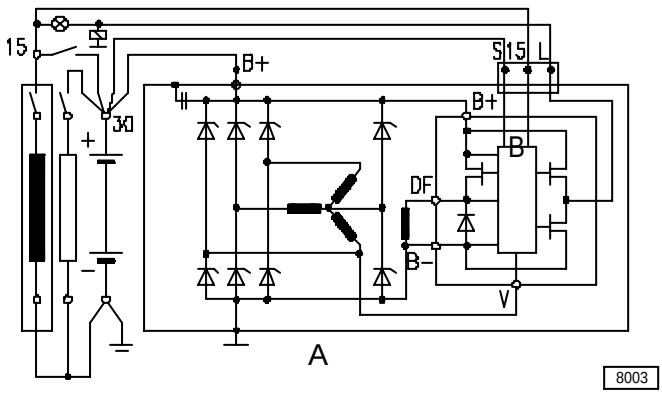
03000




TECHNICAL VIEW

7998

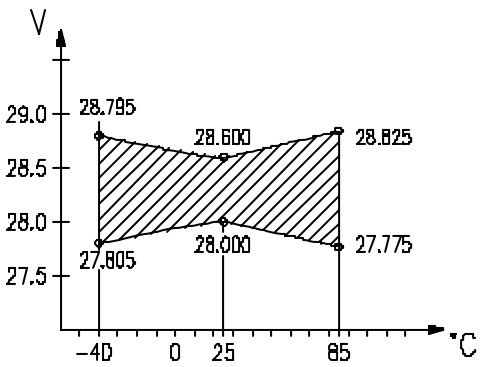
Figure 18




8003

WIRING DIAGRAM
A. Alternator B. Voltage regulator

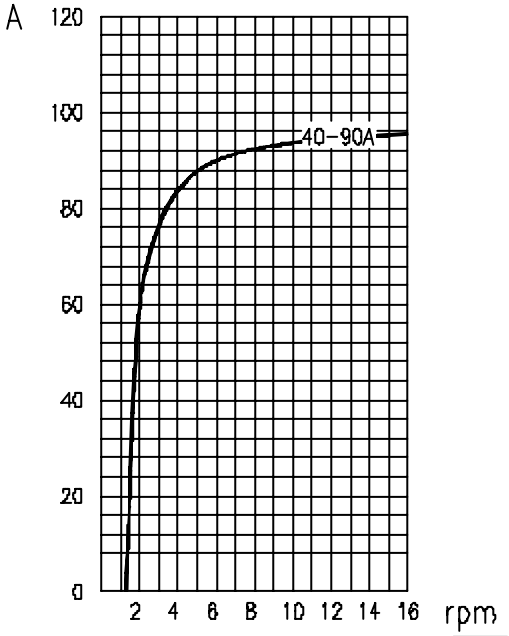
Figure 19




8000

VOLTAGE REGULATOR TEMPERATURE CHARACTERISTICS (6000 RPM)

Figure 20




8002

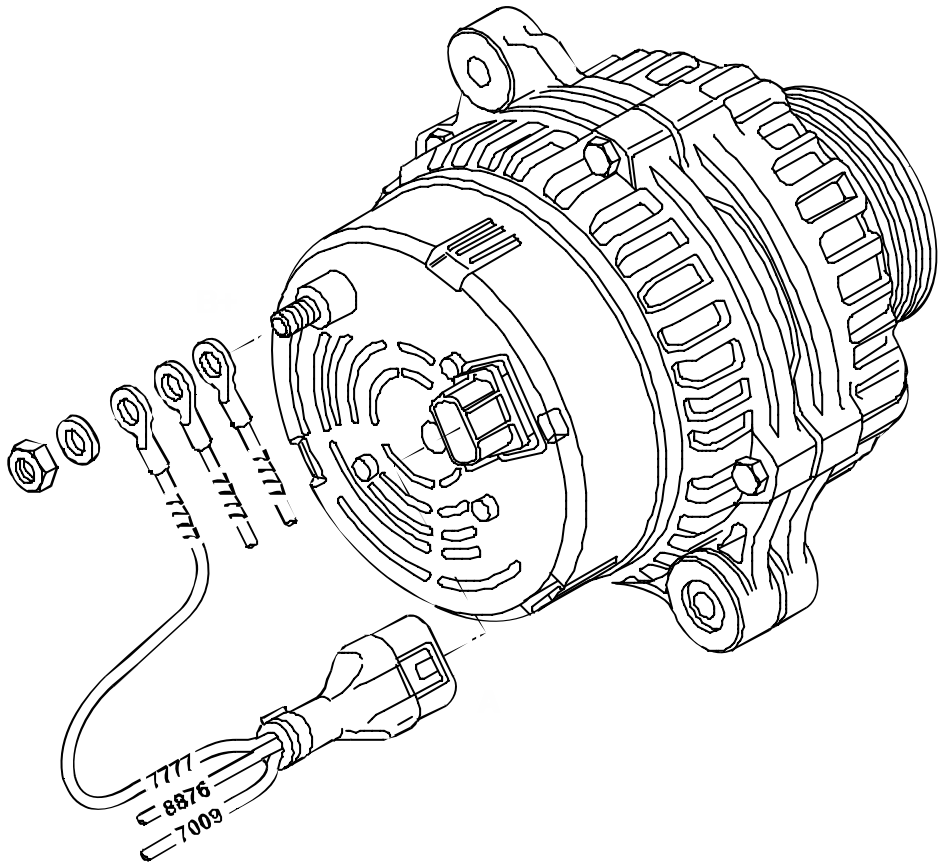
ALTERNATOR CURRENT DELIVERY CURVE

Characteristics

| | |
|---|---|
| Rated voltage | 28 V |
| Rated power | 90 A |
| Current at environment temperature | 1800 RPM/40 A |
| At 25 °C and rated voltage | 6000 RPM/90 A |
| Direction of rotation | clockwise, seen from pulley |
| Weight | 7.8 kg |

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Figure 21




8535

PERSPECTIVE VIEW WITH CORRESPONDING ELECTRICAL CONNECTIONS

| Ref. | Function | Cable colour code |
|---|---|---|
| L<br>15 (IG)<br>S | To F.F.C. center clamp J2/B24<br>To remote switch 25213 clamp 87 (via fuse F6-70601)<br>Positive (+30) | 7009<br>8876<br>7777 |
| B+ | Clamp S alternator Positive +30 power positive<br>+30 positive to starter motor<br>Positive +30 | 7777<br>7777<br>7777 |

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## 24V - 5.5 KW "NIPPONDENSO" STARTER MOTOR

08000

Figure 22

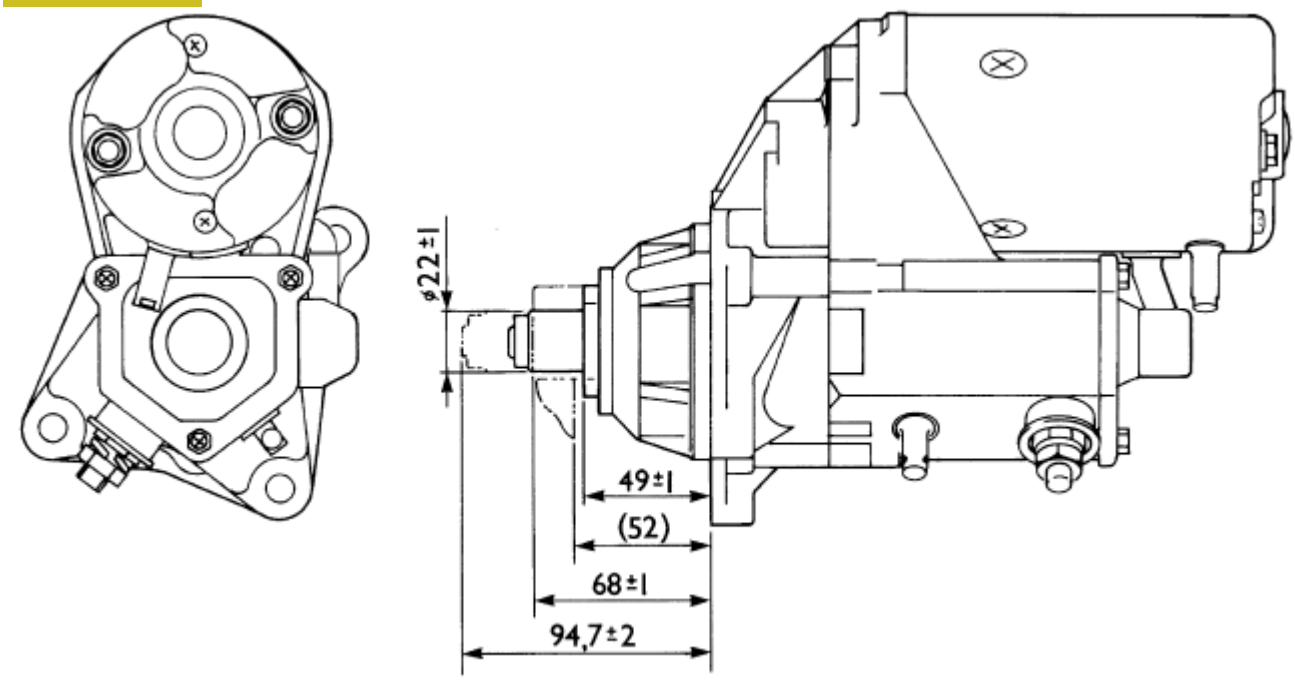
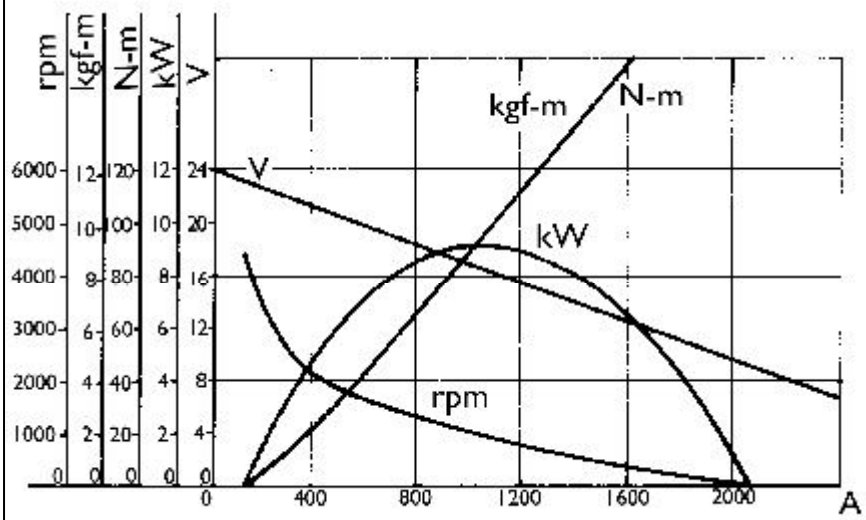


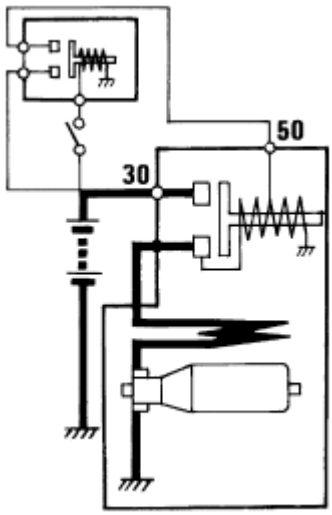

Figure 23




4957

CHARACTERISTIC CURVES

Figure 24



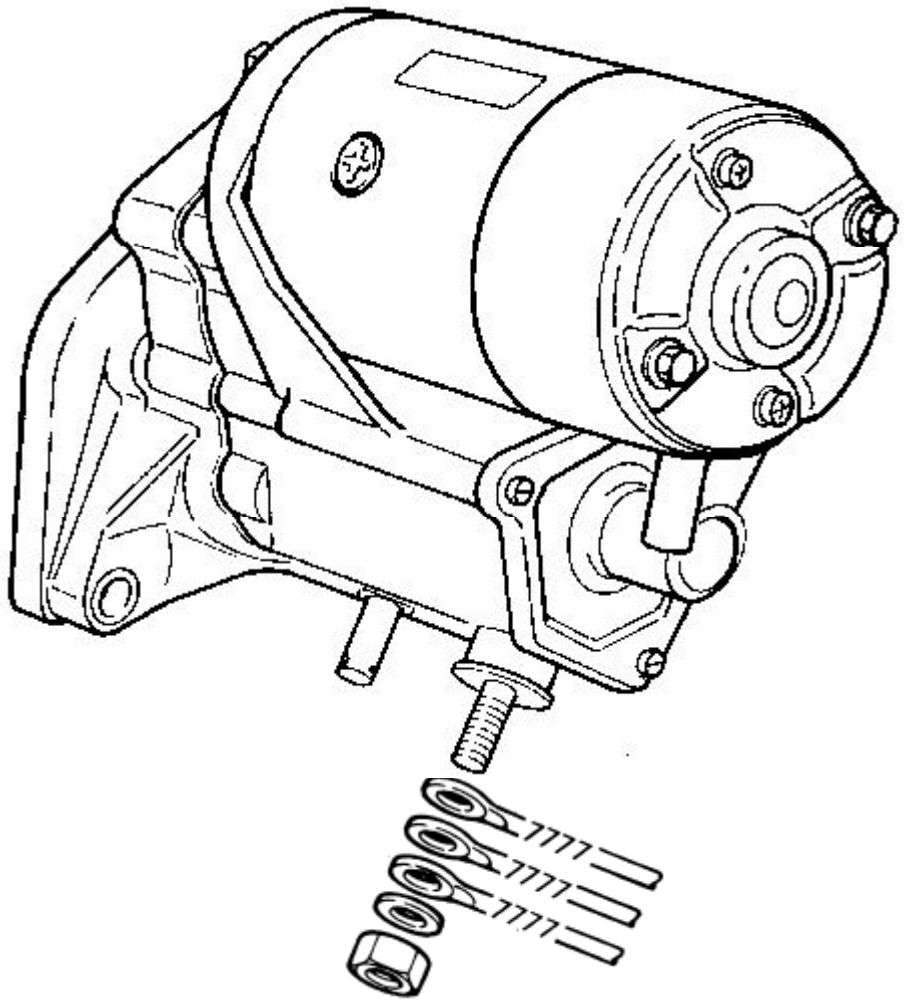

4958

WIRING DIAGRAM

| Characteristics | | Specific Power (20 °C) | Test cond. | Characteristics |
|---|---|---|---|---|
| Rated power | 5.5 kW | Loadless | 23V | 120A MAX (3800rpm MIN.) |
| System voltage | 24V | Load | 16V (49 N-m) | 690A MAX. (900rpm MIN.) |
| Engagement system | Positive approach control | Stall | 6V | 1260A MAX. (73.5 N-m MIN.) |
| Adjusted time | 30 sec. | | | |
| Direction of rotation | clockwise, seen from end of pinion | | | |
| Weight | approx. 10.5 kg | | | |
| Operating voltage | 16V MAX. (20°C) | | | |
| Water resistance | Water spray test to JIS D0203' SI' | | | |

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Figure 25




6658

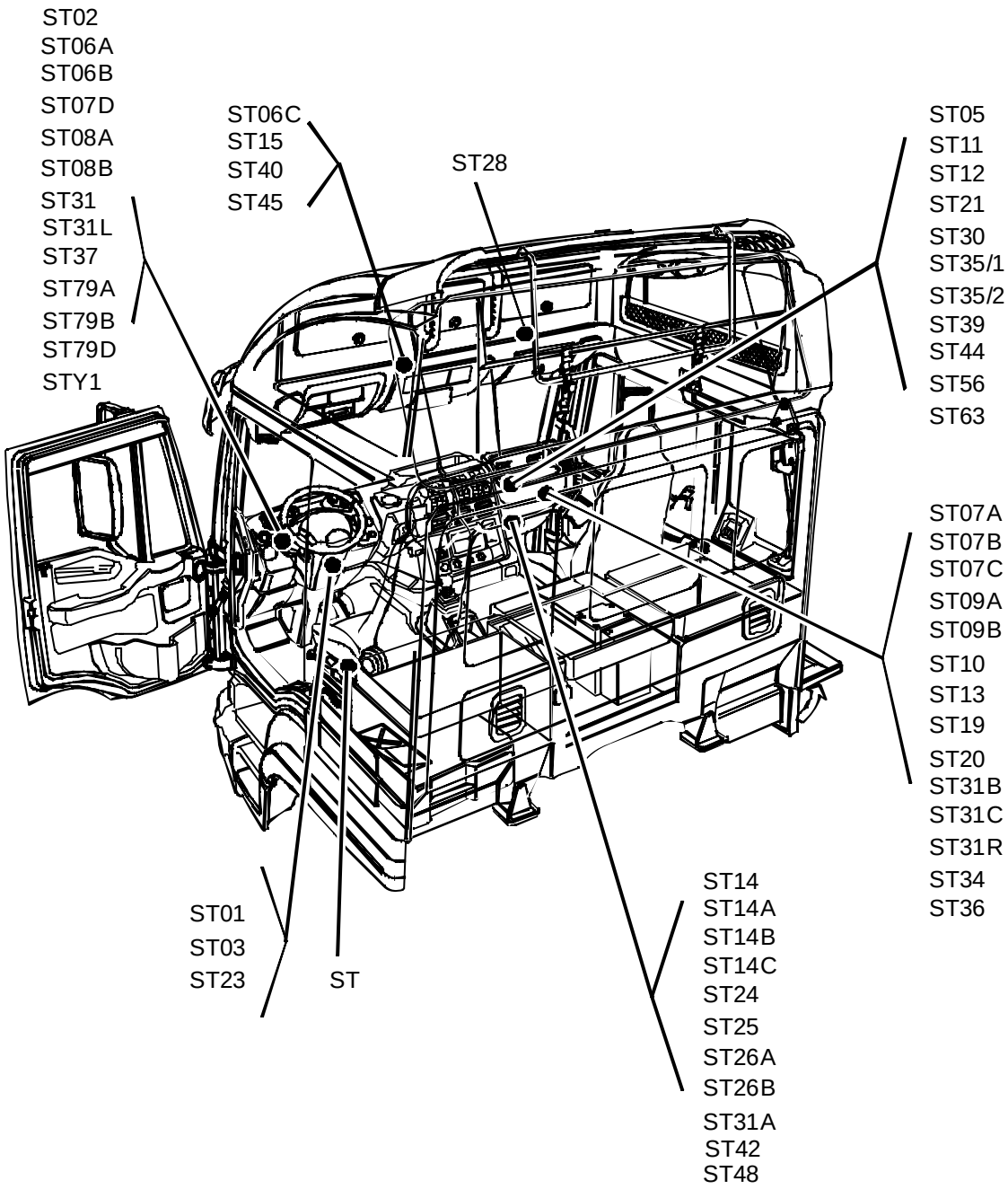
PERSPECTIVE VIEW WITH ASSOCIATED ELECTRICAL CONNECTIONS

| Connector | Function | Cable colour code |
|---|---|---|
| +30 | +30 positive for starter motor power from battery positive clamp (via the T.G.C.) | 7777 |
| +30 | +30 positive to the alternator | 7777 |
| +30 | +30 positive to remote switch for engine preheat on consent | 7777 |
| +50 | +50 positive for key switch | 8888 |

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## JUNCTION CONNECTORS
### Location of the junction connectors - cab

Figure 26

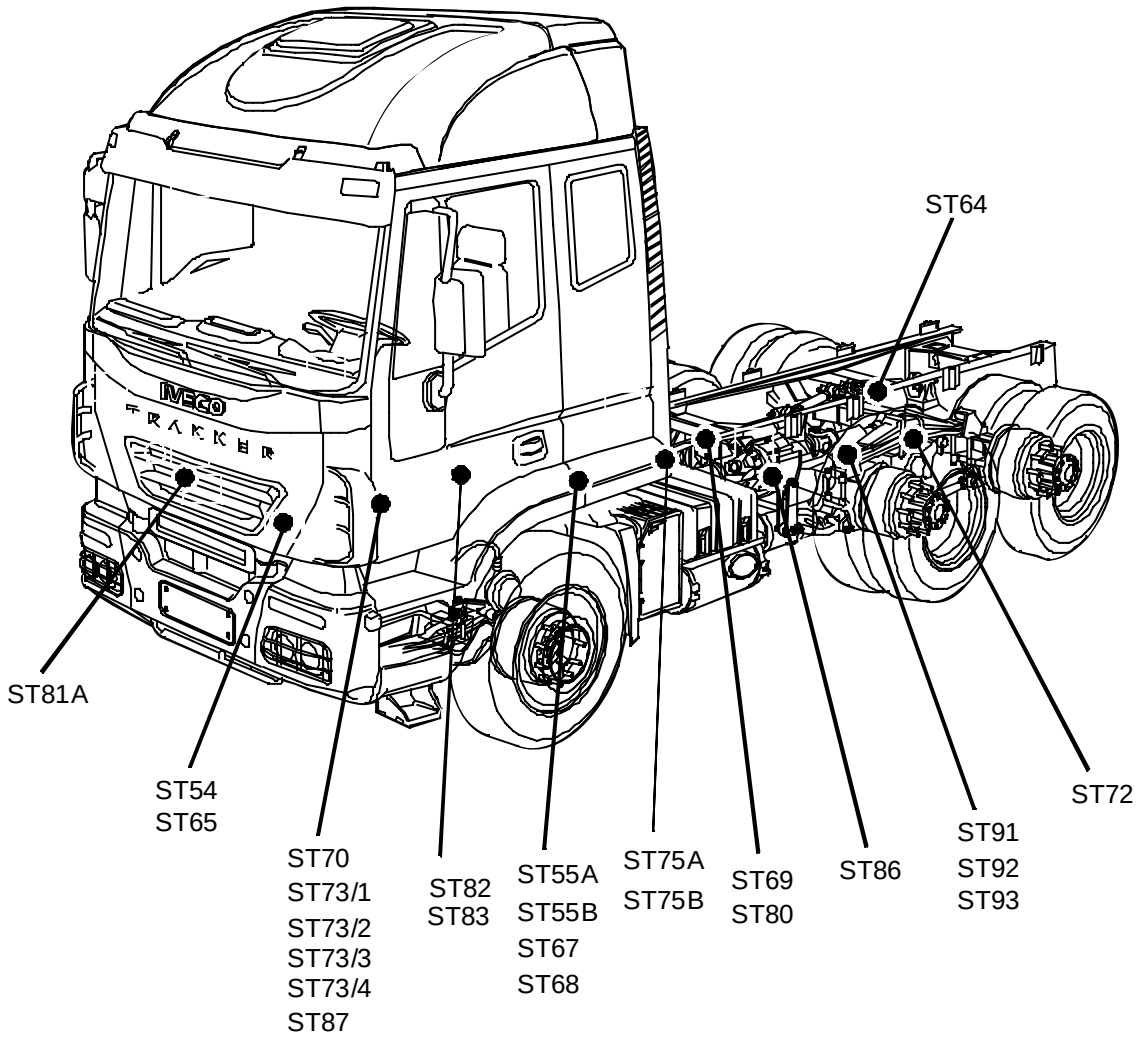



The location of the connectors (cab - chassis) could change to suit wiring needs.

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## Location of the junction connectors - chassis

Figure 27




113407

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## List of connectors

| Name | Description |
|---|---|
| ST 01 | Connection for starting commutator |
| ST 02 | Connection for steering column |
| ST 03 | Connection for speed limiter / Cruise control set |
| ST 05 | Connection for Eurotronic |
| ST 06A | Connection for roof panel wings devices on the driver side |
| ST 06B | Connection for tachograph |
| ST 06C | Connection for Toll Collect |
| ST 07A | Connection for roof panel wings devices on the passenger side |
| ST 07B | Connection for navigation and for IT tools |
| ST 07C | Connection for heatable windscreen |
| ST 07D | Connection for rotating headlights |
| ST 08A | Connection for DDM control unit |
| ST 08B | Connection for driver side door |
| ST 09A | Connection for PDM control unit |
| ST 09B | Connection for passenger side door |
| ST 10 | Connection for tools lighting |
| ST 11 | Connection for trailer retarder brake |
| ST 12 | Connection for ABS/EBS tractor and trailer electrical connection |
| ST 13 | Connection for auxiliary air heater CAN line |
| ST 14 | Connection for Ecas bodybuilders (cab) |
| ST 14A | Connection for bodybuilders (cab) |
| ST 14B | Connection for bodybuilders (cab) |
| ST 14C | Connection for set up devices (Allison) |
| ST 15 | Connection for couplings in the high roof |
| ST 19 | Connection for heater |
| ST 20 | Connection for air- conditioner |
| ST 21 | Connection for radiator water recirculation solenoid valve |
| ST 23 | Connection for Immobilizer antenna |
| ST 24 | Connection for air conditioning system control unit CAN line |
| ST 25 | Connection for Intarder |
| ST 26A | Connection for Ecas |
| ST 26B | Connection for ABS/EBS |
| ST 28 | Connection for rotating headlights |
| ST 30 | Connection for ADR (tachograph) provision |
| ST 31 | Connection for ECAS remote control |
| ST 31A | Connection for cab rear |
| ST 31B | Connection for auxiliary air heating |
| ST 31C | Connection for auxiliary air heating temperature sensor |
| ST 31L | Connection for pneumatic heated seat |
| ST 31R | Connection for pneumatic heated seat |
| ST 34 | Connection for ACC provision / simple "H" gearbox control |
| ST 35/1 | Connection for air conditioner with manual control |
| ST 35/2 | Connection for air conditioning with manual control |
| ST 36 | Connection for T.G.C. / I.G.C. |
| ST 37 | Connection for Toll Collect |
| ST 39 | Connection for differential lock |
| ST 40 | Connection for navigation and for IT tools |
| ST 42 | Connection for DDM/PDM supplies |

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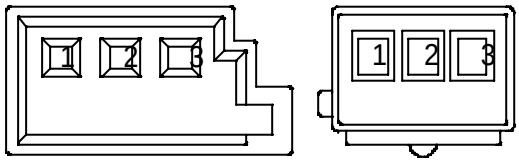
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| Name | Description |
|---|---|
| ST 44 | Connection for centralized closing with remote control |
| ST 45 | Connection for 24 V radio |
| ST 48 | Connection for DMI / EM control unit for PTO |
| ST 49 | Connection for Allison setup |
| ST 54 | Connection for ACC provision |
| ST 55A | Connection for SCR system (Urea) |
| ST 55B | Connection for SCR system (Urea) |
| ST 56 | Connection for ADR (15) Alternator |
| ST 59 | Connection for ECAS breakdown switch/longitudinal blockage of 2nd front axle (8x8) |
| ST 63 | Connection for auxiliary water heater CAN line (BCB) |
| ST 64 | Connection for 15-poles current output free pins |
| ST 65 | CAN line connection for trailer (PTO with EM) |
| ST 67 | Connection for urea dosing module solenoid valve |
| ST 68 | Connection for Urea temperature sensor |
| ST 69 | Connection for Intarder |
| ST 70 | Connection for ASR solenoid valve |
| ST 72 | Connection for 35 axles for shoes wear and tear / transverse differential blocking |
| ST 73/1 | Connection for indicating 1st front axle wear (right) |
| ST 73/2 | Connection for indicating 1st front axle wear (left) |
| ST 73/3 | Connection for indicating 2nd front axle wear (right) |
| ST 73/4 | Connection for indicating 2nd front axle wear (left) |
| ST 77 | Connection for right hand side SML indicator lamp (Side Marker Lamp) |
| ST 78 | Connection for left hand side SML indicator lamp (Side Marker Lamp) |
| ST 79A | Connection for external cab front |
| ST 79B | Connection for windshield washer and warning horn unit |
| ST 79D | Connection for brake pedal switch (ABS) |
| ST 80 | Connection for mechanic gearbox |
| ST 81A | Connection for front lights |
| ST 82 | Connection for components on the engine |
| ST 83 | Connection for components on engine |
| ST 85L | Connection for left hand side plate light |
| ST 85R | Connection for right hand side plate light |
| ST 86 | Connection for T.G.C. / I.G.C. |
| ST 88 | Connection for trailer connectors |
| ST 91 | Connection for PTO1 (DMI) |
| ST 92 | Connection for PTO2 (DMI) |
| ST 93 | Connection for PTO3 (DMI) |
| ST 99 | Connection for rear axle ECAS |
| ST | Connection for ECAS |
| STY/1 | Connection for switch on clutch |

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## Junction connector ST01 (black) - turn on key

Figure 28



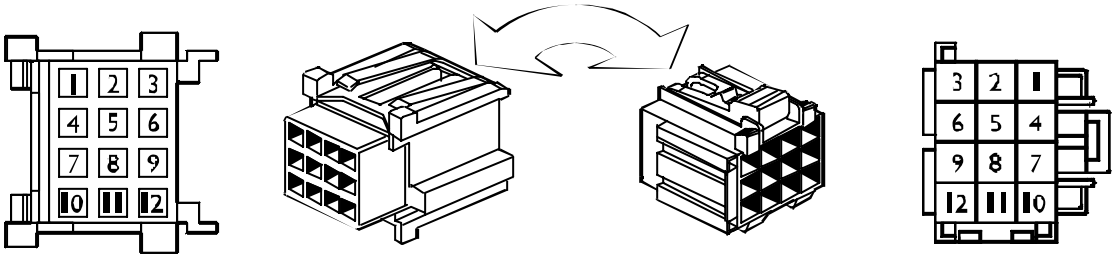

107169

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive +30 for ignition key | 7777 |
| 2 | Terminal 15 ignition key | 8887 |
| 3 | Terminal 50 ignition key | 8888 |

## ST02 (green) - connection for steering column

Figure 29




107538

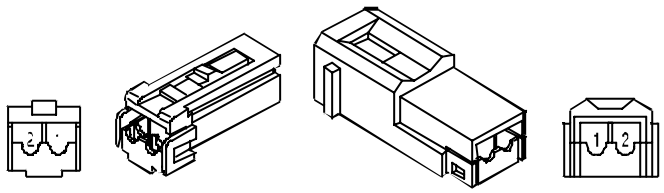
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | CAN L line (ICB) | Green |
| 2 | CAN H line (ICB) | White |
| 3 | Ground | 0000 |
| 4 | Negative for warning horn | 1116 |
| 5 | Positive +15 from ignition key (15) | 8887 |
| 6 | Positive for steering column switch unit symbols lighting | 4442 |
| 7 | Positive (+30) | 7906 |
| 8 | Positive from ignition key (50 ) | 8888 |
| 9 | Speed limiter signal | 9968 |
| 10 | Ground | 0000 |
| 11 | - | - |
| 12 | - | - |

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## ST03 junction connector - speed limiter signal / Cruise Control Set

Figure 30




101525

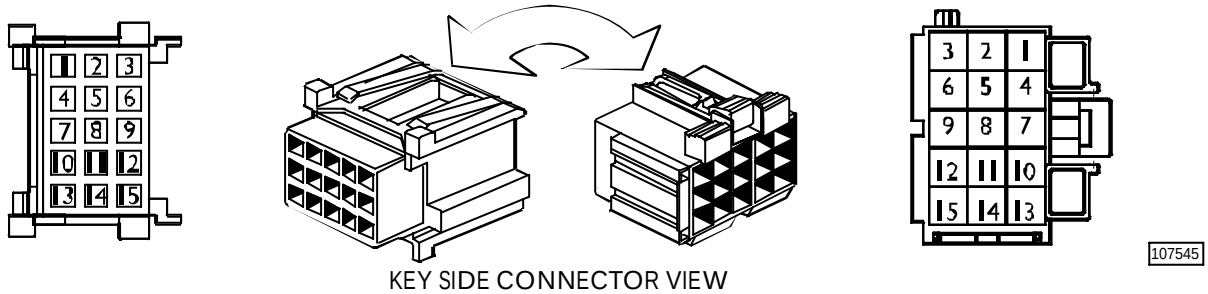
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Speed limiter signal | 9968 |
| 2 | - | - |

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## ST05 junction connector (green) - Eurotronic II

Figure 31

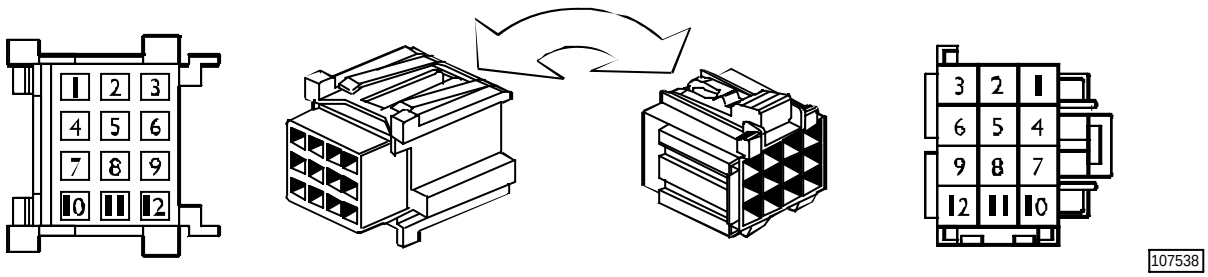



KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | CAN VDB Line (L) | Green |
| 2 | CAN VDB Line (H) | White |
| 3 | CAN VDB Line (L) | Green |
| 4 | CAN VDB Line (H) | White |
| 5 | K line automatic gearbox | 2297 |
| 6 | Automatic gearbox system power supply (Positive +15) | 8102 |
| 7 | Positive symbols lighting | 4442 |
| 8 | Negative signal forward gear with automatic gearbox | 0127 |
| 9 | VCM control unit pin - X3/24 | 0125 |
| 10 | Negative signal from neutral position of the automatic gearbox | 0147 |
| 11 | Negative signal reverse gear with automatic gearbox | 0128 |
| 12 | VCM control unit pin - X3/41 | 0126 |
| 13 | Automatic gearbox system power supply (Positive +30) | 7101 |
| 14 | Ground | 0000 |
| 15 | Speed limiter signal | 9968 |

## ST06A junction connector (yellow) - roof panel wings devices on the driver side

Figure 32



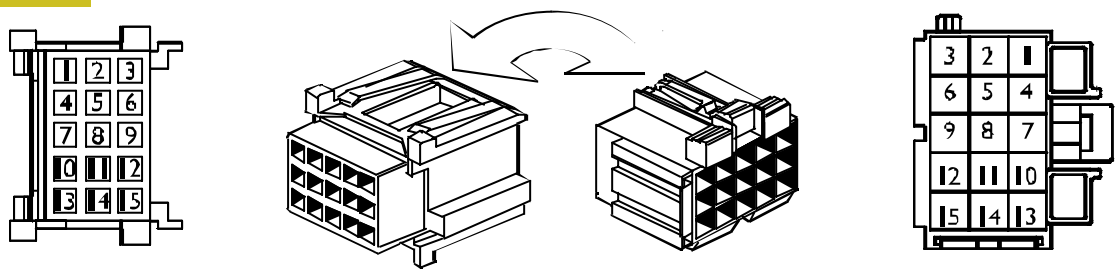

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive left loudspeaker (preamplifier) | 1188 |
| 2 | Negative left loudspeaker (preamplifier) | 1186 |
| 3 | Sliding roof closing control power supply | 7011 |
| 4 | Sliding roof opening control power supply | 7010 |
| 5 | Positive for warning horn solenoid valve | 1133 |
| 6 | CAN line (IDB) H | White |
| 7 | CAN line (IDB) L | Green |
| 8 | Positive symbols lighting | 4442 |
| 9 | Positive +15 | 8871 |
| 10 | - | - |
| 11 | - | - |
| 12 | - | - |

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## ST06B junction connector (yellow) - tachograph

Figure 33

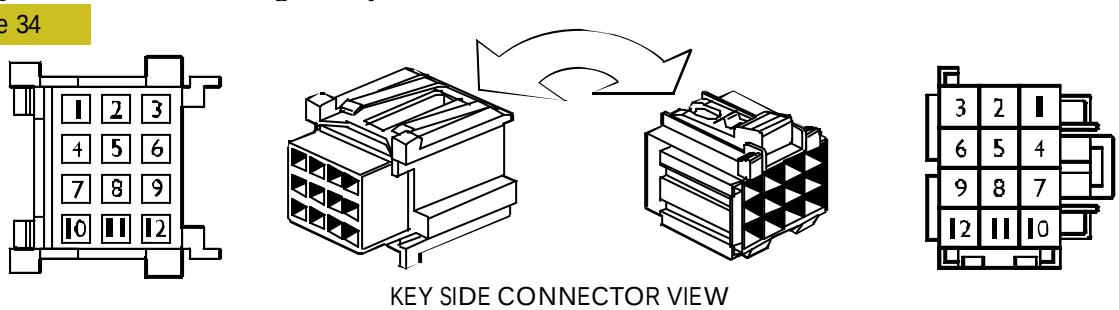



KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Isolated negative tachograph transmitter | 0058 |
| 2 | Speed signal tachograph transmitter | 5517 |
| 3 | Inverted signal tachograph transmitter | 5516 |
| 4 | Tachograph transmitter power supply | 5514 |
| 5 | Speed pulse for EDC | 5155 |
| 6 | CAN VDB Line (H) | White |
| 7 | CAN VDB Line (L) | Green |
| 8 | - | - |
| 9 | Ground | 0000 |
| 10 | Tachograph power supply (Positive +15) | 8871 |
| 11 | Positive symbols lighting | 4442 |
| 12 | Tachograph power supply (battery positive +Batt) after fuse 70058 | 7768 |
| 13 | K line | 2997 |
| 14 | Tachograph signal distance - travelled for Cluster | 5518 |
| 15 | - | - |

## ST06C junction connector (yellow) - Toll Collect

Figure 34



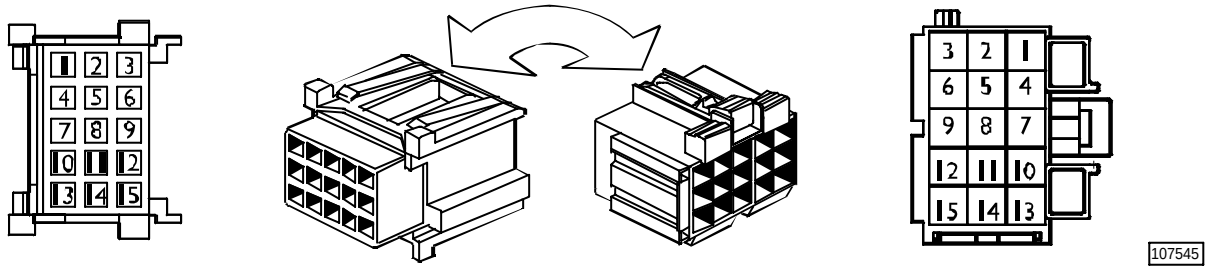

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive +30 | 7772 |
| 2 | Positive symbols lighting | 4442 |
| 3 | Positive +15 | 8871 |
| 4 | Speed signal (tachograph) | 5541 |
| 5 | Ground | 0000 |
| 6 | Positive symbols lighting | 4444 |
| 7 | - | 2222 |
| 8 | CAN line | Yellow |
| 9 | CAN line | Red |
| 10 | - | 6666 |
| 11 | Positive +30 | 7777 |
| 12 | Ground | 0000 |

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## ST07A junction connector (yellow) - roof panel wings devices on the passenger side

Figure 35

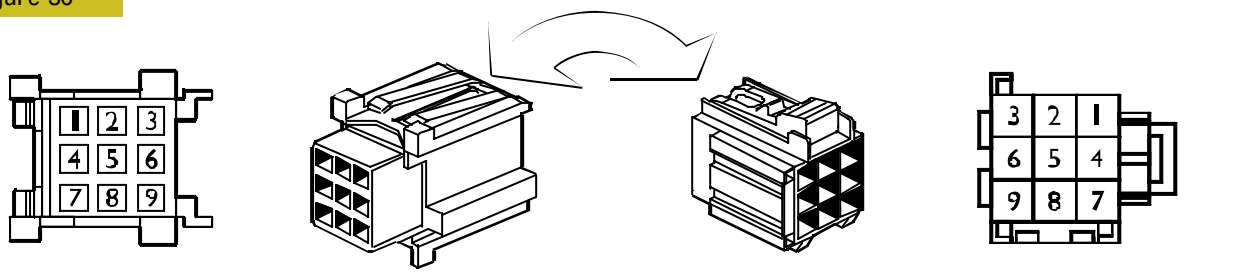



KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive for front end-outline marker lamps | 3339 |
| 2 | Positive for voltage reducer | 7772 |
| 3 | Loudspeaker signal (preamplifier) | 1184 |
| 4 | Loudspeaker signal (preamplifier) | 1183 |
| 5 | Positive for reading lights (12V) | 7712 |
| 6 | Positive 12V | 7712 |
| 7 | Positive for overhead light (white light) | 4423 |
| 8 | Positive step lighting | 4445 |
| 9 | Positive for overhead light (blue lights) | 4410 |
| 10 | Positive for overhead light (red lights) | 4422 |
| 11 | Negative for sunshade curtain | 0974 |
| 12 | Sunshade curtain closing signal | 8065 |
| 13 | Positive for sunshade curtain motor | 8063 |
| 14 | Positive for sunshade curtain motor | 8064 |
| 15 | - | - |

## ST07B junction connector (yellow) - navigation and it tools

Figure 36



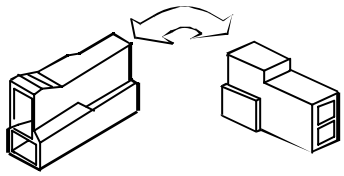

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive +30 after TGC | 7772 |
| 2 | Positive +15 | 8871 |
| 3 | Speed signal for navigator | 5541 |
| 4 | - | - |
| 5 | CAN L line (FMB) | Green |
| 6 | CAN H line (FMB) | White |
| 7 | Positive for instruments lighting | 4442 |
| 8 | Reverse gear signal | 2268 |
| 9 | - | - |

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## ST07C junction connector (black) - heatable windshield

Figure 37



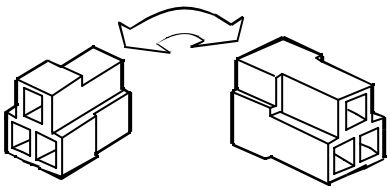
101529

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Power supply to heatable windshield | 8020 |
| 2 | Power supply to heatable windshield | 8020 |

## ST07D junction connector- rotating headlights

Figure 38



105228

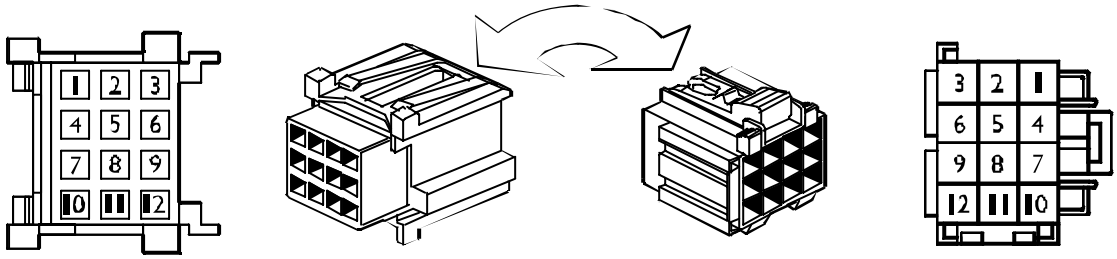
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive for left hand side rotating headlight | 1108 |
| 2 | Ground for rotating headlight | 0000 |
| 3 | Positive for right hand side rotating headlight | 1115 |

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## ST08A junction connector (blue) - DDM control unit

Figure 39



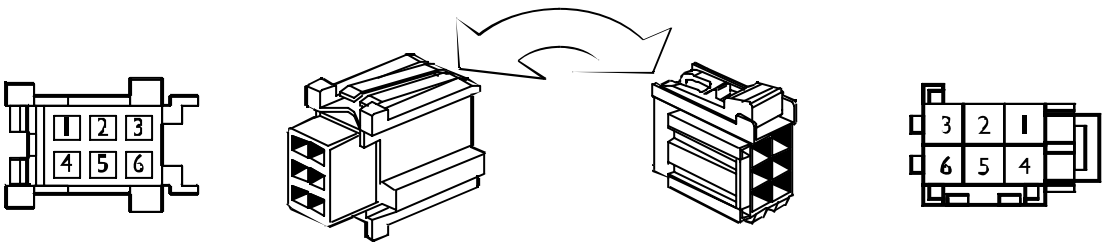

107538

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive (+30) for control unit power supply | 7991 |
| 2 | Ground | 0000 |
| 3 | Signal for loudspeaker (roof panel) | 1188 |
| 4 | Signal for loudspeaker (roof panel) | 1186 |
| 5 | K line for diagnosis | 2991 |
| 6 | CAN H line (BCB) | White |
| 7 | CAN L line (BCB) | Green |
| 8 | Centralised locking control signal - opening | 0064 |
| 9 | Centralised locking control signal - closing | 0065 |
| 10 | Signal (+) external temperature sensor | 7573 |
| 11 | Driver side electrical lock bolt | 0003 |
| 12 | External temperature sensor ground | 0550 |

## Jointing connector ST08B (blue) - driver side door

Figure 40




107188

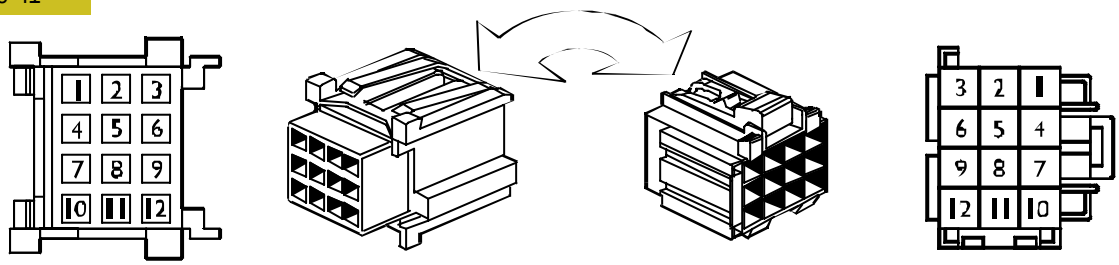
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Connection 2 between side window regulator switches | 8862 |
| 2 | Connection 1 between side window regulator switches | 8002 |
| 3 | Mirror heating supply | 8830 |
| 4 | Positive +30 (presetting) | 7990 |
| 5 | - | - |
| 6 | - | - |

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## ST09A junction connector (blue) - PDM control unit

Figure 41



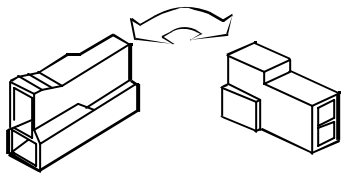

107538

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive (+30) control unit power supply | 7990 |
| 2 | Ground | 0000 |
| 3 | Positive right hand side loudspeaker | 1184 |
| 4 | Negative right hand side loudspeaker | 1183 |
| 5 | K line for diagnosis | 2290 |
| 6 | CAN H line (BCB) | White |
| 7 | CAN L line (BCB) | Green |
| 8 | Centralised locking control signal - opening | 0064 |
| 9 | Centralised locking control signal - closing | 0065 |
| 10 | - | - |
| 11 | Passenger side electrical lock bolt | 0003 |
| 12 | Free | - |

## Jointing connector ST09B (white) - passenger side door

Figure 42



101529

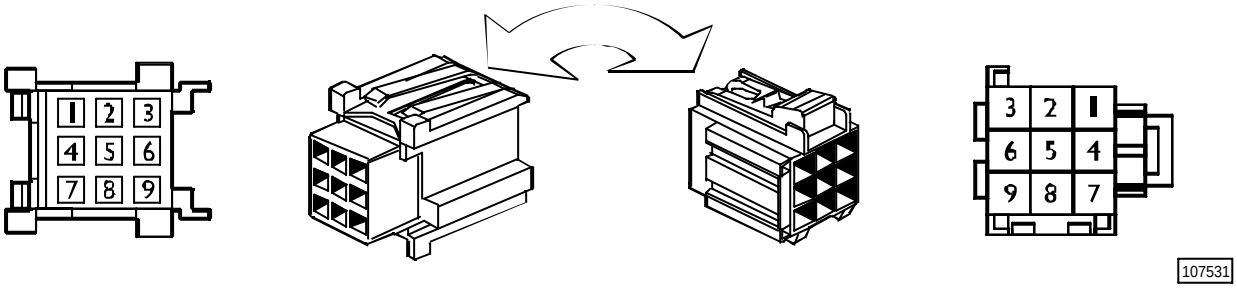
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Connection 2 between side window regulator switches | 8862 |
| 2 | Connection 1 between side window regulator switches | 8002 |

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## ST10 junction connector (green) - Instruments lighting

Figure 43

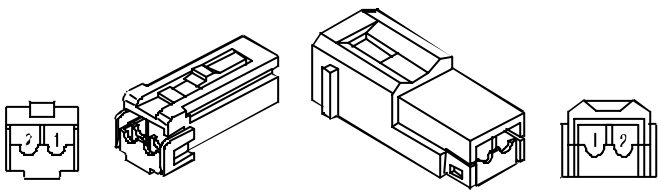



KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive for instruments lighting | 4442 |
| 2 | Positive for instruments lighting | 4442 |
| 3 | Positive for commutator for third axle lifting. | 4442 |
| 4 | Positive for switch with incorporated warning light for heatable windshield enabling | 4442 |
| 5 | Positive for switch with incorporated warning light for heated rear view mirrors | 4442 |
| 6 | Positive for switch with incorporated warning light for A.S.R. disabling | 4442 |
| 7 | Positive for instruments lighting | 4442 |
| 8 | Positive for instruments lighting | 4442 |
| 9 | Positive for instruments lighting | 4442 |

## Connector of junction ST11 - trailer retarder brake

Figure 44



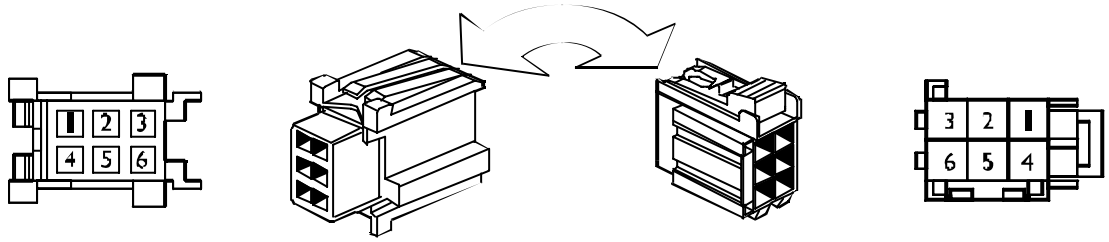

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Ground from trailer brake hand wheel switch (brake light) | 0927 |
| 2 | Ground for trailer brake hand wheel switch (brake light) | 0000 |

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## ST12 junction connector (green) - tractor and trailer ABS/EBS

Figure 45



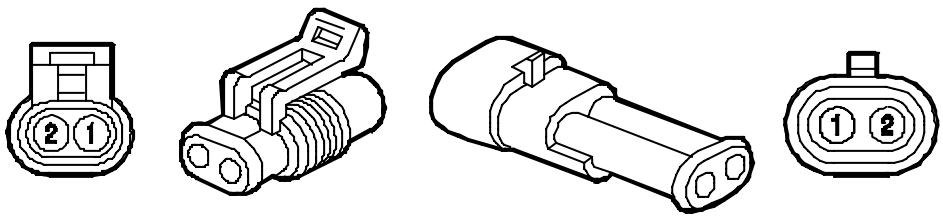

KEY SIDE CONNECTOR VIEW

107188

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | - | - |
| 2 | - | - |
| 3 | - | - |
| 4 | - | - |
| 5 | Positive pressed pedal signal (ABS) | 8153 |
| 6 | Positive for stop lights (ABS) | 8158 |

## ST13 junction connector (black) - auxilliary air heater

Figure 46




101531

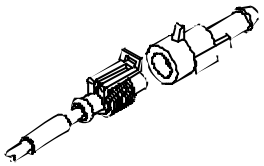
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | CAN BCB Line (L) | Green |
| 2 | CAN BCB Line (H) | White |

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## ST14 junction connector - ECAS bodybuilders (cab)

Figure 47



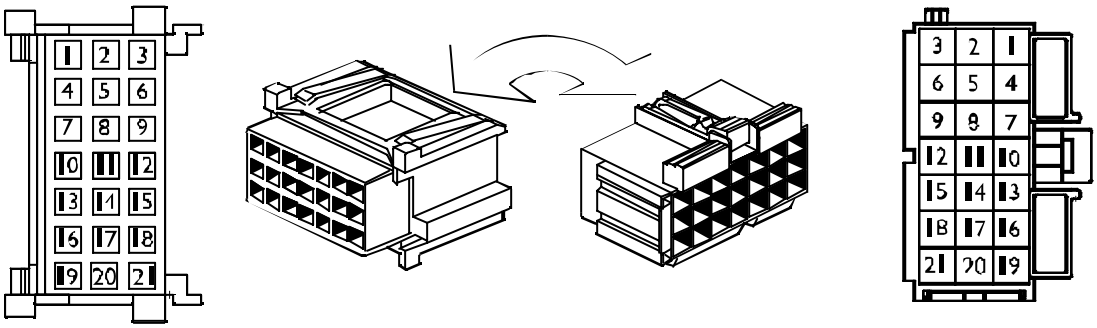
101523

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Power supply to liftable axle lowering or lifting switch | 8445 |

## ST14A junction connector (blue) - for bodybuilders (cab)

Figure 48




107554

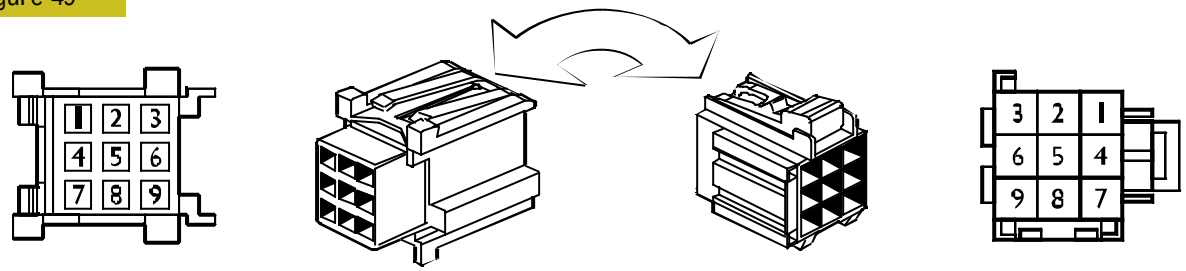
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Engine start-up signal input | 8892 |
| 2 | Engine turning off signal input | 0151 |
| 3 | Stop lights signal for bodybuilders | 1165 |
| 4 | Vehicle not in operation signal output | 5515 |
| 5 | Parking brake engaged signal output | 6656 |
| 6 | - | - |
| 7 | Speed signal from tachograph | 5155 |
| 8 | Engine condition (output signal) 0 V engine not in operation / 24 V engine in operation | 7778 |
| 9 | Gearbox in neutral position signal | 8050 |
| 10 | Reverse gear signal | 2268 |
| 11 | Positive +15 | 8871 |
| 12 | Provision for Cruise Control SET + | 8156 |
| 13 | Provision for Cruise Control SET - | 8157 |
| 14 | Provision for Cruise Control OFF | 8154 |
| 15 | Provision for Cruise Control RESUME | 8155 |
| 16 | Provision Cruise Control (internal /external choice) | 0158 |
| 17 | Ground | 0000 |
| 18 | Provision for P.T.O. 1 control signal | 0131 |
| 19 | Provision for P.T.O. 2 control signal | 0132 |
| 20 | Provision for P.T.O. 3 control signal | 0123 |
| 21 | Positive +30 | 7772 |

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## ST14B junction connector (blue) - for bodybuilders (cab)

Figure 49

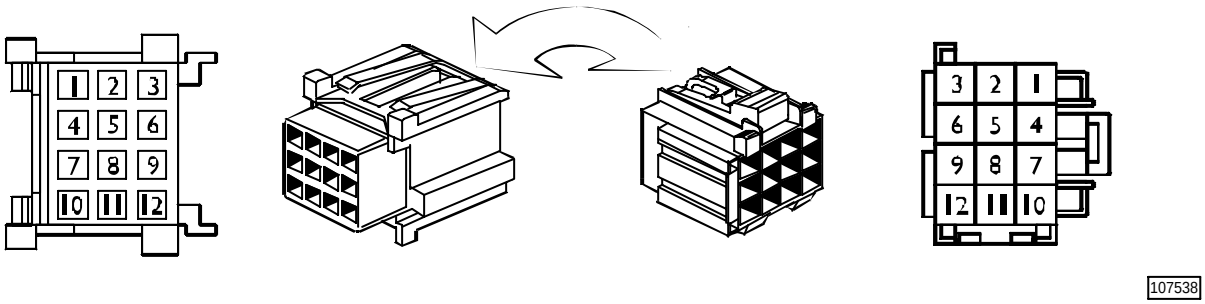



KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Signal for the second speed limiter | 0172 |
| 2 | - | - |
| 3 | Clutch status signal | 9963 |
| 4 | Programmable speed threshold indicator signal (PTS) | 5542 |
| 5 | Hazard light signal | 1113 |
| 6 | - | - |
| 7 | - | - |
| 8 | Engine rpm signal | 5584 |
| 9 | External light signal | 3333 |

## ST14C junction connector (grey) - for set up devices (Allison)

Figure 50



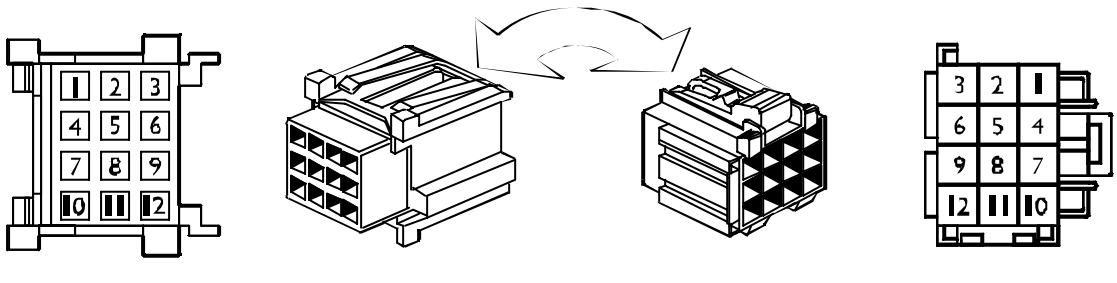

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Neutral signal for PTO | 145 |
| 2 | Stepping switch signal | 123 |
| 3 | - | - |
| 4 | PTO signal active | 143 |
| 5 | PTO signal active | 130 |
| 6 | - | - |
| 7 | - | - |
| 8 | Automatic neutral signal | 117 |
| 9 | Automatic neutral signal | 101 |
| 10 | Digital earth | 103 |
| 11 | Zone indicator signal | 113 |
| 12 | - | - |

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## ST15 - ST19 junction connector

Figure 51




KEY SIDE CONNECTOR VIEW

## ST15 (yellow) - Connection for couplings in the high roof

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Ground | 0000 |
| 2 | Positive for sliding roof closing | 7011 |
| 3 | Positive for sliding roof opening | 7010 |
| 4 | Positive for reading light | 4412 |
| 5 | Positive for overhead lights (white light) | 4423 |
| 6 | Positive for overhead lights (red lights) | 4422 |
| 7 | - | - |
| 8 | Left hand side loudspeaker | 1186 |
| 9 | Left hand side loudspeaker | 1188 |
| 10 | Right hand side loudspeaker | 1183 |
| 11 | Right hand side loudspeaker | 1184 |
| 12 | - | - |

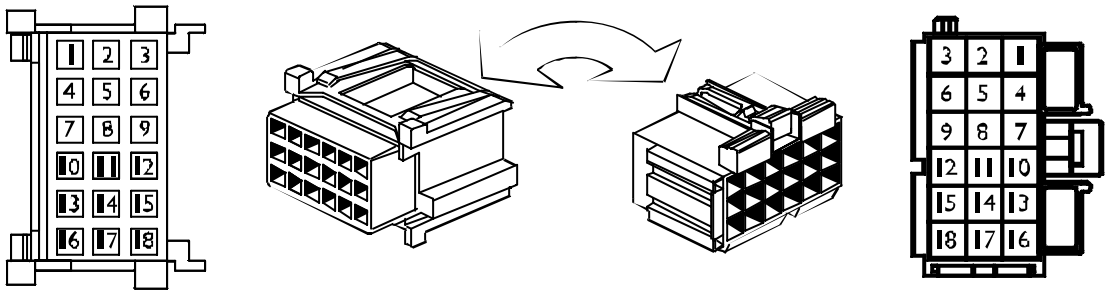
## ST19 (green) - connection for heating

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | K line | 2295 |
| 2 | Positive symbols lighting | 4442 |
| 3 | with ST 20 - 3 | 0506 |
| 4 | with ST 20 - 4 | 8087 |
| 5 | Positive for 1st speed auxiliary heating enabling (remote control switch) | 8884 |
| 6 | Positive for heater motor water recirculation enabling (remote control switch) | 7778 |
| 7 | Locked positive | 8871 |
| 8 | - | - |
| 9 | Ground | 0000 |
| 10 | Negative for auxiliary heater enabling | 0501 |
| 11 | Positive with starter up engine | 7786 |
| 12 | - | - |

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## ST20 junction connector (green) - air conditioning system

Figure 52




107552

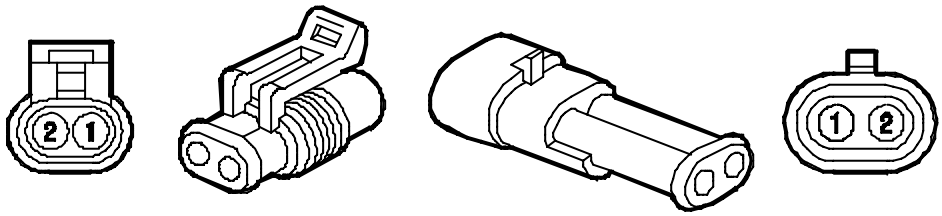
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | K line | 2296/2295 |
| 2 | Positive instruments lighting | 4442 |
| 3 | with ST 19 - 3 | 0506 |
| 4 | with ST 19 - 4 | 8087 |
| 5 | Positive for 1st speed heater enabling (remote control switch) | 8884 |
| 6 | Remote control switch signal for compressor enabling (from pressure switches) | 9933 |
| 7 | Remote control switch signal for compressor enabling (from control unit) | 9933 |
| 8 | Positive with starter up engine | 7778 |
| 9 | Ground | 0000 |
| 10 | Positive compressor control | 9993 |
| 11 | Positive +15 | 8871 |
| 12 | Positive after TGC | 7551 |
| 13 | Positive after TGC | 7551 |
| 14 | - | - |
| 15 | Negative (from control unit) for solenoid valve radiator water recirculation | 9552 |
| 16 | Positive for solenoid valve radiator water recirculation | 7550 |
| 17 | - | - |
| 18 | - | - |

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## ST21 junction connector (black) - solenoid valve for radiator water recirculation

Figure 53



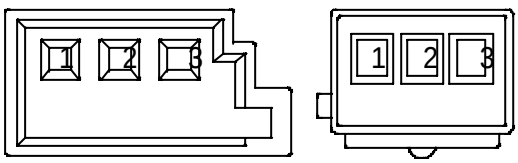

101531

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive for solenoid valve radiator water recirculation | 7550 |
| 2 | Negative for solenoid valve for radiator water recirculation | 9552 |

## ST23 junction connector - immobilizer antenna

Figure 54




107169

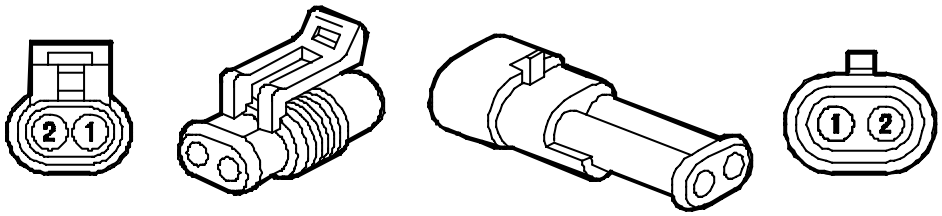
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Immobilizer antenna signal (VCM pin - X1/1) | - |
| 2 | Immobilizer antenna signal (VCM pin - X1/3) | - |
| 3 | - | - |

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## ST24 junction connector (black) - CAN line for air conditioning system

Figure 55



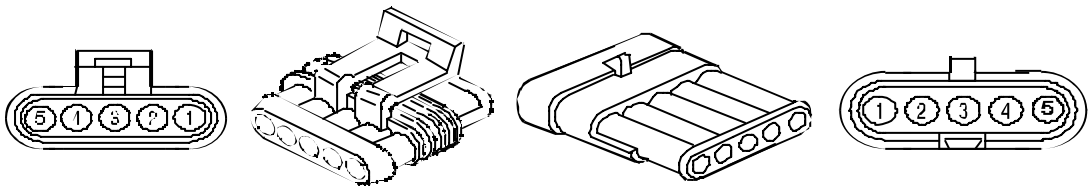

101531

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | CAN L line (BCB) | Green |
| 2 | CAN H line (BCB) | White |

## ST25 junction connector (black) - Intarder

Figure 56




101542

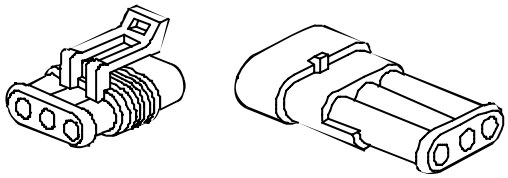
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | CAN VDB Line (L) | Green |
| 2 | CAN VDB Line (H) | White |
| 3 | Speed signal for Intarder | 5541 |
| 4 | EOL data entry line for Intarder control unit | 3393 |
| 5 | K line | 2293 |

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## ST26A - ST26B junction connector

Figure 57



101536

KEY SIDE CONNECTOR VIEW

### ST26A (black) - Ecas (CAN)

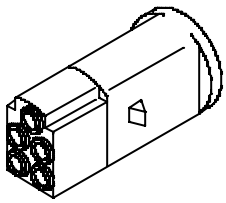
| Pin | Function | Cable colour code |
|---|---|---|
| 1 | CAN VDB Line (L) | Green |
| 2 | CAN VDB Line (H) | White |
| 3 | K line | 2294 |

### ST26B (black) - ABS/EBS (CAN)

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | CAN VDB Line (L) | Green |
| 2 | CAN VDB Line (H) | White |
| 3 | K line | 2299 |

## ST28 junction connector- rotating headlights

Figure 58



107183

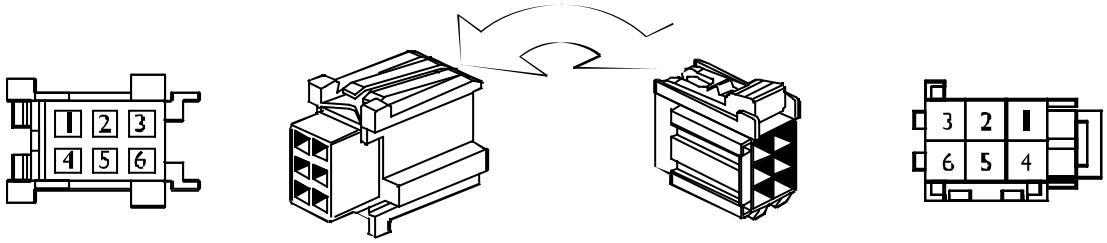
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Ground for left hand side rotating headlight | 0000 |
| 2 | Positive for left hand side rotating headlight | 1108 |
| 3 | Free | - |
| 4 | Positive for right hand side rotating headlight | 1115 |
| 5 | Ground for right hand side rotating headlight | 0000 |

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## ST30 - ST31 junction connector

Figure 59




KEY SIDE CONNECTOR VIEW

### ST30 (blue) - provision for ADR (tachograph)

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive (+Batt) tachograph | 7768 |
| 2 | - | - |
| 3 | Positive (+Batt) from IBC3 | 7768 |
| 4 | Positive (+Batt) Cluster / Central locking | 7768 |
| 5 | Battery direct positive (+Batt) after fuse 70058 (20A) | 7972 |
| 6 | Positive (+Batt) | 7972 |

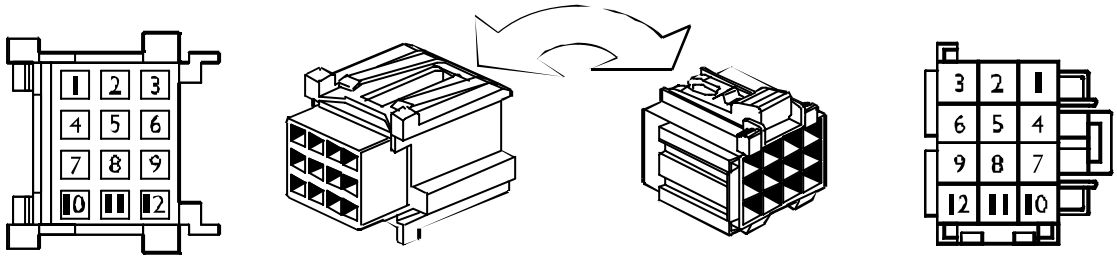
### ST31 (green) - connection for ECAS (remote control)

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Power supply to equalization adjustment system (+15) | 8810 |
| 2 | Ground | 0000 |
| 3 | Clock line on ECAS suspensions control keyboard | 6402 |
| 4 | Clock line on ECAS suspensions control keyboard | 6403 |
| 5 | - | - |
| 6 | - | - |

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## ST31A junction connector (green) - Cab rear

Figure 60



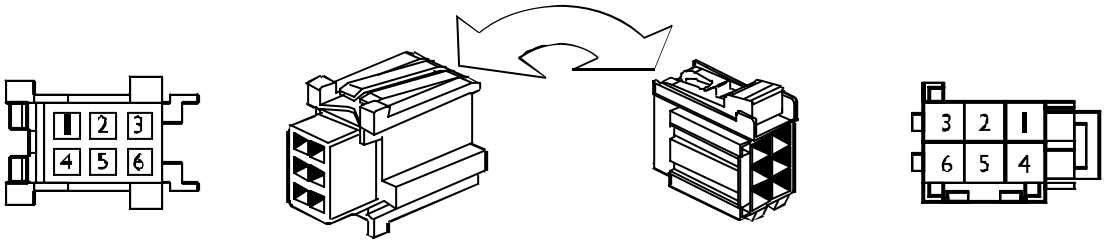

107538

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive for tool compartment lighting switch | 4448 |
| 2 | Positive for reading over head light | 4412 |
| 3 | Ground | 0000 |
| 4 | Ground for refrigerator | 0000 |
| 5 | Positive for refrigerator (24 V) | 7735 |
| 6 | Positive power supply for Bed Module | 7906 |
| 7 | Ground | 0000 |
| 8 | CAN (H) Line BCB | White |
| 9 | CAN Line (L) BCB | Green |
| 10 | Positive for telephone plug (12 V) | 7712 |
| 11 | Telephone plug ground | 0000 |
| 12 | Positive for lamp | 7772 |

## ST31B junction connector (blue) - auxiliary air heating

Figure 61




107188

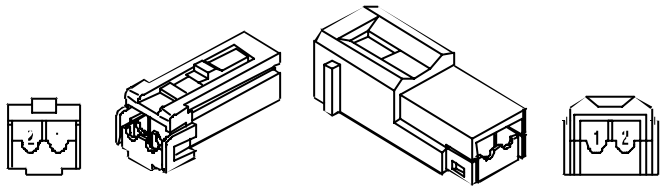
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Auxiliary air heater warning light | 6655 |
| 2 | Positive +30 | 7708 |
| 3 | Ground | 0000 |
| 4 | Power supply to auxiliary fuel pump for air heater | 7783 |
| 5 | Auxiliary heater K line | 2295 |
| 6 | Power supply to ambient temperature sensor for auxiliary sensor | 7512 |

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## ST31C junction connector (white) - water heating temperature sensor

Figure 62



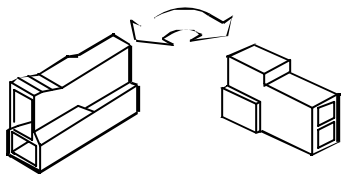

101525

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive for internal temperature detection probe | 7520 |
| 2 | Negative for internal temperature detection probe | 0000 |

## ST31L - ST31R junction connector

Figure 63



101529

KEY SIDE CONNECTOR VIEW

## ST31L - connection for pneumatic heated seat

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Ground | 0000 |
| 2 | Positive for driver side heated pneumatic seat | 8031 |

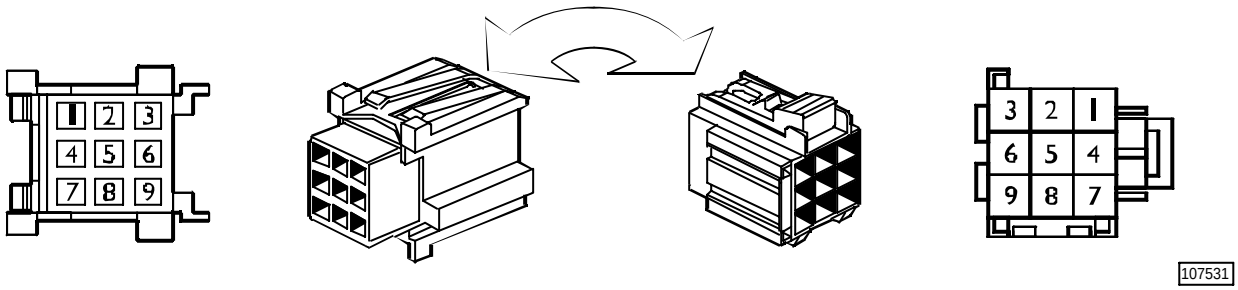
## ST31R - connection for pneumatic heated seat

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Ground | 0000 |
| 2 | Positive for passenger side heated pneumatic seat | 8031 |

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## ST34 (blue) junction connector- provision for ACC / simple gearbox control "H"

Figure 64



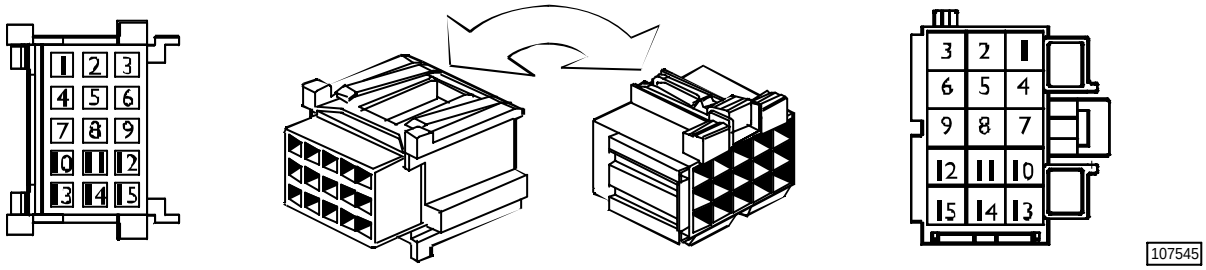

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | VCM control unit pin X3/7 | 0179 |
| 2 | Power supply to warning light for ACC (Adaptive Cruise Control) distance rule signalling / Power supply to splitter control solenoid valve (gear reducer) mechanical gearbox | 6179/9973 |
| 3 | Positive 5 V for distance control with ACC (Adaptive Cruise Control) great distance | 8179 |
| 4 | VCM control unit pin X2/9 | 0139 |
| 5 | Return from distance selector with ACC (Adaptive Cruise Control) | 6178 |
| 6 | Power supply to distance alarm buzzer with ACC (Adaptive Cruise Control) / Power supply to splitter control solenoid valve (mechanical gearbox) | 1166/9974 |
| 7 | Positive +15 | 8871 |
| 8 | Positive for instruments lighting | 4442 |
| 9 | - | - |

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## ST35/1 junction connector (yellow) - manual control air conditioning system

Figure 65

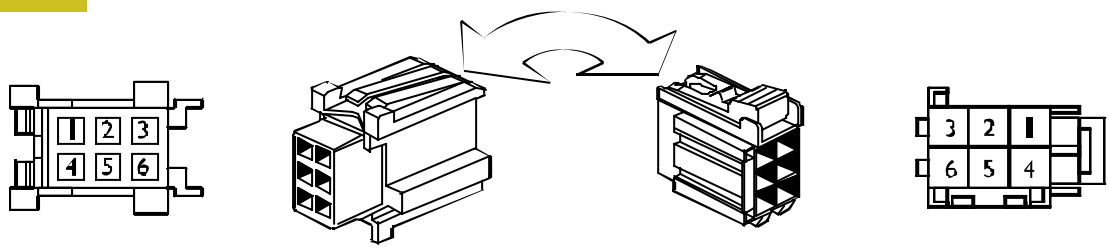



KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | - | - |
| 2 | - | - |
| 3 | - | - |
| 4 | Positive +30 | 7550 |
| 5 | - | - |
| 6 | - | - |
| 7 | - | - |
| 8 | Ambient thermostat signal | 9993 |
| 9 | Negative remote control switches air conditioning enabling command | 0555 |
| 10 | Positive symbols lighting | 4442 |
| 11 | Positive from remote control switch internal heating enabling consent | 8004 |
| 12 | Positive remote control switch air conditioner enabling command | 8097 |
| 13 | Contact of the remote control switch (87) for auxiliary heater 1st speed enabling | 8884 |
| 14 | Positive for Topflap commanding remote switch control | 8801 |
| 15 | - | - |

## ST35/2 junction connector (yellow) - manual control air conditioning system

Figure 66



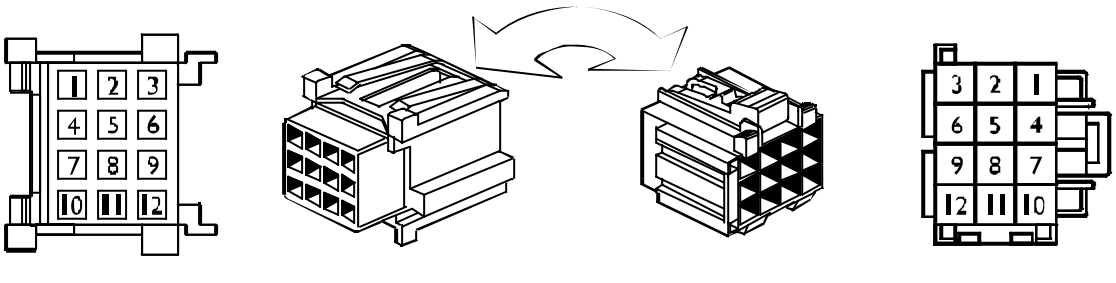

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive for windshield electric defroster command unit | 8884 |
| 2 | - | - |
| 3 | K line | 2296 |
| 4 | Positive +30 from Body Computer | 7786 |
| 5 | - | - |
| 6 | - | - |

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## ST36 junction connector (grey) - T.G.C. / I.G.C.

Figure 67

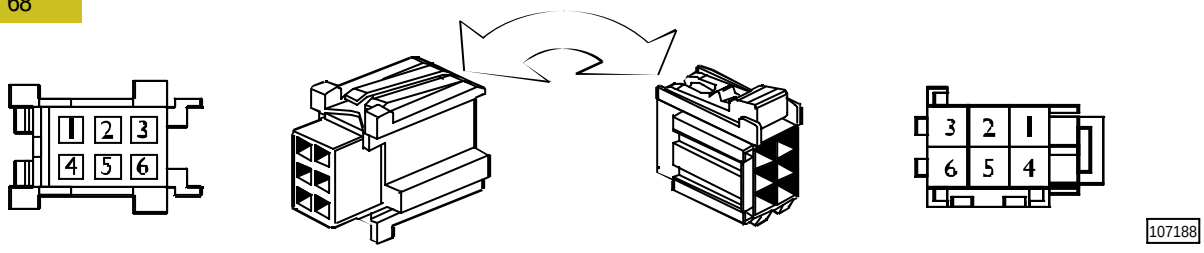



KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Alternator power supply terminal 15 | 8876 |
| 2 | Alternator power supply terminal 15 | 8876 |
| 3 | Signal for TGC closing | 8035 |
| 4 | Signal for TGC closing | 8035 |
| 5 | Battery positive (+Batt) | 7972 |
| 6 | Battery positive (+Batt) for tachograph and IC | 7768 |
| 7 | Battery positive (+Batt) for B.C. / B.M. / diagnosis /refrigerator connector | 7972 |
| 8 | CAN (H) line (BCB) | |
| 9 | CAN (L) line (BCB) | |
| 10 | Telephone socket positive (12 V) | 7712 |
| 11 | Ground for telephone | 0000 |
| 12 | Positive for bulb | 7772 |

## SST37C junction connector (yellow) - Toll Collect

Figure 68



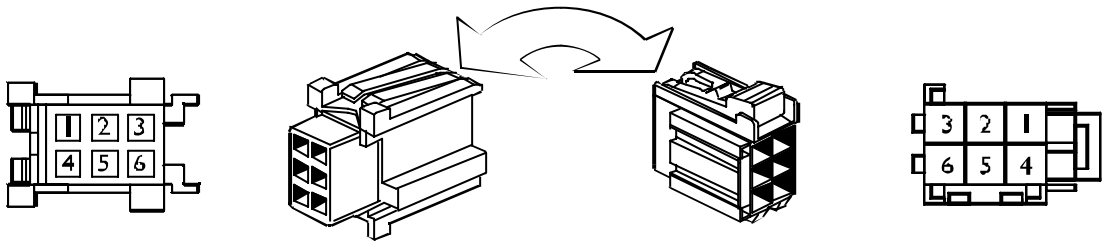

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive +30 after TGC | 7772 |
| 2 | Positive symbols lighting | 4442 |
| 3 | Positive +15 | 8871 |
| 4 | Speed signal (tachograph) | 5541 |
| 5 | Ground | 0000 |
| 6 | - | - |

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## ST39 junction connector (yellow) - differential lock

Figure 69



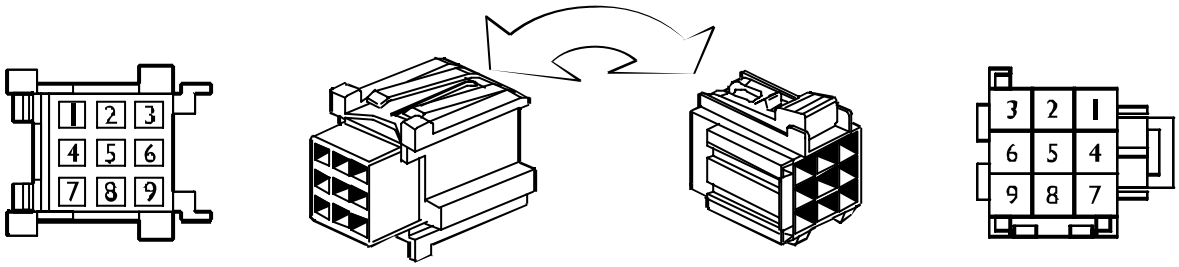

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive symbols lighting | 4442 |
| 2 | Signal from front transverse differential lock control switch | 0902 |
| 3 | Signal from longitudinal differential lock control switch | 0903 |
| 4 | Signal from rear transverse differential lock control switch | 0904 |
| 5 | Ground | 0000 |
| 6 | - | - |

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## ST40 junction connector - navigation and it tools

Figure 70



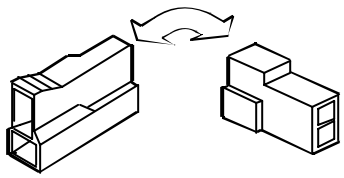

107531

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive +30 after TGC | 7772 |
| 2 | Positive +15 | 8871 |
| 3 | Speed signal for navigator | 5541 |
| 4 | Positive 12V | 7712 |
| 5 | CAN L line (ICB) | Green |
| 6 | CAN H line (ICB) | Bianco |
| 7 | Positive for instruments lighting | 4442 |
| 8 | Reverse gear signal | 2268 |
| 9 | Ground | 0000 |

## Jointing connector ST42 - DDM/PDM supplies

Figure 71



101529

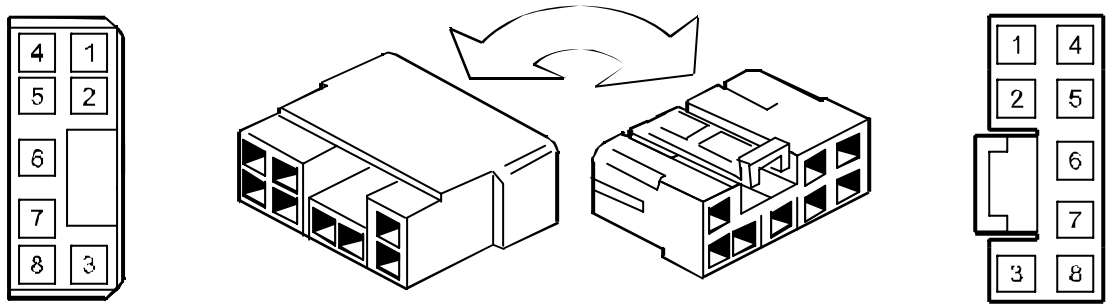
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive +30 | 7777 |
| 2 | Positive +15 | 8887 |

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## ST44 junction connector - centralized locking with remote control

Figure 72



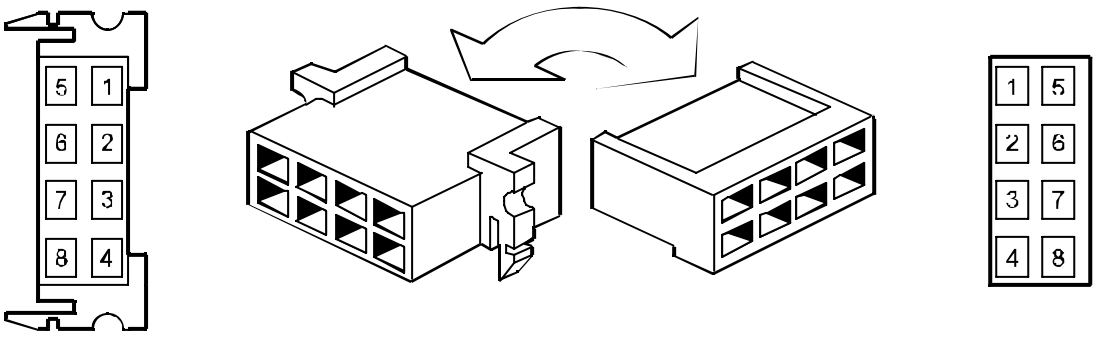

KEY SIDE CONNECTOR VIEW

113250

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Clinker control | 1113 |
| 2 | - | - |
| 3 | Battery positive (+Batt) | 7772 |
| 4 | Ground | 0000 |
| 5 | Control for centralized locking to Body Computer (door opening) | 0064 |
| 6 | Control for centralized locking to Body Computer (door closing) | 0065 |
| 7 | Power supply +15 | 8871 |
| 8 | - | - |

## ST45 junction connector- 24V connection for radio

Figure 73




KEY SIDE CONNECTOR VIEW

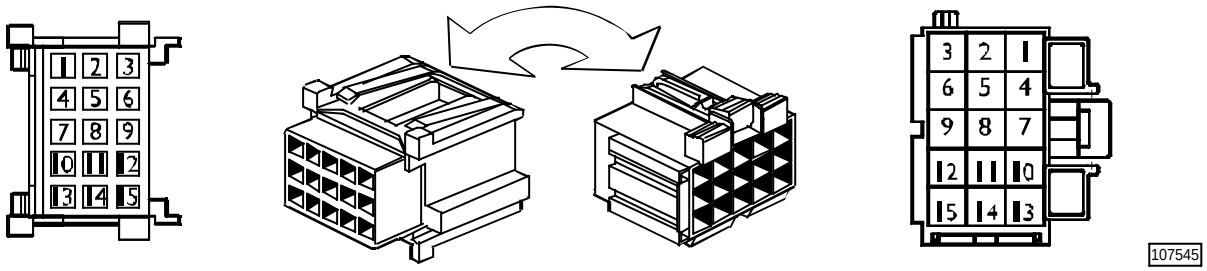
105243

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive +30 for preamplifier | 7772 |
| 2 | Positive +15 for radio receiver | 8871 |
| 3 | Ground | 0000 |
| 4 | Positive symbols lighting | 4442 |
| 5 | CAN line L (IDB) | Green |
| 6 | CAN line H (IDB) | White |
| 7 | Positive +30 for radio receiver | 7770 |
| 8 | - | - |

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## ST48 junction connector (yellow) - EM control unit (PTO)

Figure 74




KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | CAN L line (ICB) | Green |
| 2 | CAN H line (ICB) | White |
| 3 | K line | Green |
| 4 | Positive +30 after TGC | 7772 |
| 5 | Positive +30 | 7166 |
| 6 | Positive +15 | 8166 |
| 7 | Ground | 0000 |
| 8 | Wiring for CAN L line (SB) | Green |
| 9 | Wiring for CAN H line (SB) | White |
| 10 | P.T.O. control signal 1 | 0131 |
| 11 | P.T.O. control signal 1 | 0132 |
| 12 | P.T.O. control signal 1 | 0123 |
| 13 | Positive +30 for body builders connector (72072C) | 7795 |
| 14 | Positive +30 for body builders connector (72072D) | 7796 |
| 15 | - | - |

## Jointing connector ST 49 - Allison transmission setup

Figure 75




KEY SIDE CONNECTOR VIEW

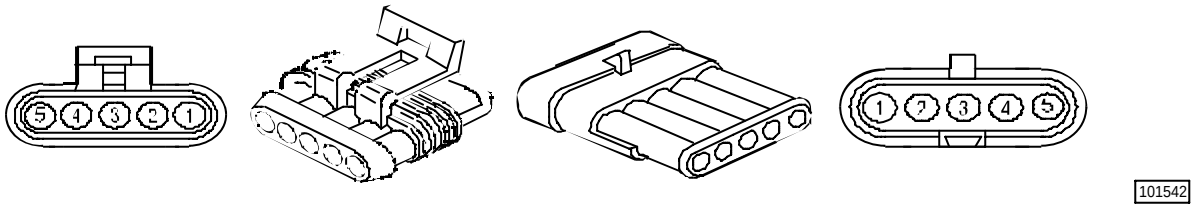
| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Starter motor remote control switch ground | 0008 |

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## ST54 junction connector- provision for ACC

Figure 76

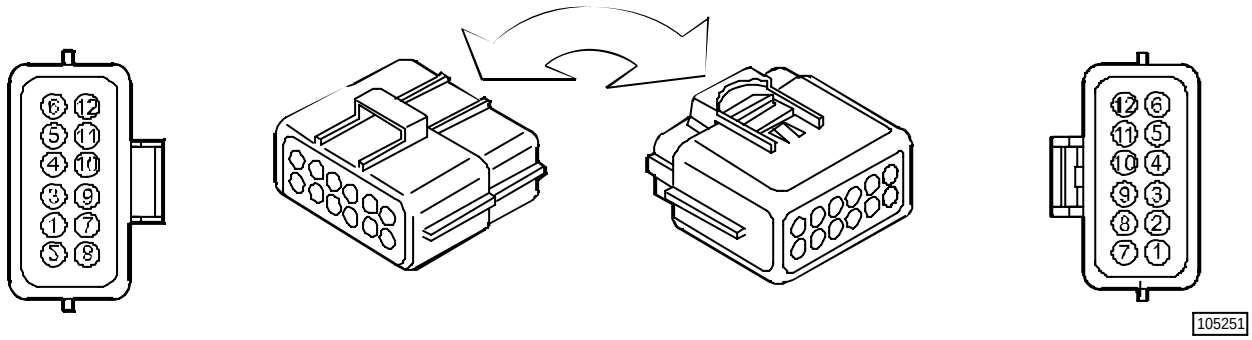



KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | CAN line L (VDB) | Green |
| 2 | CAN line H (VDB) | White |
| 3 | CAN line L (VDB) | Green |
| 4 | CAN line H (VDB) | White |
| 5 | Positive +15 | 8176 |

## ST55A junction connector- SCR system (urea)

Figure 77



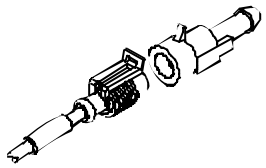

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | CAN line L (ECB) | Green |
| 2 | CAN line H (ECB) | White |
| 3 | CAN line L (ECB) | Green |
| 4 | CAN line H (ECB) | White |
| 5 | K line | 2257 |
| 6 | Positive +15 | 8540 |
| 7 | Power supply to combustion air relative humidity and temperature sensor | 8173 |
| 8 | Signal for combustion air relative humidity sensor | 5173 |
| 9 | Combustion air relative humidity and temperature sensor ground | 0173 |
| 10 | Combustion air temperature sensor signal | 5174 |
| 11 | Power supply to engine brake solenoid valve | 9966 |
| 12 | Engine brake solenoid valve ground | 0043 |

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## ST55B - ST56 junction connector

Figure 78



101523

KEY SIDE CONNECTOR VIEW

## ST55B - SCR system power supply (urea)

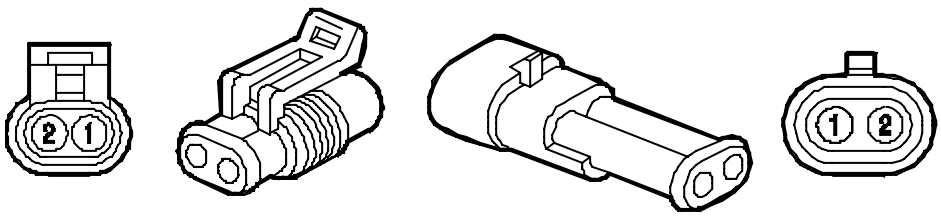
| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Battery positive (+Batt) SCR System | 7540 |

## ST56 (black) - Connection for ADR cut generator

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Alternator power supply terminal 15 | 8876 |

## ST59 junction connector - 2nd front axle ECAS fault / longitudinal lock (8x8)

Figure 79




101531

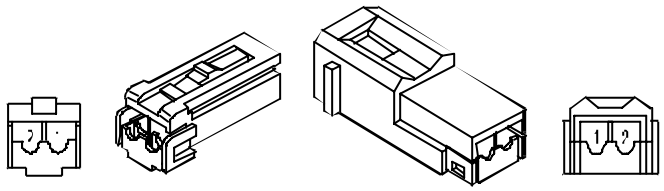
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | ECAS fault signal / front longitudinal differential locks engaged signal (8x8) | 6401 / 6643 |
| 2 | ECAS fault signal switch earth | 0000 |

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## ST63 junction connector- auxiliary water heater CAN

Figure 80



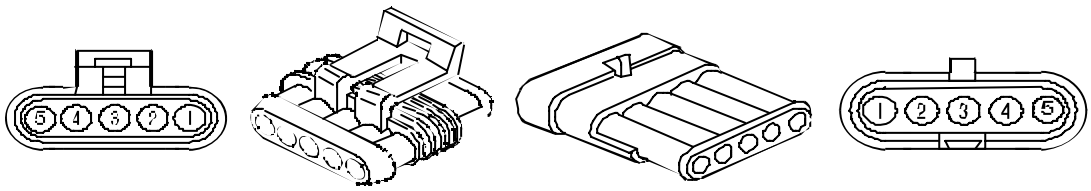

101525

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | CAN Line (L) BCB | Green |
| 2 | CAN (H) Line BCB | White |

## ST64 junction connector (black) - 15-poles current outlet free pins

Figure 81




101542

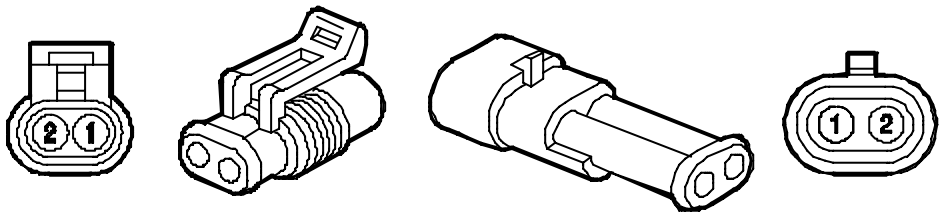
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Power supply to current outlet | 8021 |
| 2 | Power supply to current outlet | 7021 |
| 3 | Transverse differential blocking signal | 6621 |
| 4 | Power supply to positive trailer interlocking +15 | 8075 |
| 5 | Power supply to positive trailer interlocking +15 | 8075 |

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## ST65 - ST67 junction connector

Figure 82




101531

KEY SIDE CONNECTOR VIEW

## ST65 - CAN for trailer (PTO with EM)

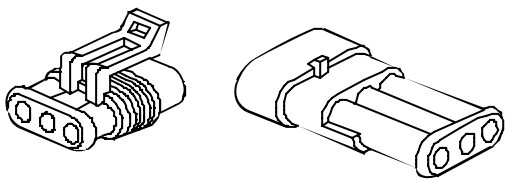
| Pin | Function | Cable colour code |
|---|---|---|
| 1 | CAN SB line (L) (connection for trailer - PTO with EM) | |
| 2 | CAN SB line (H) (connection for trailer - PTO with EM) | |

## ST67 - UREA dosing module solenoid

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Power supply to dosing module solenoid valve with SCR | 7541 |
| 2 | Urea electric dosing unit (-) control | 9541 |

## ST68 junction connector- UREA temperature sensor

Figure 83



101536

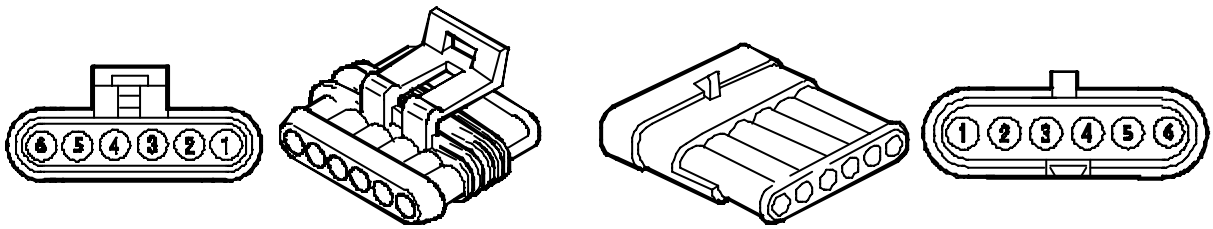
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Signal cable to urea tank level sensor with SCR | 6543 |
| 2 | Urea tank with CSR level and temperature sensor ground | 0543 |
| 3 | Signal cable to urea tank temperature sensor with SCR | 6542 |

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## ST69 junction connector- Intarder

Figure 84



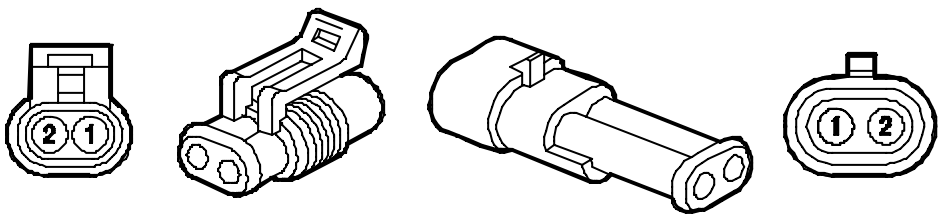

105334

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Solenoid valve for retarder oil accumulator | 0311 |
| 2 | Solenoid valve for retarder oil accumulator | 9311 |
| 3 | Water temperature transmitter for retarder | 5309 |
| 4 | Water temperature transmitter for retarder | 0309 |
| 5 | Solenoid valve for retarder enabling | 0310 |
| 6 | Solenoid valve for retarder enabling | 9310 |

## ST70 junction connector (black) - ASR solenoid valve

Figure 85




101531

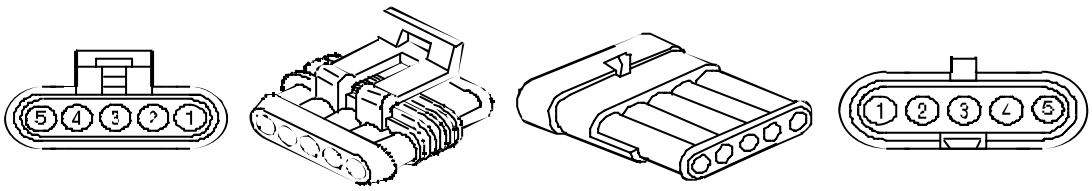
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | ASR solenoid valve (-) control | 0260 |
| 2 | ASR solenoid valve power supply | 9260 |

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## ST72 junction connector (black) - rear block wear / transverse differential lock

Figure 86




101542

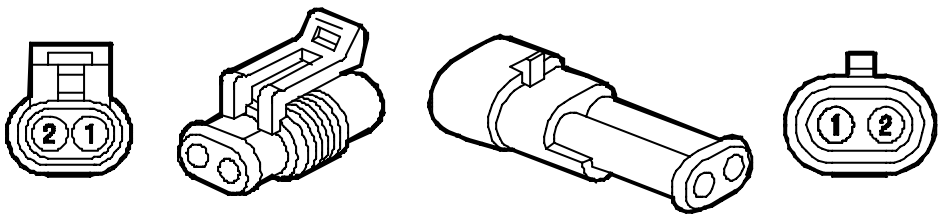
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | To the deviator for signalling of transverse differential lock of Rockwell rear axles for the third axle | 0041 |
| 2 | To the deviator for signalling of transverse differential lock of Rockwell rear axles for the third axle | 0000 |
| 3 | To the deviator for signalling of transverse differential lock of Rockwell rear axles for the third axle | 0040 |
| 4 | To the sensor for circuit signalling of rear wheel shoes wear | 6667 |
| 5 | To the sensor for circuit signalling of rear wheel shoes wear | 6664 |

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## Junction connector ST73/1 - ST73/2 - ST73/3 - ST73/4

Figure 87




101531

KEY SIDE CONNECTOR VIEW

### ST73/1 (black) - 1st front axle block wear (right)

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | To the sensor for circuit signalling of front wheel shoes wear | 6664 |
| 2 | To the sensor for circuit signalling of front wheel shoes wear | 6664 |

### ST73/2 (black) - 1st front axle block wear (left)

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | To the sensor for circuit signalling of front wheel shoes wear | 6664 |
| 2 | To the sensor for circuit signalling of front wheel shoes wear | 0000 |

### ST73/3 (black) - 2nd front axle block wear (right)

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | To the sensor for circuit signalling of front wheel shoes wear | 6664 |
| 2 | To the sensor for circuit signalling of front wheel shoes wear | 6664 |

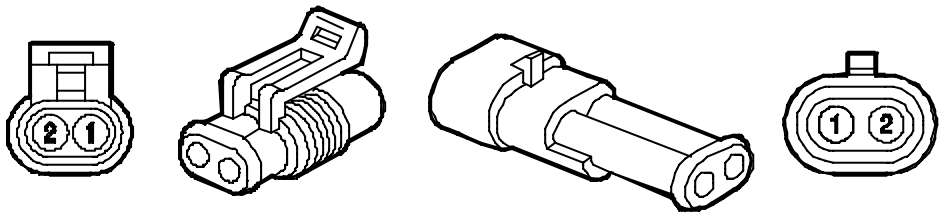
### ST73/4 (black) - 2nd front axle block wear (left)

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | To the sensor for circuit signalling of front wheel shoes wear | 6664 |
| 2 | To the sensor for circuit signalling of front wheel shoes wear | 0000 |

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## ST75A junction connector - 1st front axle differential lock

Figure 88



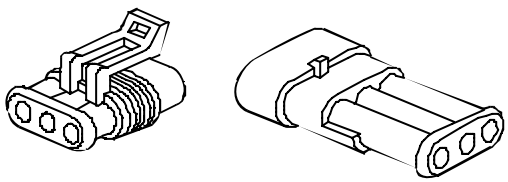

101531

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | 1st front axle differential lock signal | 6659 |
| 2 | Ground | 0000 |

## ST75B junction connector - 2nd front axle differential lock

Figure 89



101536

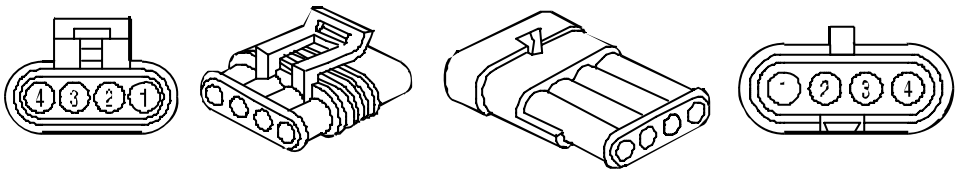
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | 2nd front axle differential lock signal | 6659 |
| 2 | Ground | 0000 |
| 3 | Front longitudinal differential lock engaged signal (8x8) | 6643 |

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## ST77 - ST78 JUNCTION CONNECTOR BODYBUILDERS (CHASSIS - TRUCK)

Figure 90




101538

KEY SIDE CONNECTOR VIEW

### ST77 (black) - Right hand side SML indicator light (Side Marker Lamp)

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Signal for side lamps | 3330 |
| 2 | Ground for side lamps | 0000 |
| 3 | Signal for side lamps | 3330 |
| 4 | Ground for side lamps | 0000 |

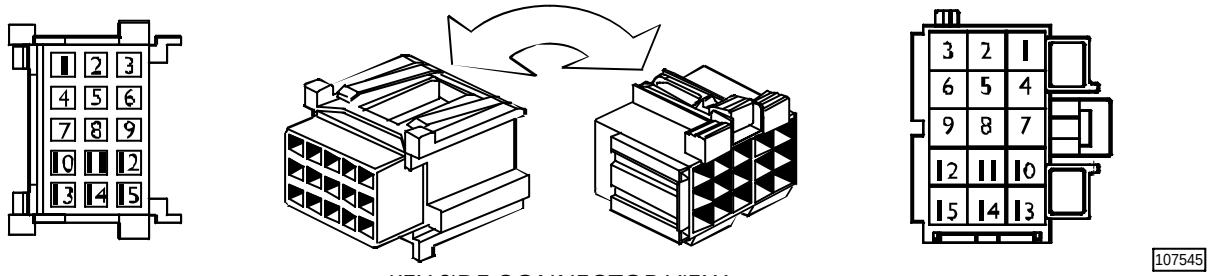
### ST78 (black) - Left hand side SML indicator lamp (Side Marker Lamp)

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Signal for side lamps | 3339 |
| 2 | Ground for side lamps | 0000 |
| 3 | Signal for side lamps | 3339 |
| 4 | Ground for side lamps | 0000 |

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## ST79A junction connector (yellow) - external cab front

Figure 91

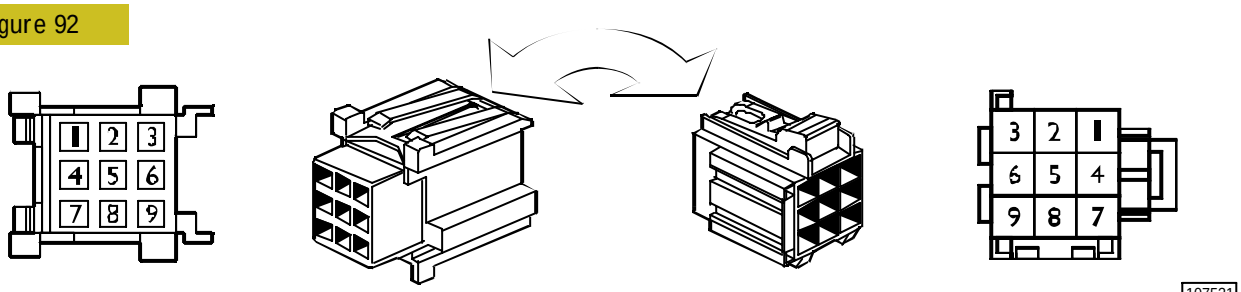



KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Ground | 0000 |
| 2 | Positive to refrigerating fluid pressure signalling switch (air conditioner) | 9993 |
| 3 | Positive from refrigerating fluid pressure signalling switch (air conditioner) | 9993 |
| 4 | Positive for solenoid valve radiator water recirculation | 7550 |
| 5 | Signal from switch on clutch for VCM (clutch cylinder 20% compressed) | 0160 |
| 6 | Gearbox synchronous protection solenoid control earth (clutch cylinder 70% compressed) | 9975 |
| 7 | Positive for windscreen unit (high speed) | 8881 |
| 8 | Positive for windscreen unit (low speed) | 8882 |
| 9 | Positive for windscreen unit | 8880 |
| 10 | Positive for windscreen unit | 8873 |
| 11 | Radiator water recirculation solenoid valve command | 9552 |
| 12 | Negative from refrigerating fluid pressure signalling switch (engine cooling) | 0583 |
| 13 | Negative from refrigerating fluid pressure signalling switch (engine cooling) | 0582 |
| 14 | - | - |
| 15 | - | - |

## Jointing connector ST79B (yellow) - windshield washer and warning horn unit

Figure 92



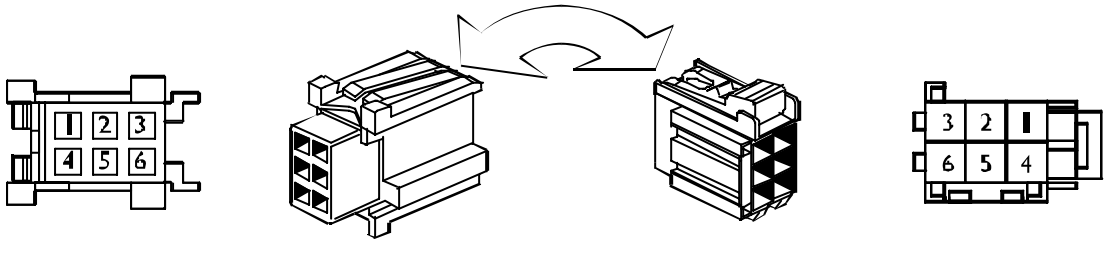

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Signal for warning horn | 1116 |
| 2 | Electrical pump power headlight wipers | 8821 |
| 3 | Signal from the Body Computer for windshield washer liquid low level indicator control | 5521 |
| 4 | Windshield washer control signal | 8886 |
| 5 | - | - |
| 6 | - | - |
| 7 | - | - |
| 8 | - | - |
| 9 | - | - |

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## ST79D junction connector (green) - brake pedal switch (ABS)

Figure 93



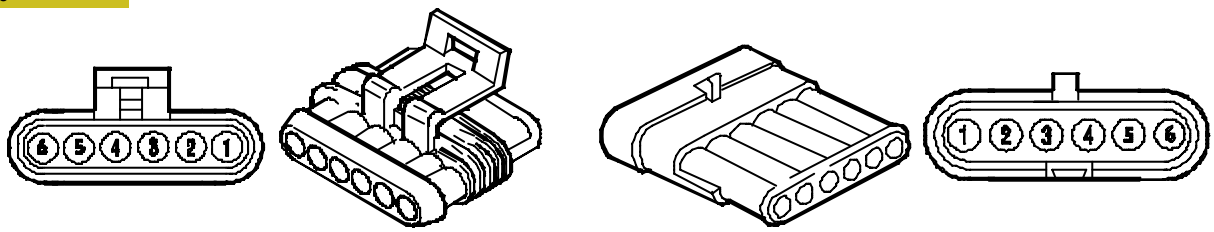

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive +30 | 7150 |
| 2 | Positive for stop lights | 8158 |
| 3 | Positive pressed pedal signal | 8153 |
| 4 | Positive +30 | 7150 |
| 5 | - | - |
| 6 | - | - |

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## ST80 junction connector (black) - mechanical gearbox

Figure 94



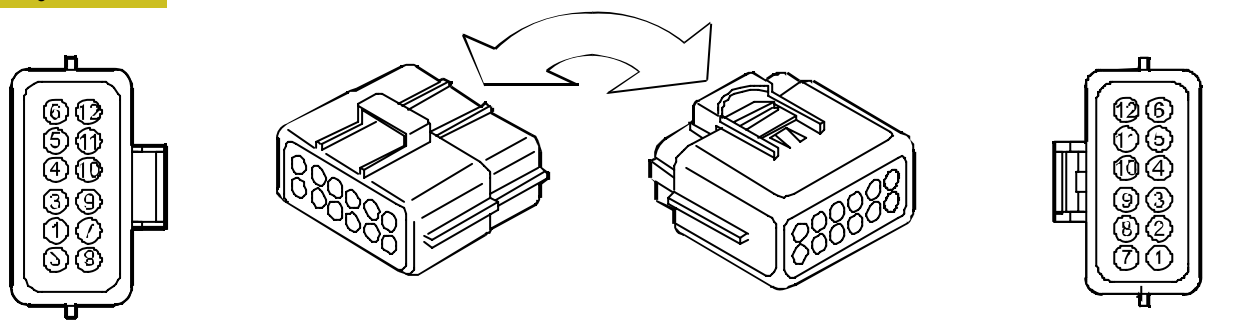

105334

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Signal for reverse lights light up switch | 2268 |
| 2 | Ground for reverse lights lighting up switch | 0000 |
| 3 | Ground for anti-start system with gears engaged switch and for reverse light light up switch | 0000 |
| 4 | Ground for anti-start system with gears engaged switch and for reverse light light up switch | 8050 |
| 5 | Signal for reduced gears engaged signalling switch | 9992 |
| 6 | Ground for reduced gears engaged signalling switch | 0000 |

## ST81A junction connector (black) - front lights

Figure 95




KEY SIDE CONNECTOR VIEW

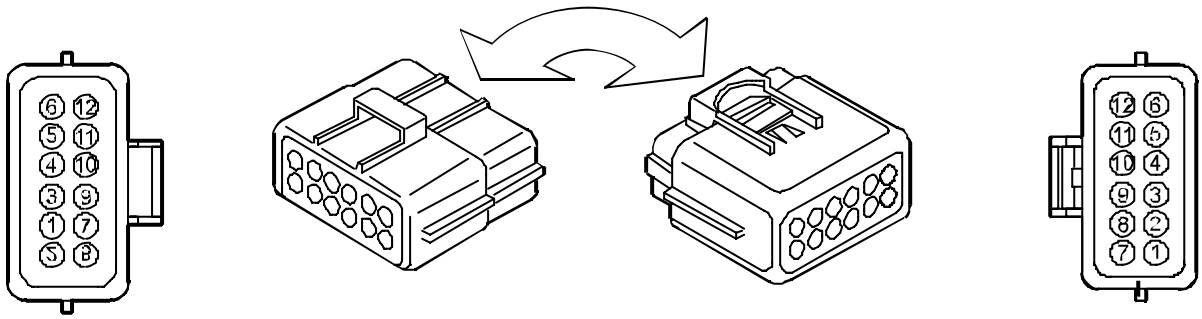
105251

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Side / left front direction indicator power supply | 1129 |
| 2 | Right / left front side light power supply | 3339 |
| 3 | Left low beam power supply | 2231 |
| 4 | Left high beam power supply | 2219 |
| 5 | Right / left fog lamp power supply | 2228 |
| 6 | - | - |
| 7 | Right side / front direction indicator power supply | 1123 |
| 8 | - | - |
| 9 | Right low beam power supply | 2223 |
| 10 | Right high beam power supply | 2221 |
| 11 | Head lamp alignment corrector control | 9936 |
| 12 | Supplementary head lamp power supply | 2229 |

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## ST82 junction connector (black) - components on engine

Figure 96



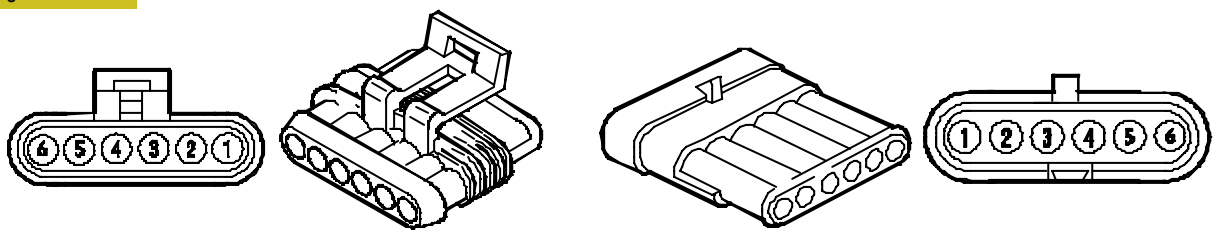

KEY SIDE CONNECTOR VIEW

105251

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | - | - |
| 2 | - | - |
| 3 | Signal for engine ventilation temperature sensor | 5166 |
| 4 | - | - |
| 5 | - | - |
| 6 | - | - |
| 7 | - | - |
| 8 | - | - |
| 9 | Signal for engine oil level thermometer transmitter | 5505 |
| 10 | Signal for engine oil level thermometer transmitter | 5506 |
| 11 | Ground for fuel filter clogged signalling switch | 0000 |
| 12 | Signal for fuel filter clogged signalling switch | 5531 |

## ST83 junction connector (black) - components on engine

Figure 97




KEY SIDE CONNECTOR VIEW

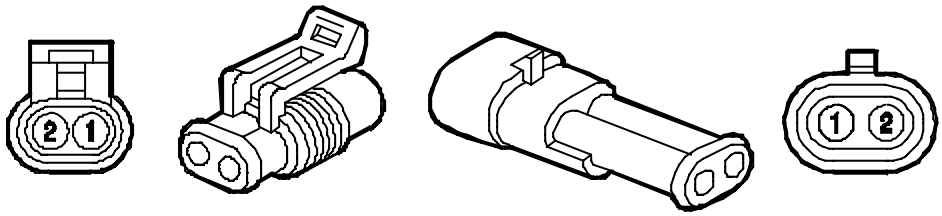
105334

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Engine oil level transmitter signal | 5506 |
| 2 | Engine oil level transmitter signal | 5505 |
| 3 | Blocked fuel filter switch signal | 5531 |
| 4 | Power drive low oil level switch signal | 5525 |
| 5 | Positive +15 for UDS power unit | 8540 |
| 6 | - | - |

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## ST86 - ST88 junction connector

Figure 98




101531

KEY SIDE CONNECTOR VIEW

## ST86 (black) - T.G.C. connection

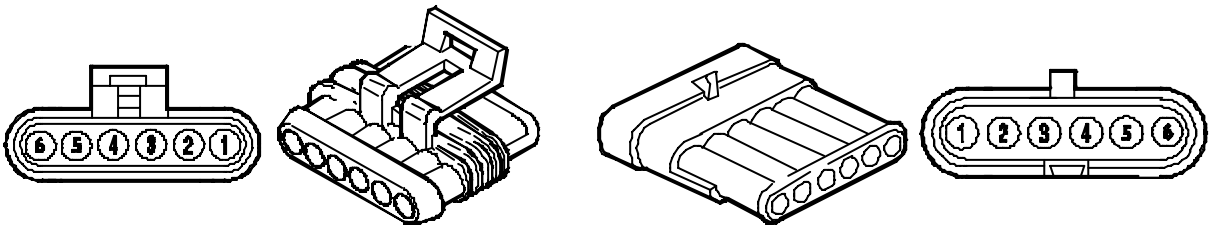
| Pin | Function | Cable colour code |
|---|---|---|
| 1 | TGC Off relay excitation | 8845 |
| 2 | TGC On relay excitation | 8835 |

## ST86 (black) - I.G.C. connection

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Provision | 8045 |
| 2 | TGC On relay excitation | 8035 |

## ST88 (black) - trailer connectors

Figure 99




105334

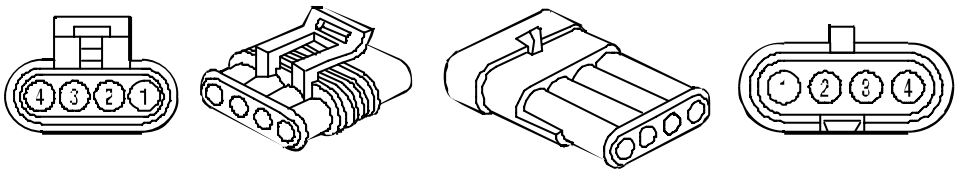
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Trailer axle lift signal | 6442 |
| 2 | Trailer brake low air pressure | 6689 |
| 3 | Positive +30 for trailer socket | 7790 |
| 4 | Positive +15 for trailer ABS socket | 8847 |
| 5 | Trailer ABS fault signal | 6671 |
| 6 | Load compartment lighting power supply | 2224 |

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## ST91 - ST92 - ST93 junction connector

Figure 100




101538

KEY SIDE CONNECTOR VIEW

## ST91 (black) - PTO1 (EM)

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | PTO 1 power take-off return signal | 6131 |
| 2 | PTO 1 solenoid valve power supply | 9131 |
| 3 | Negative consent for power take-off PTO 1 | 0391 |
| 4 | Ground | 0000 |

## ST92 (black) - PTO2 (EM)

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | PTO 2 power take-off return signal | 6132 |
| 2 | PTO 2 solenoid valve power supply | 9132 |
| 3 | Negative consent for power take-off PTO 2 | 0392 |
| 4 | Ground | 0000 |

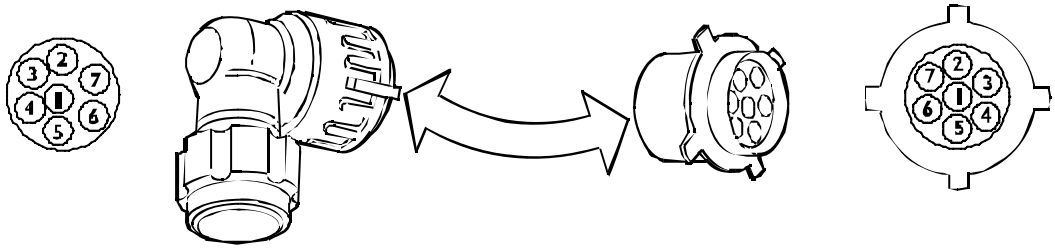
## ST93 (black) - PTO3 (EM)

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | PTO 3 power take-off return signal | 6133 |
| 2 | PTO 3 solenoid valve power supply | 9133 |
| 3 | Negative consent for power take-off PTO 3 | 0393 |
| 4 | Ground | 0000 |

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## ST99 junction connector (black) - rear axle ECAS

Figure 101



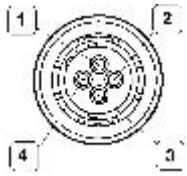

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Level sensor ground | 0400 |
| 2 | Right rear axle level sensor signal | 5421 |
| 3 | Left rear axle level sensor signal | 5422 |
| 4 | Rear axle positive electro pneumatic distributor | 9400 |
| 5 | Rear axle ground electro pneumatic distributor | 9423 |
| 6 | Ground for rear axle electro pneumatic distributor left valve command | 9425 |
| 7 | Ground for rear axle electro pneumatic distributor right valve command | 9424 |

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## ST junction connector- ECAS remote control

Figure 102



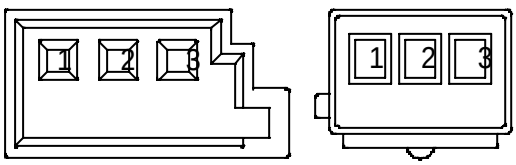

107178

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive for remote control power supply (pin 1) | 7777 |
| 2 | Negative for remote control (pin 2) | 0000 |
| 3 | Communication line with remote control (pin 3) | 3333 |
| 4 | Communication line with remote control (pin 4) | 8888 |

## STY/1 junction connector (black) - switch on clutch

Figure 103




107169

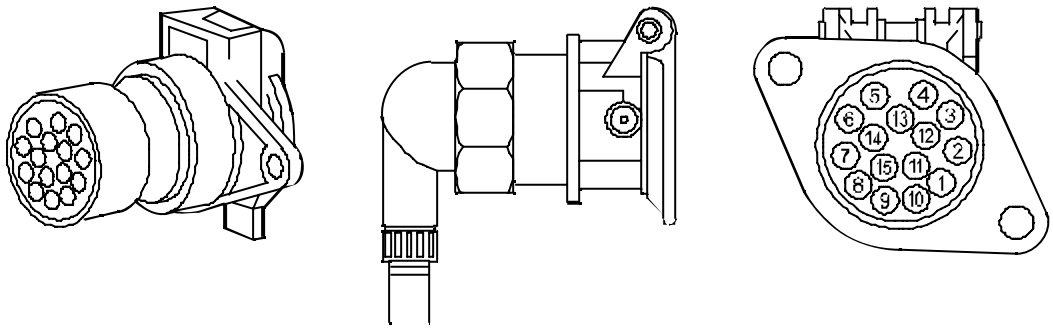
KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Ground | 0000 |
| 2 | Signal from switch on clutch for VCM | 0160 |
| 3 | - | - |

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## 15-pin current outlet for trailer electric connection (72010)

Figure 104



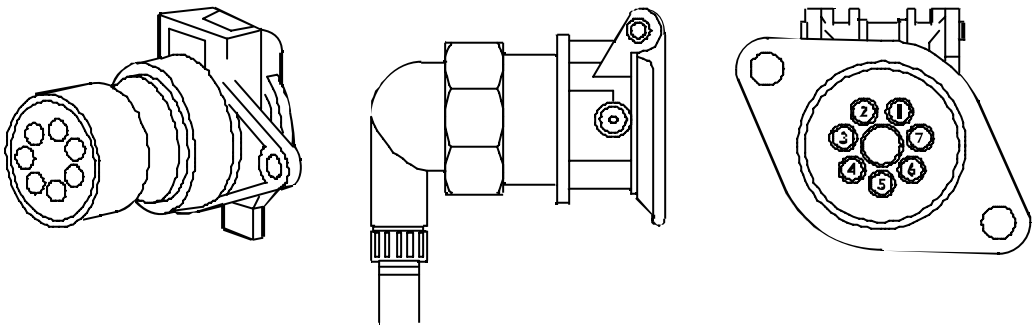

KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Left hand side trailer direction indicators | 1180 |
| 2 | Right hand side trailer direction indicators | 1185 |
| 3 | Trailer back fog light | 2283 |
| 4 | Ground | 0000 |
| 5 | Left trailer end-outline marker | 3339 |
| 6 | Right trailer end-outline marker | 3330 |
| 7 | Trailer stop lights | 1179 |
| 8 | Trailer reverse light | 2226 |
| 9 | Power supply to trailer outlet after fuse for T.M.P. devices | 7790 |
| 10 | Transverse differential blocking signal | 6621 |
| 11 | Power supply to positive trailer interlockings +15 | 8075 |
| 12 | Warning light signalling trailer axle lifted | 6442 |
| 13 | Ground | 0000 |
| 14 | Power supply to current outlet | 7021 |
| 15 | Power supply to current outlet | 8021 |

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## 7-pin current outlet for trailer electric connection

Figure 105




113252

KEY SIDE CONNECTOR VIEW

### 72000 - normal 7-pin current outlet for trailer electric connection

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Ground | 0000 |
| 2 | Left trailer end-outline marker | 3339 |
| 3 | Left hand side trailer direction indicators | 1180 |
| 4 | Trailer stop lights | 1179 |
| 5 | Right hand side trailer direction indicators | 1185 |
| 6 | Trailer end-outline marker | 3330 |
| 7 | Free | - |

### 72001 - auxiliary 7-pin current outlet for trailer electric connection

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Ground | 0000 |
| 2 | Trailer interlockings power supply with terminal +15 | 8075 |
| 3 | Trailer reverse light | 2226 |
| 4 | Free | - |
| 5 | Warning light signalling trailer axle lifted | 6442 |
| 6 | Power supply to trailer outlet after fuse for T.M.P. devices | 7790 |
| 7 | Trailer back fog light | 2283 |

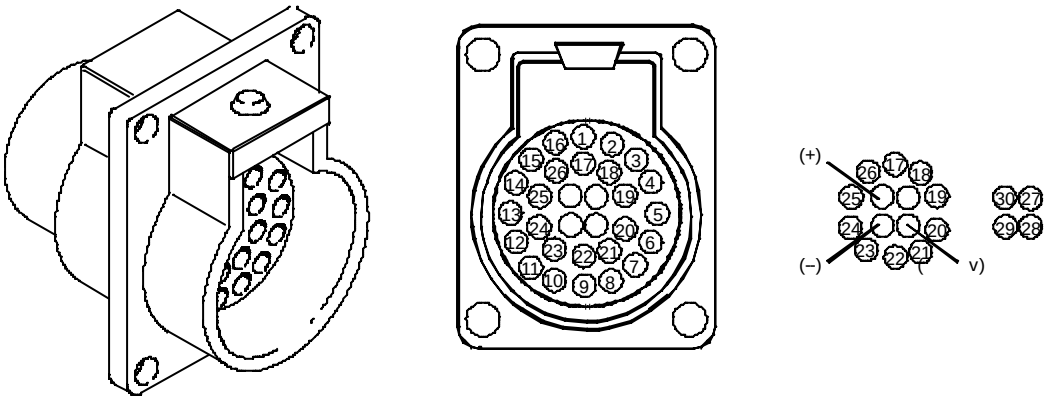
### 72006 - -pin current outlet for trailer ABS electric connection

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Positive after fuse for trailer ABS | 7772 |
| 2 | Power supply after fuse for ABS / speed limiter | 8847 |
| 3 | Ground | 0000 |
| 4 | Ground | 0000 |
| 5 | Trailer ABS fault warning light | 6671 |
| 6 | CAN "H" line (SB) | WS/BI |
| 7 | CAN "L" line (SB) | GN/VE |

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## DIAGNOSIS CONNECTOR
### Diagnosis connector - 72021

Figure 106




113302

DIAGNOSIS CONNECTOR (FRONT VIEW)

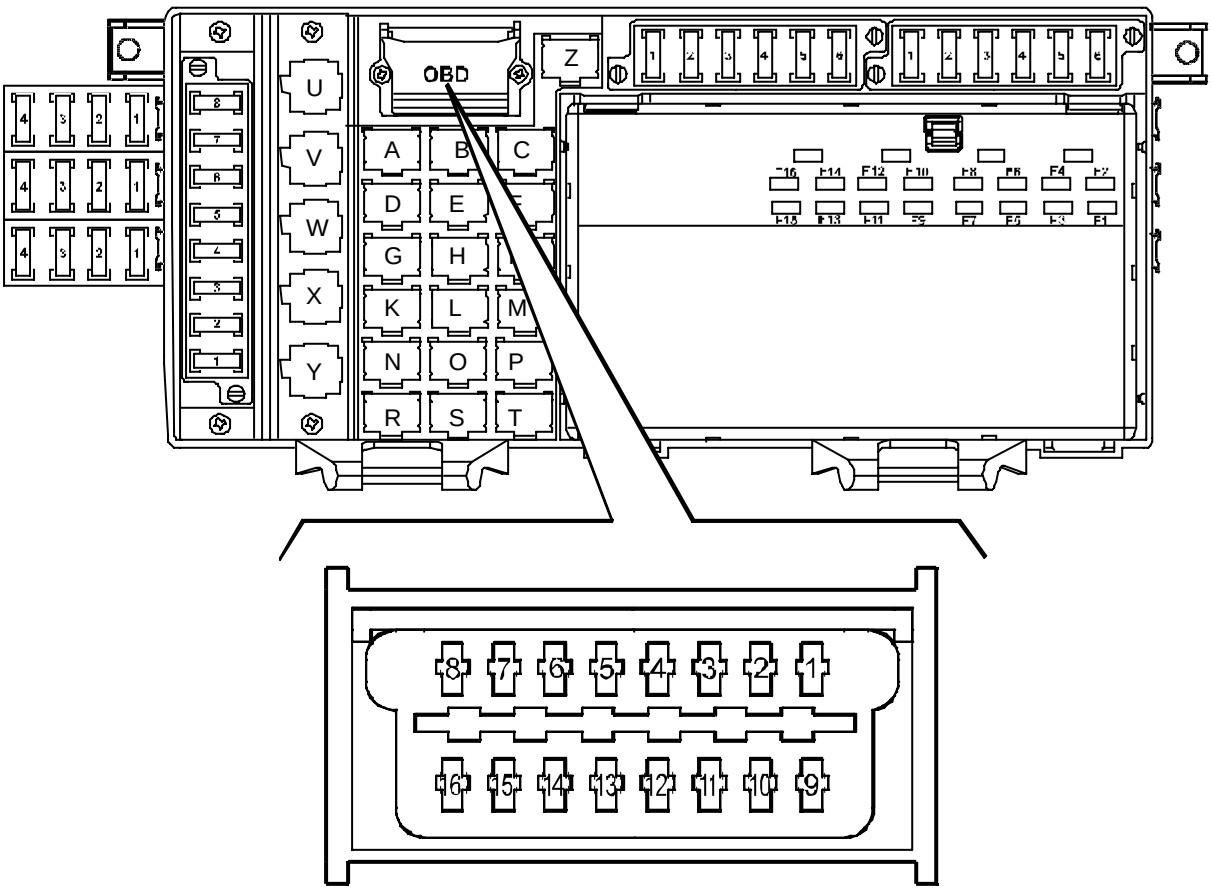
Pins 27,28,29,30 might be printed with different positions from those reported in this picture.

| Pin | System | Function | Cable colour code |
|---|---|---|---|
| 1 | Free | - | - |
| 2 | EDC (ECM) | K | 2298 |
| 3 | Free | - | - |
| 4 | ABS / EBS + ECAS | K | 2299 |
| 5 | Free | - | - |
| 6 | Intarder / EM | K | 2293 |
| 7 | Free | - | - |
| 8 | Body Controller / DDM / PDM | K | 2295 |
| 9 | Free | - | - |
| 10 | Heater / Air conditioner | K | 2296 |
| 11 | Service actuation Key to "MAR" | + 15 | 8802 |
| 12 | VCM | K | 2292 |
| 13 | Free | - | - |
| 14 | Cluster / tachograph | K | 2994 |
| 15 | Free | - | - |
| 16 | UREA (SCR system) | K | 2257 |
| 17 | Free | - | - |
| 18 | EUROTRONIC / ALLISON | K | 2297 |
| 19 | Free | - | - |
| 20 | Programming retarder EOL | - | 3393 |
| 21 | CAN H (VDB) | H | Ws/Bi |
| 22 | CAN L (VDB) | L | Gn/Ve |
| 23 | Free | - | - |
| 24 | Free | - | - |
| 25 | Startup signal | - | 8050 |
| 26 | Signal ground | - | 0050 |
| 27 | Free | - | - |
| 28 | Speed signal (B7) | v | 5542 |
| 29 | Signal ground | 31 | 0050 |
| 30 | Positive | + 30 | 7772 |

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## OBD DIAGNOSIS CONNECTOR (BLUE)

Figure 107




KEY SIDE CONNECTOR VIEW

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | - | - |
| 2 | - | - |
| 3 | - | - |
| 4 | Ground | 0000 |
| 5 | Signal ground | 0050 |
| 6 | CAN line H (ECB) | White |
| 7 | - | - |
| 8 | - | - |
| 9 | - | - |
| 10 | - | - |
| 11 | - | - |
| 12 | - | - |
| 13 | - | - |
| 14 | CAN line L (ECB) | Green |
| 15 | - | - |
| 16 | Battery direct positive (+Batt) | 7721 |

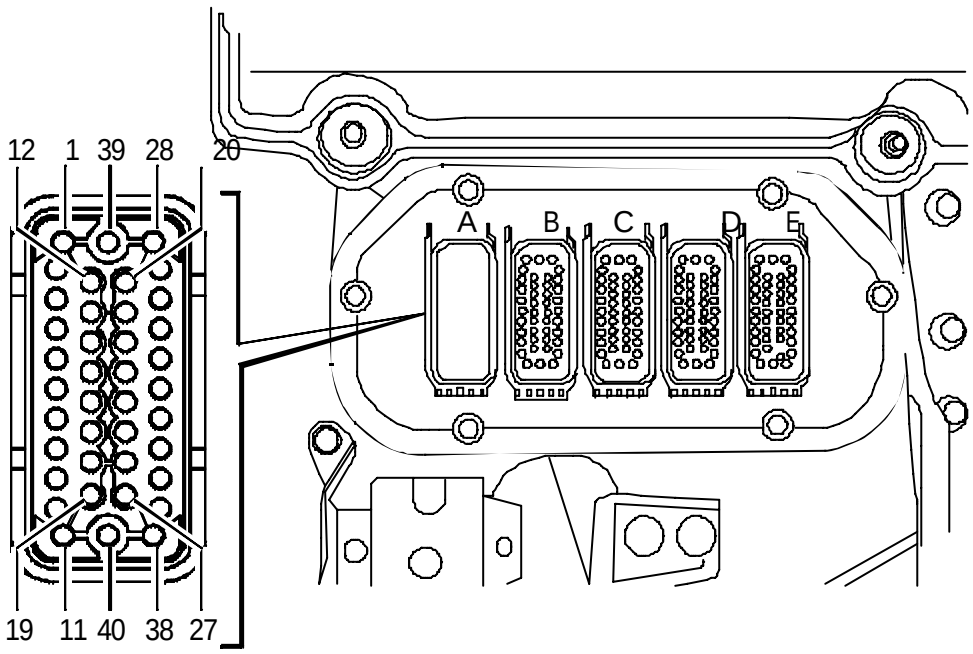
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## BULKHEAD

LEFT-HAND DRIVE

Connector A – White (free)
Connector B – Brown (ECAS)
Connector C – Yellow (SCR)
Connector D - Blue (EuroTronic/PTO/INTARDER)
Connector E – Green (EDC/ADR)

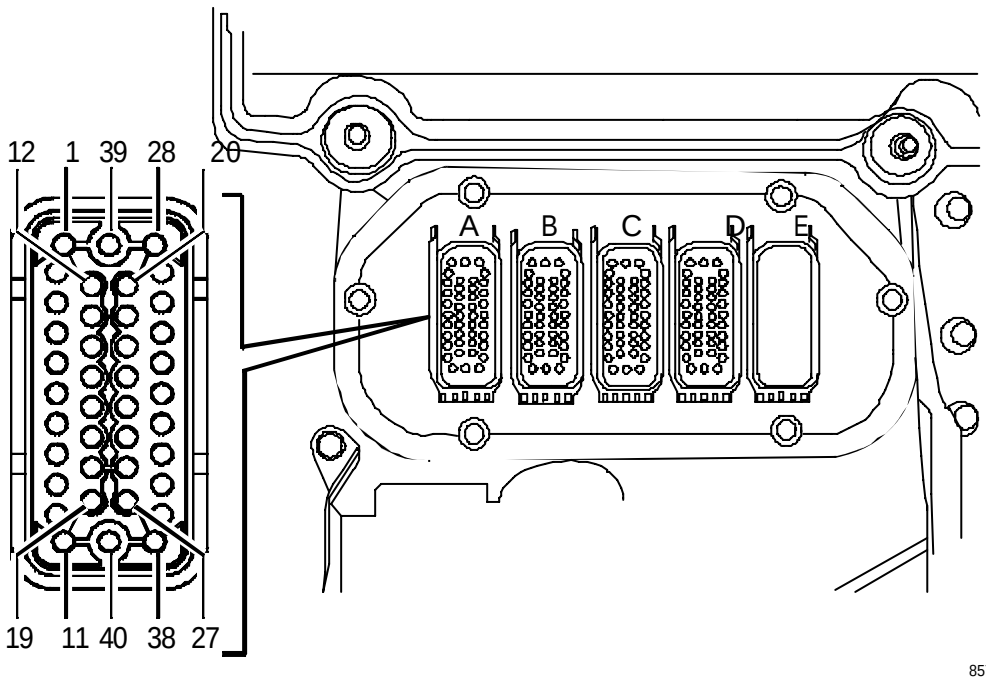
Figure 108




RIGHT-HAND DRIVING

Connector A – White (EDC/ADR)
Connector B – Brown (EuroTronic/PTO/INTARDER)
Connector C – Yellow (SCR)
Connector D – Blue (ECAS)
Connector E – Green (free)

Figure 109




The new bayonet connectors make signal continuity much more reliable than the previous system.

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**Brown bulkhead "B"**

| Pin | Description | Cable colour code |
|---|---|---|
| 1 | Ground of level and load pressure on axle sensors | 0400 |
| 2 | Rear right axle level sensor signal | 5421 |
| 3 | Rear left axle level sensor (only truck) | 5422 |
| 4 | - | - |
| 5 | CAN - L Line (SB) | Green |
| 6 | CAN - H Line (SB) | White |
| 7 | Positive for rear axle electro pneumatic distributor | 9400 |
| 8 | Ground for rear axle electro pneumatic distributor loading/unloading command | 9423 |
| 9 | Ground for rear axle electro pneumatic distributor left valve command (only truck) | 9425 |
| 10 | Ground for rear axle electro pneumatic right valve command | 9424 |
| 11 | Air pressure Transmitter signal (rear brakes) | 5561 |
| 12 | Power supply for air pressure transmitter for braking system | 5560 |
| 13 | Ground for air pressure transmitter for braking system | 0560 |
| 14 | Air pressure transmitter signal (front brakes) | 5562 |
| 15 | Sensor signal of load pressure on axles - right axle | 5443 |
| 16 | Sensor signal of load pressure on axles - left axle (only truck) | 5444 |
| 17 | - | - |
| 18 | - | - |
| 19 | Signal for raised trailer indicator | 6442 |
| 20 | CAN - L Line (BCB) | Green |
| 21 | CAN - H Line (BCB) | White |
| 22 | Ground from signalling switch gear box in a neutral position | 8050 |
| 23 | Power supply for electronic tachograph transmitter | 5514 |
| 24 | Inverted signal from electronic tachograph transmitter | 5516 |
| 25 | Speed signal from electronic tachograph transmitter | 5517 |
| 26 | Ground for electronic tachograph transmitter | 0058 |
| 27 | Positive +15 for air block turbine VGT (Shut-Off)electro valve | 8360 |
| 28 | Positive +15 for MET control unit | 8871 |
| 29 | Positive +15 for resistance of dryer braking system | 8840 |
| 30 | Positive for TGC closure (TGC On) | 8035 |
| 31 | Positive for TGC aperture (TGC Off) | 8045 |
| 32 | Ground from signalling switch tilted caisson | 6607 |
| 33 | - | - |
| 34 | Positive for head lamp illumination loading deck | 2224 |
| 35 | Positive for supplementary depth projectors | 2229 |
| 36 | - | - |
| 37 | Failure signal trailer ABS/EBS | 6671 |
| 38 | Positive +15 for power socket trailer ABS/EBS | 8847 |
| 39 | Positive + 30 for 15 pin power socket electrical connection trailer | 7790 |
| 40 | Direct positive +Bat battery for Tachograph | 7972 |

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**Yellow wall pass "C"**

| Pin | Description | Cable colour code |
|---|---|---|
| 1 | Ground from connected signalling switch PTO 1 | 6131 |
| 2 | Safety sensor signal for max. braking bridge with front axle failure with ABS | 6245 |
| 3 | Positive +15 for safety sensor for max. braking bridge with front axle failure with ABS | 8847 |
| 4 | ABS speed sensor front right wheel | 5571 |
| 5 | ABS speed sensor front right wheel | 5571 |
| 6 | Positive "EV" solenoid valve (unloaded)command front right wheel | 9920 |
| 7 | Positive for solenoid valve command PTO 1 | 9131 |
| 8 | Positive "AV" solenoid valve (loaded) command front right wheel | 9918 |
| 9 | Ground for centralised lubrication control unit | 0000 |
| 10 | Positive +15 for centralised lubrication control unit | 8898 |
| 11 | ABS speed sensor rear right wheel | 5573 |
| 12 | ABS speed sensor rear right wheel | 5573 |
| 13 | Positive "EV" (unloaded) solenoid valve command rear right wheel | 9930 |
| 14 | Ground from switch connection consent PTO 1 | 0391 |
| 15 | Positive "AV" (loaded) solenoid valve command rear right wheel | 9928 |
| 16 | Ground from signalling switch PTO 2 connected | 6132 |
| 17 | Positive for solenoid valve command PTO 2 | 9132 |
| 18 | Ground from switch connection consent PTO 2 | 0392 |
| 19 | Ground from signalling switch PTO 3 connected | 6133 |
| 20 | Ground for shielding of CAN outfitted lines | 0999 |
| 21 | CAN-L line(SB) for fitters | Green |
| 22 | CAN-H (SB)line for fitters | White |
| 23 | Positive for solenoid valve command PTO 3 | 9123 |
| 24 | Ground for ASR solenoid valve | 0260 |
| 25 | Positive ASR solenoid valve command | 9260 |
| 26 | Ground from switch connection consent PTO 3 | 0393 |
| 27 | Positive +30 for fitters (72072D connector) | 7795 |
| 28 | Ground for e with +15 clamp connected (72072C/D connectors) | 0975 |
| 29 | Positive "AV" (loaded) solenoid valve command left rear wheel | 9929 |
| 30 | Positive for solenoid valve synchronous protection mechanical gear change | 8871 |
| 31 | Positive "EV" (loaded)solenoid valve command left rear wheel | 9931 |
| 32 | Positive "AV" (loaded) solenoid valve command left front wheel | 9919 |
| 33 | Ground for solenoid valve synchronous protection mechanical gear change | 9975 |
| 34 | Positive "EV" (unloaded) solenoid valve command front left wheel | 9921 |
| 35 | ABS speed sensor front left wheel | 5570 |
| 36 | ABS speed sensor front left wheel | 5570 |
| 37 | ABS speed sensor rear left wheel | 5572 |
| 38 | ABS speed sensor rear left wheel | 5572 |
| 39 | - | - |
| 40 | Ground for ABS solenoid valves | 0000 |

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**Blue wall pass "D"**

| Pin | Description | Cable colour code |
|---|---|---|
| 1 | Positive +15 for Eurotronic 2 / Mass from connected slow gears signalling switch (9 gear changes) | 8101 / 0177 |
| 2 | Ground for Eurotronic 2 / Positive for connection of electro valve reduced gears (9 gear changes) | 0000 / 9973 |
| 3 | Positive for gear change beeper/ Positive for electro valve connection normal gears (9 gear changes) | 6100 / 9974 |
| 4 | Ground for gear change beeper | 1101 |
| 5 | - | - |
| 6 | Positive +30 for Eurotronic 2 | 7101 |
| 7 | K line Eurotronic 2 (18-pin diagnosis connector) | 2297 |
| 8 | CAN - L Line (VDB) | Green |
| 9 | CAN - H Line (VDB) | White |
| 10 | CAN - L Line (VDB) | Green |
| 11 | CAN - H Line(VDB) | White |
| 12 | Speed signal from integral traction tachograph transmitter (Retarder) | 5103 |
| 13 | Positive for integral traction tachograph transmitter (Retarder) | 8300 |
| 14 | Ground for water temperature sensor for Retarder | 0309 |
| 15 | Signal water temperature sensor for Retarder | 5309 |
| 16 | Positive for oil accumulator electro valve Retarder | 9311 |
| 17 | Ground for oil accumulator electro valve Retarder | 0311 |
| 18 | Positive for electro valve connection Retarder | 9310 |
| 19 | Positive for electro valve connection Retarder | 0310 |
| 20 | Positive for Air heater supplementary pump /K Line K water heater (10-pin diagnosis connector) | 7783 / 2295 |
| 21 | Positive for control and signalling unit supplementary heater | 7775 |
| 22 | Command for supplementary heater with passage for micro-switch with command lever heater tap | 7506 |
| 23 | Positive from switch for internal aerator | 7711 |
| 24 | Positive +30 for supplementary water heater | 7708 |
| 25 | Ground for supplementary fuel pump Air heater | 0000 |
| 26 | CAN - L line(BCB) | Green |
| 27 | CAN - H line(BCB) | White |
| 28 | CAN - L line(BCB) | Green |
| 29 | CAN - H line (BCB) | White |
| 30 | Positive for electro valve water re-circulation engine block | 9506 |
| 31 | Positive for warning light supplementary connected heater/connection consent electro valve water re-circulation engine block | 6605 |
| 32 | Ground for integral traction tachograph transmitter (Retarder) | 0000 |
| 33 | Positive +15 alternator (TGC with ADR) | 8876 |
| 34 | Positive +15 alternator (TGC with ADR) | 8876 |
| 35 | Ground (TGC ADR) | 0000 |
| 36 | - | - |
| 37 | Ground from safety control unit switch - TGC signal (ADR) Off | 0176 |
| 38 | Ground from safety control unit switch - TGC signal (ADR) On | 0178 |
| 39 | - | - |
| 40 | - | - |

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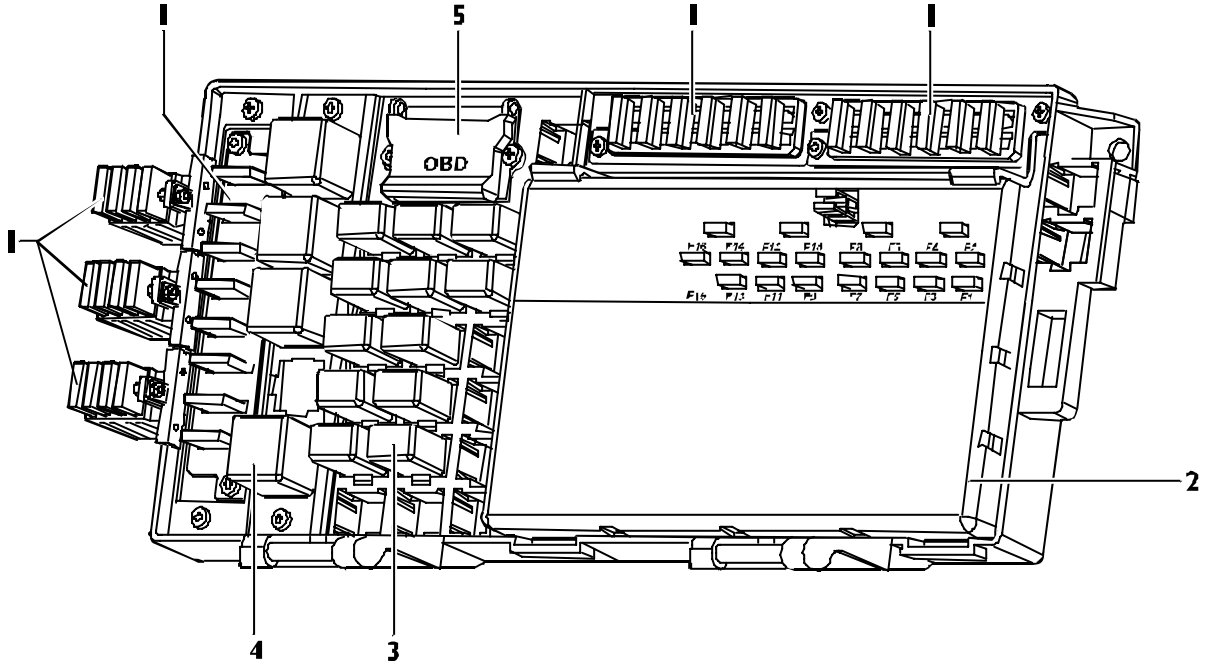
**Green wall pass "E"**

| Pin | Description | Cable colour code |
|---|---|---|
| 1 | CAN - L line (ECB) | Green |
| 2 | CAN - H line (ECB) | White |
| 3 | - | - |
| 4 | - | - |
| 5 | - | - |
| 6 | - | - |
| 7 | Positive +15 alternator | 8876 |
| 8 | Ground from request EDC system diagnosis switch (predisposition) | 0163 |
| 9 | Ground from request EDC system diagnosis switch (predisposition) | 5163 |
| 10 | ACC Power supply | 8176 |
| 11 | Load signal from alternator | 7009 |
| 12 | Positive for front thermal mirror | 8830 |
| 13 | Positive +15 for EDC (from IBC3) | 8015 |
| 14 | Ground for front thermal mirror | 0000 |
| 15 | - | - |
| 16 | CAN L line (VDB) | Green |
| 17 | CAN H line (VDB) | White |
| 18 | CAN L line (VDB) | Green |
| 19 | CAN H line (VDB) | White |
| 20 | - | - |
| 21 | - | - |
| 22 | K line EDC control unit (2-pin diagnosis connector) | 2298 |
| 23 | Positive +30 for starting engine connection (clamp 50) | 8888 |
| 24 | Positive for connection electro magnetic compressor joint (Valeo) | 9993 |
| 25 | Direct positive battery (+Bat) for SCR control unit | 7540 |
| 26 | - | - |
| 27 | K line SCR control unit (16-pin diagnosis connector) | 2257 |
| 28 | - | - |
| 29 | - | - |
| 30 | Ground from low cooling water level sensor warning light) | 5520 |
| 31 | - | - |
| 32 | Ground from low cooling water level sensor | 5527 |
| 33 | Positive for connection ventilator engine (baruffaldi) | 5166 |
| 34 | Positive for electro magnetic joint connection switch (baruffaldi ventilator) | 5187 |
| 35 | Ground for electro magnetic joint connection switch (baruffaldi ventilator) | 0014 |
| 36 | - | - |
| 37 | Engine rpm sensor signal for bodybuilders (ST14B) | 5587 |
| 38 | - | - |
| 39 | Positive +30 for EDC | 7151 |
| 40 | Positive +30 for EDC | 7151 |

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## CENTRAL INTERCONNECTING UNIT

Figure 110

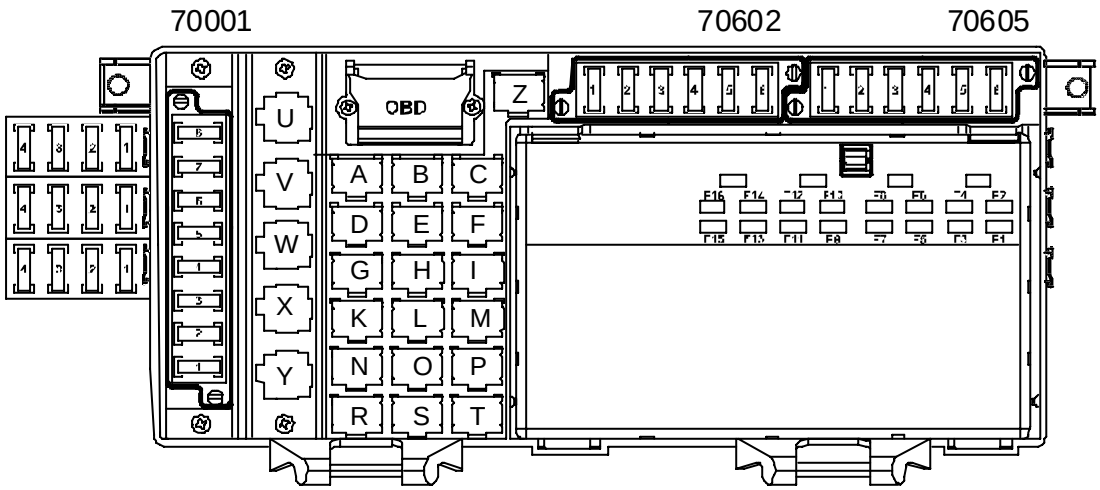



| Ref. | Description |
|---|---|
| 1 | Fuse holder |
| 2 | Body Controller (IBC3) |
| 3 | Mini switches |
| 4 | Micro remote control switches |
| 5 | OBD |

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## FUSE

Figure 111




Fuse holder 70602

| Ref. | Function | Delivery (A) | Terminal |
|---|---|---|---|
| 1 | DDM / Driver power windows | 20/15 | +30/+15 |
| 2 | PDM / Passenger power windows | 20/15 | +30/+15 |
| 3 | EDC | 30 | +30 |
| 4 | ABS | 5 | +15 |
| 5 | - | 15 | +30 |
| 6 | ABS | 15 | +30 |

Fuse holder 70605

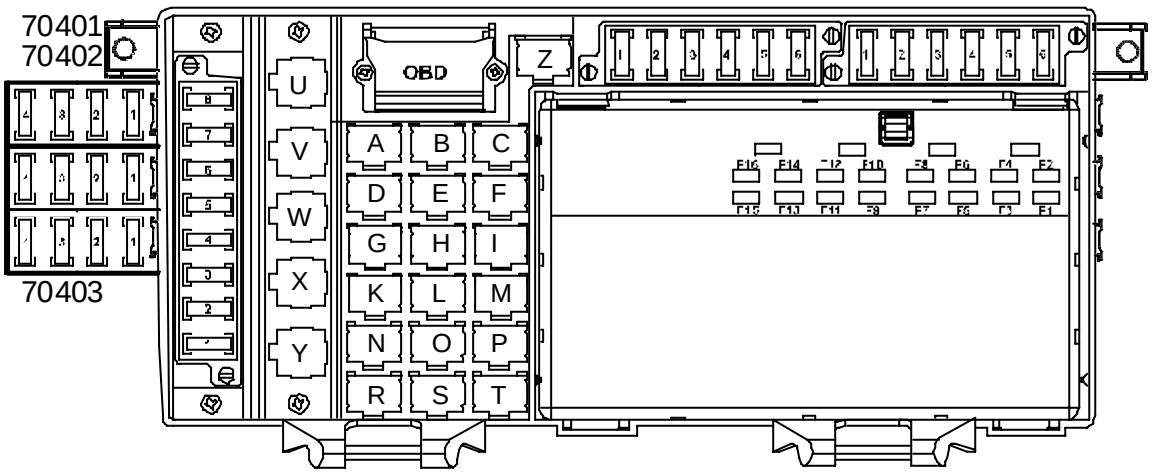
| Ref. | Function | Delivery (A) | Terminal |
|---|---|---|---|
| 1 | Fridge / tool collect / OBD / Data communication + navigation | 10 | +BAT |
| 2 | ECAS/EM | 5 | +15 |
| 3 | ECAS | 7.5 | +30 |
| 4 | Retarder / ABS | 10 | +30 |
| 5 | Retarder | 10 | +15 |
| 6 | Heated seats/central lubrication/door lock with RF | 7.5 | +15 |

Fuse holder 70001

| Ref. | Function | Delivery (A) | Terminal |
|---|---|---|---|
| 1 | EUROTRONIC 2 | 10 | +30 |
| 2 | Air conditioner | 15 | +30 |
| 3 | Air conditioner | 5 | +30 |
| 4 | Additional heater | 15 | +30 |
| 5 | Additional heater | 5 | +30 |
| 6 | Courtesy lights | 5 | +30 |
| 7 | ACC/Heated windscreen/tool collect/Data communication + navigation | 10 | +15 |
| 8 | MC-NET / Beacon lights/headlamp washer pump | 10 | +30 |

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Figure 112




Fuse holder 70401

| Ref. | Function | Delivery (A) | Terminal |
|---|---|---|---|
| 1 | Sun visors | 7.5 | +15 |
| 2 | - | - | - |
| 3 | - | - | +30 |
| 4 | 12V internal lighting | 5 | - |

Fuse holder 70402

| Ref. | Function | Delivery (A) | Terminal |
|---|---|---|---|
| 1 | Heated windscreen | 25 | +30 |
| 2 | VGT solenoid valve/servoshift | 10 | +15 |
| 3 | Heated mirrors | 15 | +15 |
| 4 | Heated windscreen | 25 | +30 |

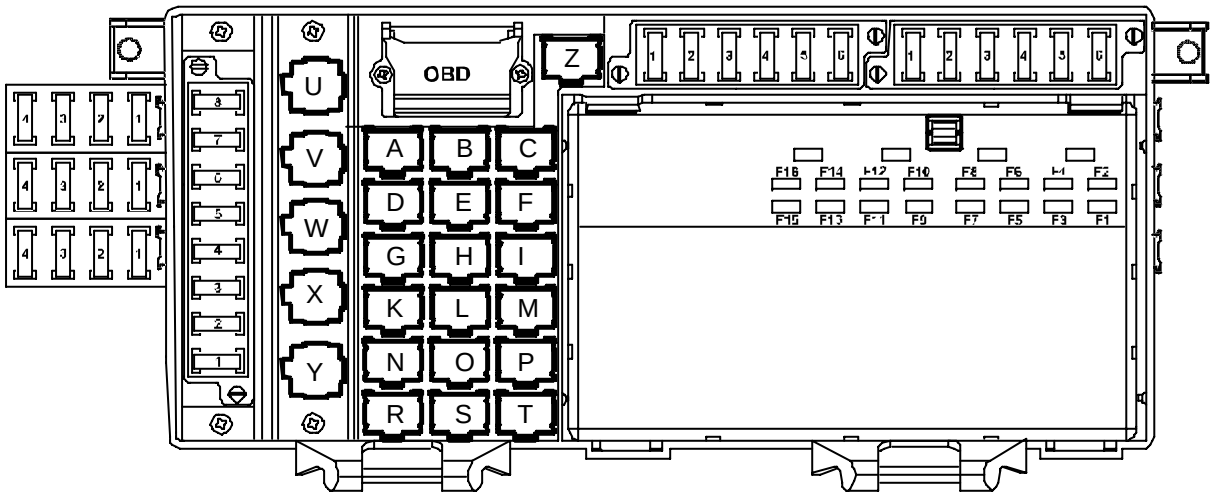
Fuse holder 70403

| Ref. | Function | Delivery (A) | Terminal |
|---|---|---|---|
| 1 | EM | 15 | +30 |
| 2 | EM | 15 | +30 |
| 3 | ACC | 5 | +15 |
| 4 | SRC (UREA) | 20 | + batt. |

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## REMOTE SWITCHES

Figure 113




112591

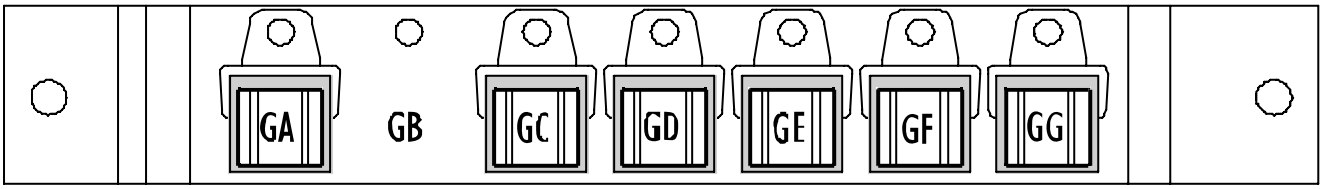
| Ref. | Description | Component code |
|---|---|---|
| A | Horn remote control switch | 25805 |
| B | Remote control switch for water heater (opt.) | 25337 |
| C | - | - |
| D | Remote control switch for electrical bush opening | 25352 |
| E | Remote control switch for water heater (opt.) | 25325 |
| F | - | - |
| G | Electrical manhole lock remote control switch | 25351 |
| H | Remote control switch for manual climate control system (opt.) | 25310 |
| I | Remote control switch for manual climate control system (opt.) | 25874 |
| K | Remote control switch for electro-magnetic engagement of baruffaldi fan | 25737 |
| L | Remote control switch for manual climate control system | 25332B |
| M | Remote control switch for manual climate control system | 25322 |
| N | Remote control switch for vehicle diagnosis (opt.) | 25705 |
| O | Remote control switch for manual climate control system (opt.) | 25332A |
| P | Remote control switch for manual climate control system (opt.) | 25327 |
| R | Remote control switch for headlamp washer consensus (opt.) | 25740 |
| S | Remote control switch for main electric/mechanic switch (opt.) | 25203/25903 |
| T | Remote control switch for main electric switch (opt.) | 25202 |
| U | Engine start up remote control switch | 25200 |
| V | Remote control switch for key 15 distribution | 25213 |
| W | - | - |
| X | - | - |
| Y | - | - |
| Z | - | - |

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## Additional remote control switches

Positioned behind the BODY COMPUTER.

Figure 114

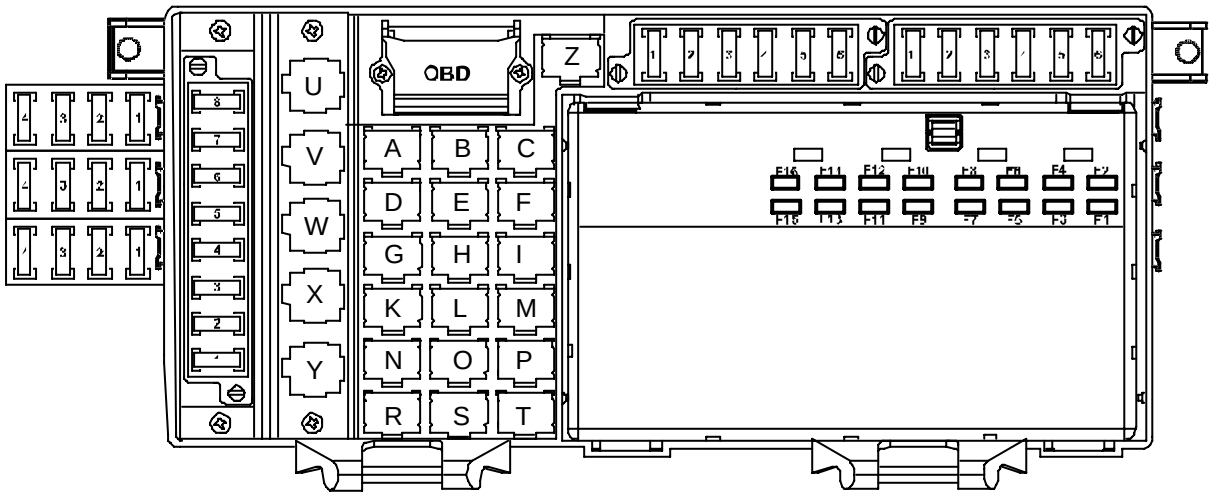



| Ref. | Description | Component code |
|---|---|---|
| GA | Remote control switch for heated windscreen control | 25306 |
| GB | - | - |
| GC | Remote control switch for heated windscreen | 25818 |
| GD | - | - |
| GE | - | - |
| GF | - | - |
| GG | - | - |

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## FUSE ASSEMBLY BODY CONTROLLER (IBC3)

Figure 115




## FUSES IBC3

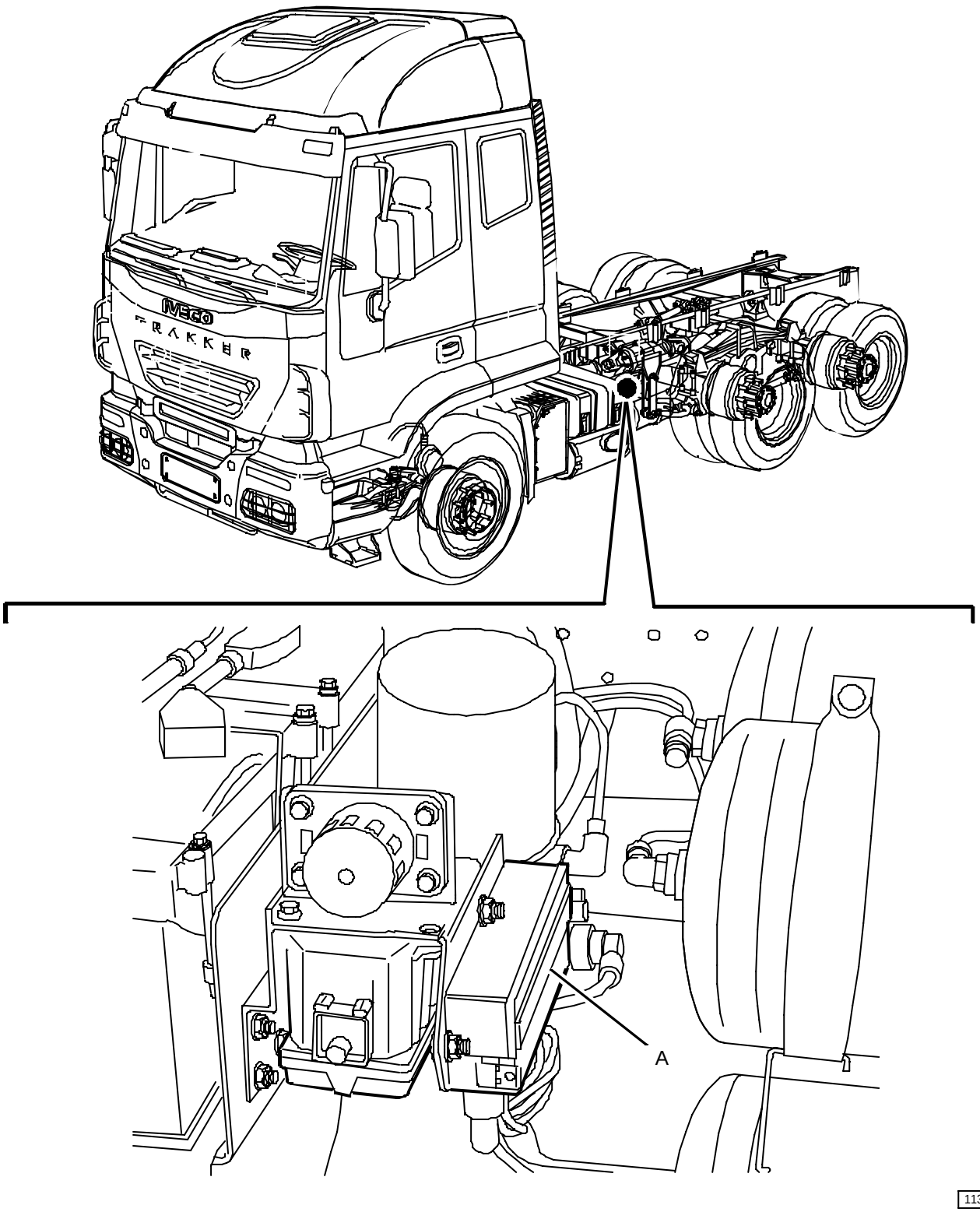
| Ref. | Function | Rating (A) | Terminal |
|---|---|---|---|
| F1 | - | 10 | +15/1 |
| F2 | - | 20 | +15 |
| F3 | VCM / SWI | 10 | +30 |
| F4 | Tachograph / Bed Module / Cluster / Centralised closure | 5 | +BAT |
| F5 | - | 20 | +30 |
| F6 | - | 20 | +30 |
| F7 | - | 20 | +30 |
| F8 | - | 20 | +30 |
| F9 | ST14A bodybuilders connector / 72072D (EM -framework) | 10 | +30 |
| F10 | Beeper | 10 | +30 |
| F11 | Tension reducer / Radio | 20 | +30 |
| F12 | Air dryer resistance | 10 | +15 |
| F13 | Bodybuilders connector 72072C (EM - cabin) | 10 | +30 |
| F14 | 30-pin junction / Cigarette lighter | 10 | +30 |
| F15 | Radio / Acclimatiser | 5 | +15/1 |
| F16 | - | 20 | +15/1 |

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## SUPPLEMENTARY FUSES (70000)

They are located on the left side of the vehicle, next to the batteries and the TGC. The fuse compartment can be accessed by levering on the two springs available on cover (A).

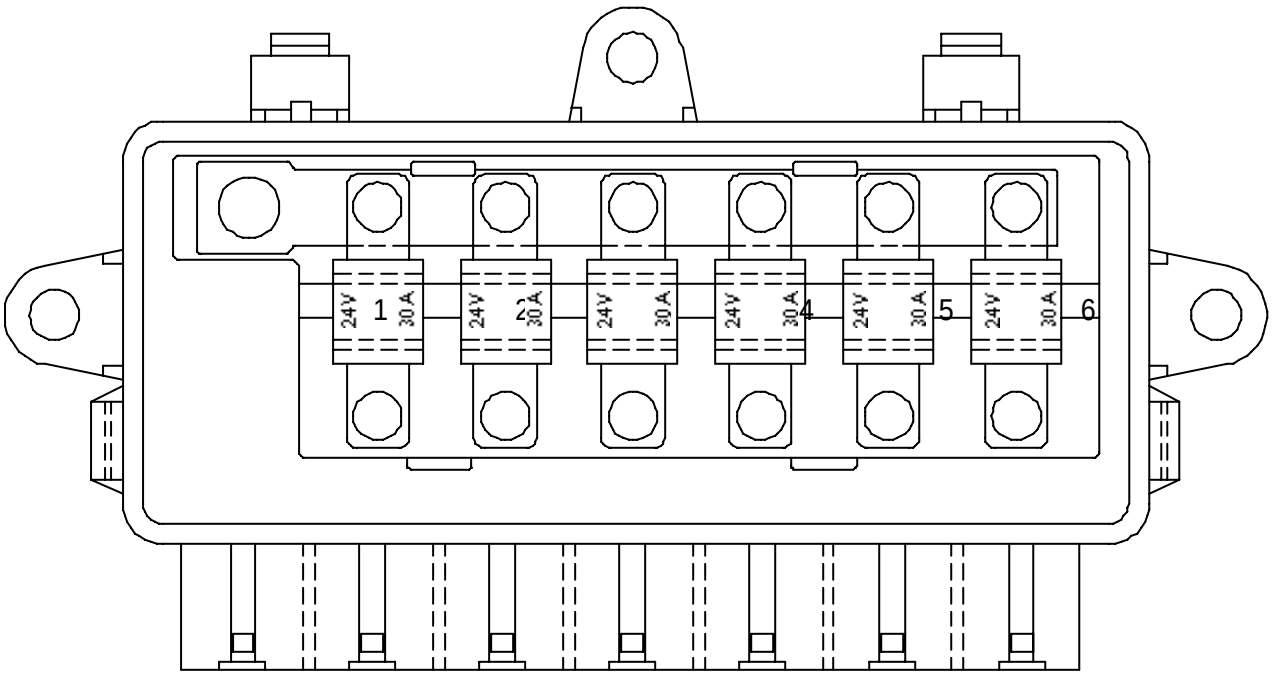
Figure 116




A. Auxiliary fuse holder

Aquila Trucks Centres

Figure 117



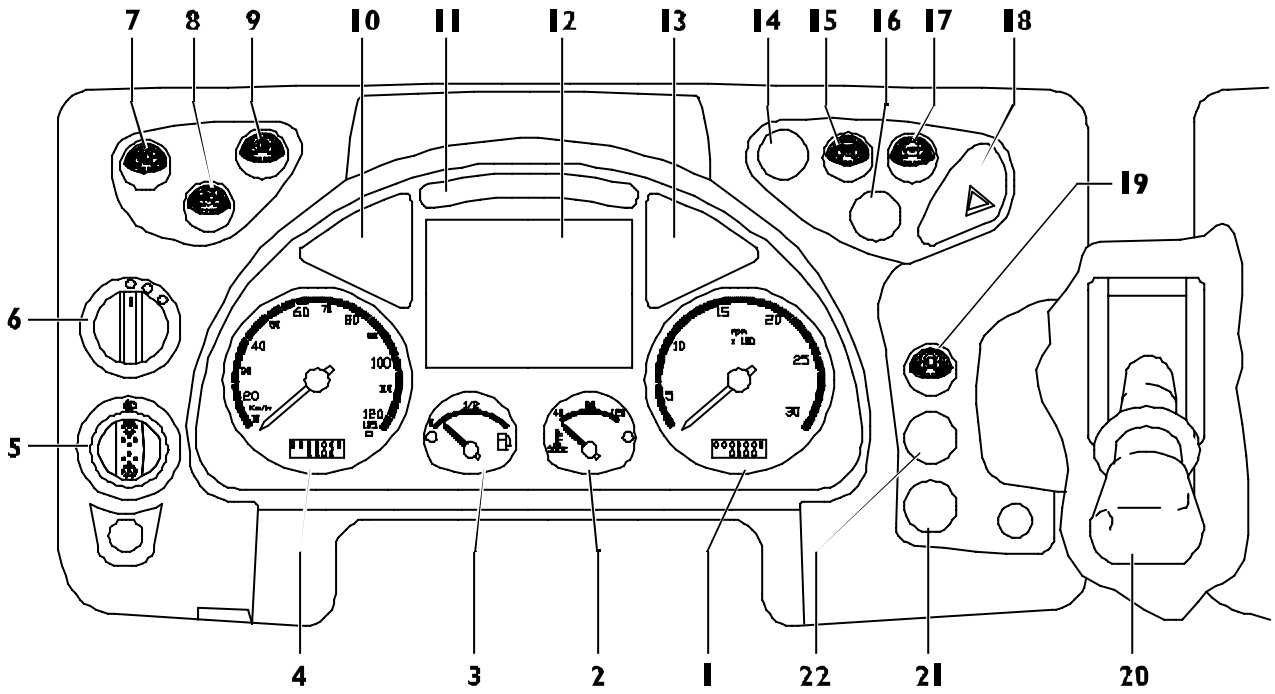

49731

| Ref. | Function | Delivery A |
|---|---|---|
| 1 | MET | 30 |
| 2 | MET | 30 |
| 3 | Presetting | 30 |
| 4 | Presetting | 30 |
| 5 | Current tap - ABS/EBS | 30 |
| 6 | Presetting | 30 |

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## INSTRUMENT BOARD

Figure 118

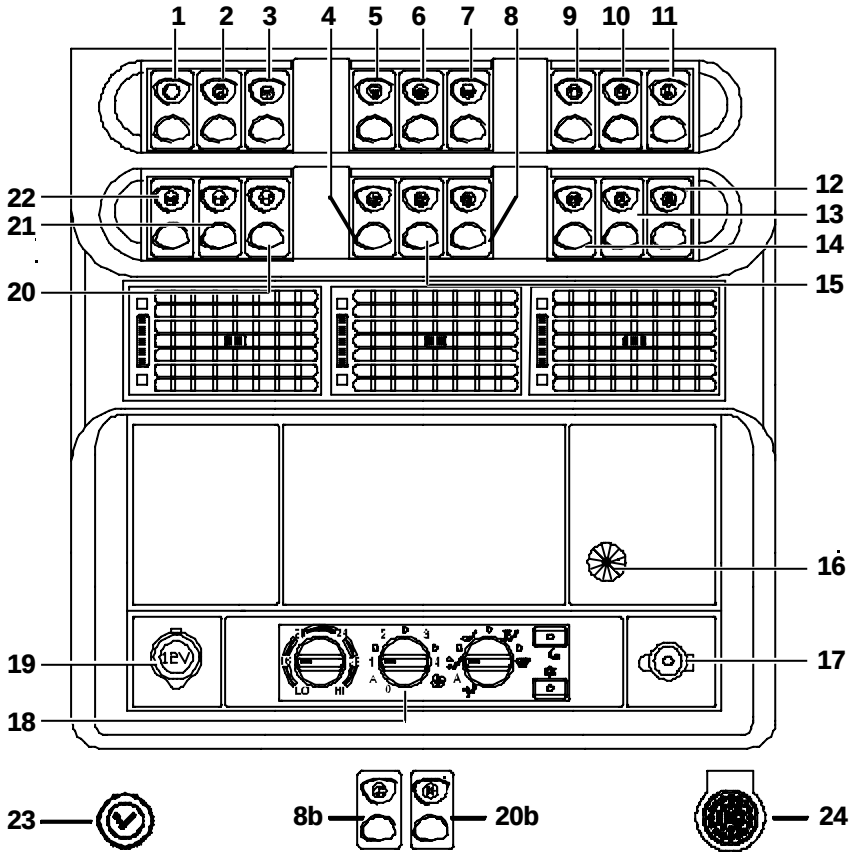



| Ref. | Description |
|---|---|
| 1 | Revs counter |
| 2 | Coolant thermometer |
| 3 | Fuel level gauge |
| 4 | Speedometer |
| 5 | Headlamp trim control |
| 6 | External light switch |
| 7 | Fog light actuation switch |
| 8 | Auxiliary headlamp actuation switch |
| 9 | Rear fog light actuation switch |
| 10 | Optical indicator cluster |
| 11 | Optical indicator cluster |
| 12 | Display |
| 13 | Optical indicator cluster |
| 14 | Free |
| 15 | ABS actuation switch (if available) |
| 16 | Free |
| 17 | ASR actuation switch (if available) |
| 18 | Emergency light actuation switch |
| 19 | Speed limiter cut-in switch |
| 20 | Parking brake |
| 21 | Free |
| 22 | Free |

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## CENTRAL DASHBOARD CONTROLS

Figure 119



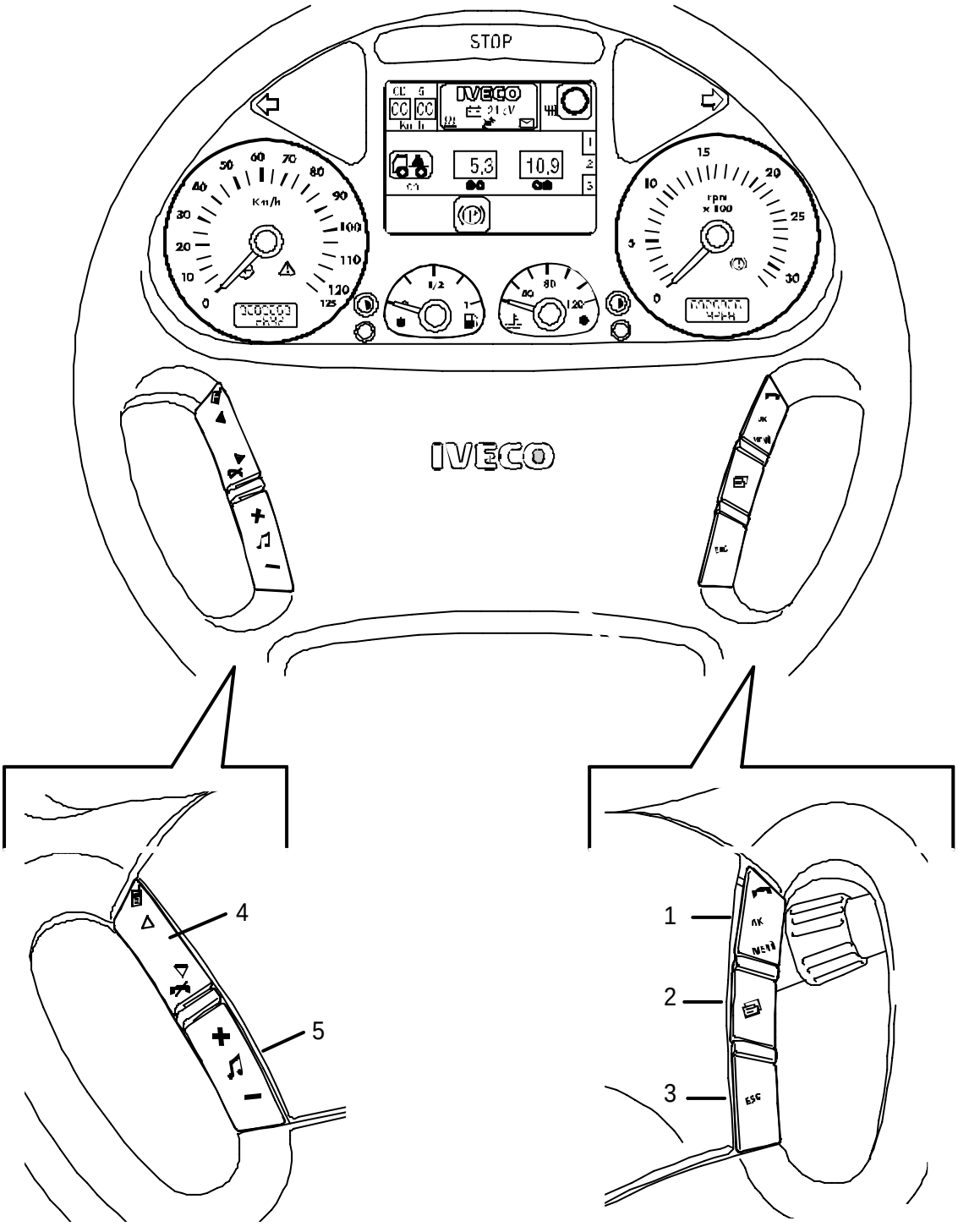

| Ref. | Description |
|---|---|
| 1 | Switch for engine brake engagement |
| 2 | Control for electric hatch pit (OPT) |
| 3 | Pneumatic horns |
| 4 | Power takeoff switch 1 (OPT) |
| 5 | Heated windscreen actuation switch (OPT) |
| 6 | Sunshade curtain control (OPT) |
| 7 | Central roof lamp cabin lights |
| 8 | Multipower power takeoff control (OPT) |
| 8b | Loading platform light actuation switch |
| 9 | Roof side roof lamps cabin lights control |
| 10 | Fuel heater (OPT) |
| 11 | Rearview mirrors heating (before it was embedded into the door) |
| 12 | Switch for immediately connecting supplementary water heater (OPT) |
| 13 | Engine/cabin pre-heating selector (OPT) |
| 14 | Switch for connecting supplementary air heater (OPT - for manual version only) |
| 15 | Power takeoff 2 (OPT) |
| 16 | Supplementary water heater thermostat (OPT) |
| 17 | Key switch for ECO - POWER function |
| 18 | Heating/venting or air conditioner controls (OPT) |
| 19 | 12V current outlet |
| 20 | Front differential locking switch |
| 20b | Rotating lamps switch (OPT) |
| 21 | Rear differential locking switch |
| 22 | Longitudinal differential locking switch |
| 23 | Lighter |
| 24 | 30-pin diagnosis outlet |

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## CONTROLS ON THE STEERING WHEEL

The steering wheel features some keys that enable selecting and controlling certain functions.

Figure 120



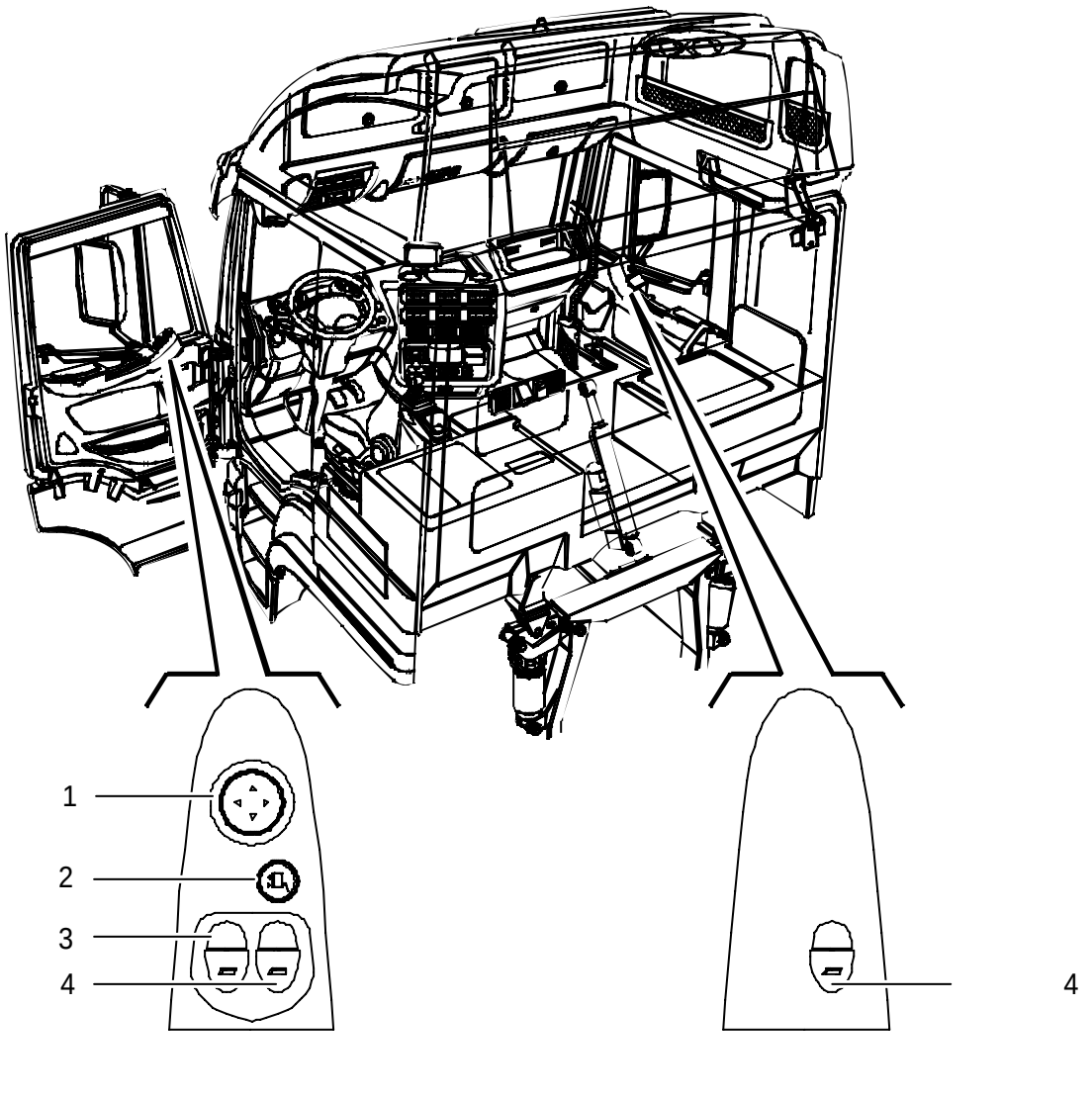

Left hand side:
4. KEY y
   KEY b
5. KEY +
   KEY -

Right hand side:
1. MEBU KEY/OK
2. PAGE PUSH BUTTON
3. ESCAPE KEY

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## REARVIEW MIRRORS AND WINDOW REGULATOR CONTROL ADJUSTMENT

Figure 121




| Ref. | Description |
|---|---|
| 1 | Rearview mirror orientation control |
| 2 | Mirror selector control |
| 3 | Driver window regulator |
| 4 | Passenger window regulator |

Key 2 on AS was placed on the left and in its place there was the mirror heating key that on AT/AD is placed on central dashboard as series.

Adjustment functions for rearview mirrors and window regulator control are managed by DDM and FDM units, and consequently they are present as optionals.

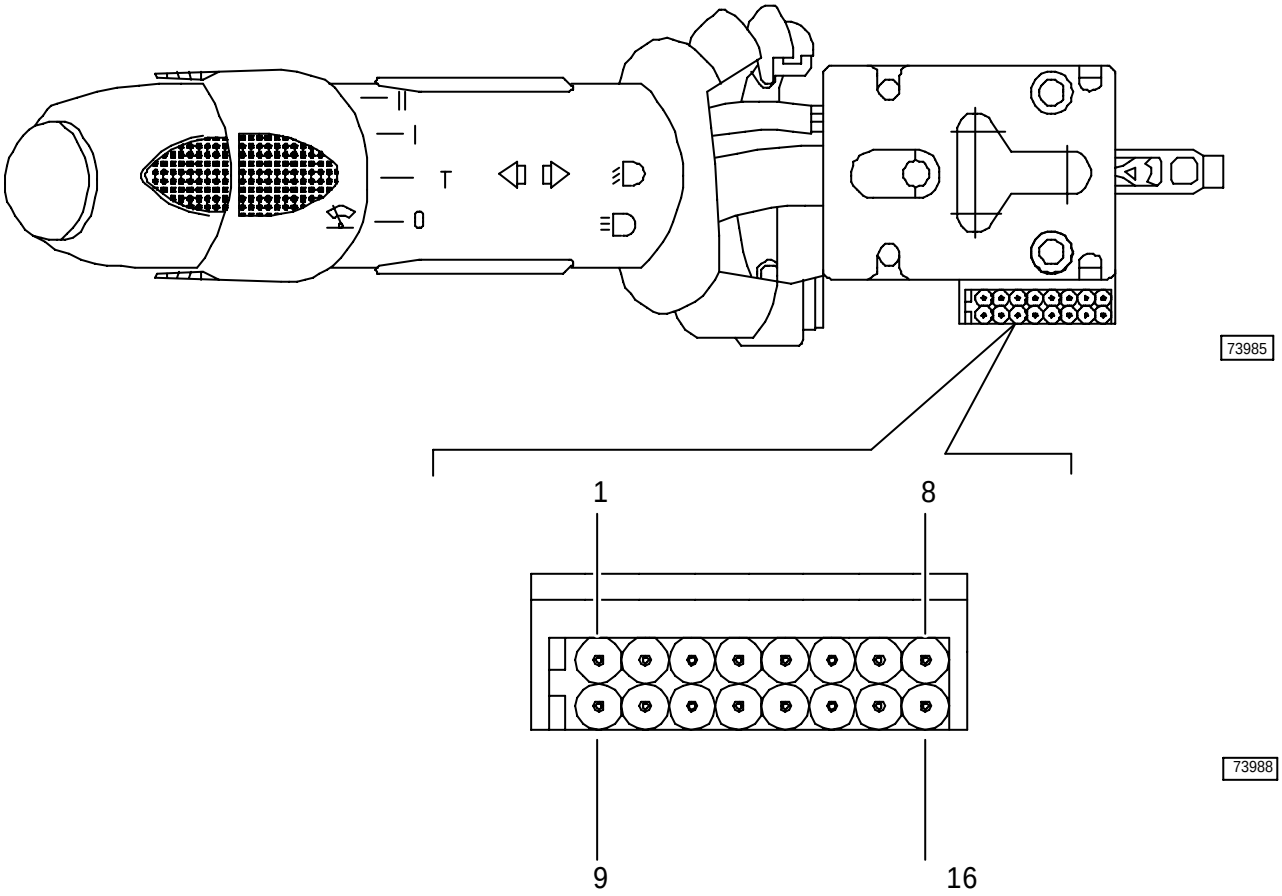
## EXTERNAL REARVIEW MIRRORS HEATING

By pressing the related button, the rearview mirrors heating is activated and the related icon is displayed on the display. To deactivate such function, press the button again. The icon will not be displayed any more. It is possible to select this function also with moving vehicle. Heating has a maximum length of 30 minutes.

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## LEFT LIGHT CONTROL 54033

Figure 122

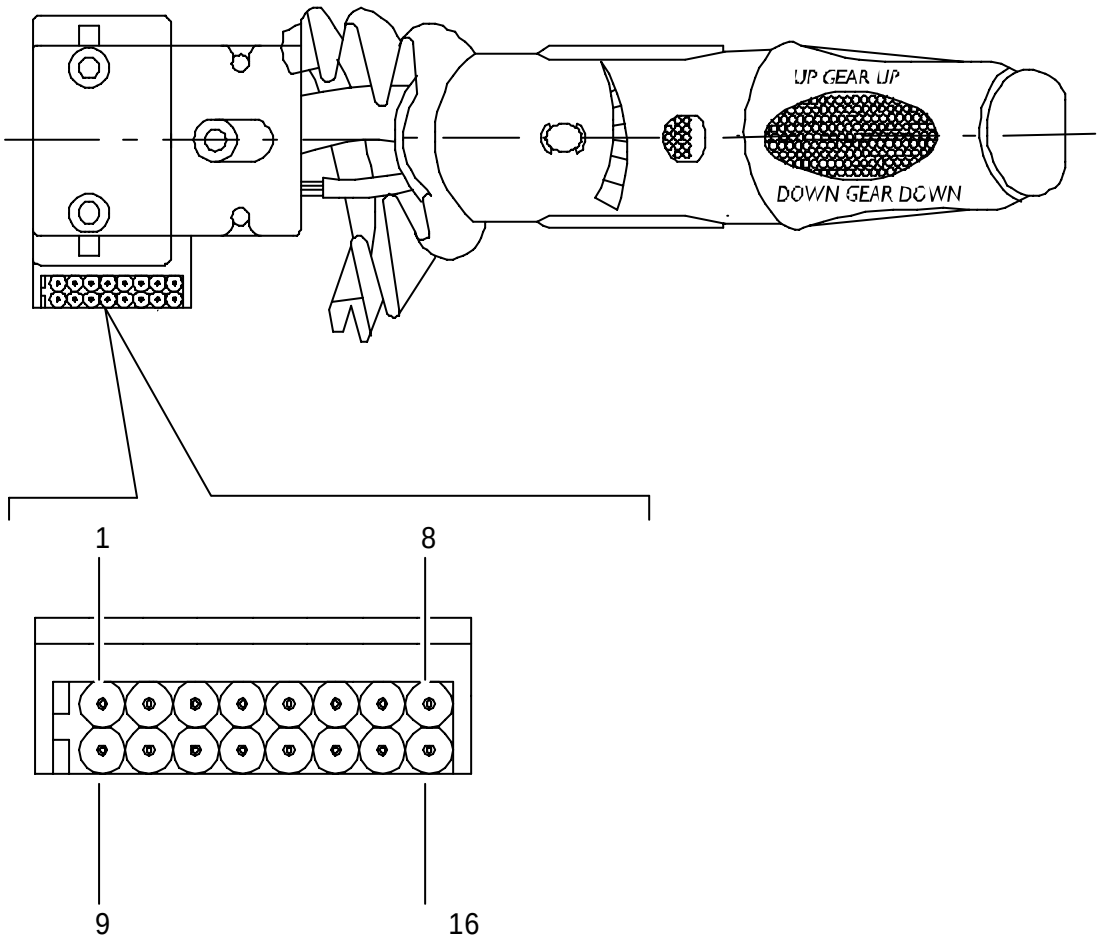



| Ref. | Description |
|---|---|
| 1 | Windshield wiper (top speed) |
| 2 | Windshield wiper (slow speed) |
| 3 | Windshield wiper (intermittent) |
| 4 | Windshield wiper (one stroke) |
| 5 | - |
| 6 | Dipped lights on |
| 7 | Light flashes |
| 8 | Ground |
| 9 | Washer electrical pump control |
| 10 | - |
| 11 | - |
| 12 | - |
| 13 | - |
| 14 | - |
| 15 | Right direction indicator |
| 16 | Left direction indicator |

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## RIGHT LIGHT CONTROL 54030

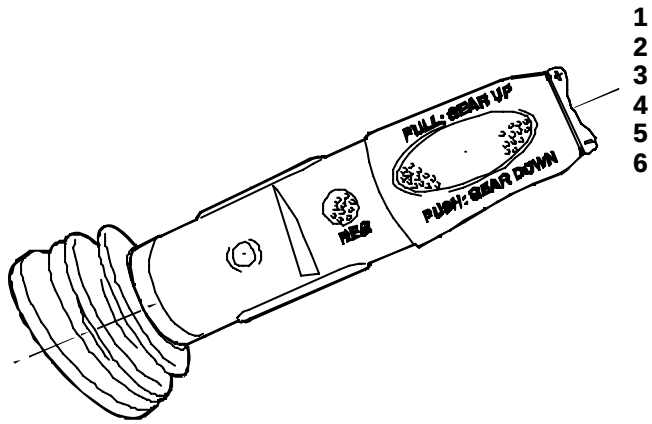
Figure 123




| Ref. | Description |
|---|---|
| 1 | Intarder (Position 4) |
| 2 | Change gear (down) |
| 3 | Cruise Control (set/acceleration) |
| 4 | Cruise Control (Resume) |
| 5 | Intarder (Position 1) |
| 6 | Intarder (Position 3) |
| 7 | Intarder (Position 2) |
| 8 | - |
| 9 | Intarder (Position 5) |
| 10 | Intarder (Position 6) |
| 11 | Cruise Control (deceleration) |
| 12 | - |
| 13 | - |
| 14 | - |
| 15 | Change gear (up) |
| 16 | Ground (from the SWI) |

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Figure 124




108920

RIGHT MULTIFUNCTION LEVER

The multifunction lever located on the right side of the steering column enables insertion of the engine brake function and the intarder when installed.

The former is selected by moving the lever to positions 1 and 2 and remains o even when the same lever is used to selected the intarder function at positions 3, 4, 5 and 6 related to available braking power ratings.

When the engine brake function is selected the control lever signal is transmitted to the (Steering Wheel Interface) S.W.I. center.

Which activates the engine brake on warning light on Instrument Cluster IC, and via Body Computer B.C. sends the request fro engine rake to the EDC, EBS and automated EuroTronic center (when present).

When the operator selects the engine brake manually, selection is displayed in the Cluster with a blinking warning light, which goes to steady when the engine brake is turned on. In the manual mode, engine brake action is also conditioned by accelerator pedal release. In the automatic mode, the engine brake is activated by the EDC center on receipt of a request from the EBS center.

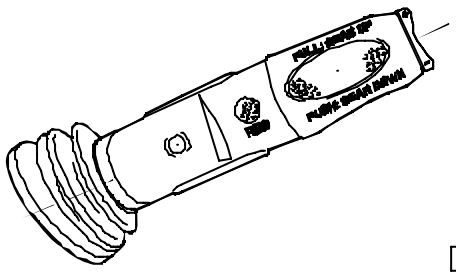
In this condition, the EDC center pilots the engine brake electro valve and the VGT actuator to the fully closed position.

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## ENGINE BRAKE CONTROL AND INTARDER

### Vehicles with Intarder mechanical gearshift

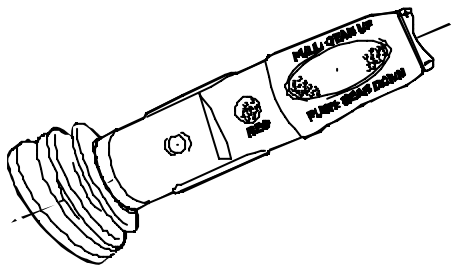
Figure 125




1 Position 0 = disenabled
2 Position 1 = 50% engine brake
3 Position 2 = 100% engine brake + 20% Intarder
4 Position 3 = 100% engine brake + 40% Intarder
5 Position 4 = 100% engine brake + 60% Intarder
6 Position 5 = 100% engine brake + 80% Intarder
Position 6 = 100% engine brake + 100% Intarder

### Vehicles with Intarder EuroTronic transmission

Figure 126

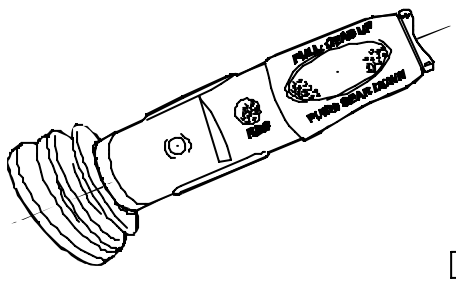



1 Position 0 = disenabled
2 Position 1 = 50% engine brake
3 Position 2 = 100% engine brake + 25% Intarder
4 Position 3 = 100% engine brake + 50% Intarder
5 Position 4 = 100% engine brake + 75% Intarder
6 Position 5 = 100% engine brake + 100% Intarder
Position 6 = 100% engine brake + 100% Intarder *

(*) The intarder can be more effective with automatic downshifting managed by the transmission electronic control centre.

### Vehicles with mechanical gearshift or Eurotronic transmission in the manual mode without Intarder

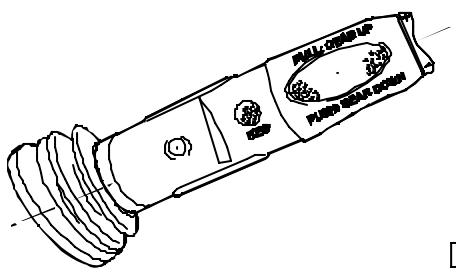
Figure 127




0 Position 0 = disenabled
1 Position 1 = 50% engine brake
2 Position 2 = 100% engine brake

### Vehicles with Eurotronic transmission in the automatic mode without Intarder

Figure 128



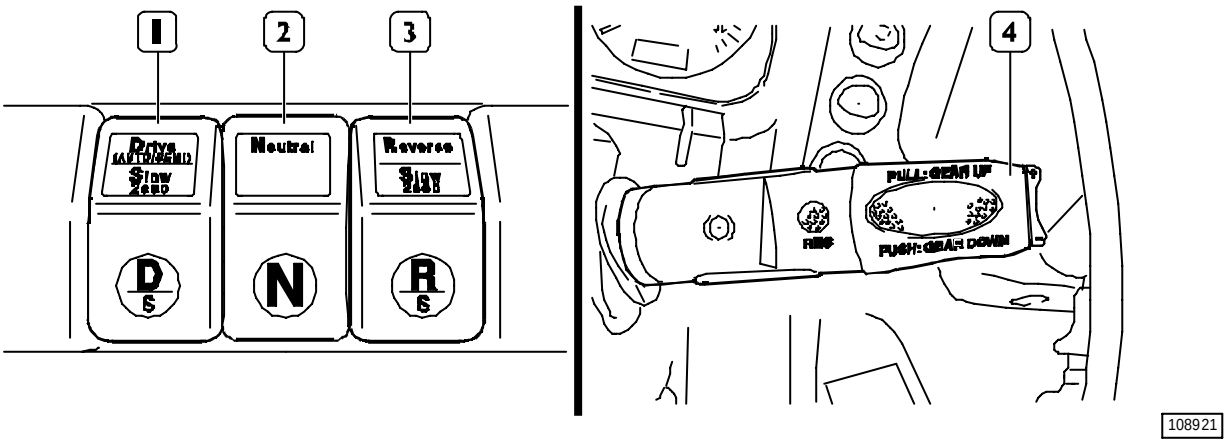

0 Position 0 = disenabled
1 Position 1 = 100% engine brake
2 Position 2 = 100% engine brake + downshifting in the automatic mode

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## GEAR SELECTION FUNCTION

On the new range of Euro 4 vehicles the gear selector has been eliminated. Its functions are performed by the control pushbutton panel on the central panel of the dashboard, in combination with the drive control system lever.

Figure 129




1. Pushbutton D - AUTO/SEMI mode
2. Pushbutton N - neutral
3. Pushbutton R - Reverse gear
4. Drive control system - gear selection

### Driving in manual mode (semi)

1) Parking brake engaged.
2) Start the engine
3) Gearbox in neutral (position N).
4) Briefly press pushbutton "D" (1). The automatic system is activated and the calculated pick-up gear is engaged.The display shows the pick-up gear together with "AUTO".
5) Turn off the automatic system by again pressing button "D". The display passes from showing "AUTO" to "SEMI".
6) The pick-up gear can be corrected with the following operations on the drive control system (4): By slightly moving the drive control system upwards (pulling it) the gearbox shifts one ratio up.By slightly moving the drive control system downwards (pressing it) the gearbox shifts one ratio down.By keeping the drive control system in the desired position (pulling / pressing it) the gearbox shifts two ratios up or down respectively.

**NOTE** The following pick-up gears are available: $1^{st}$, $2^{nd}$, $3^{rd}$, $4^{th}$, $5^{th}$.

7) Press the accelerator pedal releasing the parking brake. The vehicle starts (the clutch engages automatically).

Changing ratio while driving the vehicle

Shifting up to a higher ratio

- By slightly moving the drive control system (4) downwards (pressing it) the gearbox shifts one ratio up.
- By keeping the drive control system (4) in this position the gearbox shifts two ratios up.

Shifting down to a lower ratio

- By slightly moving the drive control system (4) downwards (pressing it) the gearbox shifts one ratio down.
- By keeping the drive control system (4) in this position the gearbox shifts two ratios down.

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## Driving in automatic mode (Auto)

1) Parking brake engaged.
2) Start the engine
3) Gearbox in neutral (position N).
4) Briefly press pushbutton "D" (1). The automatic system is activated and the calculated pick-up gear is engaged.The display shows the pick-up gear together with "AUTO".
5) After entering AUTO mode, the same guidelines given for the SEMI mode apply (points 6 and 7) for selecting the pick-up gear.

Changing ratio while driving the vehicle

While driving the vehicle the display shows the engaged ratio. All the ratio changing operations are automatic and depend on the situation of driving the vehicle, the load, the position of the accelerator pedal, the speed and number of revolutions of the engine. The gear can always be changed manually with the drive control system (4), without having to leave automatic mode.

Keeping the engaged ratio

If in automatic mode you want to keep the engaged ratio, you need to briefly press pushbutton "D" (1). The gearbox will pass on to manual mode (SEMI). Later operations on the gearbox are possible only by pulling or pressing the drive control system (4) (as described for driving in manual mode). To pass back into automatic mode, you need to briefly press pushbutton "D" (1).

## Pass into neutral (Position N)

Press pushbutton "N" (2). The display shows N.Positioning in neutral "N" has priority over the other operations of changing ratio. It is always possible to pass into neutral starting from any ratio.When the vehicle is driving forwards, from the neutral position (N) it is always possible to engage a gearbox ratio. For this you need to briefly press pushbutton "D" (1).

**NOTE** So as not to wear out the mechanical parts of the clutch control, if stopping the vehicle for longer than 1 - 2 minutes (for instance, in a queue, at a level crossing, etc.), the gearbox must be put into neutral (N).
This closes the clutch and the control system is lightened.

## Reverse gear

- With the vehicle stationary, briefly press pushbutton "R" (3). The slow reverse gear ratio (RL) is engaged.
- Press the accelerator pedal. The vehicle starts (the clutch engages automatically).

**NOTE** With the vehicle stationary and in reverse gear it is possible to change between the two reverse gear ratios RL (slow) and RH (fast) by using the drive control system (4)

By slightly moving the drive control system upwards (pulling it) ⇒ RH

By slightly moving the drive control system downwards (pressing it) ⇒ RL

## Operations in slow mode

For manoeuvring in harsh driving conditions (off-road, for instance) there is a supplementary operating mode, with the aid of which the driver can fine tune the clutch according to the travel of the accelerator pedal (up to 100%). In this way the engine speed is limited and rapid vehicle acceleration is prevented.

Turning on

- The vehicle must be stationary

Forward drive manoeuvres

- Press and hold pushbutton "D" (1) (> 2 sec.) The forward drive manoeuvre mode is turned on. The display shows "SLOW"

Reverse drive manoeuvres

- Press and hold pushbutton "R" (> 2 sec.) The reverse drive manoeuvre mode is turned on. The display shows "RL SLOW"

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Turning off

With the vehicle stationary

- Briefly press pushbutton "D" (1). The calculated pick-up gear is engaged and automatic mode turned on or briefly press pushbutton "R" (3). The slow reverse gear ratio (RL) is engaged.

During the forward drive manoeuvre:

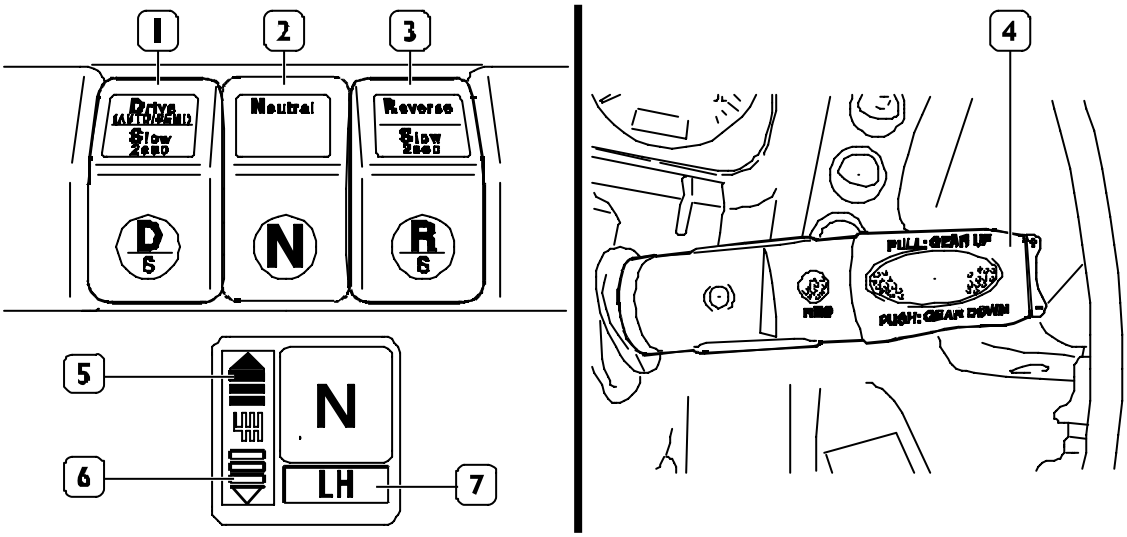
- Briefly press pushbutton "D" (1). The automatic system is activated or operate the kick-down.

During the reverse drive manoeuvre:

- Briefly press pushbutton "R" (3). or operate the kick-down.

## FUNCTION ENGAGING EMERGENCY MODE (LIMP HOME)

Figure 130




108922

This is an emergency function in which the normal system of automatic control is put out of service.

### 1) Engagement

Indicator (Display): LH = engage emergency mode (when changing ratio).

### 2) Activation by the driver

Ignition turned off (until the indicator is turned off).
Ignition turned on, within 5 seconds:
Press pushbutton N (2) for at least 5 seconds.

### 3) Indicator LH

After turning on emergency mode (when changing ratio).
Gearbox in neutral.
Clutch released (open).

### 4) "Clutch status" indicator

Bar with arrow tip pointing upwards (5) (blinking) = clutch released.
Bar with arrow tip pointing downwards (6) = the clutch is about to engage or is engaged.

**NOTE** When changing ratio, blinking stops: (as soon as a new ratio is engaged it starts blinking again!)

### 5) Operations to perform

After turning on the emergency mode (see point 3), start up the engine.
When the engine is running, press and then release again the brake pedal.
Engage the required pick-up gear.

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Forwards:

- By slightly moving the drive control system (4) upwards (pulling it) the gearbox shifts one ratio up.
- By slightly moving the drive control system (4) downwards (pressing it) the gearbox shifts one ratio down.

In reverse gear:

- Briefly press pushbutton "R" (3). (the slow reverse gear ratio "RL" is engaged).
- By slightly moving the drive control system (4) upwards (pulling it) the gearbox passes to the fast reverse gear ratio RH.

Engage the clutch: press pushbutton D (1) until the bars stop blinking with the arrow tip pointing upwards and when the bars appear with the arrow tip pointing downwards (5 / 6).



The clutch can be engaged slowly or even suddenly.

**NOTE** If the vehicle accidentally moves on a slope with a gear engaged, the clutch will automatically engage

Disengage the clutch: briefly press pushbutton "D" (1) or alternatively press the brake pedal.



If on pressing the brake pedal the clutch is engaged with the pushbutton "D" (1) (for example vehicle pick-up uphill), in order to be able to release the clutch again with the brake pedal, it will be necessary to first briefly take your foot off the brake pedal: a ratio shift will only be possible with the vehicle stationary.

Leaving emergency mode.
Turn off the ignition and wait for the indicator to disappear.
When next starting up the system will be in normal mode.

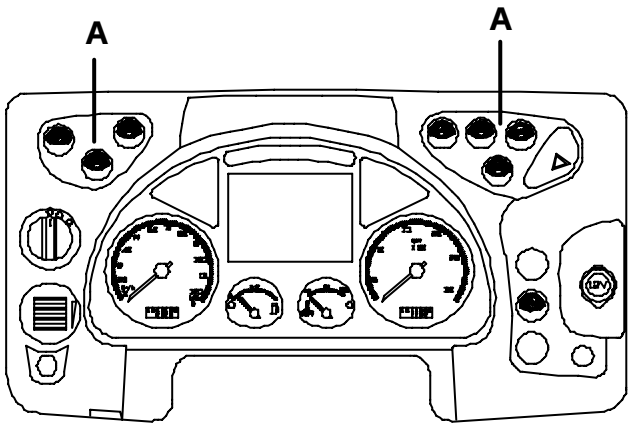
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## CLUSTER

Proceed as follows to remove the Cluster:

– Use a screwdriver for leverage inside the two slots in the two groups of switches (A) located in the upper panel.

Figure 131

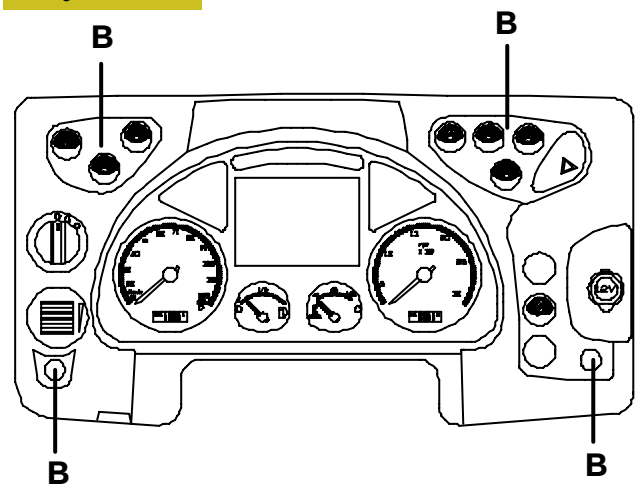



49733

– Remove the two protection caps.

– Loose the four panel retainer screws (B).

Figure 132



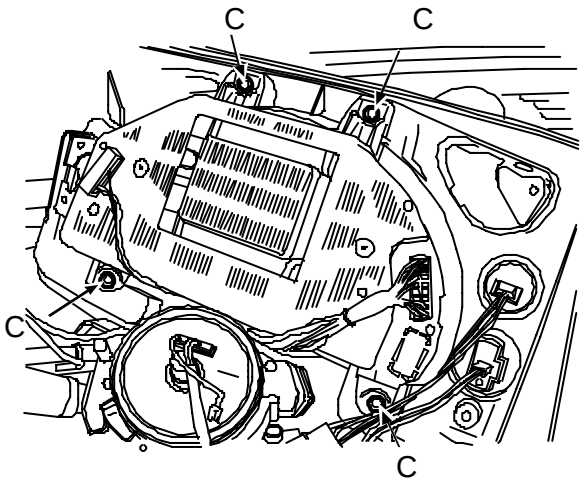

49733

– Move the panel as far outwards as possible after relocating the steering wheel far from the panel.

– Disconnect the two Cluster attaching screws.

– Loosen the four retainer screws (C).

Figure 133

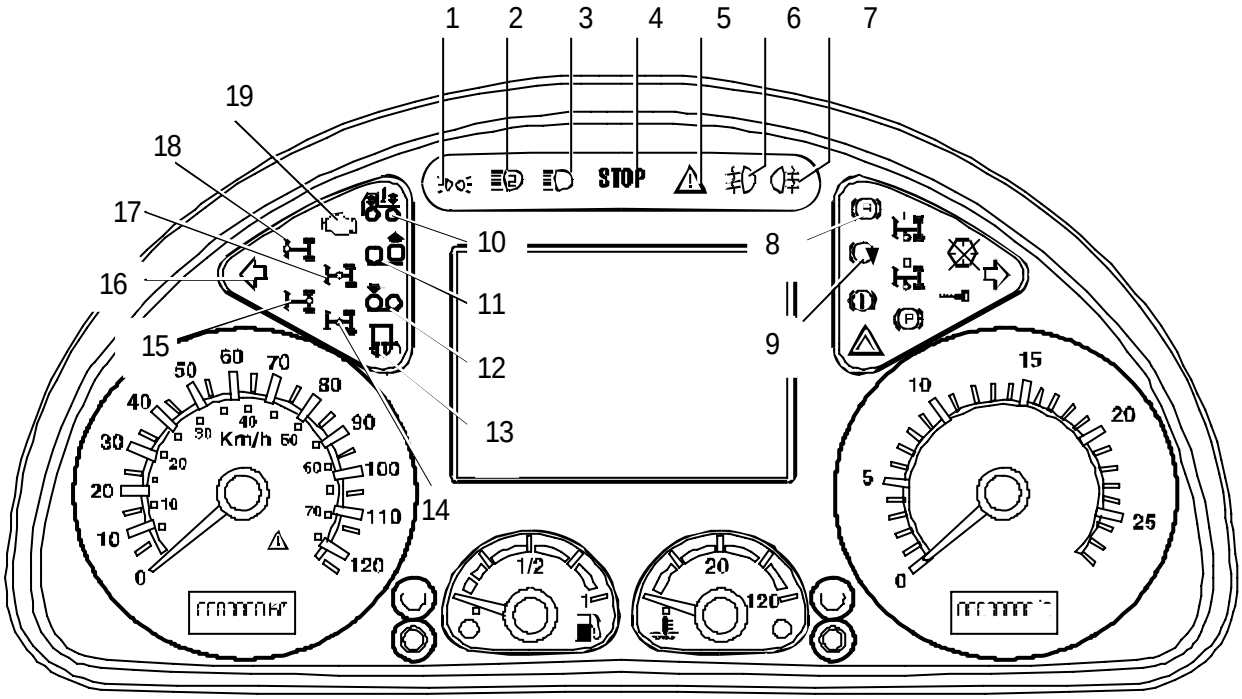



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## Cluster (optical indicators)

Figure 134

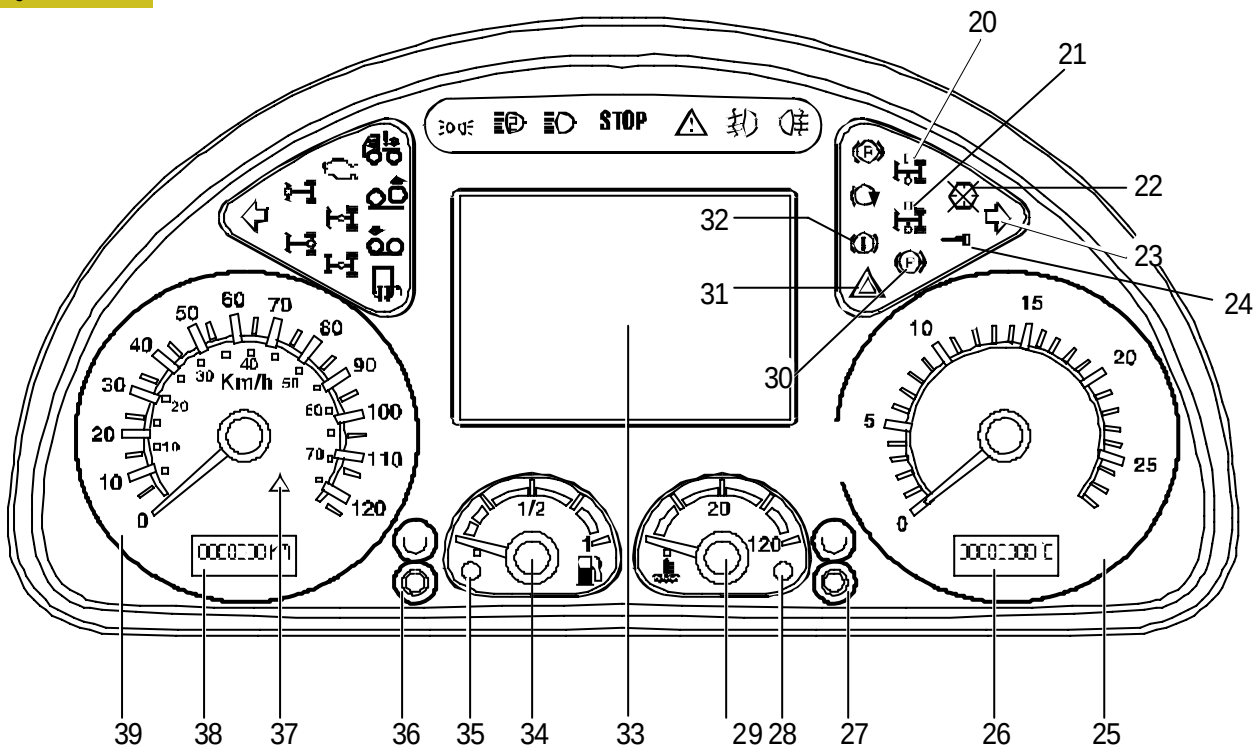



102385

| Ref. | Description |
|---|---|
| 1 | External lights |
| 2 | Auxiliary headlamps |
| 3 | High-beam headlamps |
| 4 | Generic anomaly/failure signal |
| 5 | Generic alarm |
| 6 | Fog headlamps |
| 7 | Rear fog lights |
| 8 | * Retarder |
| 9 | * Engine brake |
| 10 | Vehicle suspensions not in running trim |
| 11 | Third axle lifted |
| 12 | Pick-up assist provision |
| 13 | Mirror heating |
| 14 | Longitudinal tandem differential locking |
| 15 | Longitudinal/transverse rear differential locking |
| 16 | Left indicator light |
| 17 | Longitudinal differential locking |
| 18 | Longitudinal/transverse front differential locking |
| 19 | OBDII anomaly |
| * | Warning light: blinking with the function requested by the driver; ON steady with the function actuated |

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Figure 135



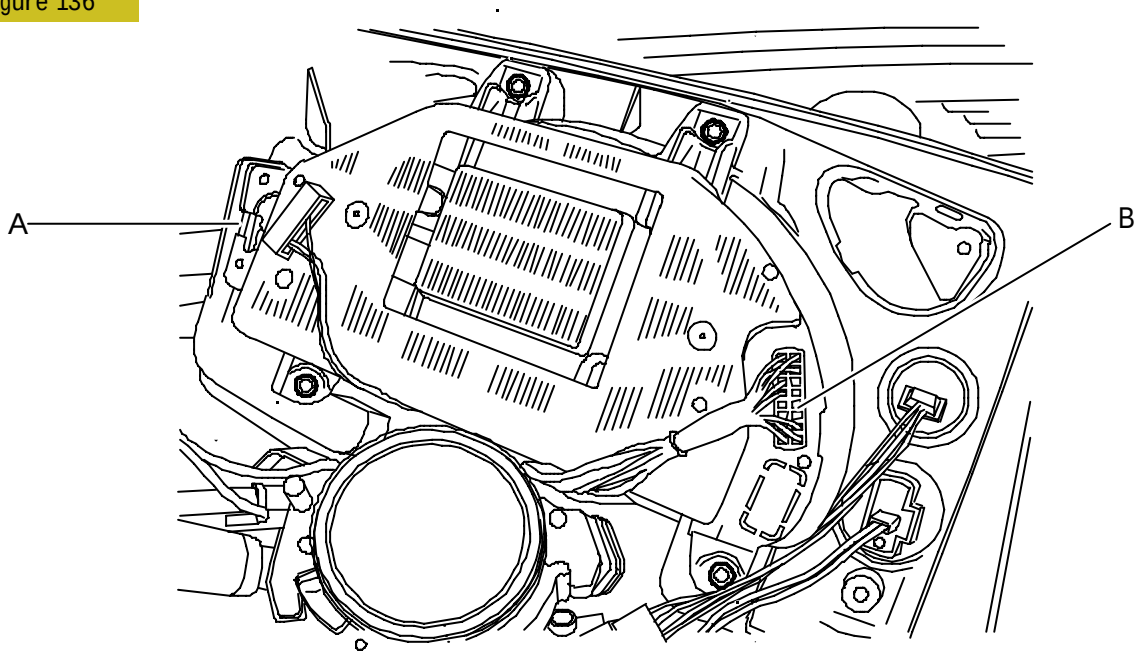

102386

| Ref. | Description |
|---|---|
| 20 | Power take-off 1 (PTO 1) |
| 21 | Power take-off 2 (PTO 2) |
| 22 | Instrument panel failure (Cluster) |
| 23 | Right indicator light |
| 24 | Immobilizer |
| 25 | Analog revs counter |
| 26 | Temperature/time display |
| 27 | Instrument illumination itensity/temperature/time display button |
| 28 | Coolant temperature (high temperature warning light) |
| 29 | Full/trip odometer display button |
| 30 | Hand brake ON |
| 31 | Emergency lights |
| 32 | Braking system failure |
| 33 | Display |
| 34 | Fuel level |
| 35 | Fuel level (low level warning light) |
| 36 | Odometer/mileage indicator display button |
| 37 | Tachograph anomaly |
| 38 | Full/trip odometer/mileage indicator display |
| 39 | Analog speedometer |

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## CLUSTER (PIN-OUT)

Figure 136




Connector A - Blue

| Pin | Description | Cable colour code |
|---|---|---|
| 1 | - | - |
| 2 | CAN H line (VDB) | White |
| 3 | CAN L line (VDB) | Green |
| 4 ÷ 17 | - | - |
| 18 | Positive +15 (from IBC3) | 8871 |
| 19 | Ground | 0000 |
| 20 | Direct positive battery (+Bat from ICB3) | 7906 |

Connector B - Black

| Pin | Description | Cable colour code |
|---|---|---|
| 1 | K line (14-pin diagnosis connector) | 2994 |
| 2 | - | - |
| 3 | Trailer ABS failure signal | 6671 |
| 4 | - | - |
| 5 | - | - |
| 6 | - | - |
| 7 | - | - |
| 8 | ECM failure signal | 6150 |
| 9 | Speed signal for diagnosis connector (28-pin) | 5540 |
| 10 | Ground from switch for tilted caisson signalling | 6607 |
| 11 | - | - |
| 12 ÷ 17 | - | - |
| 18 | - | - |
| 19 | Speed signal for Toll Collect (predisposition) | 5541 |
| 20 | - | - |

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## Display operation

Display varies subject to the following:

- Key on MAR with engine off
- Key on MAR with engine started and vehicle stationary
- Key on MAR at vehicle speed over 15 Km/h
- Key out

Key in MAR with engine off

Turning the key to MAR displays control of main vehicle systems.
Their presence is indicated in green, if all is OK, or yellow in case of a light anomaly/breakdown, or red in case of a serious anomaly/breakdown, with activation of a buzzer.

The list of systems present on the vehicle and their status can be displayed with the Multiplex system during Start-Up, by receiving the diagnostic message from the various centers.
System Check Ok or System Check Failed information is provided at Start-Up Test end.
The defective system then sends its diagnostic message that is displayed with the icon of the defect under review.

The Multiplex system can indicate vehicle and electronic system errors. In case of an error detected by the Body Computer, it sends the Instrument Cluster a message containing the following information, via the CAN line:

- the status of the light associated to the defect (red for a serious and yellow for a slight anomaly)
- the error code

At receipt of the error message, the Instrument Cluster displays the following in the central display area:

- the colored icon related to the defective component or center
- the related error code

It also advises the operator by activating the Buzzer. After recognizing the error, the operator presses key "OK" and the central display area returns showing the previous information (virtual tool or menu).
The icon related to the error detected is stored in the lower layer of the display or with a specific warning.

No options such as to distract attention or options not related to an operation useful for vehicle operation are available during operation, which is why the Menus available in case of a moving vehicle are reduced to the base essential and scanning of the various displays is obtained simply with the "Menu" key (without reading the list of options).
With the vehicle stationary, scanning of the complete set of menus available is enabled with keys "Arrow up" and "Arrow down".

Breakdown

After acknowledging the error, the operator presses key OK on the steering wheel and the icon appears in the lower display layer.

Yellow color (light anomaly/breakdown):

Proceed with caution and contact a Service Network workshop as soon as possible.

Red color (serious anomaly/breakdown):

Park the vehicle on the roadside in a non-dangerous area or contact the Dealer or the 24 hour Client Center number in unusual hours or in a decentralized area.

Two menus are available:

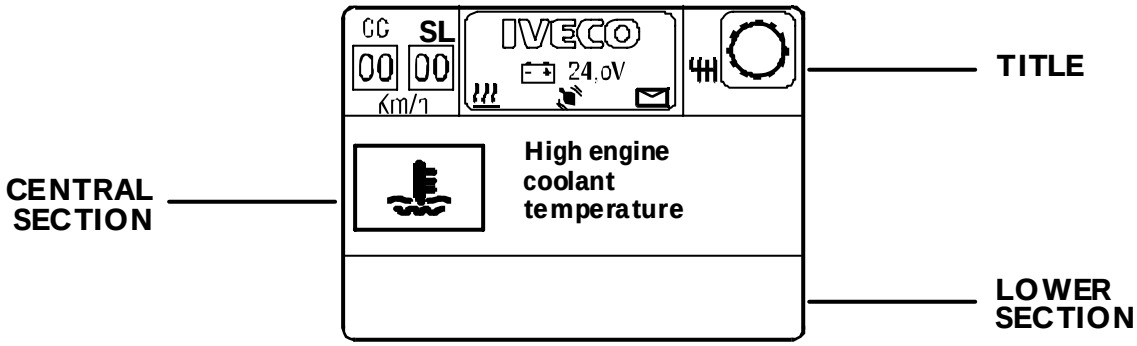
- TRAVEL MENU
- DIALOG MENU

External mirrors and lights can also be adjusted.
When the key is inserted, the present electronic systems perform a test by activating the related lights, enabling the operator to check their efficiency (and learn of the existence of vehicle systems).

Aquila Trucks Centres

## Display structure

Figure 137




73662

### TITLE

- Speed set by Cruise Control
- Speed Limiter set
- Supplementary heater enabled
- Battery voltage
- Radio/RDS information
- Telephone/ EMS message information
- Gears (downshifted/normal gears), suggested gears, auto/manual mode.

### CENTRAL SECTION

- Engine oil pressure
- Engine oil level
- Consumption indicator
- Turbo pressure
- Engine oil temperature
- Reservoir, trailer, service air pressure
- Front / rear / trailer brake wear (vehicles with EBS)
- Light setting adjustment
- Mirror positioning
- Failure messages
- Load on the axles (OPT)

### LOWER SECTION

- Alarms
- Active functions indications (intarder, etc.)

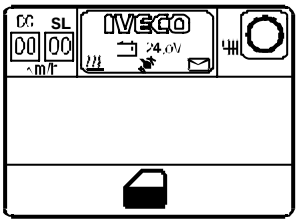
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## Optical status indicators on display

The corresponding icon appears at activation of the following functions of occurence of the following anomalies.

Figure 138




| Meaning | Symbol | Colour | Meaning | Symbol | Colour |
|---|---|---|---|---|---|
| Pre-heating | | yellow | ASR on | ASR | yellow |
| Cab unhooked<br>Unhooked cab enable | | red<br>yellow | ASR off | ASR | yellow |
| Door open | | red | Reduced ABS operation | | yellow |
| Low front axle brake air pressure | | red | Automatic chains | | yellow |
| Low rear axle brake air pressure | | red | Trailer without EBS/ABS | | yellow |
| Low trailer brake air pressure | | red | Tipper body | | yellow |
| Loading deck light (tractor only) | | yellow | Instrument Cluster trouble | IC | red |
| Windscreen defroster | | yellow | Low hydraulic pressure of third steering axle | | red |
| Minimum engine coolant level | | yellow | Low engine coolant level | | red |
| High engine coolant temperature | | yellow | Very high engine coolant temperature | | red |
| Low windscreen washer reservoir level | | yellow | Low fuel level / Ad Blue | | yellow |
| Front axle brake wear | | red | Rear axle brake wear | | red |
| Rear second axle brake worn | | red | Brake wear on a specific wheel | | red |
| Power steering low fuel level | | yellow | Air filter clogged | | yellow |
| Oil filter clogged | | yellow | Water in fuel filter | | yellow |
| Fuel filter clogged | | yellow | Engine oil level too high | | yellow |
| Low engine oil level | | red | High engine oil temperature | | red |
| Low engine oil pressure | | red | High engine oil temperature | | red |
| Low parking brake air pressure | | red | Brake wear on a specific wheel | | yellow |
| Low trailer brake air pressure | | red | Low/poor generator charge | | yellow<br>red |

After recognizing the error, the operator must press OK on the steering wheel and the icon appears in the lower display section.

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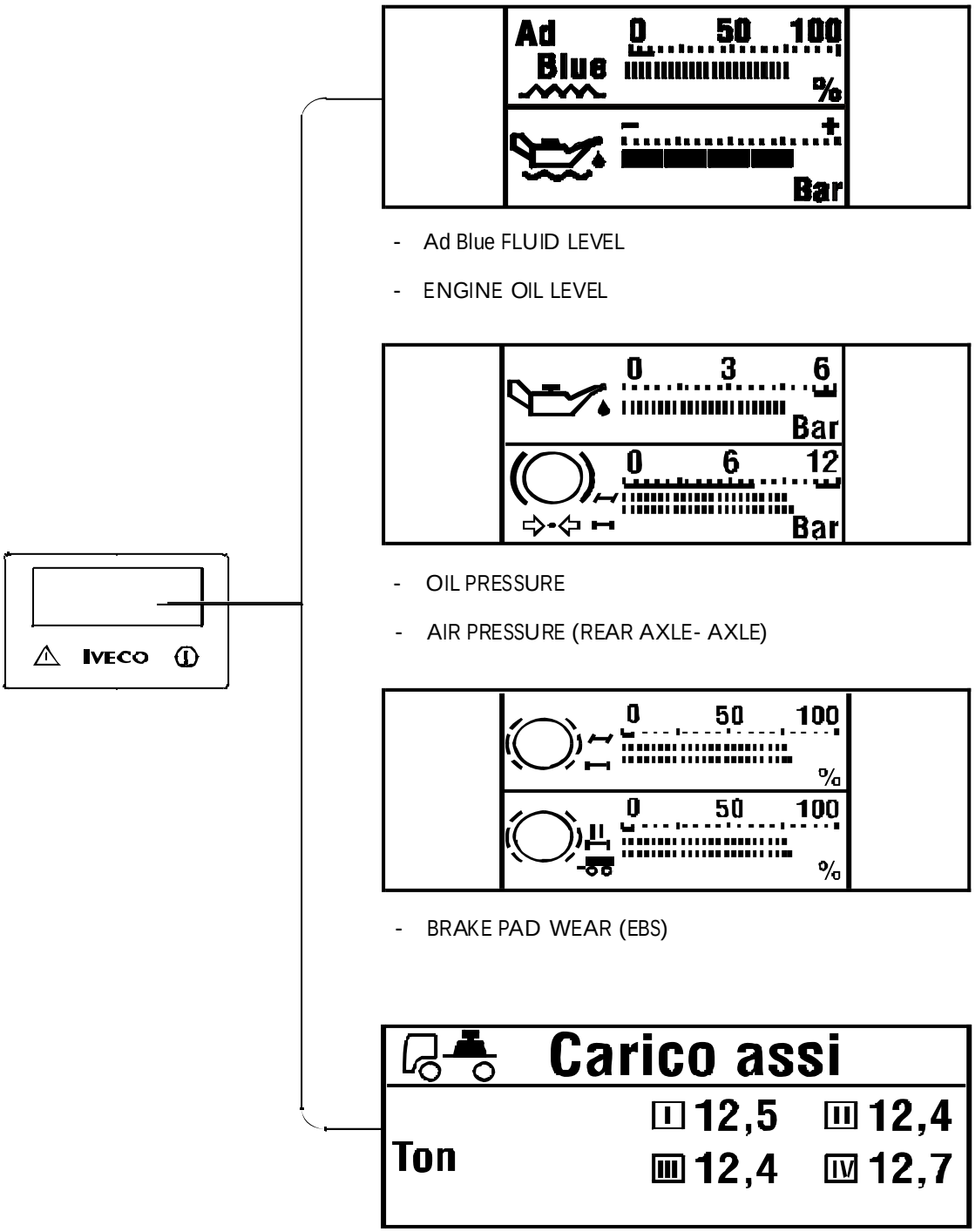
## Aquila Trucks Centres

| Meaning | Symbol | Colour | Meaning | Symbol | Colour |
|---|---|---|---|---|---|
| TCO ECU failure | TCO | red | BM ECU failure | BM | red |
| Parking brake failure |  | red | CM ECU failure | CM | red |
| Second importance light failure |  | yellow | Air conditioning system failure |  | red |
| BC ECU failure | BC | yellow/red | Additional heater failure |  | red |
| ECM failure | ECM | yellow/red | SWI ECU failure | SWI | red |
| EuroTronic failure |  | red | RFC ECU trouble/fault | RFC | yellow/red |
| EBS failure |  | red | First importance light failure |  | red |
| ABS failure |  | red | Right turn indicator fault |  | yellow |
| Intarder failure |  | red | Left turn indicator fault |  | yellow |
| FFC ECU trouble/fault | FFC | yellow/red | Central locking system failure |  | yellow |
| DDM ECU failure | DDM | red | EAC defect | EAC | yellow |
| Distance alarm signalling |  | yellow | EAC failure | EAC | red |
| ACC sensor defect |  | red | Trailer EBS failure |  | red |
| ACC sensor dirty |  | red | Reduced power and engine |  | yellow |
| ARB enabled |  | yellow | Rotating headlights |  | yellow |
| TPM steering axle low tire pressure |  | yellow | VCM failure | VCM | yellow/red |
| TPM engine axle low tire pressure |  | yellow | SCR failure | SCR | yellow/red |
| Trailer: attention thresholds reached |  | yellow | ASR / ESP disabled |  | yellow |
| Trailer: anti-theft enabled |  | yellow | ESP enabled |  | yellow |
| Airbag default/defect |  | red | Power steering failure |  | red |
| EM defect | EM | yellow | Power steering liquid low pressure |  | yellow |
| EM failure | EM | red | | | |
| CDM ECU failure | CDM | red | | | |

Aquila Trucks Centres

## Display instruments

Figure 139




- Ad Blue FLUID LEVEL
- ENGINE OIL LEVEL
- OIL PRESSURE
- AIR PRESSURE (REAR AXLE- AXLE)
- BRAKE PAD WEAR (EBS)
- LOAD GAUGE ON AXLES

112594

Aquila Trucks Centres

## BODY CONTROLLER (IBC3)

The Body Controller is the central unit which represents the heart of electrical system and together with MET central unit make up Easy Mux system.

The two central units communicate between each other via CAN line (BCB).

Instead through the CAN line (VDB), the IBC3 communicates with the vehicle different electronic systems.

**Body controller inputs:**

- Coolant low level contact
- Windscreen wiper liquid low level contact
- Alternator warning lamp
- Key 15
- Additional heater
- Brake system air low pressure sensor
- Emergency switch
- Door unlocking pushbutton
- Rear fog lights switch
- External lights switch
- Headlamp attitude rectifier
- Sunroof unlock/lock control
- Unfastened seat belts
- TGC unlock/lock
- Rear cross differential locking control
- Front differential locking control
- Longitudinal differential locking control
- Trailer handle pressure gauge
- Heater immediate engagement control

**Signals received via CAN network:**

- Gear in
- Trailer brake signal

**Body controller outputs:**

- Controls illumination
- Windscreen washer electric pump
- Lh / rh clearance headlamp
- Steps light
- Internal roof lamp
- Sun roof opening / closing relay
- Horns power supply relays
- Lighter
- Windscreen electric defroster power supply
- Remote control switch for inserting loads with key in
- Fitter outputs
- TGC (Current General Remote Control Switch ) / CGE (Emergency General Control) /MBS (Current General Control)
- Central door lock motor control
- Additional main beam headlight control
- Additional heater engagement control

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**IBC3 displays following information on Instrument Cluster:**

- Fuel level
- Oil level
- External air temperature
- Brake circuit air pressure

**IBC3 controls following devices:**

Lights (parking lights, dipped headlights, additional lights, front fog lights, rear fog lights, blinkers, stop lights, reverse lights, steps lights, cab lights, high roof cab lights, headlights attitude)

- Central locking
- Air-conditioner
- Additional heater
- Air drier

**Limp Home:**

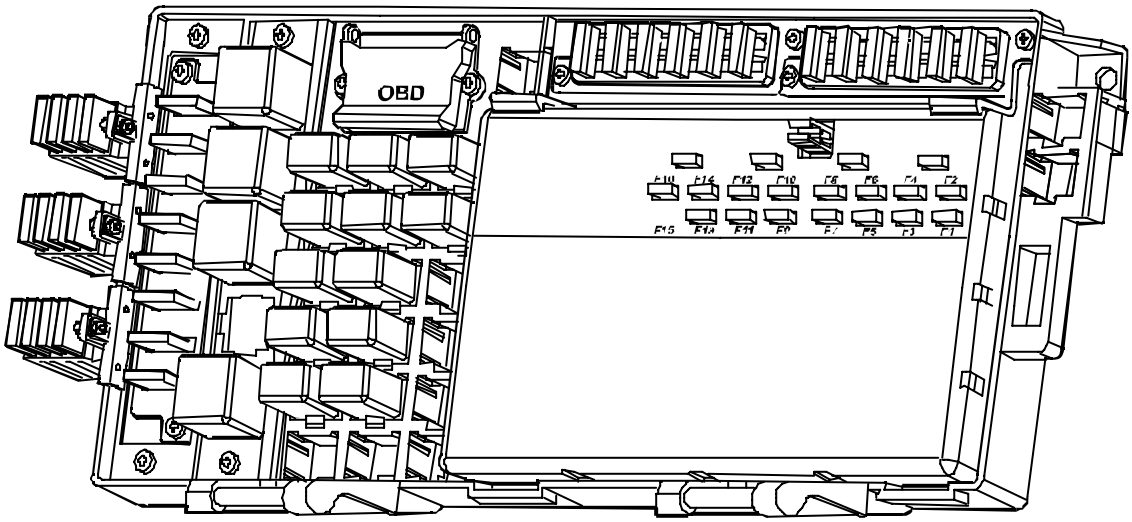
It identifies central unit status in case of micro processor failure; in this condition, following functions are ensured:

- Power supply (battery voltage, key 30, 15 and 15/1) from central unit to other cab loads
- Switching off of disabled TGC
- Switching on of windscreen wiper at minimum speed (or keeping previous control)
- Switching on steps lights
- Switching on clearance lights

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## BODY CONTROLLER

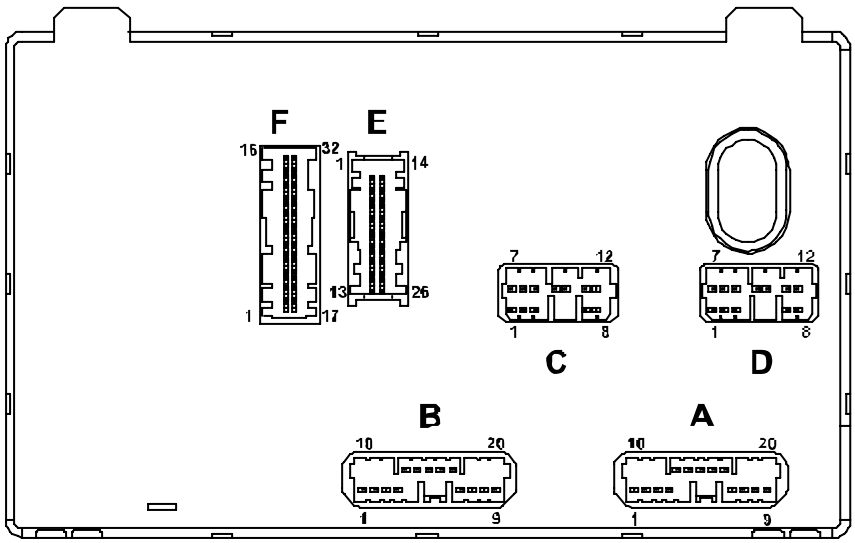
Figure 140




112595

### Linking connectors

Figure 141




108903

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Body controller connector "A"

| Pin | Description | Cable colour code |
|---|---|---|
| 1 | - | - |
| 2 | Positive from TGC (+30) | 7905 |
| 3 | - | - |
| 4 | - | - |
| 5 | - | - |
| 6 | Positive +30 for VCM / SWI | 7906 |
| 7 | Direct battery positive (+batt) | 7768 |
| 8 | Positive from service relay (+15/1) | 8887 |
| 9 | - | - |
| 10 | - | - |
| 11 | - | - |
| 12 | - | - |
| 13 | - | - |
| 14 | Positive from TGC (+30) | 7905 |
| 15 | Direct battery positive (+Bat) for DTCO (Tachograph) / central locking | 7768 |
| 16 | Direct battery positive (+batt) for BM (Bed Module) | 7906 |
| 17 | - | - |
| 18 | - | - |
| 19 | - | - |
| 20 | - | - |

Body controller connector "B"

| Ref. | Description | Cable colour code |
|---|---|---|
| 1 | Positive +15 for air conditioner / body builders (ST14A) | 8871 |
| 2 | Positive from service relay (+15/1) | 8887 |
| 3 | Positive +30 for cigar lighter / diagnostic interface | 7772 |
| 4 | Positive +30 for body builders (connector 72072C) | 7796 |
| 5 | - | - |
| 6 | Positive +30 for voltage reducer | 7772 |
| 7 | Positive +15 from ignition key | 8887 |
| 8 | Positive from TGC (+30) | 7905 |
| 9 | Positive +30 for body builders (ST14A / connector 72072D) | 7772 |
| 10 | - | - |
| 11 | - | - |
| 12 | - | - |
| 13 | - | - |
| 14 | Positive from TGC (+30) | 7905 |
| 15 | - | - |
| 16 | Positive +15 for brake system drier heater coil | 8840 |
| 17 | Positive +30 for horn relay | 1116 |
| 18 | - | - |
| 19 | - | - |
| 20 | - | - |

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Body controller connector "C" (grey)

| Ref. | Description | Cable colour code |
|---|---|---|
| 1 | Power supply for brake system air pressure sending unit | 5560 |
| 2 | Positive +15 for alternator | 8876 |
| 3 | Air pressure sending unit signal (front brakes) | 5562 |
| 4 | Air pressure sending unit signal (rear brakes) | 5561 |
| 5 | Windscreen wiper motor fixed stop (31B) | 8873 |
| 6 | - | - |
| 7 | Positive from TGC (+30) | 7905 |
| 8 | Earth for brake system air pressure sending unit | 0560 |
| 9 | Front marker light power supply | 3339 |
| 10 | Windscreen wiper motor high speed power supply (53B) | 8881 |
| 11 | Windscreen washer pump power supply | 8886 |
| 12 | Windscreen wiper motor low speed power supply (53) | 8882 |

Body controller connector "D" (blue)

| Ref. | Description | Cable colour code |
|---|---|---|
| 1 | Earth from windscreen washer fluid low level sensor | 5521 |
| 2 | - | - |
| 3 | Ground | 0000 |
| 4 | Charge signal from alternator | 7009 |
| 5 | Signal from external temperature sensor | 7573 |
| 6 | Earth from radiator water low level sensor | 5527 |
| 7 | CAN H line (BCB) | White |
| 8 | CAN L line (BCB) | Green |
| 9 | CAN L line (VDB) | White |
| 10 | CAN H line (VDB) | Green |
| 11 | External temperature sensor earth | 0550 |
| 12 | Control unit IBC3 K line (diagnostic connector pin 8) | 2995 |

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Body controller connector "E" (blue)

| Ref. | Description | Cable colour code |
|---|---|---|
| 1 | Ground from left door button | 0003 |
| 2 | Ground from right door button | 0003 |
| 3 | Ground from parking brake engaged switch | 6662 |
| 4 | Hazard lights signal for body builders (ST14B) | 1113 |
| 5 | - | - |
| 6 | - | - |
| 7 | - | - |
| 8 | Positive + 15 for cab tilt enablement switch | 8871 |
| 9 | Positive for opening TGC (TGC off) | 8045 |
| 10 | Positive +15 for ECM / VCM | 8051 |
| 11 | - | - |
| 12 | - | - |
| 13 | Positif +15 pour Cluster / DTCO / MET / Eurotronic 2 | 8871/8802 |
| 14 | Engine running signal for air conditioner / body builders (ST14A)<br>Signal moteur en route pour climatiseur / dispositifs d'équipement (ST 14A) | 7778 |
| 15 | Vehicle parked signal for body builders (ST14A) | 5515 |
| 16 | Reversing signal for body builders (ST14A) | 2268 |
| 17 | - | - |
| 18 | Positive for enablement of supplementary headlight activation relay | 2229 |
| 19 | Positive for sunroof closure control relay | 7011 |
| 20 | Positive for sunroof opening control relay | 7010 |
| 21 | Positive for TGC closure (TGC On) | 8035 |
| 22 | Positive for headlamp washer pump relay | 8820 |
| 23 | - | - |
| 24 | Positive for fifth wheel lighting switch / side lights for body builders (ST14B) | 3333 |
| 25 | Positive for interior courtesy light | 4440 |
| 26 | Positive for step light | 4445 |

Body controller connector "F"

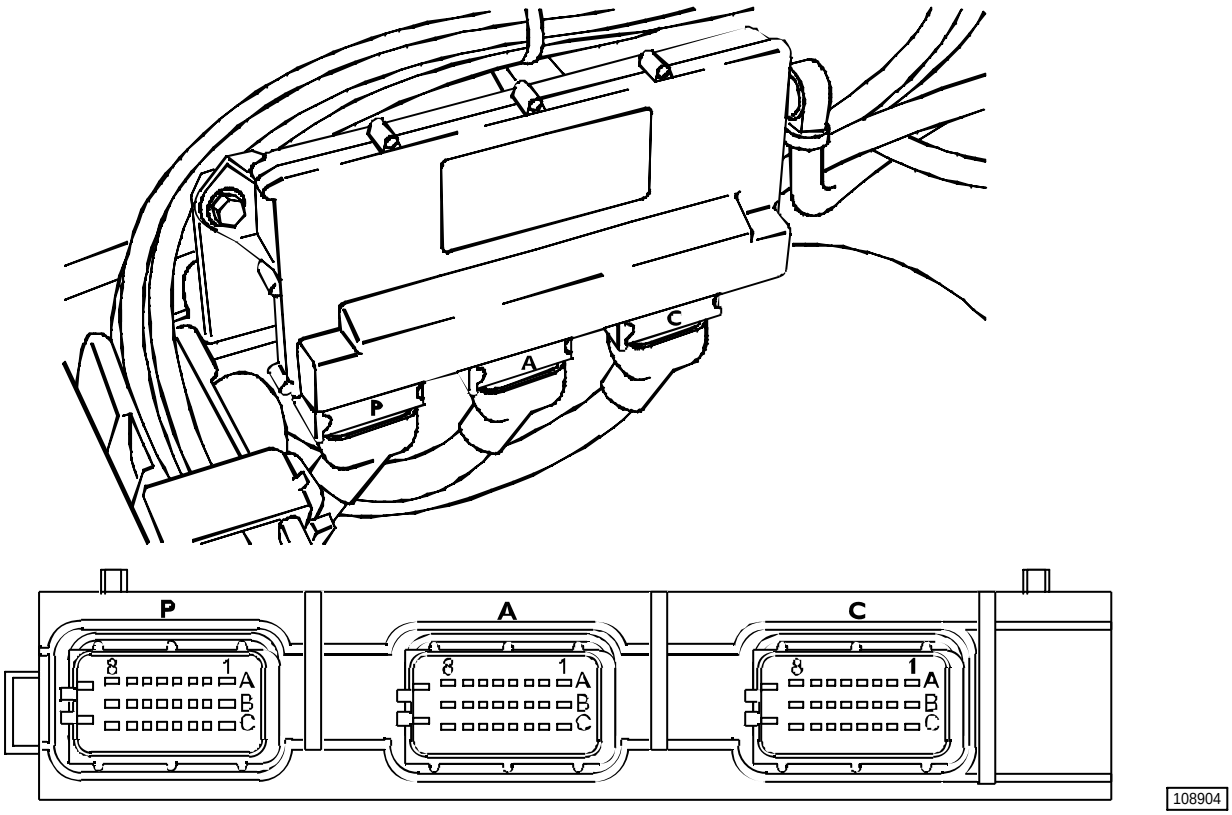
| Ref. | Description | Cable colour code |
|---|---|---|
| 1 | Positive +30 for Cluster | 7906 |
| 2 | Signal from head light alignment corrector control switch | 9936 |
| 3 | Positive for independent water heating pump enablement | 7786 |
| 4 | Ground from radiator low level sensor (for warning light) | 5520 |
| 5 | Ground from supplementary headlight switch | 2229 |
| 6 | - | - |
| 7 | Ground from longitudinal differential lock switch | 0903 |
| 8 | Ground from hatch opening control switch | 0970 |
| 9 | Ground from supplementary heater activation switch | 0501 |
| 10 | - | - |
| 11 | Ground from TGC activation switch (TGC On) | 0945 |
| 12 | Ground from exterior lighting switch (exterior light) | 3333 |
| 13 | Ground from rear fog lamp switch | 2284 |
| 14 | - | - |
| 15 | - | - |
| 16 | - | - |
| 17 | Positive for symbol lighting | 4442 |
| 18 | Head lamp alignment corrector control switch power supply | 8871 |
| 19 | - | - |
| 20 | Ground from trailer brake hand wheel switch (brake light) | 0927 |
| 21 | - | - |
| 22 | Ground from rear transverse differential lock switch | 0904 |
| 23 | Ground from front differential lock switch | 0902 |
| 24 | Ground from hatch opening control switch | 0971 |
| 25 | Control signal for central locking - locking | 0064 |
| 26 | Ground from hazard light switch | 1113 |
| 27 | Ground from TGC off switch (TGC Off) | 0946 |
| 28 | Ground from exterior lighting switch (low-high beams) | 2237 |
| 29 | Ground from fog lamp switch | 2228 |
| 30 | - | - |
| 31 | Ground from courtesy light on switch | 0941 |
| 32 | Control signal for central locking - locking | 0065 |

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## CHASSIS ELECTRONIC MODULE (M.E.T.)

MET central unit is placed on the chassis, actuates the controls and collects signals from sensors installed outside the cab, and communicates with ICB3 through CAN BCB network.

Figure 142




It supplies locked positive (+15) to UDS central unit (Denox 2), trailer, fitters and checks vehicle illumination. It supplies other loads too, such as air-conditioner compressor and fuel filter and pre-filter heating.

**Distributes key 15 to:**

- UDS (DENOX 2)
- Trailer
- Fitters

**Powers the following lights:**

- Parking lights
- Parking lights for fitters
- Marker
- Brake lights
- Fog lights and rear fog lights
- Direction indicators
- Reverse gear

**Powers other loads:**

- The conditioner compressor
- Fuel filter and prefilter heating
- ECAD solenoid valves
- Servoshift solenoid valve

**Acquires the following signals:**

- Reverse gear engaged
- Front differential locked signals
- Rear differential locked signals
- Longitudinal differential lock signals

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- Underdrive gears in
- Engaging 5th and 6th gears
- Suspensions air low pressure
- Hydraulic guide liquid low pressure
- Brake liquid low pressure
- Air-conditioning system high or low pressure
- Air-conditioning system high or low pressure
- Front axle brake pads wear status
- Rear axle brake pads wear status
- Front parking brake
- Front brakes converter cylinder end switch
- Rear brakes converter cylinder end switch
- Side PTO in
- Rear or total PTO in
- Clogged air filter
- Clogged air filter
- Fuel level
- Engine oil level

## Pin - Out

| Pin | Description | Cable colour code |
|---|---|---|
| A-1 | Reversing light positive +30 | 2226 |
| A-2 | Positive +30 for trailer brake lights | 1179 |
| A-3 | Positive +30 for left brake light | 1177 |
| A-4 | Positive +30 for right brake light | 1172 |
| A-5 | Positive +30 for number plate light | 3307 |
| A-6 | Positive +30 for right rear side lights | 3315 |
| A-7 | Positive +30 for left rear side lights | 3330 |
| A-8 | Positive +30 for right trailer side lights | 3339 |
| B-1 | Positive +30 for trailer rear fog lamp | 2283 |
| B-2 | Positive +30 for rear fog lamps | 2283 |
| B-3 | Positive +30 for right trailer direction indicators | 1185 |
| B-4 | Ground from transverse differential lock engaged indicator switch (1st rear axle) | 0040 |
| B-5 | Ground from transverse differential lock engaged indicator switch (2nd rear axle) | 0041 |
| B-6 | Ground from longitudinal differential lock engaged indicator switch | 6603 |
| B-7 | Positive +30 for rear marker lights | 3306 |
| B-8 | Positive +30 for left rear side lights | 3305 |
| C-1 | Positive +15 for trailer | 8075 |
| C-2 | Positive +30 for left rear direction indicators | 1120 |
| C-3 | Positive +30 for right rear direction indicators | 1125 |
| C-4 | Positive +30 for left trailer direction indicators | 1180 |
| C-5 | Ground from ECAS air system low pressure switch / Earth from front longitudinal differential lock indicator switch (8x8) | 6401/6643 |
| C-6 | Ground from rear brake wear sensor (1st rear axle) | 6667 |
| C-7 | Ground from rear brake wear sensor (2nd rear axle) | 6667 |
| C-8 | - | - |

Aquila Trucks Centres

A connector

| Pin | Description | Cable colour code |
|---|---|---|
| A-1 | Positive +30 for left high beam | 2219 |
| A-2 | Positive +30 for right low beam | 2223 |
| A-3 | Positive +30 for right high beam | 2221 |
| A-4 | Positive +30 for left low beam | 2231 |
| A-5 | Signal from water in fuel filter sensor | 5530 |
| A-6 | Ground from front wheel block wear sensor (2nd axle) | 6664 |
| A-7 | Ground from front transverse lock engaged signal switch (1st axle) | 6659 |
| A-8 | Positive +30 for diesel heater coil | 7733 |
| B-1 | Positive +30 for diesel pre-filter heater coil | 7753 |
| B-2 | Head lamp alignment corrector control | 9936 |
| B-3 | Ground from switch for circuit II power steering oil flow indicator | 6632 |
| B-4 | Ground from power steering fluid low level sensor | 5525 |
| B-5 | Ground from front transverse lock engaged indicator switch (2nd axle) | 6659 |
| B-6 | Ground from air filter clog switch | 6663 |
| B-7 | Ground from front wheel block wear sensor (1st axle) | 6664 |
| B-8 | Positive +30 for fog lights | 2228 |
| C-1 | - | - |
| C-2 | Positive +30 for front side lights | 3339 |
| C-3 | Positive +15 from IBC3 | 8871 |
| C-4 | CAN L line (BCB) | Green |
| C-5 | CAN H line (BCB) | White |
| C-6 | Positive +30 for front / right side direction indicators | 1123 |
| C-7 | Positive +30 for front / left side direction indicators | 1129 |
| C-8 | Positive +15 for water in fuel filter presence sensor | 8879 |

C connector

| Pin | Description | Cable colour code |
|---|---|---|
| A-1 | Positive +30 for ECAD regeneration solenoid (air system) | 9043 |
| A-2 | Positive +30 for ECAD discharge solenoid (air system) | 9043 |
| A-3 | Positive +30 for rear transverse differential lock solenoid | 9325 |
| A-4 | Positive +30 for longitudinal differential lock solenoid | 9323 |
| A-5 | Positive +30 for front transverse differential lock solenoid | 9063 |
| A-6 | Ground from switch in front power steering lock valve | 6631 |
| A-7 | Ground from side PTO engaged indicator switch (without EM) | 6132 |
| A-8 | Ground from low hydraulic circuit pressure indicator with 3rd steering axle | 0491 |
| B-1 | Ground from trailer brake circuit indicator switch | 6689 |
| B-2 | Ground from distributor crawler gear engagement indicator switch (4x4) | 9976 |
| B-3 | Engine oil level sending unit signal | 5505 |
| B-5 | Fuel level sending unit | 5557 |
| B-6 | Ground from total/rear PTO engaged indicator switch (without EM) | 6131 |
| B-7 | Ground from switch in front power steering switch valve | 6631 |
| B-8 | Positive +15 for UDS control unit (SCR system) | 8540 |
| C-1 | Ground | 0000 |
| C-2 | Engine oil level sending unit earth | 5506 |
| C-3 | Fuel level sending unit | 5555 |
| C-4 | Ground from four wheel drive engagement indicator switch | 6602 |
| C-5 | Ground from reverse engagement indicator switch | 2268 |
| C-6 | Ground from crawler gear engagement indicator switch | 9992 |
| C-7 | Ground from fuel filter blocked indicator switch | 5531 |
| C-8 | - | - |

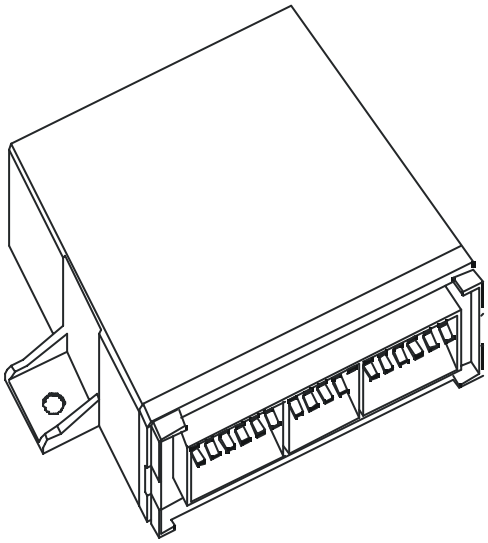
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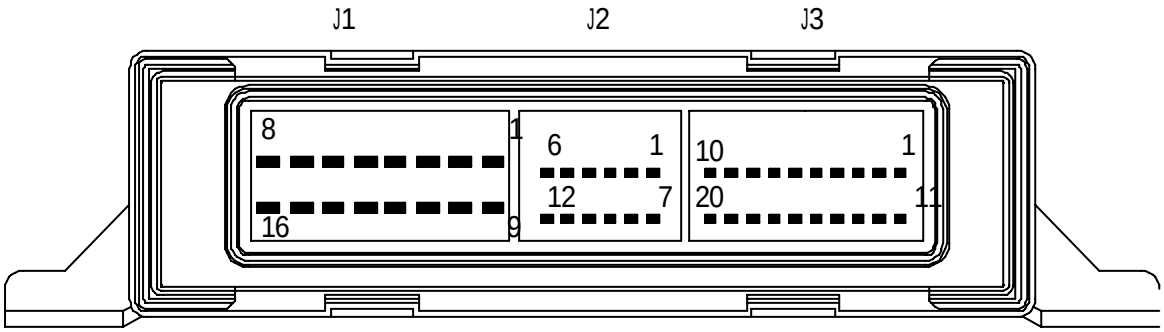
## D.D.M. / P.D.M.

The D.D.M. is located inside the operator door; the P.D.M. inside the passenger door.

Figure 142/1



50239




49723

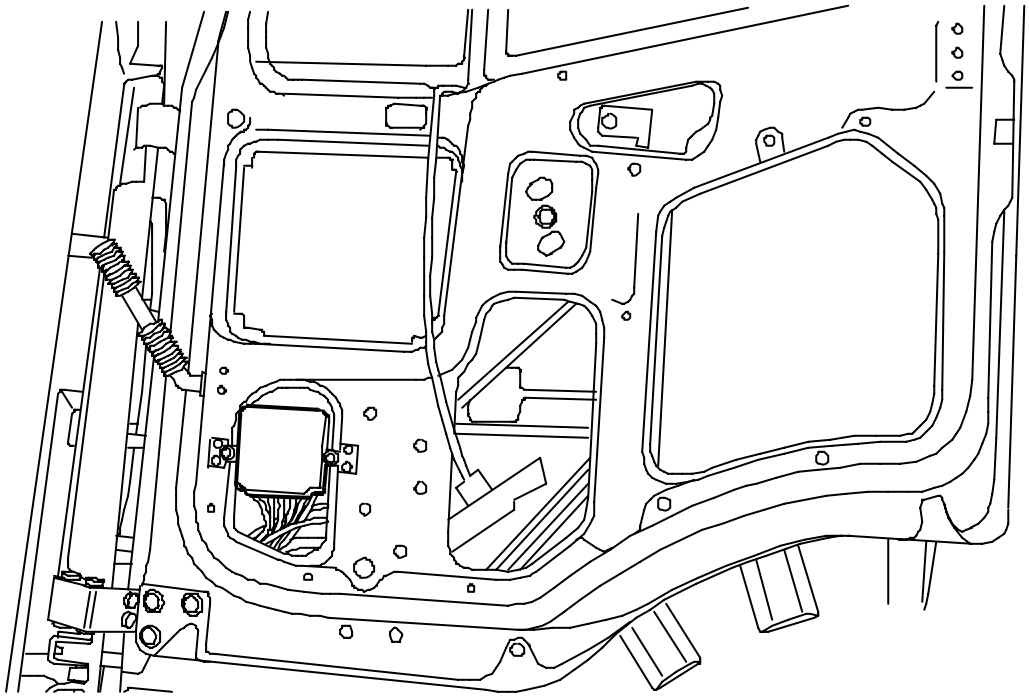
| Inputs | Outputs |
|---|---|
| Rearview mirror heating | Rearview mirror heating |
| Rearview mirror adjustment | Rearview mirror adjustment |
| Window lifter | Window lifter |
| Centralized lock | Centralized lock |

The only difference between D.D.M. and P.D.M. is that the P.D.M. pin J2/10 is connected by means of a jumper with pin J1/8 towards the ground for passenger module recognition.

Aquila Trucks Centres

## D.D.M. / P.D.M.

Figure 142/2



49838

These control unit manage all the functions appertaining to the two vehicle doors, namely:

- mirror heating
- mirror adjustment
- window lifter
- centralized lock.

They are located inside the vehicle door and removal is as follows:

1. remove the door lining;
2. disassemble the loudspeaker tray by removing the three fastening screws;
3. take DM off the tray by removing the two fastening screws
4. disconnect the three electric connection adapters.

Disassembling operations are the same for both doors.

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**P.D.M.**

| CONNECTOR J1 | | |
|---|---|---|
| Pin | Cable | Function |
| 1 | - | Free |
| 2 | - | Free |
| 3 | - | Free |
| 4 | 9965 | Centralized lock motor control (CDL) |
| 5 | 9964 | Centralized lock motor control (CDL) |
| 6 | 8863 | Window lifter motor control (opening) |
| 7 | 8865 | Window lifter motor control (closing) |
| 8 | 0000 | Mass – Bridge with (J2-10) for module recognition |
| 9 | - | Free |
| 10 | - | Free |
| 11 | 0000 | Negative for centralized door lock release push button |
| 12 | 0000 | Negative for main rearview mirror heating |
| 13 | 0000 | Negative for wide angle rearview mirror heating |
| 14 | - | Free |
| 15 | 2990 | K line for diagnosis |
| 16 | 7990 | Center power positive |
| CONNECTOR J2 | | |
| Pin | Cable | Function |
| 1 | Ws/Bi | CAN H line (BCB) |
| 2 | - | Approach rearview mirror control (vertical) |
| 3 | - | Approach rearview mirror control (horizontal) |
| 4 | 8851 | Wide angle rearview mirror control (return) |
| 5 | 8852 | Wide angle rearview mirror control (vertical) |
| 6 | 8857 | Main rearview mirror control (return) |
| 7 | Gv/Ve | CAN L line (BCB) |
| 8 | 8853 | Wide angle rearview mirror control (horizontal) |
| 9 | - | Approach rearview mirror control (return) |
| 10 | 0000 | Mass – Bridge with (J1-8) for passenger side ECU recognition |
| 11 | 8859 | Main rearview mirror control (horizontal) |
| 12 | 8858 | Main rearview mirror control (vertical) |
| CONNECTOR J3 | | |
| Pin | Cable | Function |
| 1 | 0962 | Negative from passenger side glass lifter push button |
| 2 ÷ 9 | - | Free |
| 10 | 4442 | Positive for passenger side glass lifter push button light |
| 11 | 0961 | Negative from passenger side glass lower push button |
| 12 | 0960 | Negative for passenger side glass control push button + lighting |
| 13 ÷ 20 | - | Free |

Aquila Trucks Centres

**D.D.M.**

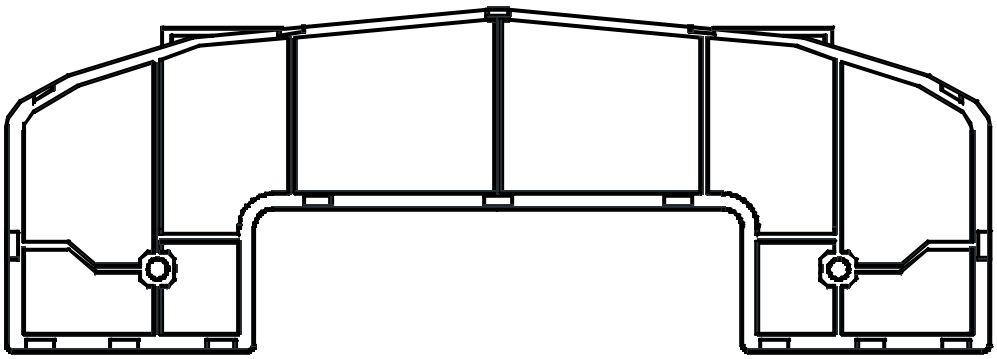
| CONNECTOR J1 | | |
|---|---|---|
| Pin | Cable | Function |
| 1 | - | Free |
| 2 | - | Free |
| 3 | - | Free |
| 4 | 9965 | Centralized door lock motor control |
| 5 | 9964 | Centralized door lock motor control |
| 6 | 8863 | Window lifter motor control |
| 7 | 8865 | Window lifter motor control |
| 8 | 0000 | Control unit earth |
| 9 | - | Free |
| 10 | - | Free |
| 11 | 0000 | Negative for Centralized door lock |
| 12 | 0000 | Negative for main rearview mirror heating |
| 13 | 0000 | Negative for wide angle rear view mirror heating |
| 14 | - | Free |
| 15 | 2991 | K line for diagnosis |
| 16 | 7991 | Positive for center power |
| CONNETOR J2 | | |
| Pin | Cable | Function |
| 1 | Ws/Bi | CAN H line (BCB) |
| 2 | - | Free |
| 3 | - | Free |
| 4 | - | Free |
| 5 | - | Free |
| 6 | 8806 | Main rearview mirror control (return) |
| 7 | Gv/Ve | CAN L line (BCB) |
| 8 | 8843 | Free |
| 9 | - | Free |
| 10 | - | Free |
| 11 | 8809 | Main rearview mirror control (horizontal) |
| 12 | 8808 | Main rearview mirror control (vertical) |
| CONNECTOR J3 | | |
| Pin | Cable | Function |
| 1 | 0962 | Negative from passenger side window lifter push button |
| 2 | 0966 | Negative from passenger side window lower push button |
| 3 | 0967 | Negative from operator side window lifter push button |
| 4 | - | Free |
| 5 | - | Free |
| 6 | 0953 | Negative from right rearview mirror control push button (movement to the right) |
| 7 | 0954 | Negative from left rearview mirror control push button (movement to the left) |
| 8 | 0951 | Negative from right rearview mirror control push button (movement downwards) |
| 9 | 0952 | Negative from left rearview mirror control push button (movement upwards) |
| 10 | 4442 | Positive for passenger/operator side window push button lighting |
| 11 | 0961 | Negative from passenger side window lower push button |
| 12 | 0960 | Negative for passenger side window control push button + lighting |
| 13 | 0951 | Negative for operator side window control push button + lighting |
| 14 | - | Free |
| 15 | 0950 | Negative for rearview mirror control joystick push buttons |
| 16 | 0600 | Negative for rearview mirror control joystick push button lighting |
| 17 | - | Free |
| 18 | - | Free |
| 19 | 4442 | Positive for rearview mirror control joystick push button lighting |
| 20 | - | Free |

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## S.W.I. (Steering wheel / steervator interface)

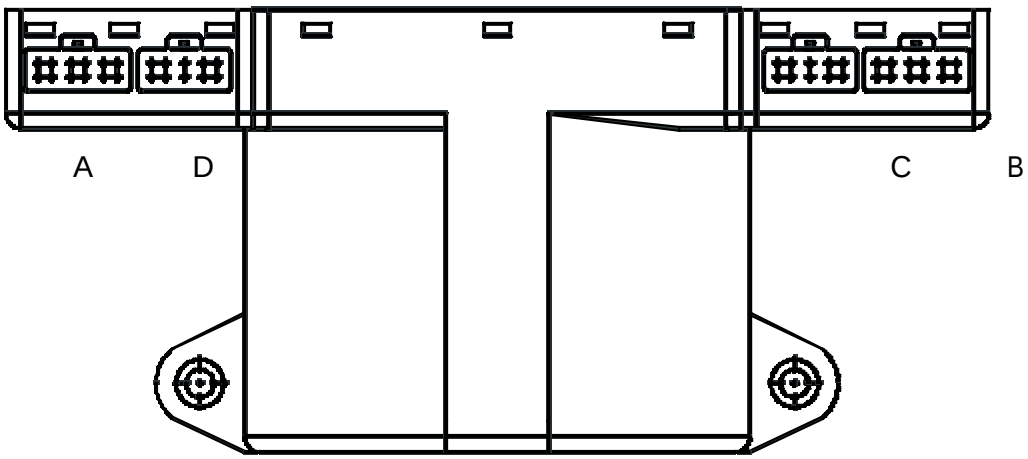
The function of this electronic center located on the steering column is to group together all controls from the two steervator levers and the steering wheel.
It is connected to the vehicle electronic system via a CAN line.

Figure 143



UPPER VIEW

Figure 144



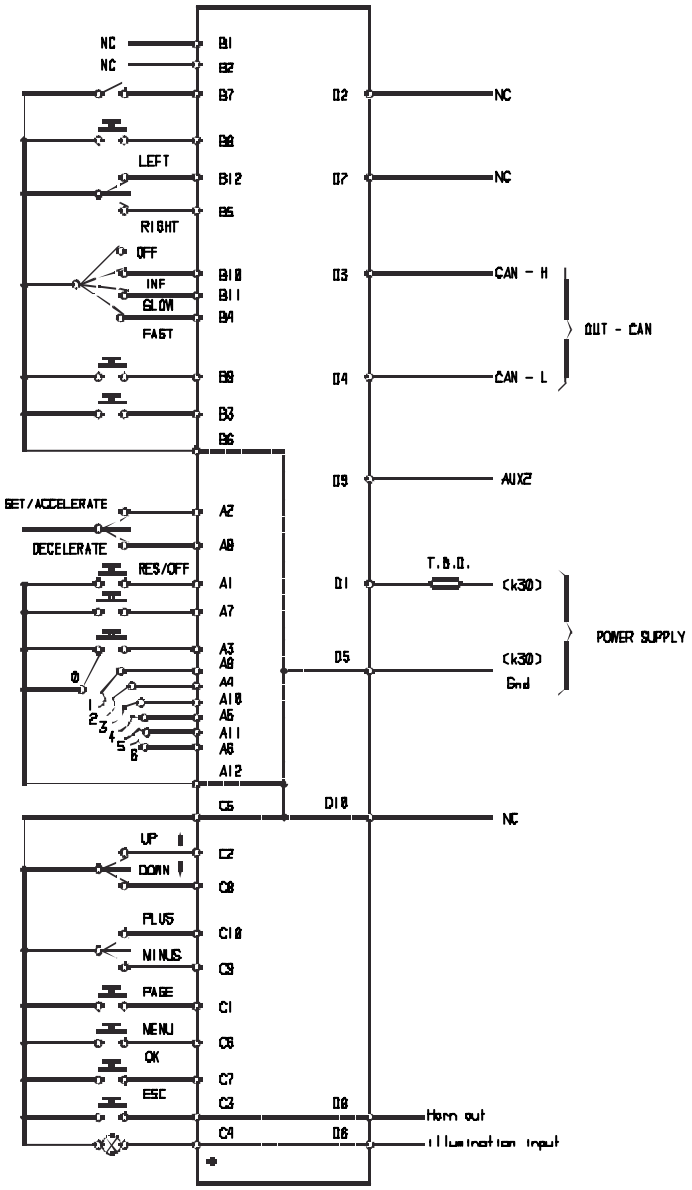

FRONT VIEW

50240

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## SWI functions

Figure 145




| Inputs | Outputs |
|---|---|
| Key switch<br>Cruise Control keys<br>INTARDER lever<br>Change gear<br>Flood/dipped lights<br>Direction indicators<br>Windshield wiper<br>Controls on steering wheel<br>Control lighting | Messages on CAN line |

Aquila Trucks Centres

## Connectors

Figure 146



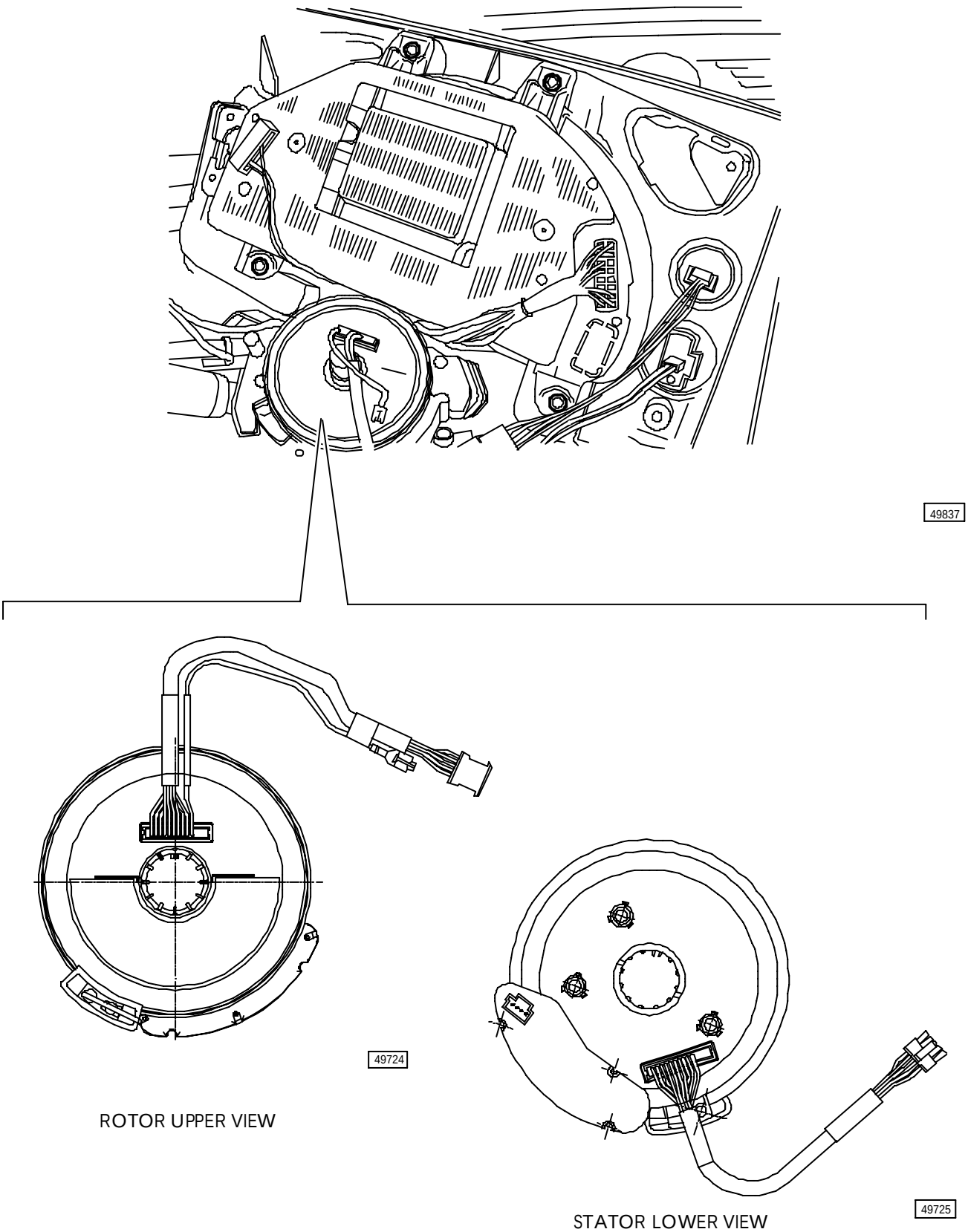

| A - Right lever | | B - Left lever | | C - Steering wheel | | D | |
|---|---|---|---|---|---|---|---|
| 1 | Cruise Control (Resume) | 1 | - | 1 | Display page selection | 1 | + 30 |
| 2 | Cruise Control (Set/Acc.) | 2 | - | 2 | Display cursor movement (high) | 2 | - |
| 3 | Change gear (down) | 3 | Wiper electro pump controls | 3 | Horn | 3 | CAN H |
| 4 | Intarder (pos.2) | 4 | Wiper (top speed) | 4 | Lever lighting (output) | 4 | CAN L |
| 5 | Intarder (pos.4) | 5 | Direction indicators (right) | 5 | Earth | 5 | Earth |
| 6 | Intarder (pos.6) | 6 | Earth | 6 | Menu selection / confirmation | 6 | Lever lighting (input) |
| 7 | Change gear (up) | 7 | Flood lights on | 7 | Main display return (instruments) | 7 | - |
| 8 | Cruise Control (deceler.) | 8 | Light flashes | 8 | Display cursor movement (low) | 8 | Horn (output) |
| 9 | Intarder (pos.1) | 9 | Wiper (one stroke) | 9 | Control (-) | 9 | AUX 2 |
| 10 | Intarder (pos.3) | 10 | Wiper (intermittent) | 10 | Control (+) | 10 | Earth |
| 11 | Intarder (pos.5) | 11 | Wiper (low speed) | | | | |
| 12 | Ground | 12 | Direction indicators (left) | | | | |

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## SPIRALED CONTACT

Located below the steering wheel.
Its function is to collect all controls present on the steering wheel and send them to the SWI center.

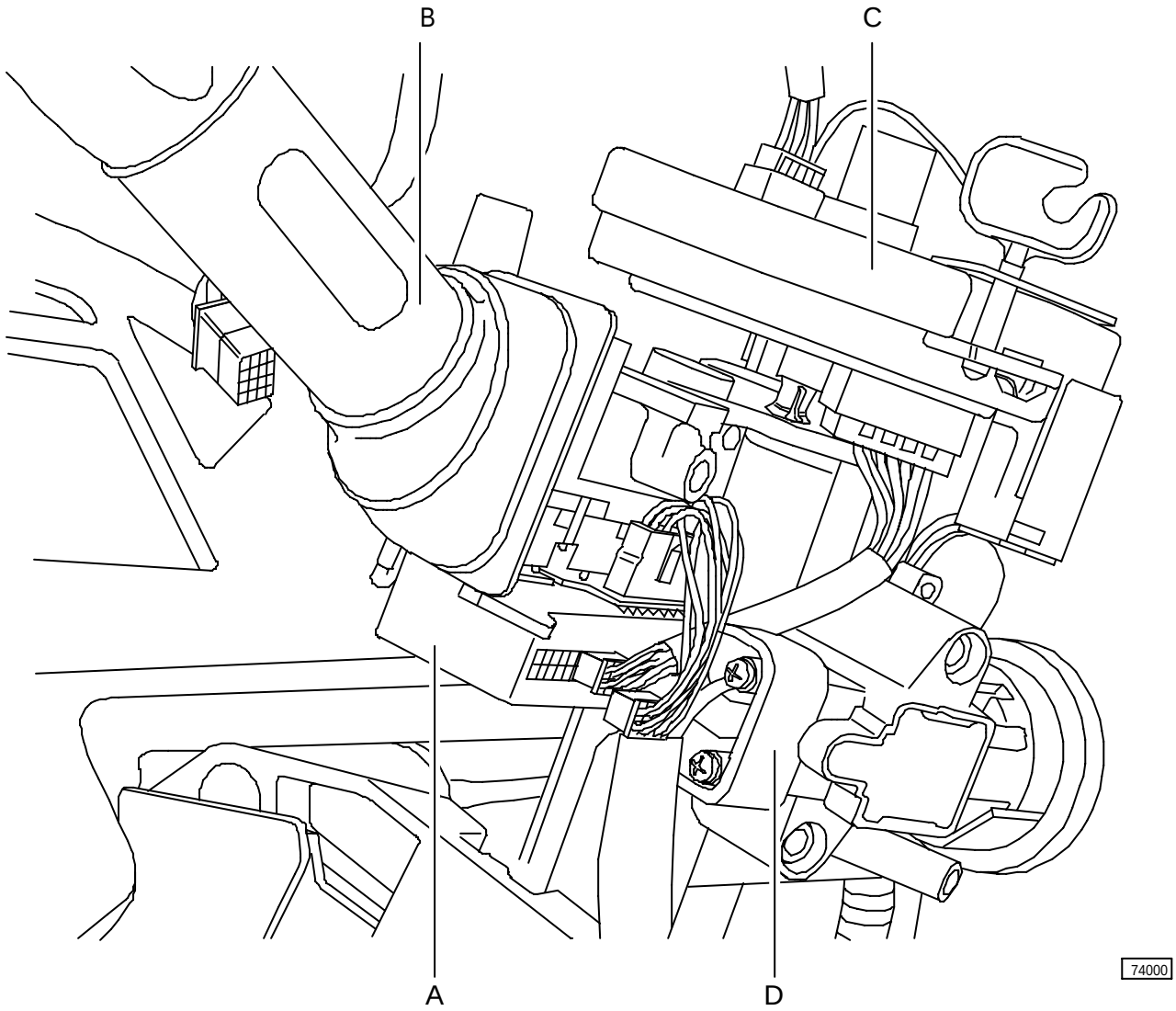
Figure 147



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## STEERING COLUMN (COMPONENT LOCATION)

Figure 148

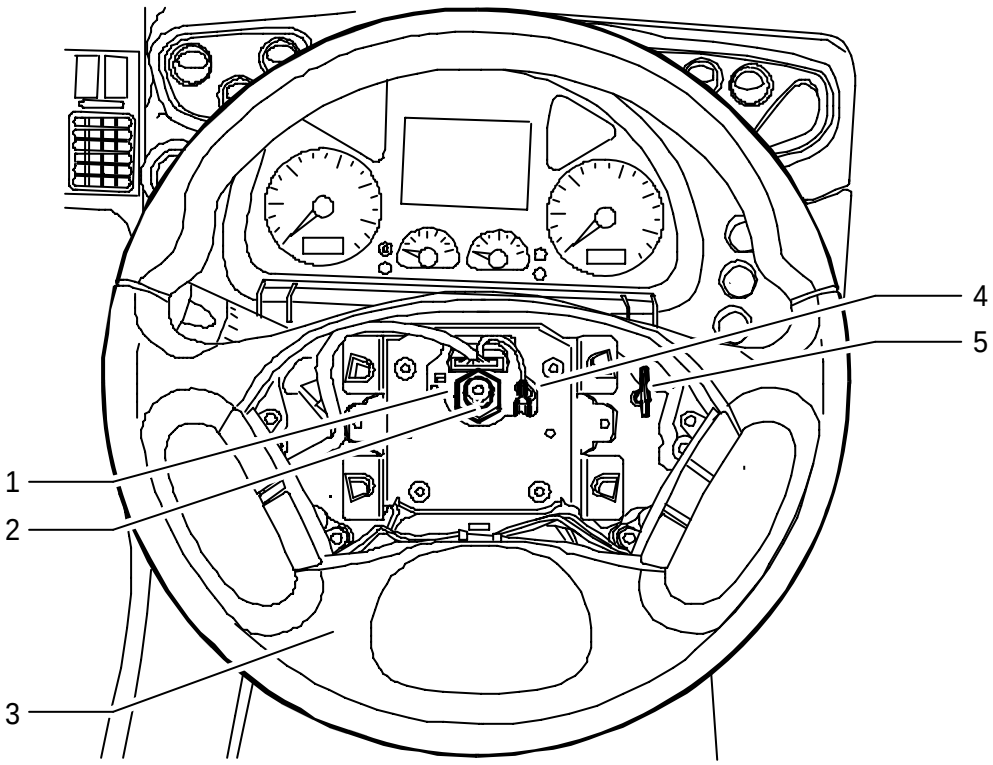



A. S.W.I center. - B. Steervator - C. Spiraled contact - D. Start block

**NOTE** Follow the procedures described in the following pages in case of spiraled contact disassembly.

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Figure 149




72850

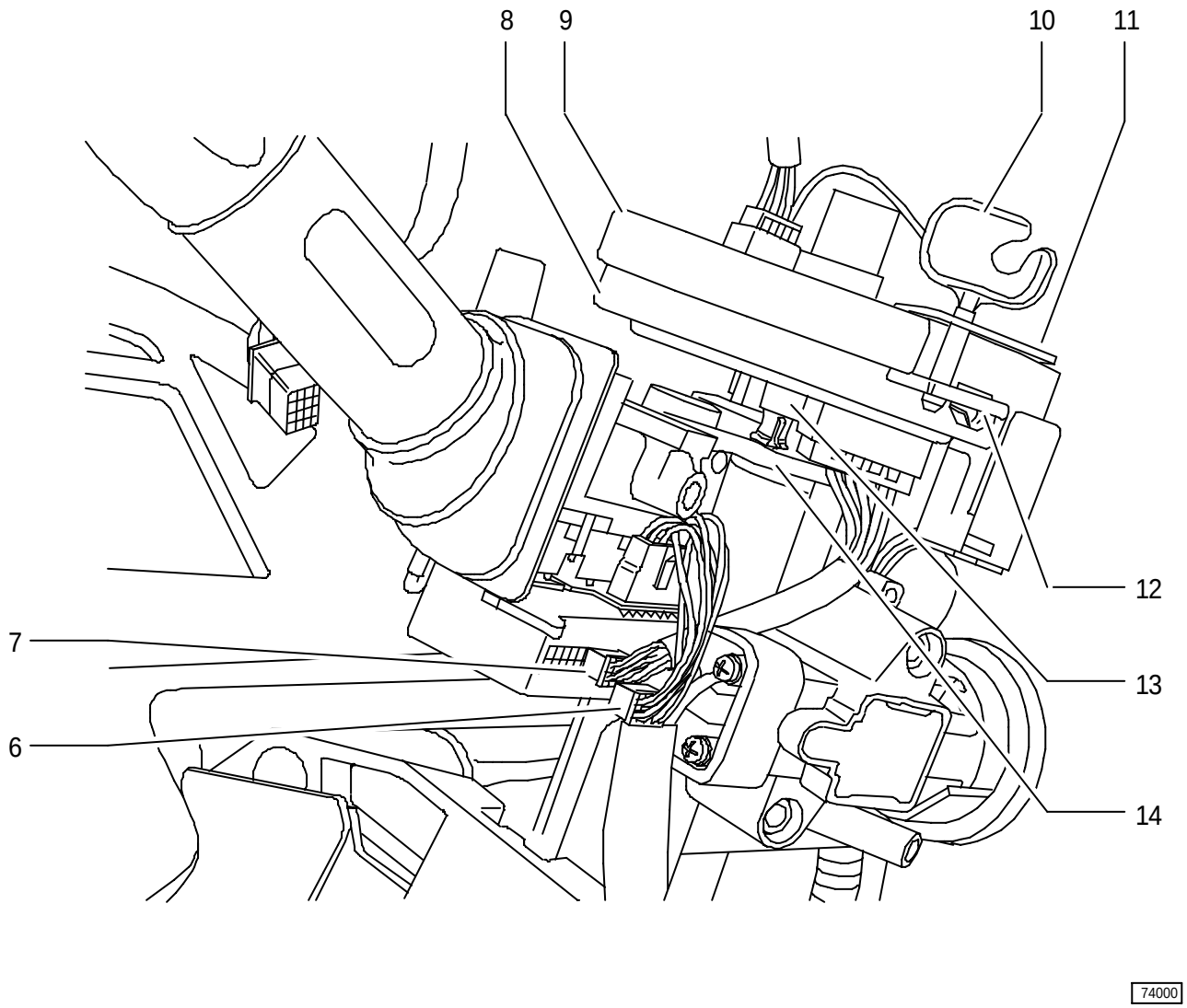
Carefully follow the procedures described hereunder to replace the spiraled contact, to avoid damaging the spiraled cable contained in its box when disassembling and aligning the steering wheel incorrectly.

Disconnect mass cable connection (4).

Remove nut (1) and mark steering wheel assembly position on shaft (2) and remove the steering wheel (3).

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Figure 150




Disconnect electrical connections (6 and 7) from the S.W.I.

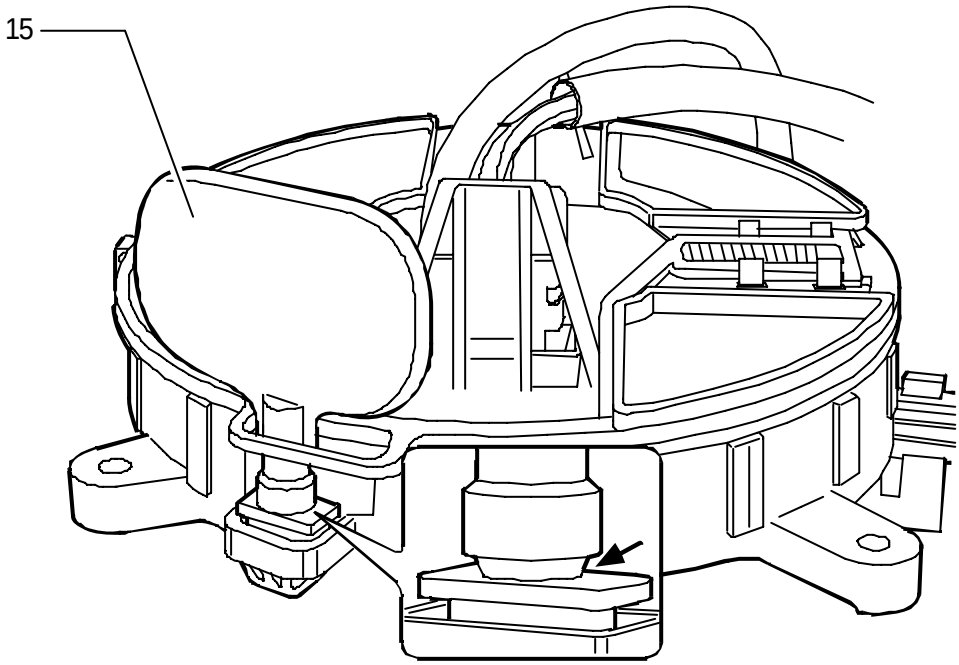
Secure contact rotor (9) to its container by inserting key (10) into slots (11 and 12), to prevent rotor (9) and stator (8) from rotating during disassembly.

Keep this situation until assembly. In the lack of a key, use an adequate size nut and bolt.

Carefully raise the contact so elastic retainer pins (13) are removed from support (14). Store it carefully.

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Figure 151




72857

Invert the sequence of operations described above for reassembly.

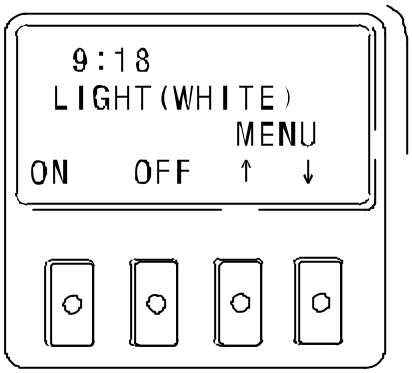
The spiraled contact is supplied spare with its stop key (15) assembled as shown in the figure. After assembly on the steering wheel control support, rotate the key to cause breakage at the point indicated by the arrow and return it to steering wheel seat (5).

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## B.M. (BED MODULE)

Positioned at the cab rear

Figure 152




10697

The B.C. identifies its presence but CANNOT be diagnosed.

Its functions are as follows
(variable configuration according to vehicle accessories):

- Time in hours and minutes
- Switching on/off of cab interior lights (selection of white/nightime lights).
- Opening/closing doors.
- Opening/closing electric windows.
- Opening/closing electric hatch.
- Lowering/raising sun blinds.
- Switching radio on/off
- Radio volume adjustment
- Radio tuning
- Wake up function.
- Switching additional heater on/off.
- Temperature adjustment (only with additional heater switched on). (Automatic).
- Adjustment of heater on time (9 hours max.)

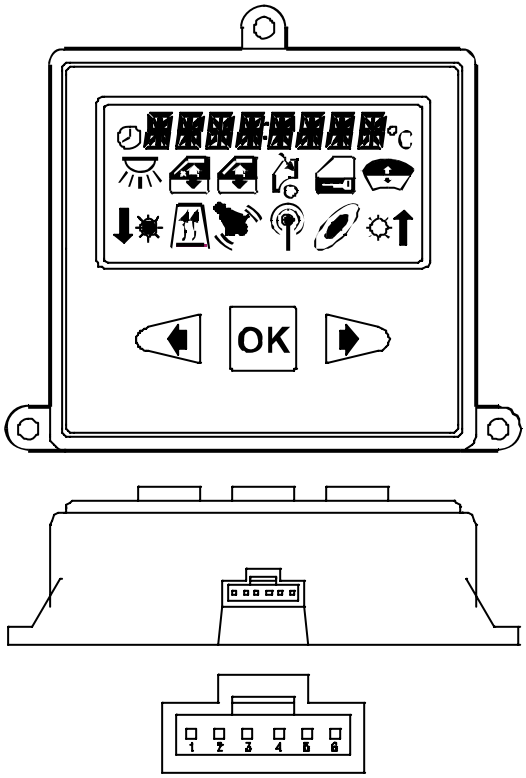
**NOTE** Press the switch on the instrument panel before adjusting heater temperature.

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## E.B.M. (EASY BED MODULE)

E.B.M. (Easy Bed Module) substitutes the previous (B.M.) roughly carrying out same functions. It has three keys and a display with icons for the various functions and the visualisation of the time. The B.M.E. connector is the same as the B.M. and the electrical connections are unchanged.

Figure 153




113411

Technical features

| | |
|---|---|
| - Supplier | ITALAMEC |
| - Nominal Voltage | 24V |
| - Working Voltage | 18V ÷ 32V |
| - Working Temperature | -30°C ÷ +60°C |
| - Absorption - stand by | <200mA |
| - Absorption - normal display mode | <200mA |
| - Absorption - sleep mode | <3mA |
| - Data transmission speed (CAN line) | 62,500 (BIT/SEC) |

Pin - out

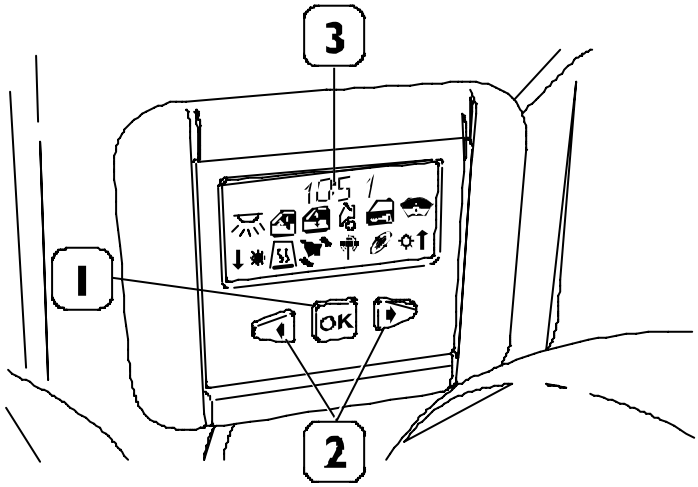
| Pin | Description | Cable code colour |
|---|---|---|
| 1 | Direct Positive battery (+Bat) | 7906 |
| 2 | Ground | 0000 |
| 3 | - | - |
| 4 | CAN L line (BCB) | Green |
| 5 | CAN H line (BCB) | White |
| 6 | - | - |

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E.B.M. Functions

The functions which are carried out by E.B.M. vary according to the configuration of the accessories expected on the vehicle.

Figure 154




113412

1. Confirmation key - 2. Key for the selection of the desired function - 3. Clock

| Function | Symbol | Availability |
|---|---|---|
| Indication of hour and minutes | | Always |
| Switching on / off of internal cabin lights (white lights) | | Always |
| Switching on / off of internal cabin lights (red lights) | | Only for vehicles with medium-high roofs |
| Opening/closure doors | | Optional |
| Opening/closure electric windows | | Optional |
| Opening/closure electric trapdoor | | Optional |
| Lowering /raising of sun blinds | | Optional |
| Switching on / off radio<br>Regulation of radio volume<br>Radio tuning | | Optional |
| Switching on / off radio<br>Regulation volume<br>Selection CD tracks | | Optional |
| Alarm clock setting | | Only if the alarm clock function is present on the Cluster |
| Alarm clock repetition (snooze) / switching off (stop) | | Only if the alarm clock function is present on the Cluster |
| Switching on / off supplementary heater<br>Regulation of temperature (if heater is switched on)<br>Regulation of duration of heater functioning (max.9 hours) | | Optional |

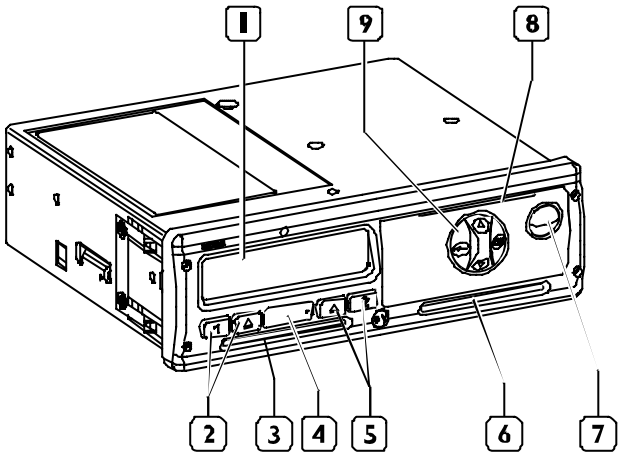
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## TACHOGRAPH
## Digital Tachograph (DTCO)

Digital Tachograph (DTCO) is a series tachograph for new production vehicles and replaces analogue tachographs in case of failure.
DTCO electrical connections are the same as MTCO electrical connections. In the case of DTCO tachograph, the sensor on the gearbox must be replaced; from electrical point of view, this sensor is the same as former sensor.
The sensor being used for MTCO tachograph (KITAS 2170) cannot be used on new DTCO tachograph, for which KITAS 2171 sensor is mounted.
This sensor (KITAS 2171 sensor) is also compatible with MTCO sensor; however, once it has been configured, it can only be used for that tachograph family.

1. Display
2. Keypad (driver-1)
3. Card feeder slot-1
4. Download interface / calibration interface
5. Keypad driver-2
6. Card feeder slot-2
7. Release button, printer drawer
8. Tear-off edge
9. Keys of Display menu

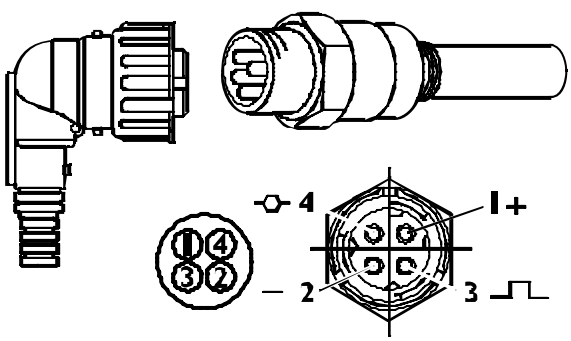
Figure 155




108905

DIGITAL TACHOGRAPH DTCO

Figure 156

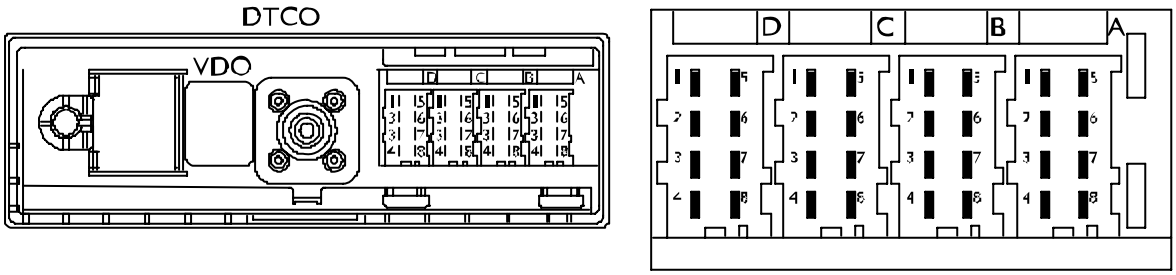



106343

TACHOGRAPH SENSOR (KITAS 2171)

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Figure 157




108906

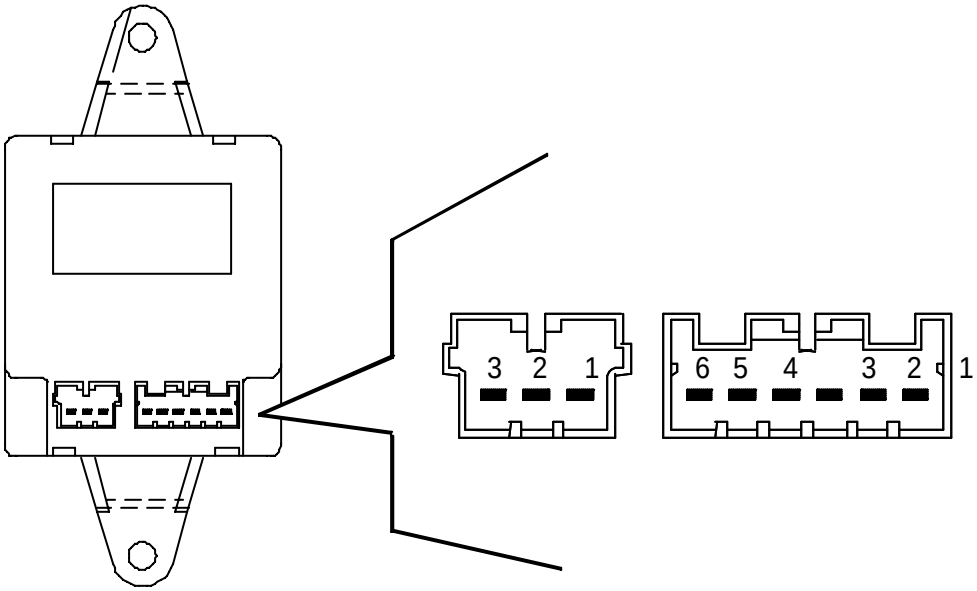
| Pin | | Description | Cable colour code |
|---|---|---|---|
| A | 1 | Direct positive battery (+Bat) | 7768 |
| | 2 | Positive ideogram illumination(from IBC3) | 4442 |
| | 3 | Positive +15 (from IBC3) | 8871 |
| | 4 | CAN H line (VDB) | White |
| | 5 | Ground | 0000 |
| | 6 | Ground | 0000 |
| | 7 | - | - |
| | 8 | CAN L line (VDB) | Green |
| B | 1 | Power supply for electronic tachograph transmitter | 5514 |
| | 2 | Ground for electronic tachograph transmitter | 0058 |
| | 3 | Speed signal for electronic tachograph transmitter | 5517 |
| | 4 | Inverted signal from electronic tachograph transmitter | 5516 |
| | 5 | - | - |
| | 6 | Speed signal for Intarder / Navigator (pre-disposition) | 5540 |
| | 7 | Speed signal for fitters (ST14A connector) | 5155 |
| | 8 | Space travelled Signal (pre-disposition) | 5518 |
| C | 1 | | - |
| | 2 | | - |
| | 3 | | - |
| | 4 | | - |
| | 5 | | - |
| | 6 | | - |
| | 7 | | |
| | 8 | | - |
| D | 1 | | - |
| | 2 | | - |
| | 3 | | - |
| | 4 | | - |
| | 5 | | - |
| | 6 | | - |
| | 7 | K line (14-pin diagnosis connector) | 2297 |
| | 8 | | - |

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## M.C. NET INTERFACE

The M.C. Net Interface control unit is introduced in the vehicles Trakker Euro 4/5 and acts as interface for the SWI control units (controls on wheel), IC (Cluster) and the Radio, by means of the CAN VDB and IDB lines. The CAN ICB line, which in the vehicles Trakker Euro 3 connected the SWI and IC control units has been removed.

Figure 157/1




Technical features

| | |
|---|---|
| - Supplier | ITALAMEC |
| - Nominal Voltage | 24V |
| - Working Voltage | 18V ÷ 32V |
| - Working Temperature | -30°C ÷ +60°C |
| - Absorption - stand by - 27V | <5mA |

Pin - out A

| Pin | Description | Cable code colour |
|---|---|---|
| 1 | Direct Positive battery (+Bat) | - |
| 2 | CAN H line (IDB) | White |
| 3 | CAN L line (IDB) | Green |

Pin - out B

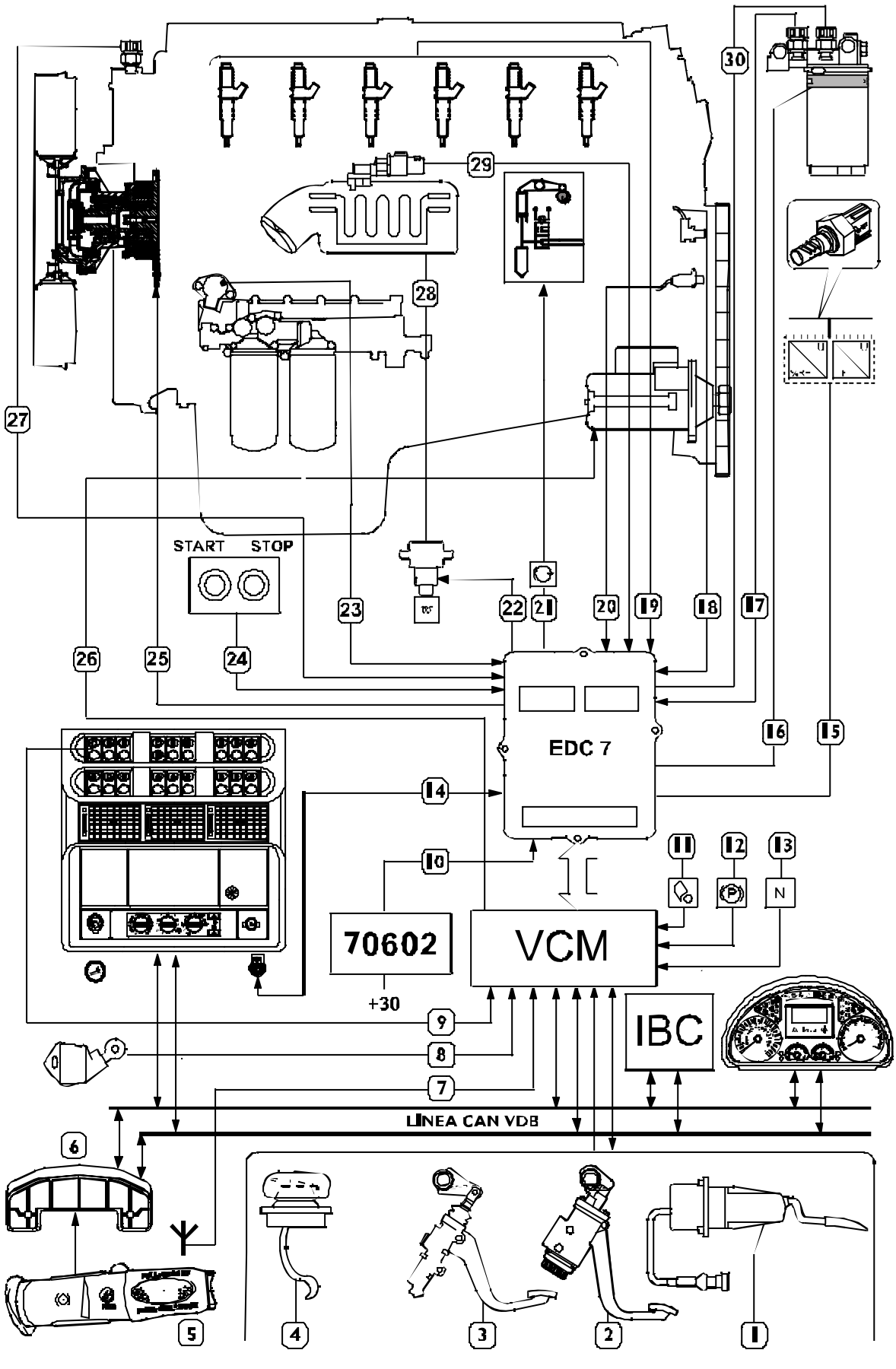
| Pin | Description | Cable code colour |
|---|---|---|
| 1 | - | - |
| 2 | Ground | 0000 |
| 3 | - | - |
| 4 | CAN H line ((VDB) | 7797 |
| 5 | CAN L line ((VDB) | White |
| 6 | - | Green |

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## INJECTION SYSTEM ASSEMBLY

Figure 157/2



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| Ref. | Description |
|---|---|
| 1 | Position sensor on accelerator pedal |
| 2 | Secondary primary brake switch |
| 3 | Sensor on clutch pedal |
| 4 | Engine brake switch |
| 5 | Right stalk |
| 6 | SWI control unit |
| 7 | Immobilizer antenna |
| 8 | Ignition key |
| 9 | Engine brake selector |
| 10 | Safety fuses (30A) |
| 11 | Cab release switch |
| 12 | Handbrake engaged |
| 13 | Idle switch |
| 14 | Diagnostic connector |
| 15 | Relative humidity and temperature sensor for EDC |
| 16 | Fuel prefilter |
| 17 | Water sensor |
| 18 | Engine revs sensor |
| 19 | Injectors |
| 20 | Distribution sensor |
| 21 | Engine brake solenoid valve |
| 22 | Preheating insertion contactor |
| 23 | Oil pressure/temperature sensor |
| 24 | Engine start/stop buttons |
| 25 | Baruffaldi electromagnetic joint |
| 26 | Starter |
| 27 | Coolant temperature sensor |
| 28 | Pre-heating resistance |
| 29 | Air pressure/temperature sensor |
| 30 | Fuel temperature sensor |

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## ENGINE CONTROL UNIT OPERATION STRATEGIES

### ECM – EDC7UC31 electronic control unit

The EDC7UC31 control unit manages the following main functions:

Fuel injection

Turbine geometry variation

Exhaust brake engagement

Self-diagnosis

Recovery

Also permits:

Interfacing with other on-board electric systems on the CAN EDB line (or ECB) SAE J1939

EOL and Service programming

Diagnosis

### Fuel metering

The fuel metering is calculated in function of:

- the accelerator pedal position from the VCM (Vehicle Control Module)
- engine speed
- quantity of introduced air.

The result may be correct in function of:

- the water temperature
- the diesel temperature (DIESEL DENSITY)

or to avoid

- overloading
- overheating
- excessive turbine speed

The delivery may be modified in the case of:

- engine brake or brake pedal activation (signals via CAN)
- the intervention of limitation devices (ASR, speed limiting device, etc.) (signals via CAN)
- the intervention of ANTI-POLLUTION devices: sensor Δp, Sensor NOx, signals via CAN from the control unit DCU15
- serious problems that involve the reduction in load and engine stalling.

The control unit, after determining the mass of the introduced air and measuring its pressure and temperature, calculates the corresponding fuel mass to inject in the involved cylinder (mg. per delivery), also taking the diesel temperature into account (density)

The fuel mass calculated in this way is converted into crank degrees, that is, before and during injection.

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## Correction of flow according to water temperature

When cold, the engine encounters greater resistance in operating; there is greater mechanical friction, the oil is still very viscous, the various clearances are not yet optimised.

In addition, the injected fuel tends to condense on the still cold metallic surfaces.

When the engine is cold, more fuel is metered than when the engine is hot.

## De-rating

If the engine overheats, the injection is changed, lowering the flow rate in proportion to the temperature reached by the cooling liquid. The control unit considers the oil temperature in the case of a water temperature sensor failure.

Turbine speed adjustment

Turbine speed is adjusted continuously and corrected if needed through geometry variation.

## Turbine speed adjustment

Turbine speed is adjusted continuously and corrected if needed through geometry variation.

## Injection advance electronic control

The advance (starting moment, expressed in degrees) may be different from an injection to the next one, also in a different manner from a cylinder to another, and is calculated, similarly to the flow rate, in function of engine load (accelerator pedal position, engine speed and introduced air).

The advance is corrected as necessary:

- during acceleration
- based on water temperature

and to obtain:

- reduced emissions, noise and overloading
- improved vehicle acceleration

When starting, a high advance is set based on water temperature.

The delivered starting moment feed-back is provided by the injector solenoid valve impedance variation.

## Engine speed regulator

The control unit controls the engine speed at all speeds and in particular:

- minimum speed
- and maximum speed

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## Starting the engine

During the first engine motoring over revolutions, cylinder N phase and recognition signal synchronisation occurs °1 (flywheel sensor and camshaft sensor). When starting, the accelerator pedal signal that arrives via CAN is ignored. The diesel delivery when starting is set exclusively based on the water temperature by means of a specific map. When the control unit detects a number of revolutions and a flywheel acceleration that is such to consider the engine as started and no longer driven by the starting motor, it engages the accelerator pedal signal..

## Cold start

If only one of the three temperature sensors (water, air or fuel) registers a temperature lower than 10 °C, the pre-post hearing is activated.

Upon activation of the key contact, the pre-heating warning light turns on the electric dashboard (cluster display) and remains on for a variable amount of time depending on the temperature (whereas the resistance at the intake manifold heats the air) , then it flashes. At this point, the engine may be started.

With engine running, the warning lamp switches off, while the resistance goes on being powered for a certain (variable) period of time carrying out the post heating.

If, with warning lamp blinking, the engine is not started within 20 ÷ 25 seconds (absence time) the operation is canceled in order not to discharge the batteries.

The preheating curve is also variable based on the battery voltage.

## Hot start

If the temperatures of reference all exceed 10 °C, upon activation of the key contact, the indicator lamp turns on for approx. 2 sec. for a brief test, and then turns off. At this point, the engine may be started.

## Run Up

Upon activation of the key contact, the central unit transfers the information stored during the last engine stop to the main memory (see: After run), and carried out a system diagnosis.

## After Run

Each time the engine is turned off using the key, the central unit remains powered for a few seconds thanks to the internal MAIN RELAY.

This permits the microprocessor to transfer some data from the main memory (volatile) to a non volatile, erasable and rewritable memory (EEPROM), to make it available for the next start (see: Run Up).

The data consists essentially of:

- various settings (engine idling, etc.)
- the calibration of some components
- fault memory.

This procedure lasts a few seconds, typically from 2 to 7 (depending on the quantity of data to save), after which the ECU deactivates the main power supply.

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It is very important that this procedure is not interrupted, for example by turning off the engine from the battery cut-off switch, or by disconnecting the battery cut-off switch before at least 10 seconds have passed the engine was turned off.

If this happens, system functionality remains guaranteed up until the fifth time it is turned off incorrectly (also not consecutively) after which an error is stored in the failure memory and upon the following engine startup, the engine will function with degraded services while the EDC warning light remains on.

Repeated interruptions of the procedure could in fact lead to central unit damage.

## Cut-off

This function cuts off delivery during deceleration, during exhaust brake, etc.

## Cyclinder Balancing

This function permits an individual and personalised control of the fuel flow rate and the delivery start for each cylinder, in a different manner from cylinder to cylinder, to compensate for the hydraulic injector tolerances

The fuel flow rate difference by cylinder is not signalled by the central unit but by the instrument IVECO - IRISBUS.

## Synchronization Search

If the sensor signal does not arrive to the cam shaft, the central unit can still detect the cylinders into which the fuel must be injected.

If this occurs when the engine is already running, the combustion succession has already been obtained, and therefore the central unit continues with the sequence on which it is already synchronised.

If this occurs when the engine is stopped, the central unit energises a single solenoid valve. At the latest by the 2nd engine shaft revolution, an injection will occur in that cylinder, for which the central unit only has to synchronise itself on the combustion sequence and start the engine..

To reduce the number of connections, the length of the connection cables with the injectors and as a result, disturbances in the transmitted signal, the control unit is assembled directly on the engine by means of a heat exchanger that permit its cooling, using electric dowels that reduce the vibrations transmitted by the engine.

The control unit is connected to the wiring through 3 connectors.

- 89-way connector "1" for the components on the Vehicle
- 36-way connector "2" for the components on the Engine
- 16-way connector "3" for the connection to the injectors and exhaust brake solenoid valve

Internally, there is an ambient pressure sensor that is used to additionally improve injection system management.

The control unit offers an on-board diagnostic system via CAN:

- ODB (On Board Diagnostic)
- Cluster diagnosis.

It is also equipped with a very advanced self-diagnosis system and it is capable of recognizing and memorizing, in function of the environmental conditions, the possible anomalies, even of an intermittent type, that occurred on the system during operation, ensuring a more correct and reliable repair action with the help of the IVECO-IRISBUS diagnostic instruments.

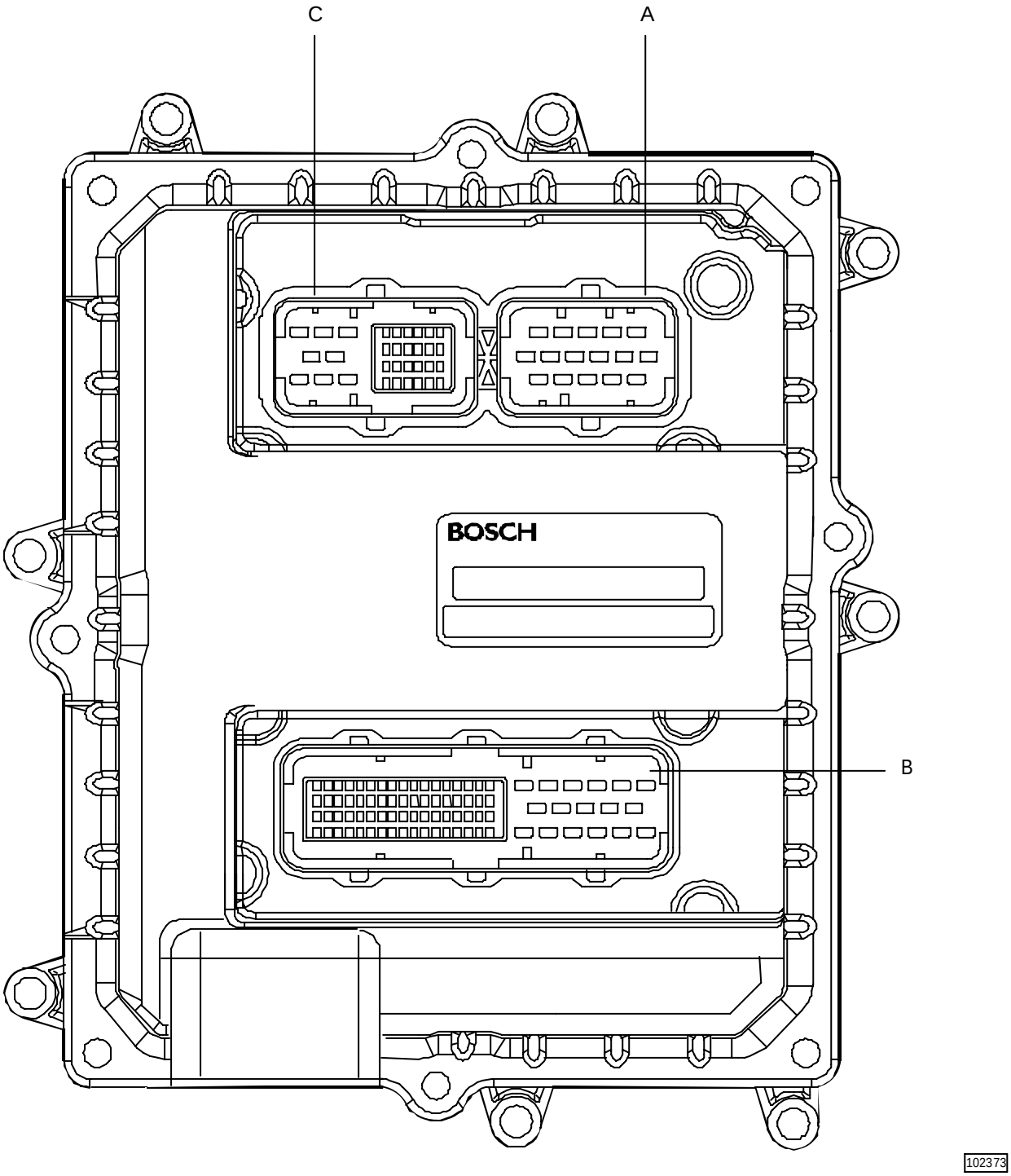
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## EDC (ECM) SYSTEMS

EDC 7 UC31 electronic control unit

Figure 158

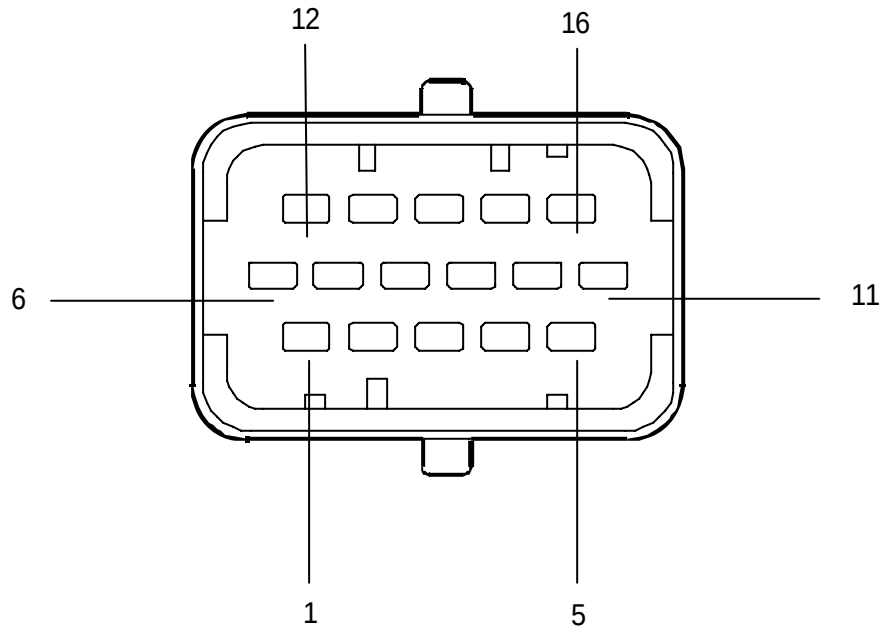



A. Injector connector - B. Chassis connector - C. Sensor connector

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Electric injector connector 3 "A"

Figure 159




102374

Colour legend

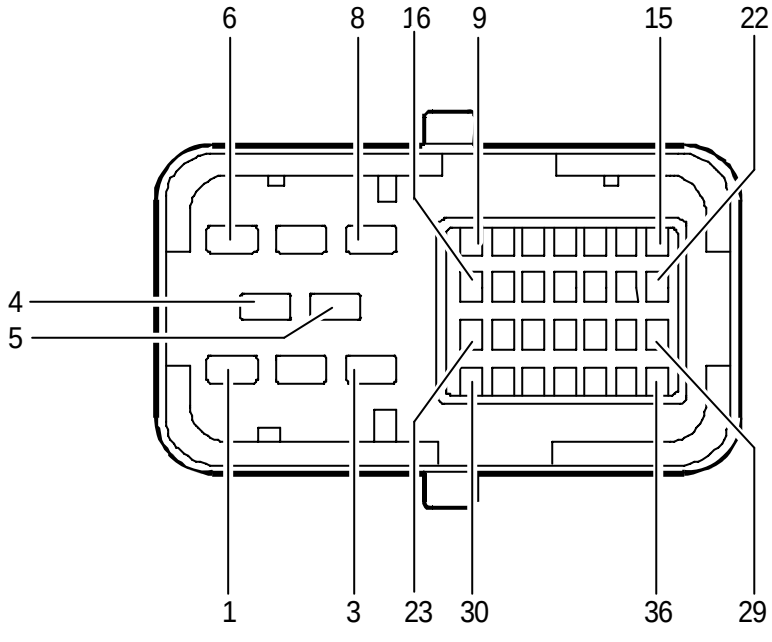
| | |
|---|---|
| C | ORANGE |
| A | LIGHT BLUE |
| B | WHITE |
| L | BLUE |
| G | YELLOW |
| H | GREY |
| M | DARK BROWN |
| N | BLACK |
| W | LIGHT BROWN |
| S | PINK |
| R | RED |
| V | GREEN |
| Z | PURPLE |

| Pin | Description (F3B) | Description (F2B) | Cable colour code | |
|---|---|---|---|---|
| | | | F3B | F2B |
| 1 | - | Cylinder 5 pump injector | - | N |
| 2 | - | Cylinder 6 pump injector | - | N |
| 3 | Cylinder 4-5-6 pump injector shared cable | Cylinder 4 pump injector | N | N |
| 4 | - | Cylinder 1 pump injector control | - | B |
| 5 | - | Cylinder 3 pump injector control | - | V |
| 6 | Cylinder 2 pump injector control | Cylinder 2 pump injector | B | R |
| 7 | Engine brake control solenoid | Engine brake control solenoid | C | C |
| 8 | Engine brake control solenoid | Engine brake control solenoid | M | M |
| 9 | - | - | - | - |
| 10 | - | - | - | - |
| 11 | Cylinder 1-2-3 pump injector shared cable | Cylinder 2 pump injector control | R | G |
| 12 | Cylinder 3 pump injector control | Cylinder 3 pump injector | V | R |
| 13 | Cylinder 1 pump injector control | Cylinder 1 pump injector | B | R |
| 14 | Cylinder 4 pump injector control | Cylinder 4 pump injector control | L | L |
| 15 | Cylinder 6 pump injector control | Cylinder 6 pump injector control | H | V |
| 16 | Cylinder 5 pump injector control | Cylinder 5 pump injector control | Z | Z |

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Sensor connector 2 "C"

Figure 160




Colour legend

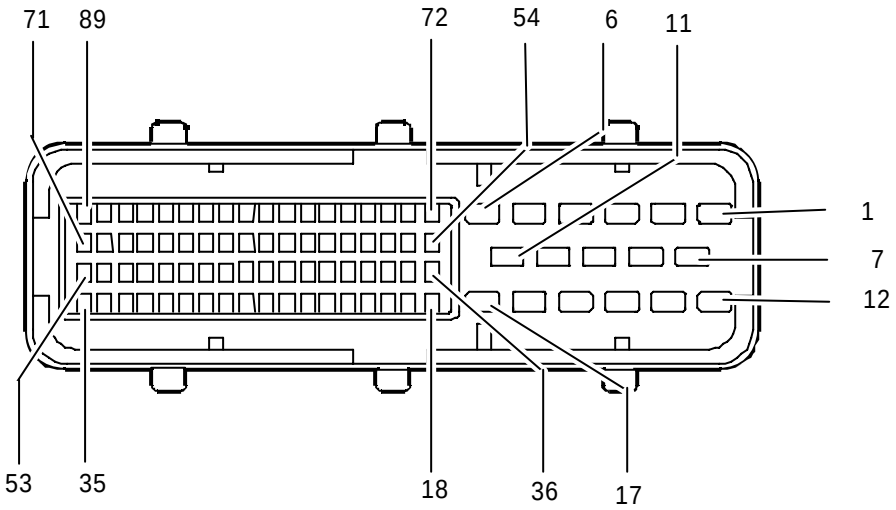
| | |
|---|---|
| C | ORANGE |
| A | LIGHT BLUE |
| B | WHITE |
| L | BLUE |
| G | YELLOW |
| H | GREY |
| M | DARK BROWN |
| N | BLACK |
| W | LIGHT BROWN |
| S | PINK |
| R | RED |
| V | GREEN |
| Z | PURPLE |

| Pin | Description | Cable colour code |
|---|---|---|
| 1 | Variable geometry turbine control solenoid | M |
| 2 | - | - |
| 3 | Variable geometry turbine control solenoid | N |
| 4÷8 | - | - |
| 9 | Earth for engine rpm sensor on timing system (timing sensor) | B |
| 10 | Engine rpm signal on timing system (timing sensor) | R |
| 11÷14 | - | - |
| 15 | Water temperature sensor signal | S |
| 16 ÷17 | - | - |
| 18 | Fuel temperature sensor earth | CN |
| 19 | Engine rpm sensor earth (flywheel sensor) | N |
| 20 | Turbocharger speed sensor earth | M |
| 21÷22 | - | - |
| 23 | Engine rpm sensor signal (flywheel sensor) | B |
| 24 | Oil temperature/pressure sensor earth | M |
| 25 | Air temperature/pressure sensor earth | B |
| 26 | Water temperature sensor earth | G |
| 27 | Oil temperature sensor signal | CN |
| 28 | Oil pressure sensor signal | L |
| 29 | - | - |
| 30 | Turbocharger speed sensor signal | B |
| 31 | - | - |
| 32 | Oil temperature/pressure sensor power supply | C |
| 33 | Air temperature/pressure sensor power supply | R |
| 34 | Air pressure sensor signal | V |
| 35 | Fuel temperature sensor signal | BR |
| 36 | Air temperature sensor signal | C |

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Chassis connector I "B"

Figure 161




| Pin | Description | Cable colour code |
|---|---|---|
| 1 | - | - |
| 2 | Control unit power supply positive (+30) | 7151 |
| 3 | Control unit power supply positive (+30) | 7151 |
| 4 | - | - |
| 5 | Ground | 0151 |
| 6 | Ground | 0151 |
| 7 | - | - |
| 8 | Control unit power supply positive (+30) | 7151 |
| 9 | Control unit power supply positive (+30) | 7151 |
| 10 | Ground | 0151 |
| 11 | Ground | 0151 |
| 12 | Ground enabling preheating activation | 0094 |
| 13÷15 | - | - |
| 16 | Ground enabling engine fan activation | 0014 |
| 17÷25 | - | - |
| 26 | Signal from fuel air temperature sensor | 5173 |
| 27 | Signal from combustion air humidity sensor | 5174 |
| 28 | Ground for combustion air humidity and temperature sensors | 0173 |
| 29 | Ground from EDC system diagnosis request switch (wiring) | 5163 |
| 30 | - | - |
| 31 | - | - |
| 32 | Ground from engine bay start-up button | 8892 |
| 33 | Engine rpm signal for bodybuilders (ST14B) | 5587 |
| 34 | Can - L line (ECB) | Green |
| 35 | Can - H line (ECB) | White |
| 36÷39 | - | - |
| 40 | Positive +15 (from IBC3) | 8015 |
| 41÷46 | - | - |
| 47 | Ground from engine bay shut-down button | 0151 |
| 48÷54 | - | - |
| 55 | Positive for engine brake solenoid (wiring) | 9966 |
| 56 | - | - |
| 57 | Positive enabling engine fan activation | 5187 |
| 58 | Ground for engine brake solenoid (wiring) | 0043 |
| 59÷67 | - | - |
| 68 | Power for combustion air humidity and temperature sensors | 8173 |
| 69÷74 | - | - |
| 75 | Positive enabling preheating activation | 9164 |
| 76÷84 | - | - |
| 85 | Ground from EDC system diagnosis request switch (wiring) | 5163 |
| 86÷88 | - | - |
| 89 | K line (diagnostic connector pin 2) | 2298 |

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## SYSTEM COMPONENTS
## Pump injector (78247)

It mainly consists of three components as follows:

A) Solenoid valve

B) Plunger unit

C) Sprayer

These three parts CANNOT be replaced individually and are NOT subject to overhaul.

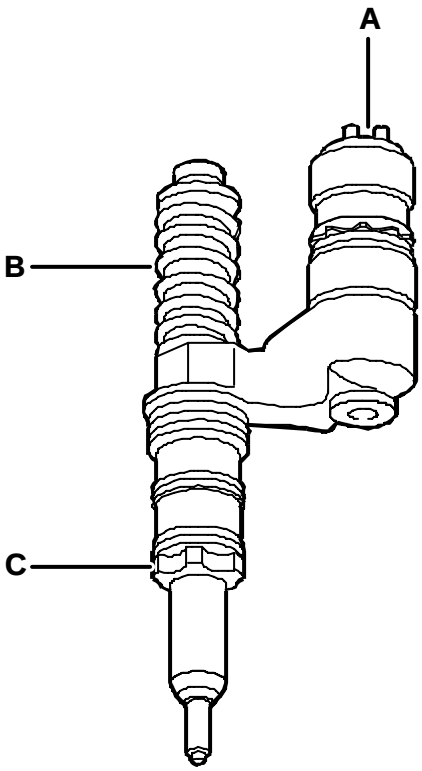
The pump is actuated mechanically at each cycle by a rocker arm and compresses the fuel contained in the pressure chamber.

The sprayer features the same assembly and operation as a conventional injector; it is opened by the fuel under pressure and injects it fine pulverized into the combustion chamber.

An electro valve controlled directly by the electronic center sets delivery modalities based on the control signal.

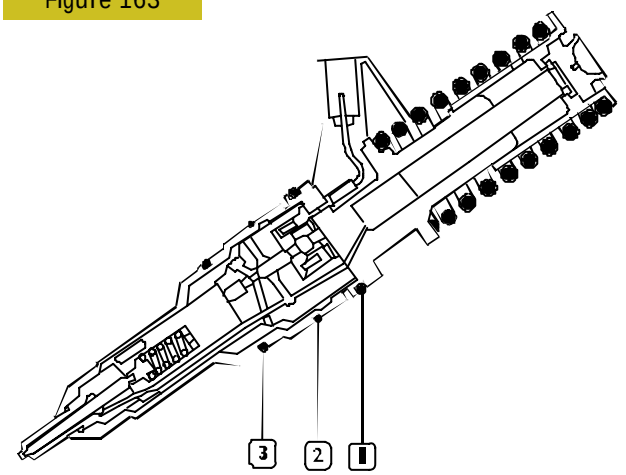
An injector holder houses the lower part of the pump injector in the cylinder head.

Figure 162




PUMP INJECTOR F2B (CURSOR 8)
1. Fuel/oil seal - 2. Fuel/diesel seal - 3. Fuel/exhaust gas seal - A. Plunger - B. Nozzle - C. Solenoid valve

Figure 163




PUMP INJECTOR F3A / F3B (CURSOR 10 / 13)
1. Fuel/oil seal - 2. Fuel/diesel seal - 3. Fuel/exhaust gas seal - A. Plunger - B. Nozzle - C. Solenoid valve

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The electro valve is of the N.A. type.

Coil resistance is ~ 0.56 ÷ 0.57 Ohm.

Maximum operating voltage is ~ 12 ÷ 15 Amp.

Based on voltage absorbed by the electro valve, the electronic center can identify whether injection was correct or mechanical problems exist.

It can also detect injector errors ONLY with the engine running or during starts.

Injectors are connected to the center with connector ST - E mounted on the engine front with a twisted cable, to avoid possible electromagnetic interference problems, so junctions or repairs on it must NOT be performed.

Figure 164

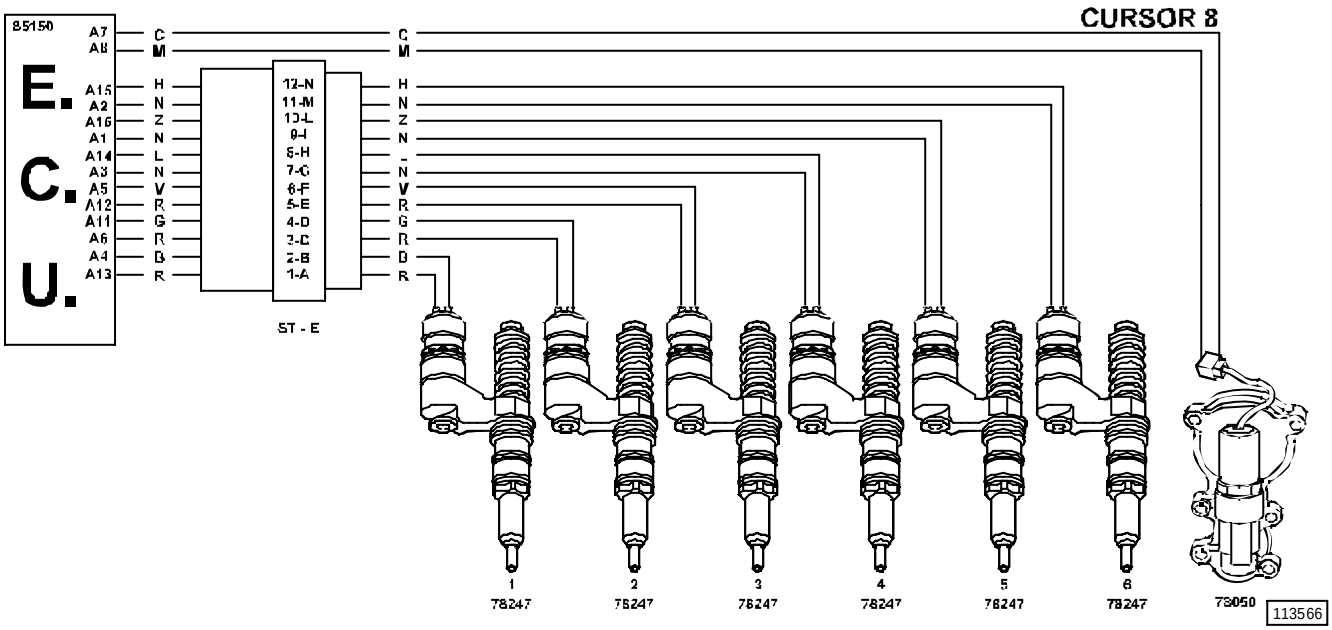
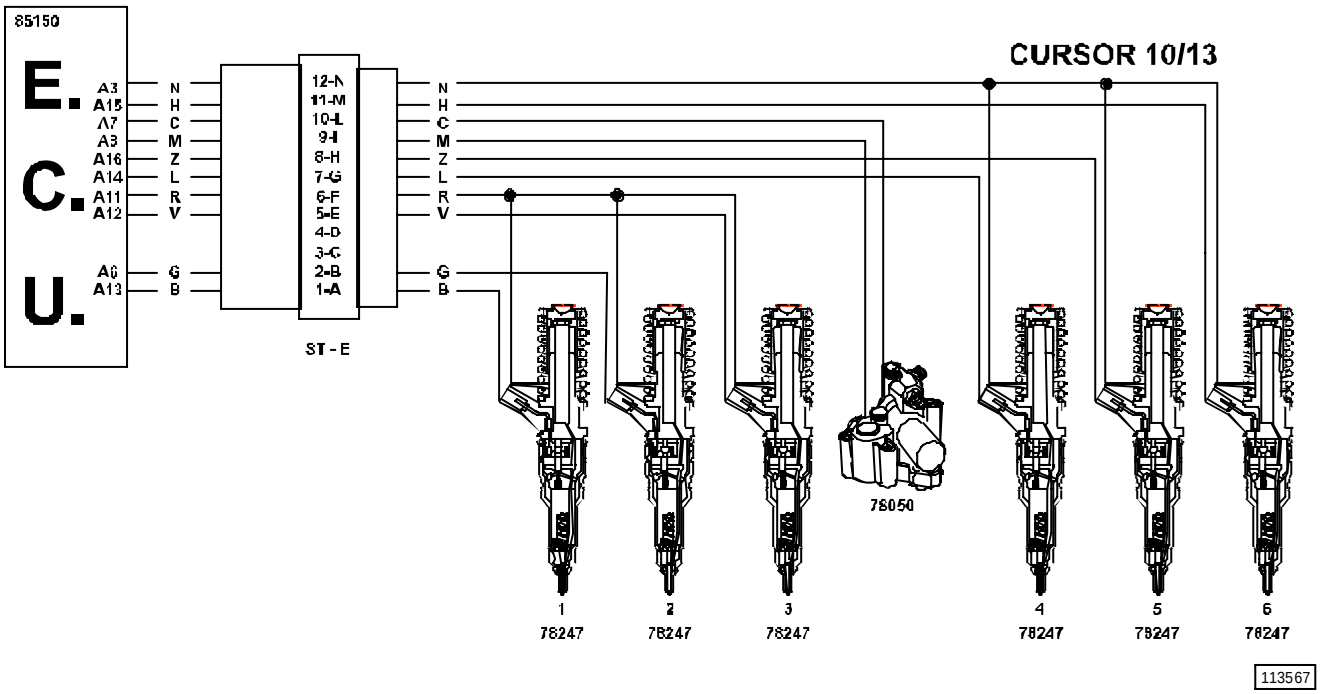


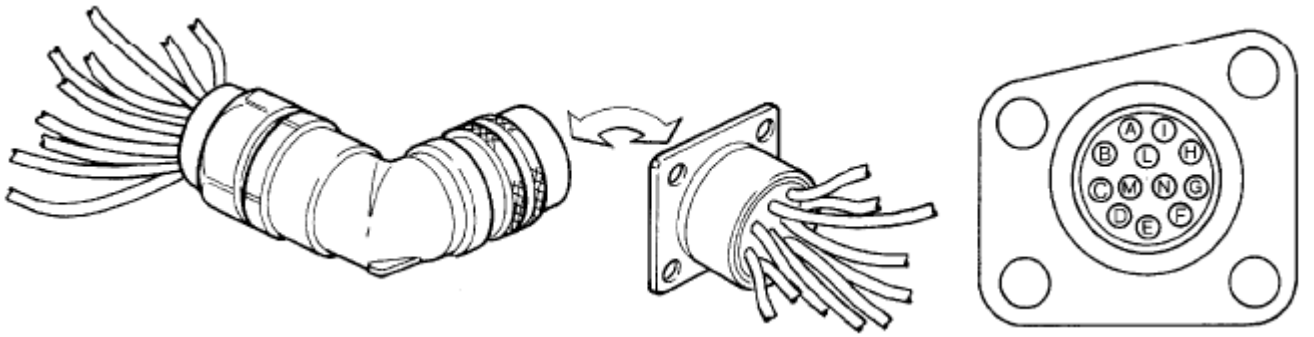

Figure 165



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## ST-E CONNECTOR

Figure 166




113569

Colour legend

| | |
|---|---|
| C | ORANGE |
| A | LIGHT BLUE |
| B | WHITE |
| L | BLUE |
| G | YELLOW |
| H | GREY |
| M | DARK BROWN |
| N | BLACK |
| W | LIGHT BROWN |
| S | PINK |
| R | RED |
| V | GREEN |
| Z | PURPLE |

| Pin ST-E | F2B | | | F3A / F3B | | |
|---|---|---|---|---|---|---|
| | Cable | Function | Pin ECU | Cable | Function | Pin ECU |
| 1-A | R | Injector 1 supply | A13 | B | Injector 1 control | A13 |
| 2-B | B | Injector 1 control | A6 | G | Injector 2 control | A6 |
| 3-C | R | Injector 2 supply | - | - | - | - |
| 4-D | G | Injector 2 control | - | - | - | - |
| 5-E | R | Injector 3 supply | A12 | V | Injector 3 control | A12 |
| 6-F | V | Injector 3 control | A11 | R | Injector 1/2/3 supply | A11 |
| 7-G | N | Injector 4 supply | A14 | L | Injector 4 control | A14 |
| 8-H | L | Injector 4 control | A16 | Z | Injector 5 control | A16 |
| 9-I | N | IInjector 5 supply | A8 | M | Engine brake control electro valve | A8 |
| 10-L | Z | Injector 5 control | A7 | C | Engine brake electro valve supply | A7 |
| 11-M | N | IInjector 6 supply | A15 | H | Injector 6 control | A15 |
| 12-N | H | Injector 6 control | A3 | N | Injector 4/5/6 supply | A3 |

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## Engine coolant temperature sensor (85153)

This N.T.C. type sensor located on the water outlet sump on the engine head left measures coolant temperature for the various operating logics with a hot or cold engine and identifies injection enrichment requirements for a cold engine or fuel reduction requirements for a hot engine.

The coolant temperature signal is used for display on the Cluster and to control the fan.

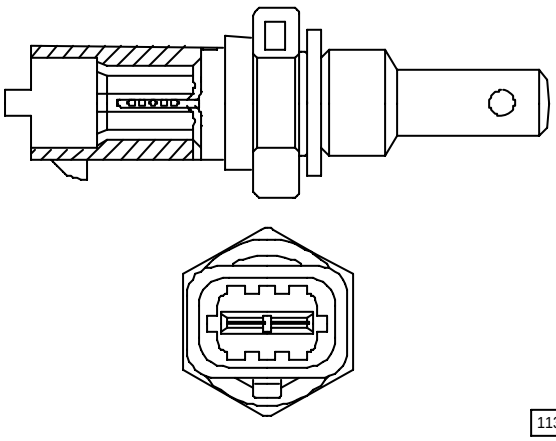
It is connected to electronic control unit pins C 15 / C 26

Sensor behavior as a function of temperature:

| | |
|---|---|
| - 10 °C | 8,10 ÷ 10,77 kOhm |
| + 20 °C | 2,28 ÷ 2,72 kOhm |
| + 80 °C | 0,29 ÷ 0,364 kOhm |

At 60 to 90 _C, voltage at C 15 and C 26 ranges from 0.6 to 2.4V.

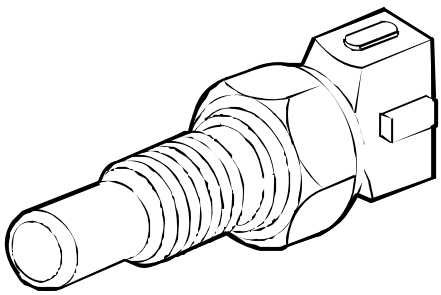
Figure 167



113561

TECHNICAL VIEW

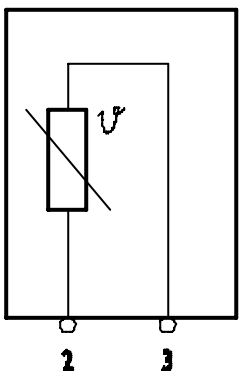
Figure 168



113562

PERSPECTIVE VIEW

Figure 169




106983

WIRING DIAGRAM

| Connector | Function | Cable colour |
|---|---|---|
| 2 | To EDC center pin C 15 | — |
| 3 | To EDC center pin C26 | — |

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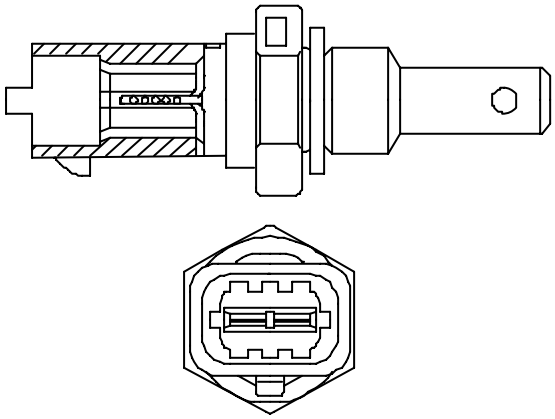
## Fuel temperature sensor (47042)

Features

| | |
|---|---|
| Supplier | BOSCH |
| Maximum torque | 35 Nm |

This N.T.C. type sensor located on the fuel filter on the engine left side detects fuel temperature and enables the electronic control unit to measure fuel density and volume for delivery correction.

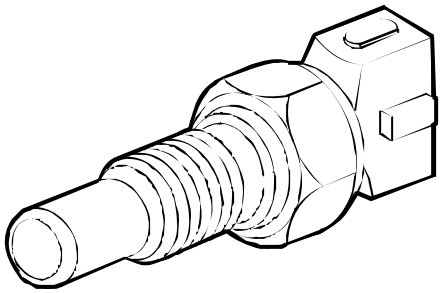
Figure 170



TECHNICAL VIEW

113561

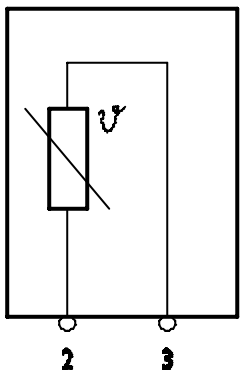
Figure 171



PERSPECTIVE VIEW

113562

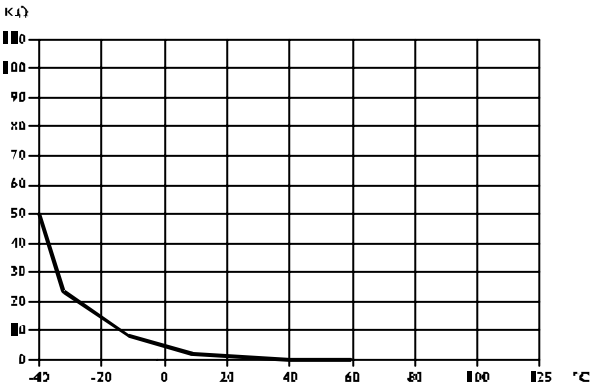
Figure 172




WIRING DIAGRAM

8528

Figure 173




RESISTANCE BEHAV IOR

113562

| Connector | Function | Cable colour |
|---|---|---|
| 2 | To EDC center pin C18 | — |
| 3 | To EDC center pin C35 | — |

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## Flywheel pulse transmitter (48035)

Features

| | |
|---|---|
| Supplier | BOSCH |
| Torque | 8 ± 2 Nm |
| Resistance | 880 ÷ 920 Ω |

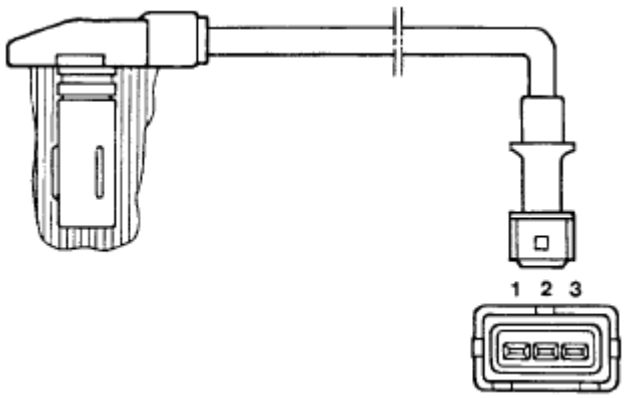
This induction type sensor located on the flywheel generates signals obtained from the magnetic flow lines that close through 54 holes in three series of 18 in the flywheel.

The electronic control unit uses this signal to detect the various engine ratings and pilot the electronic rev counter.

The rev counter does not operate in the absence of this signal.

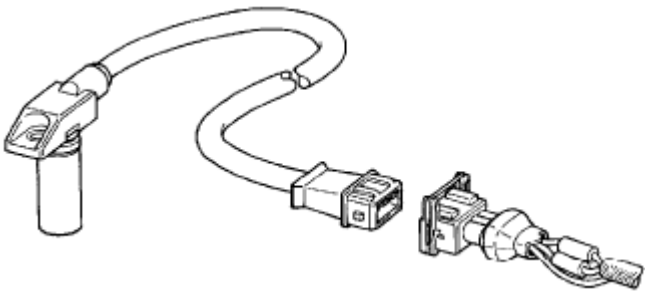
This sensor's air gap is NOT ADJUSTABLE.

Figure 174



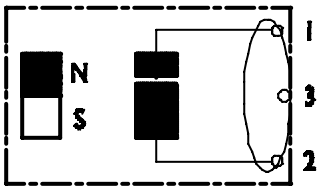

TECHNICAL VIEW 106984

Figure 175



PERSPECTIVE VIEW 106985

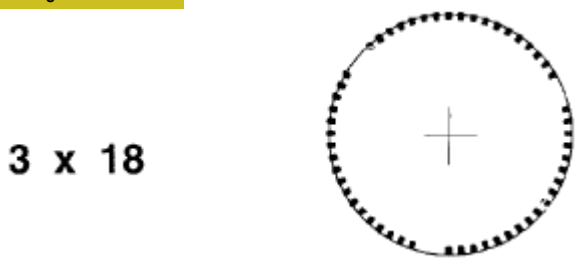
Figure 176




106986

WIRING DIAGRAM

Figure 177




8520

HOLES ON FLYWHEEL

| Connector | Function | Cable colour |
|---|---|---|
| 1 | To EDC center pin C 23 | — |
| 2 | To EDC center pin C 19 | — |
| 3 | Shields | — |

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## Camshaft pulse transmitter (48042)

Features

| | |
|---|---|
| Supplier | BOSCH |
| Torque | 8 ± 2 Nm |
| Resistance | 880 ÷ 920 Ω |

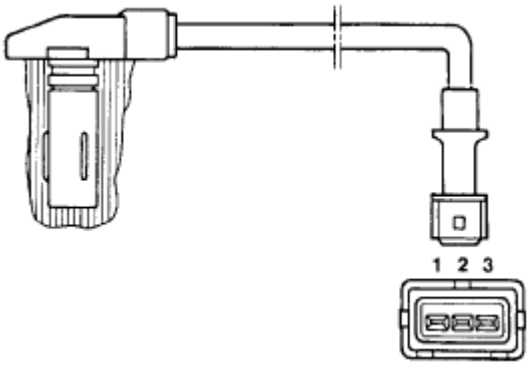
This induction type sensor located on the camshaft generates signals obtained from the magnetic flow lines that close through the 6 plus 1 phase teeth of a impulse wheel mounted on the shaft.

The electronic control unit uses the signal generated by this sensor as an injection step signal.

Though electrically identical to (48035) engine rpm sensor mounted in the camshaft in is NOT interchangeable with it as it cable is shorter and it features a larger diameter.

This sensor's air gap is NOT ADJUSTABLE.

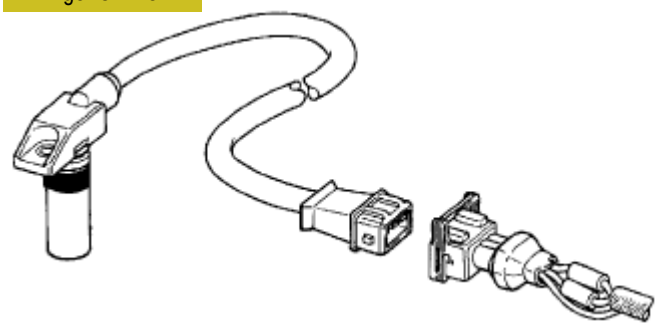
Figure 178




106987

TECHNICAL VIEW

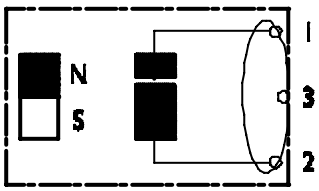
Figure 179



106988

PERSPECTIVE VIEW

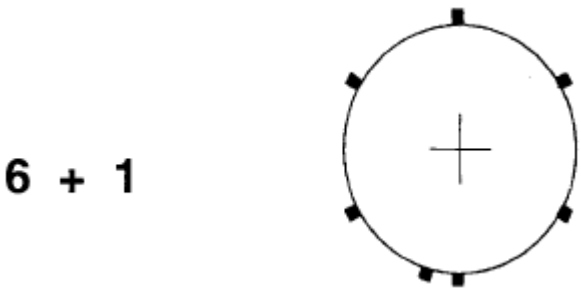
Figure 180




106989

WIRING DIAGRAM

Figure 181




8520

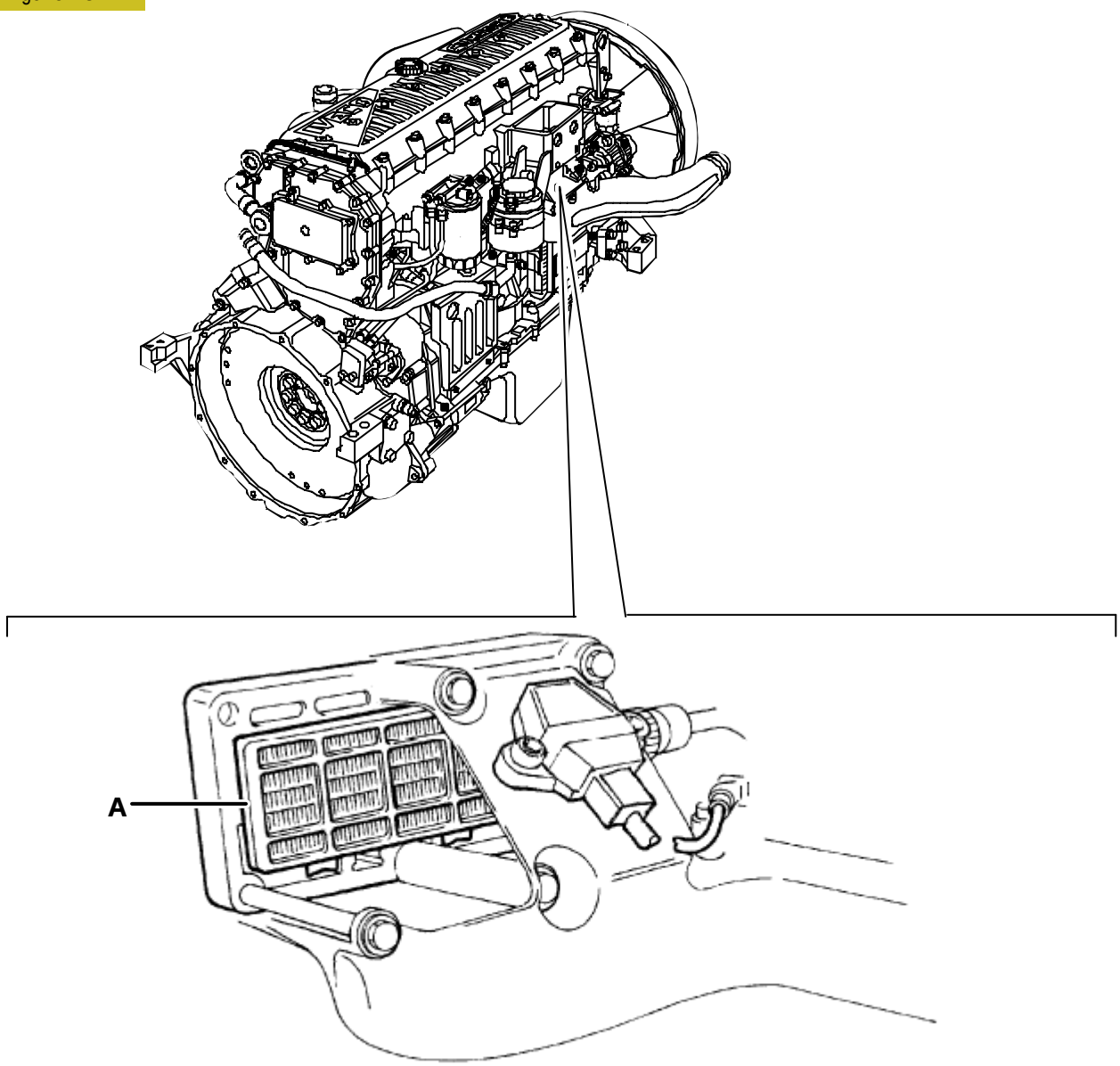
REFERENCE ON SOUND WHEEL

| Connector | Function | Cable colour |
|---|---|---|
| 1 | To EDC center pin C 10 | — |
| 2 | To EDC center pin C 9 | — |
| 3 | Shields | — |

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## Pre-post reheat resistor (61121)

Figure 182




A. Pre/ort reheat resistor / 0.7 Ohm

106990

This resistor located between the cylinder head and the intake duct is used to heat air in pre/post reheat operations.

By inserting the key switch, when even only one of the water, air or gas oil temperature sensors record less than 10 _C, the electronic center activates pre/post reheating and switches on the warning light on the cab instrument panel for a variable period according to temperature, after which the light starts blinking to inform the operator that the engine can be started.

The warning light goes off after engine start but the resistor continues being supplied for a variable period of time to complete post reheating.

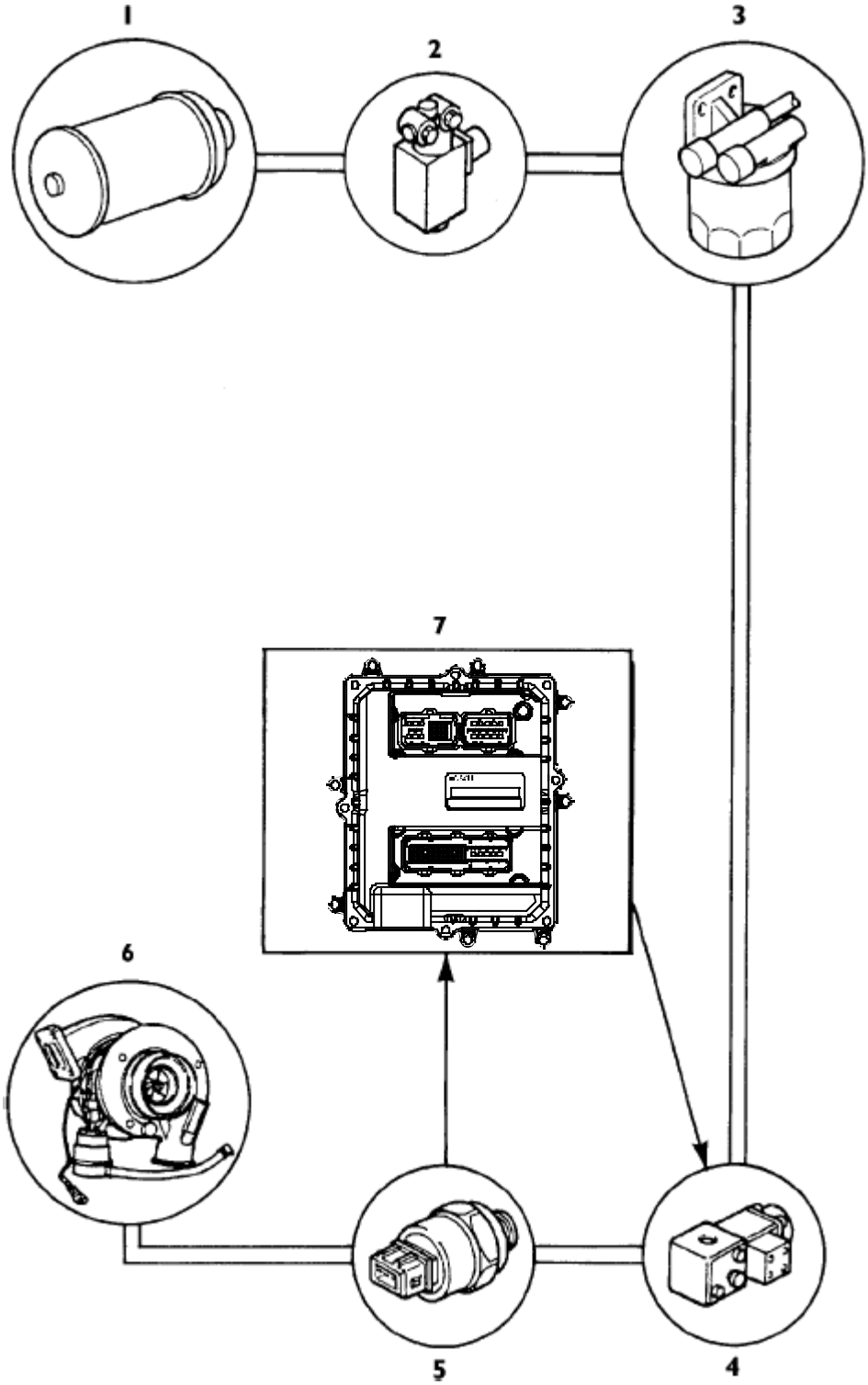
The operation is cancelled to prevent uselessly discharging the battery if the engine is not started within 20/25 seconds with the warning light blinking.

When reference temperature is above 10 _C, actuating the ignition key makes the warning light go on for some 2 seconds to complete the test and then turns it of to indicate the engine can be started.

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## VGT control card

Figure 183

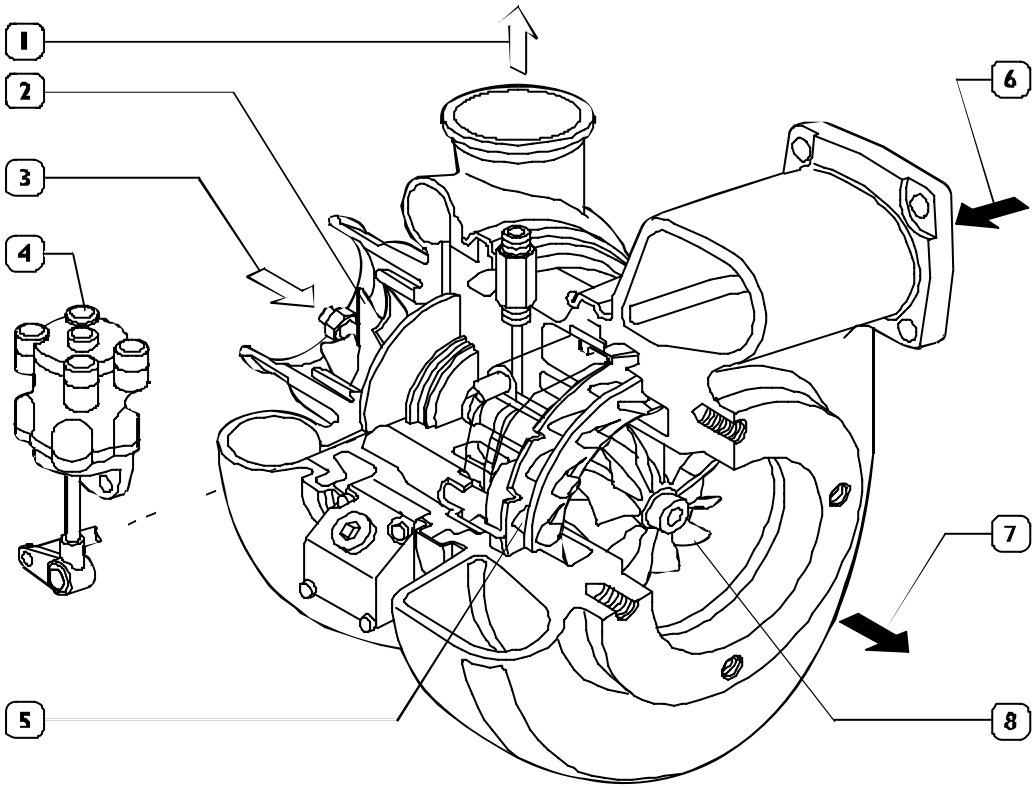



1. Service reservoir - 2. Shut-off electro valve - 3. Air filter - 4. VGT electro valve - 5. Actuator position sensor - 6. Turbine actuator - 7. EDC center

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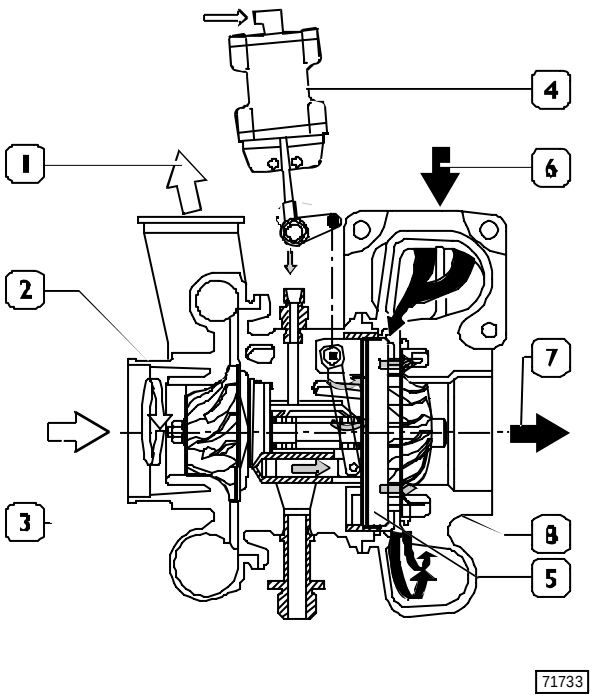
## Variable geometry Holset turbo compressor (series HY)

Figure 184

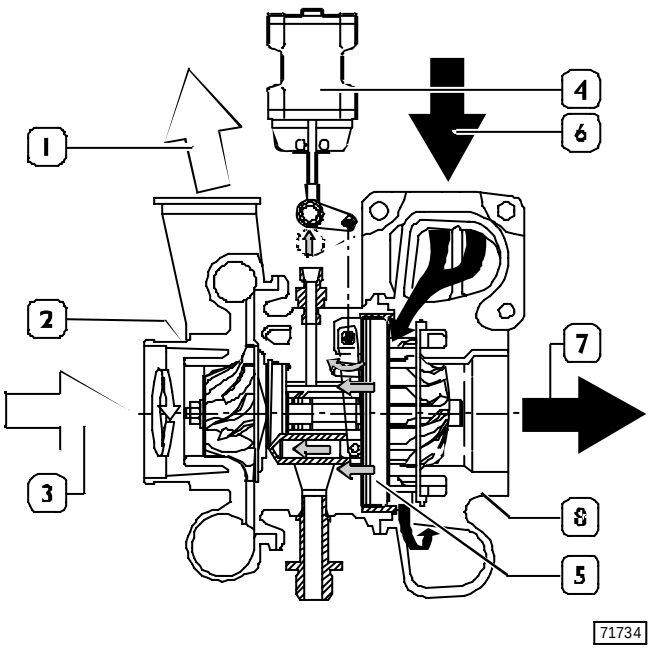



1. Intake duct air delivery - 2. Compressor - 3. Air intake - 4. Actuator - 5. Exhaust gas speed adjustment - 6. Exhaust gas intake - 7. Exhaust gas outlet - 8. Turbine

Figure 185




MINIMUM FLOW SECTION




MAXIMUM FLOW S ECTION

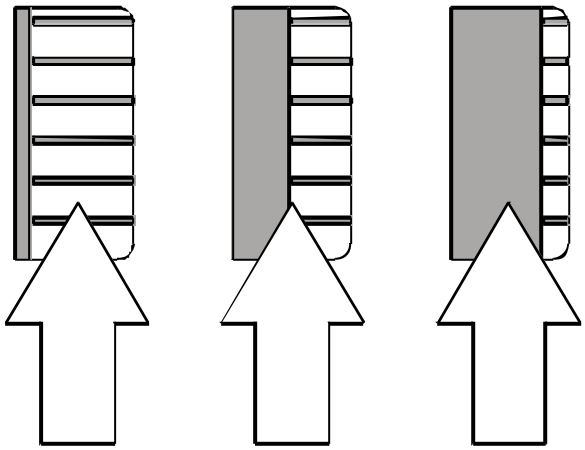
1. Air delivery to intake manifold - 2. Compressor - 3. Air intake - 4. Actuator - 5. Exhaust gas delivery adjustment ring - 6. Exhaust gas intake - 7. Exhaust gas outlet - 8. Turbine

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Operating principle

Figure 186

Exhaust gas section with engine under load




106992

The VGT variable geometry turbo compressor consists of a centrifugal compressor and a turbine provided with a mobile device that adjusts the rate of exhaust gas to the turbine rate by changing the gas passage cross section.

This solution enables keeping gas and turbine rates high even when the engine is operating at low rpm.

Making gasses pass through a reduced cross section in fact increases their rate so the turbine too rotates faster.

Movement of the exhaust gas intake cross section partialization device is obtained by means of a mechanism controlled by a compressed air actuator, which is controlled by a proportional electro valve.

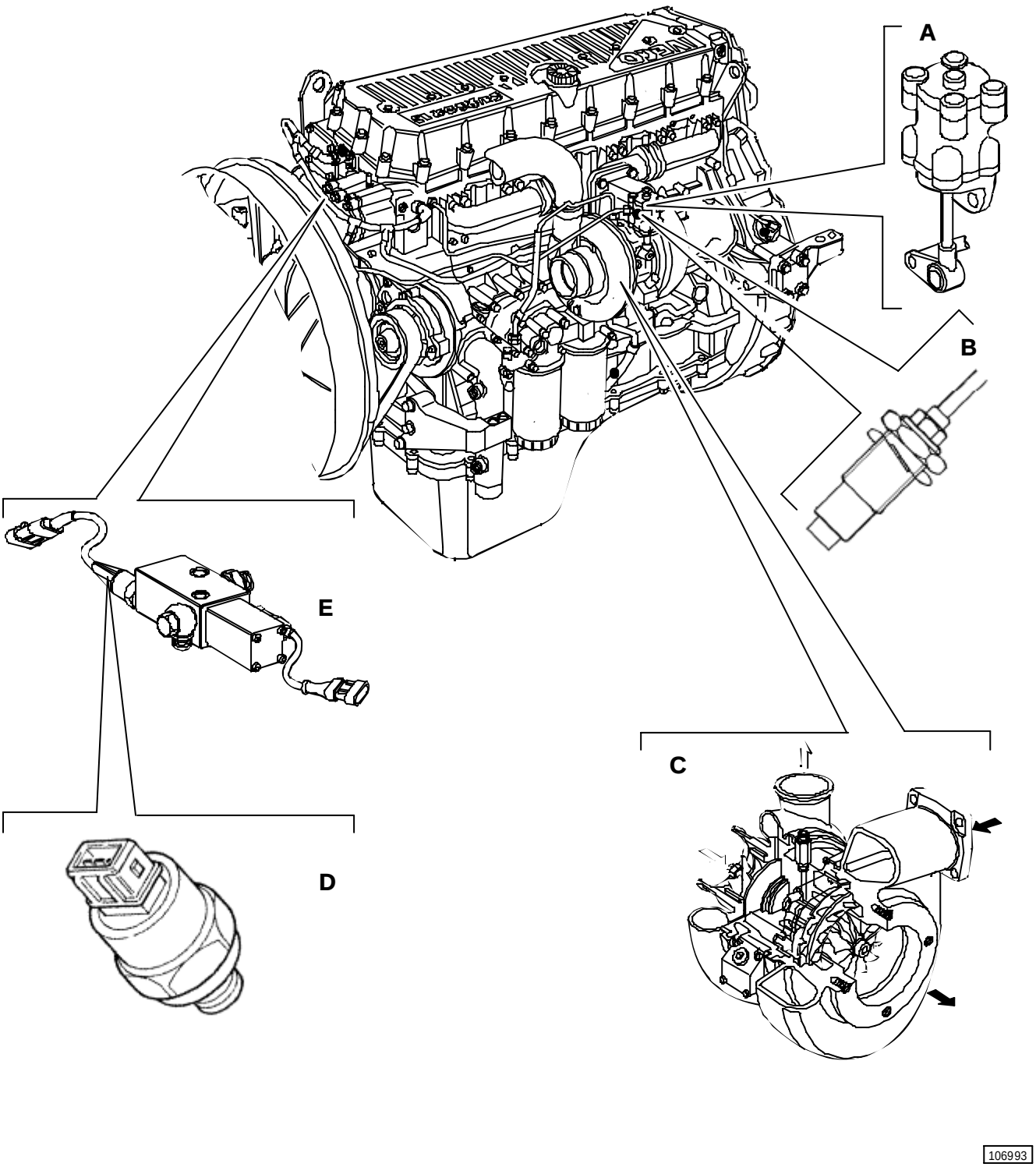
The device is fully closed at low rpm, while at high engine rpm the electronic control system increases cross section to enable incoming gasses to flow without increasing their speed.

A thoroidal chamber is cast into the central body for coolant passage.

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## Engine components (VGT)

Figure 187

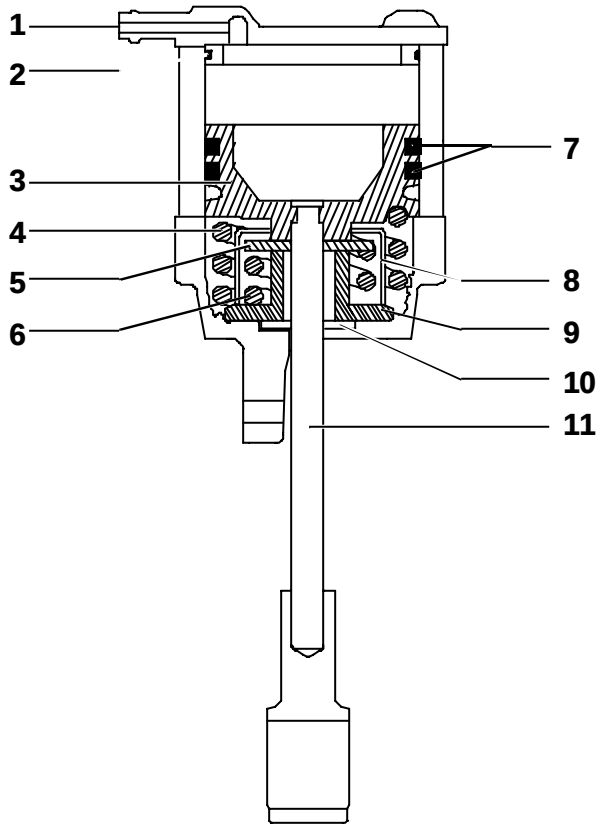



A. Actuator - B. Turbine rpm sensor - C. Turbo compressor - D. VGT actuator position sensor - E. VGT activator control electro valve

Aquila Trucks Centres

## Actuator

Figure 188




1. Air intake - 2. Washer - 3. Piston - 4. External spring - 5. Internal spring control disc - 6. Internal spring - 7. O-Ring - 8. Spring holder - 9. Run end - 10. Dust cover - 11. Control rod

Operating principle

The actuator piston connected to the control rod is piloted through the compressed air admitted from air intake 1 on the top of the actuator.

Modulating air pressure varies piston and turbine control rod movement.

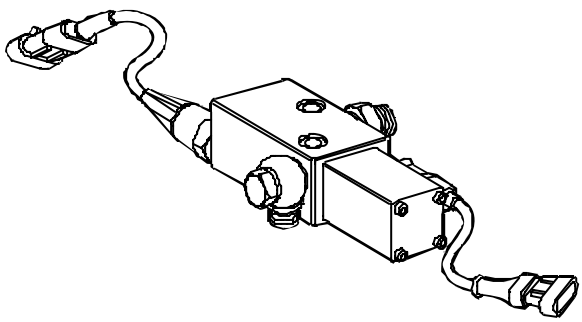
During its movement, the piston progressively compresses external spring 4 until the piston base reaches internal spring 6 control disc 5.

By further increasing pressure, the piston compresses the internal spring through disc 5 until run end, which is reached when disc 5 interferes with lower run end 10.

Use of the two springs enables changing the ratio between pressure and piston travel. About 85% of rod travel is contrasted by the external spring, the remaining 15% being contrasted by the internal one.

## VGT control solenoid valve

Figure 189




This is an N.C. type proportional solenoid valve mounted on the engine front, behind the fan.

Through a PWM signal, the electronic center pilots this electro valve to adjust turbine actuator feed pressure; actuator position changes modify the exhaust gas intake cross section on the fan blades and thus its speed.

The VGT electro valve is connected between electronic center pins C3/C1.

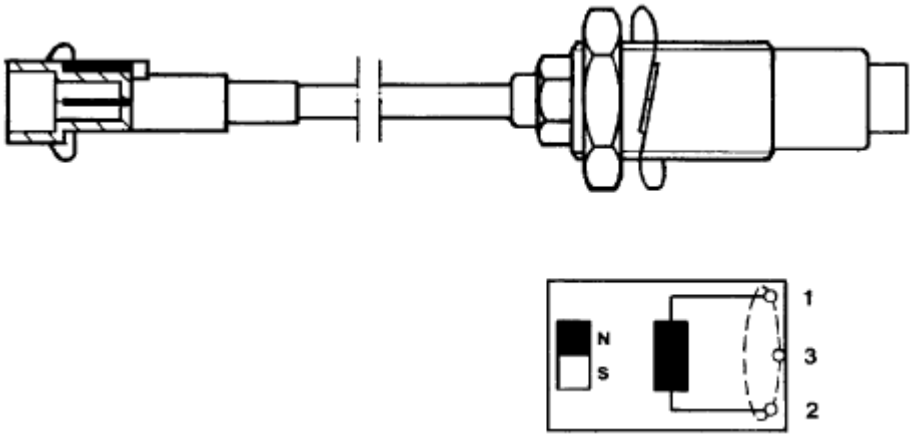
Coil resistance is ~ 20 ÷ 30 Ohm.

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## Turbine speed sensor (48043)

This is an inductive sensor positioned on the impeller shaft.
It generates signals obtained from the magnetic flow lines, which close through a notch obtained on the shaft itself.
The signal generated by this sensor is used by the electronic control unit to verify that the turbine revs number does not exceed the maximum value.
To control the revs number, the control unit acts on variable geometry.
If the revs number keeps on increasing until it reaches excessive r.p.m. values, the electronic control unit will detect an anomaly.
The gap of this sensor CANNOT BE ADJUSTED.
It is connected on electronic control unit pins C30 / C20.
The sensor resistance value is 400 Ohm.

Figure 190

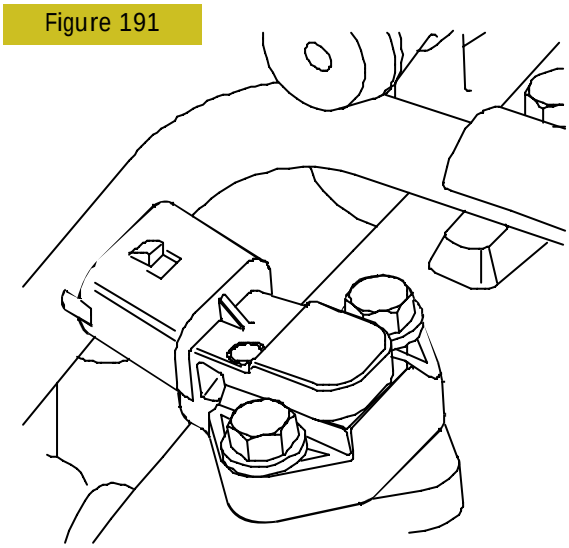



Wiring diagram

106996

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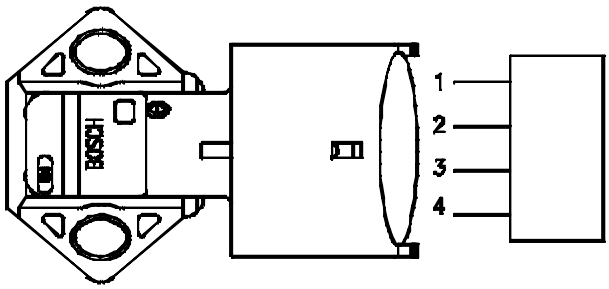
Figure 191



50324

Sensor external view

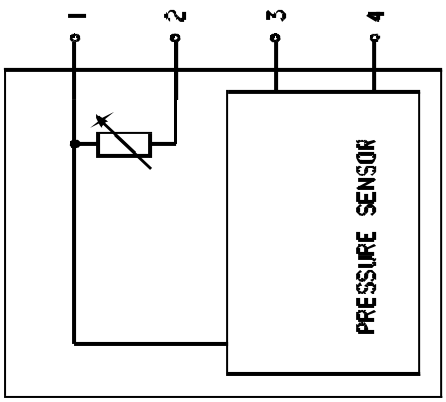
Figure 192




50323

Linking connector

Figure 193




50344

Wiring diagram

Air pressure/temperature sensor (85156).

This component incorporates a temperature sensor and a pressure sensor.

Ilt replaces the temperature sensors (85155) and pressure sensors (85154) available in the preceding systems.

It is fitted onto the intake manifold and measures the maximum supplied air flow rate used to accurately calculate the amount of fuel to be injected at every cycle.

The sensor is powered with 5 V.

The output voltage is proportional to the pressure or temperature measured by the sensor.

| | | |
|---|---|---|
| Pin (EDC) | 25/C - 33/C | Power supply |
| Pin (EDC) | 36/C | Temperature |
| Pin (EDC) | 34/C | Pressure |

Oil temperature/pressure sensor (42030 / 47032)

This component is identical to the air pressure/temperature sensor and replaced single sensors 47032 / 42030.

It is fitted onto the engine oil filter, in a horizontal position.

It measures the engine oil temperature and pressure.

The measured signal is sent to the EDC control unit which controls, in turn, the indicator instrument on the dashboard (low pressure warning lights / gauge).

| | | |
|---|---|---|
| Pin (EDC) | 24/C - 32/C | Power supply |
| Pin (EDC) | 27/C | Temperature |
| Pin (EDC) | 28/C | Pressure |

The engine oil temperature is used only by the EDC control unit.

| Ref. | Description | Control unit pin | |
|---|---|---|---|
| | | Oil | Air |
| 1 | Ground | 24C | 25C |
| 2 | Temp. Sign. | 27C | 36C |
| 3 | +5 | 32C | 33C |
| 4 | Press. Sign. | 28C | 34C |

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## Fan with electromagnetic joint (F2B)

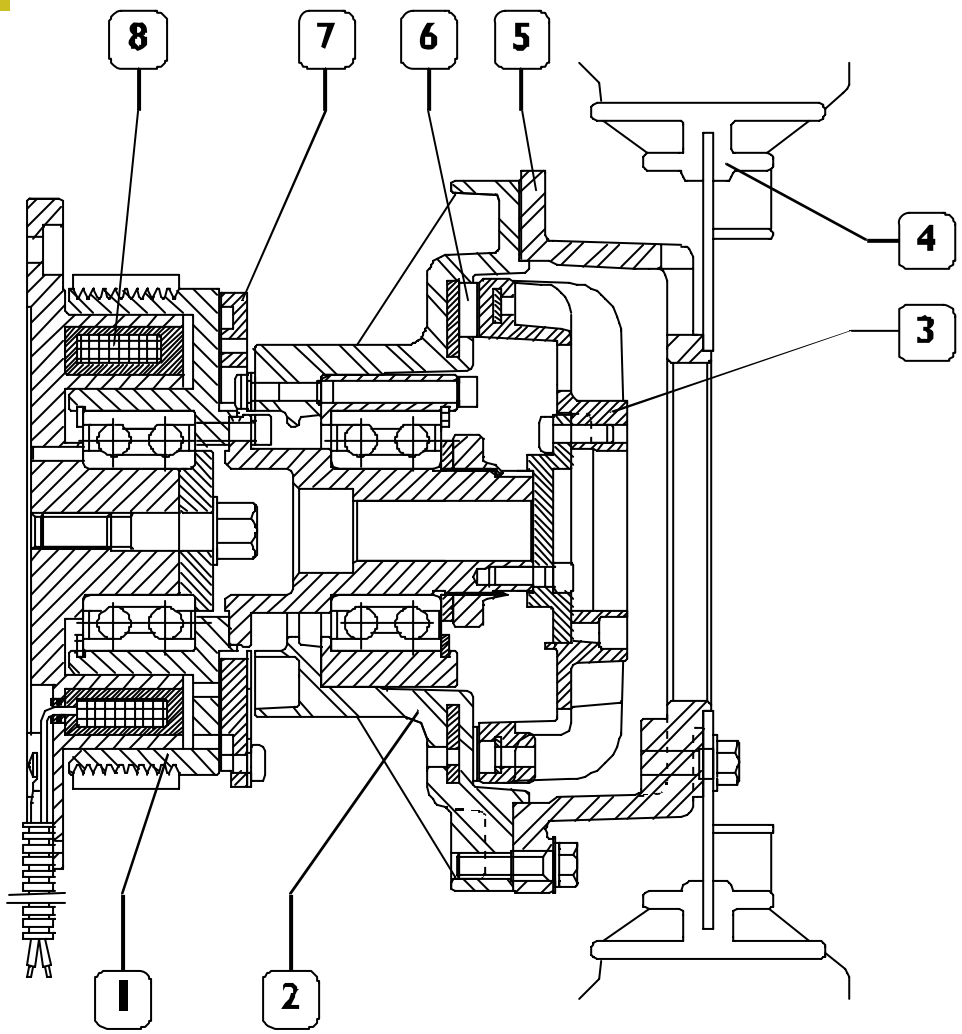
The fan has an effective speed, called second speed, that is controlled by the EDC control unit by coil (8) excitation.
When coil (8) is de-energised, the fan is driven by the four magnets (6) at a speed (called first speed) of about 450 rpm.
The first speed is activated when:

- Water temperature is less than 93° C and the Intarder and the air conditioner are off, or
- Water temperature is less than 85° C and the air conditioning system is on but the circuit pressure is below 22 bar, or
- Water temperature is less than 85° C and the Intarder is on with braking power 41% lower than max. power.

The second speed is activated when:

- Water temperature reaches 93° C with Intarder off or on with braking power less than 41%, second speed will deactivate when temperature drops to 88° C, or
- Water temperature reaches 85° C with Intarder on and braking power 41% higher than max. power or air conditioning system on and circuit pressure equal to 22 bar.

Figure 194

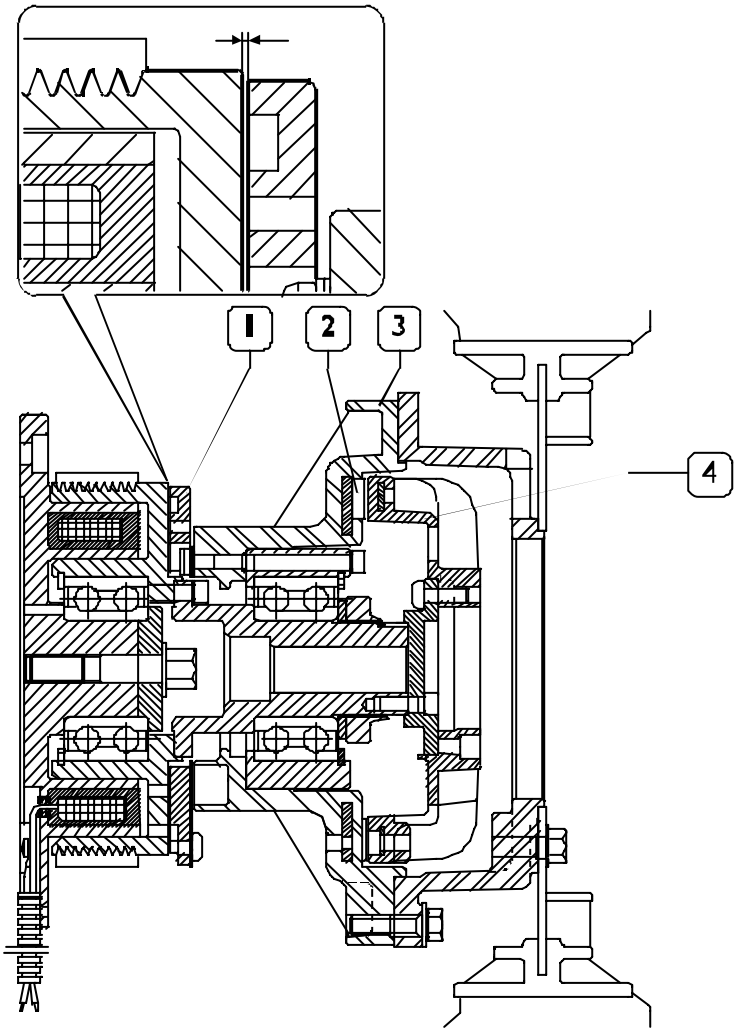



1. Pulley - 2. Support - 3. Disk with fins - 4. Fan - 5. Fan adapter- 6. Round magnets - 7. Floating ring - 8. 24V coil

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## Fan at first speed position

Figure 195




87170

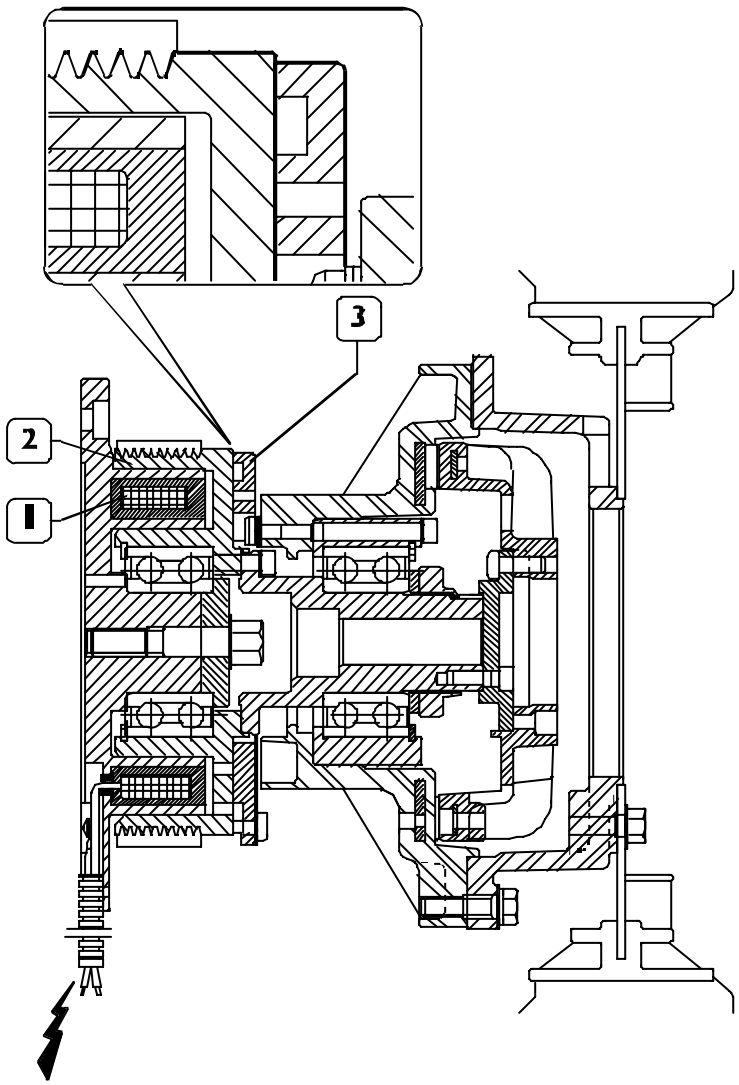
In this condition the floating ring (1) is at rest, fan movement is therefore induced by the 4 magnets (2) keyed into the support.

The first speed is therefore always actuated and due to the effect of the magnetic field generated by the magnets (2), the fan can follow the output shaft speed up to 450 rpm. Higher output shaft speeds will produce a slipping between the support (3) and the keyed disk (4).

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## Fan with second speed on

Figure 196




The second speed is activated by the EDC control unit that controls coil (1), the magnetic field generated by the coil attracts the floating ring (3) to the pulley (2), thus making them integral.

Under this condition the fan speed is proportional to the output shaft speed.

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## Fan with electromagnetic junction (F3A - F3B)

The fan features two possible rotation speeds controlled by the EDC center by exciting the compressed air electro valve for slow speed and by coil (11) for second speed.
When neither low nor second speed is activated, the fan is drawn slowly by friction forces present (neutral position).
The parameters/systems that may require fan action via the BC center are as follows:

- Coolant temperature
- Conditioning system coolant pressure
- Intarder

Low speed is activated when:

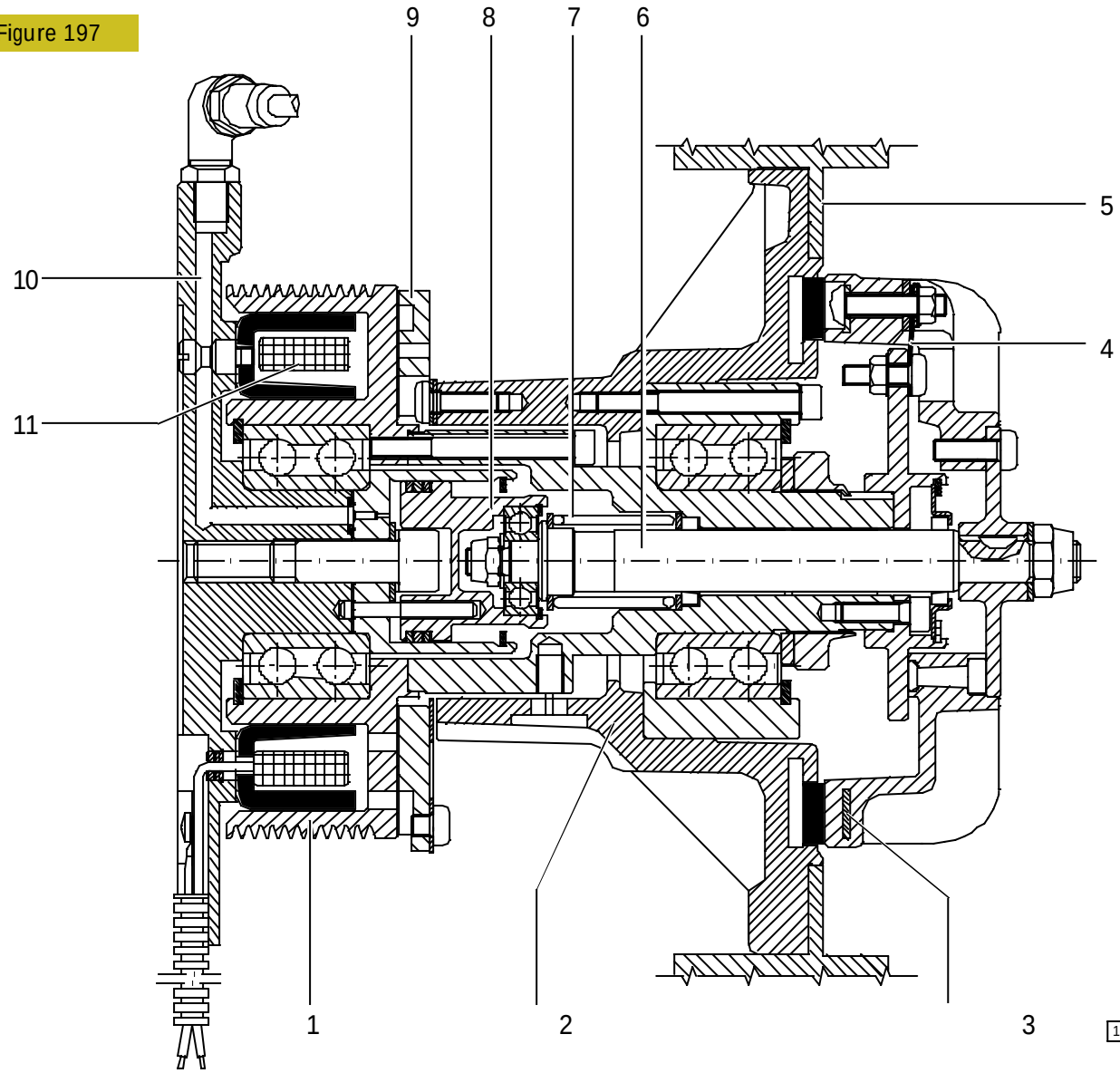
- Engine coolant temperature reaches 80 _C and the intarder is cut in at deceleration power under 41% of maximum.
- Conditioner coolant pressure reaches 18 bars.

Second speed is activated when:

- Conditioner coolant pressure reaches 22 bars.
- Engine coolant temperature reaches 80 _C and the intarder is cut in at deceleration power over 41% of maximum.
- Engine coolant temperature is over 88 _C.

When second speed activation is required, the system pilots the fan for 5 seconds at low speed, then second speed is cut in. This operating logic enables increasing belt and fan component reliability in time.
When fan low speed remains cut in for over 1 minute, the system activates second speed until control parameters return below action limits.

Figure 197

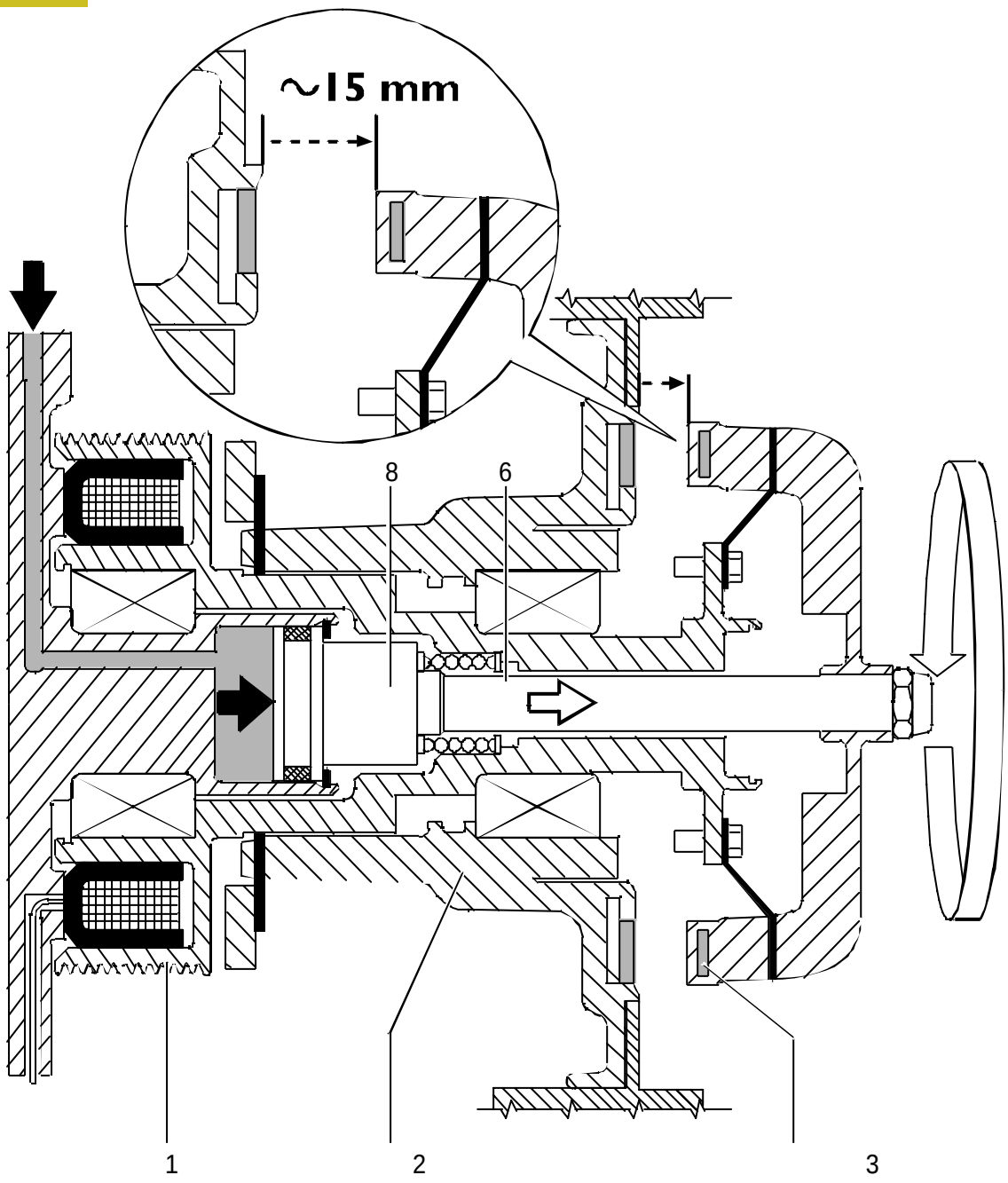



1. Pulley - 2. Fan hub - 3. Permanent magnets - 4. Blades - 5. Fan - 6. Shaft - 7. Return spring - 8. Piston - 9. Floating ring - 10. Air supply pipe - 11. Coil

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## Fan cut out (neutral position)

Figure 198



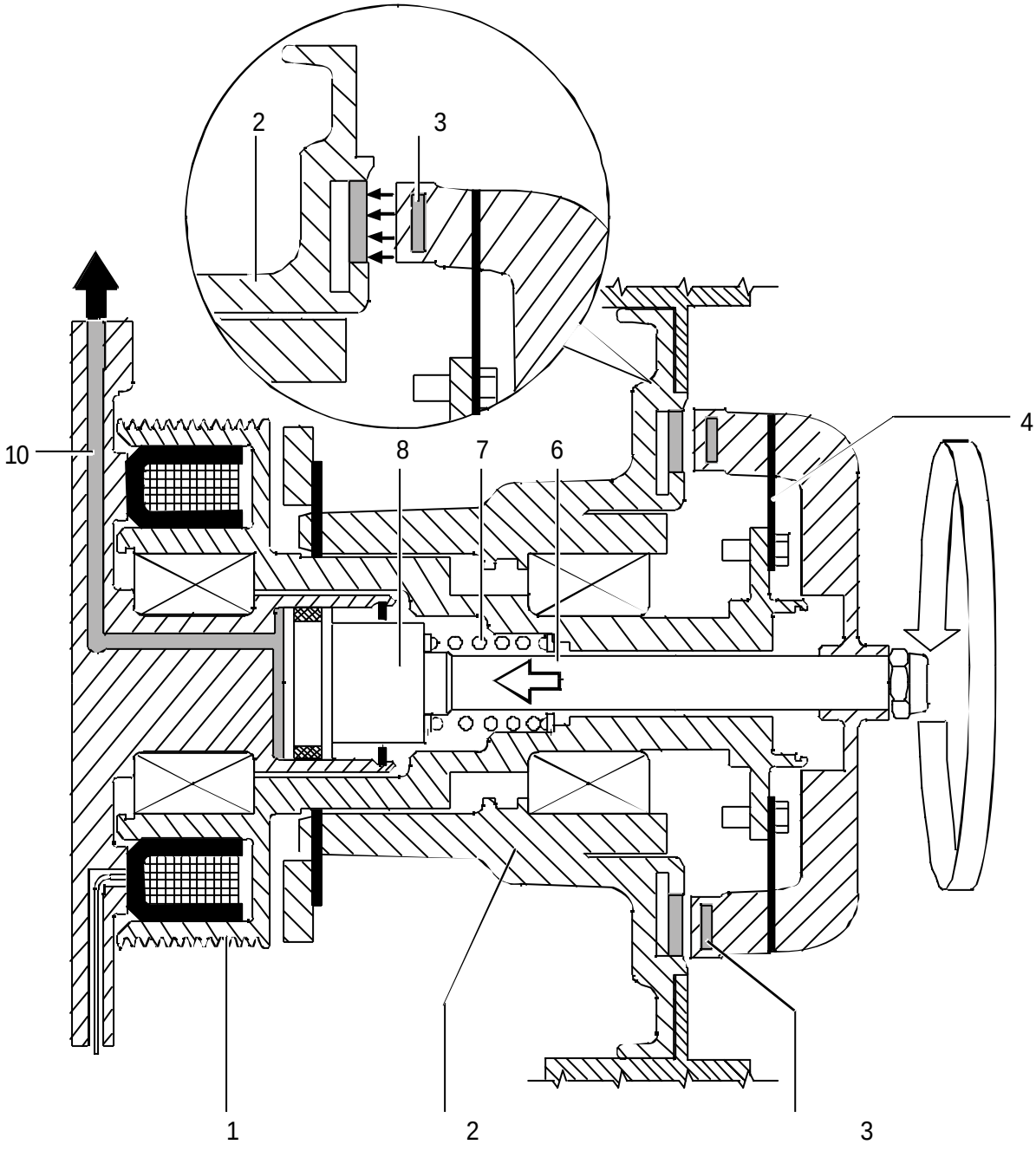

When fan action is not required for proper engine operation, the EDC center pilots the compressed air electro valve to move piston (8), displaces permanent magnets (3) from fan hub (2). The magnetic field generated by magnets (3) is not enough to move fan hub (2) by induction.

The fan may rotate slowly due to friction present.

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## Fan with first speed engaged

Figure 199




When low speed action is required, the EDC center discharge air from duct (10) through the compressed air electro valve; piston (8) moves and draws permanent magnets (3) towards fan hub (2). Piston travel is ensured by return spring (7) and blades (4).

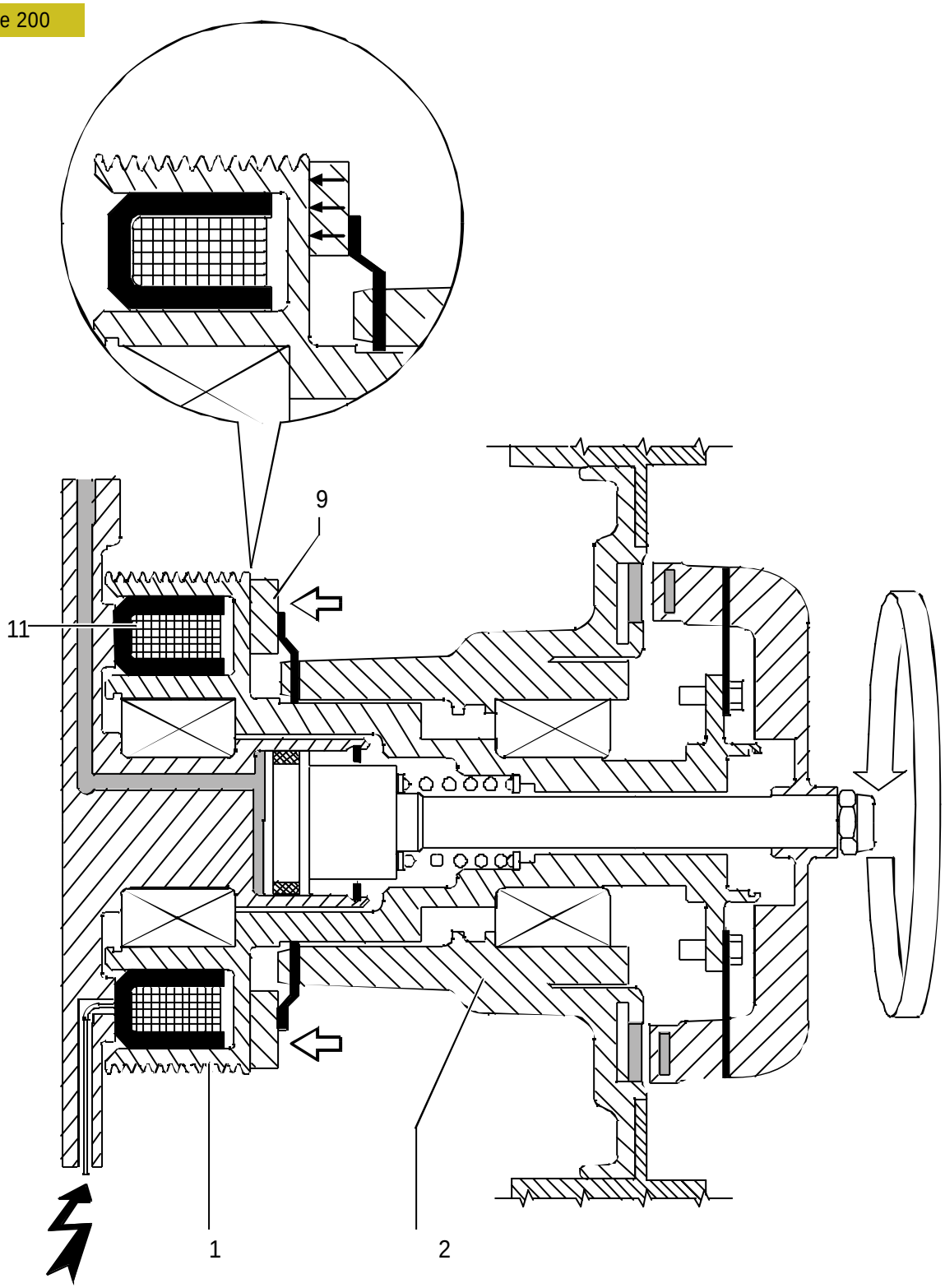
The shaft rotates at the same speed as pulley (1) and the effect of the magnetic field generated by magnets (3) is to make fan hub (2) rotate at the maximum speed of 650 rpm.

For F2B the first speed is always connected since there are no pneumatic solenoid valve nor air exhaust system inside the assembly.

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## Fan with second speed cut it

Figure 200

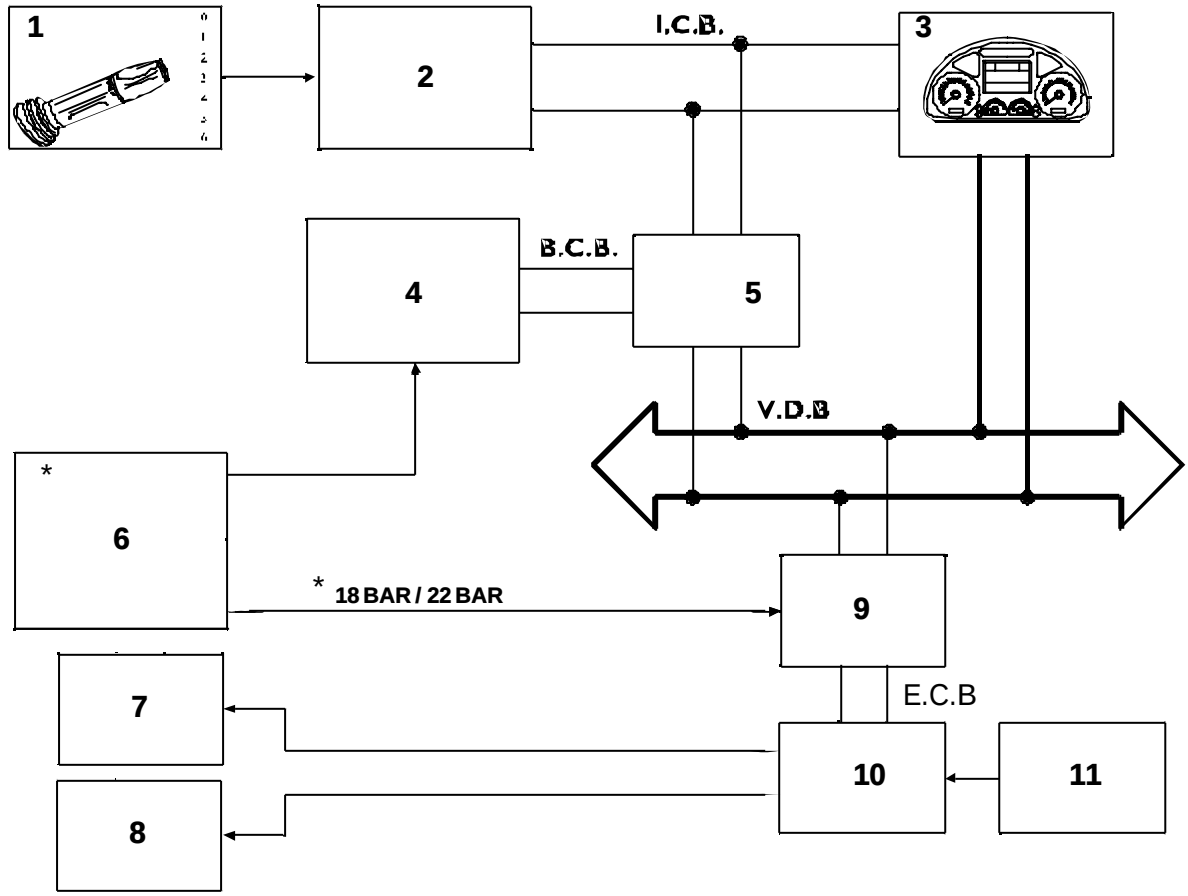



When low speed is not enough to properly cool the engine, the EDC center pilots second speed cut-in by exciting coil (11).
The magnetic field generated by the coil attracts fan hub (2) floating ring (9) to pulley (1) making the two units solidal.
In this condition fan speed is the same as pulley speed.

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## Fan control diagram

Figure 201




1. Engine brake switch - 2. Steering Wheel Interface - 3. Instrument Cluster - 4. Conditioner - 5. Body Computer - 6. Conditioner pressure switches - 7. Fan electro valve - 8. Fan electro valve - 9. VCM - 10. EDC - 11. Water temperature sensor - * The pressure switches involved in fan control are the (18-22 bar) conditioner coolant pressure warning ones.

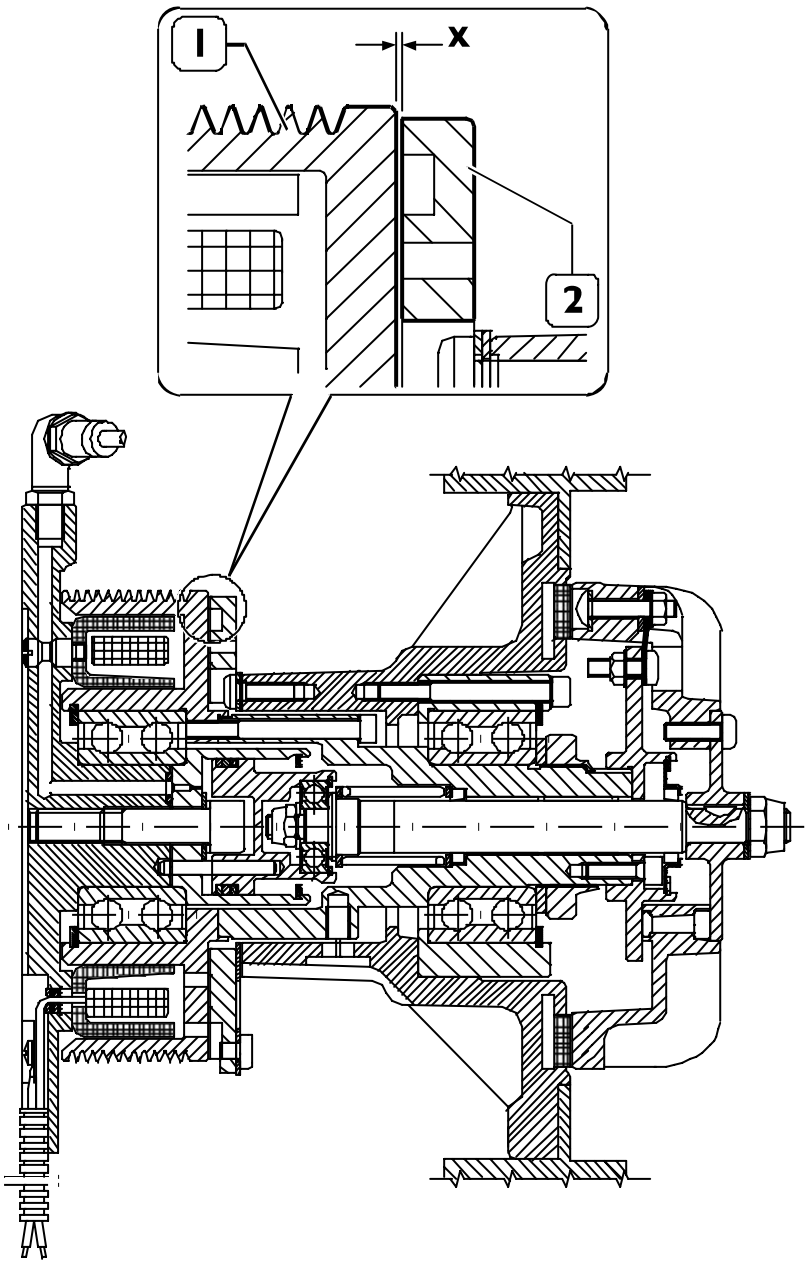
## Defect identification

| Defect | Cause |
|---|---|
| The fan always rotates at low speed | - Air supply pipe clogged<br>- Air supply pipe broken |
| The fan does not rotate above 650 rpm (low speed) | - Center output does not pilot the coil<br>- Interruption of the center to coil wire<br>- Coils short-circuited<br>- Improper mechanical parts sliding |
| The fan always rotates at second speed | - The center output always pilots the coil<br>- Improper mechanical parts sliding |

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## lectric fan wear check

Figure 202




77469

In rest conditions, gap X between pulley (1) and floating ring (2) (subject to wear) must range between 0.5 and 1.2 mm.
Wear up to maximum gap thickness of 2.5 mm is permitted.

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## VCM (VEHICLE CONTROL MODULE) ELECTRONIC CONTROL UNIT

This Electronic Control Unit is interfaced with the other on-board electronic systems through CAN lines:

- ECB - Engine Control Bus
- VDB - Vehicle Data Bus
- ICB - Instrument Cluster Bus
- FMB - Fuhrpark Managemant Bus

Among the Electronic Control Unit input signals we find those of the accelerator pedal sensor, deviator for signalling (ABS) stop, switch on clutch and switch for Economy function, which previously were connected to the EDC Electronic Control Unit.

The Immobilizer Elec. Cont. Unit is eliminated and the immobilizer antenna is connected to the Elec. Cont. Unit VCM.

The VCM operates also Cruise Control which before was connected onto Body Computer.

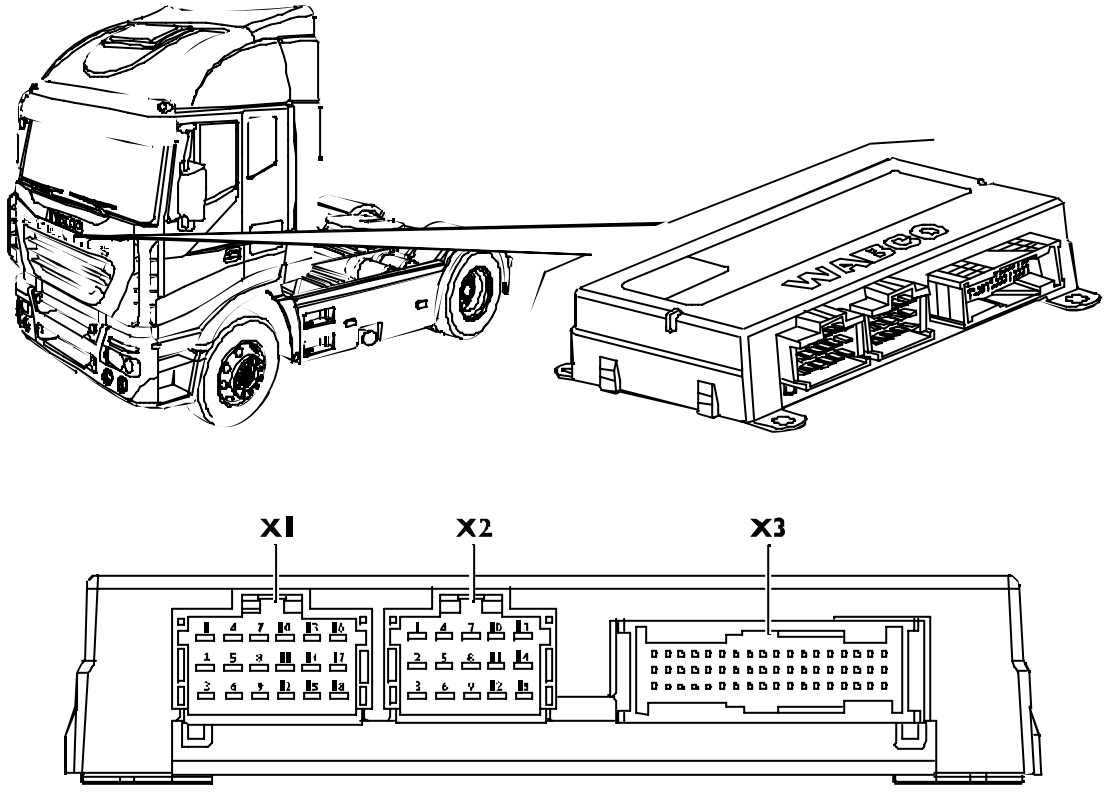
### VCM main functions

- Driveability: accelerator pedal control and generation of torque requirements via CAN towards the engine according to the driveability maps, Required torque = f (Engine Speed, Accelerator Pedal Position).
- Arbitration of the requirements of Torque and Engine Speed: from external systems (Brakes, Transmission, Fitters, etc.) towards the engine during the phases of braking, changing gear, operations in PTO mode, VCM determines the requirement with the highest priority and transmits the corresponding requirement of Torque or Engine Speed via CAN to the engine.
- Speed limiter: (main, programmable and secondary) VCM determines the extent of the requirement of torque towards the engine ensuring that the active speed limits are not exceeded.
- Cruise Control: VCM adjusts the vehicle speed according to the set Cruise speed by modulating the requirement of torque transmitted via CAN to the engine (torque limitation or control), via the requirement of turning on the exhaust brake and Intarder, integrating the control functions of the conditions of engagement and release.
- Adaptive Cruise Control: VCM reads the data of the Radar relating to the distance of the preceding vehicle, adjusts the vehicle speed according to the set Cruise speed, keeping the distance selected by the driver, modulating the requirement of torque transmitted via CAN to the engine (torque limitation or control), via the requirement to turn on the exhaust brake and Intarder, integrating the functions of control of the conditions of engagement and release and in case of risk of collision activating the conventional brakes (interacting with the EBS system).
- Engine starting / stopping control logic and associated safety devices: requirement control from cab, engine bay, fitter connector.
- Power take off (PTO mode): management of the requirement to adjust engine speed via CAN in accordance with the conditions relating to the PTO 0, 1, 2, 3 (pre-programmed) modes with actuation by the engine.
- Low Idle control logic: dynamic High Idle control with requirement relating to the engine via CAN the VCM controls the requirement for engine speed adjustment via CAN with actuation by the engine.
- Exhaust Brake activation logic: control of driver requirements and arbitration of the requirements from external systems (Brakes, Transmission, Fitters, etc.), transmission of the value via CAN and actuation by the engine.
- Engine cooling fan activation logic (Baruffaldi): management of control logic, transmission of the activation request via CAN and actuation by the engine.
- ZF Simple H Gearbox: gearbox control with solenoid activation to pass from low range and high range in conditions of safety
- ALLISON Gearbox: standard CAN interface control on lever side, external requirements (Fitters) and for display logic on Instrument Panel.
- New EUROTRONIC lever (used for ALLISON too): driver requirement control for sending to EUROTRONIC gearbox and recovery in case of breakdown.
- Vehicle security system: Immobilizer
- Communication on CAN bus: Point-to-point communication from external bus for dedicated connection to apparatuses of Fleet Management in accordance with Bus - FMS. Interface for connection to Tester for diagnosis via CAN of the on-board systems.
- Others: Interface towards Instrument Panel on dedicated bus (ICB on Heavy Range) for information / controls to / from Driver. HW signal generation for fitter connector.

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## Electronic Control Unit location

Figure 203




## Pin - out

Connector X1

| Pin | Description | Cable color code |
|---|---|---|
| 1 | Immobiliser aerial input signal | - |
| 2 | - | - |
| 3 | Immobiliser aerial output signal | - |
| 4 | Positive +30 (from IBC3) | 7993 |
| 5 | Positive +15 (from IBC3) | 8802 |
| 6 | Ground | 0000 |
| 7 | Gearbox in neutral signal for body builders (ST14A) | 8050 |
| 8 | Power to ACC (Adaptive Cruise Control) distance rule reached indicator warning light / Positive for splitter gear activation solenoid (9 speed gearbox) | 6179/9973 |
| 9 | EDC system faulty signal for cluster | 6150 |
| 10 | Handbrake engaged signal for bodybuilders (ST14A) | 6656 |
| 11 | Power to ACC (Adaptive Cruise Control) distance alarm buzzer / Positive for normal gear activation solenoid (9 speed gearbox) | 1166/9974 |
| 12 | Clutch status signal for bodybuilders (ST14B) | 9963 |
| 13 | Brake light signal for bodybuilders (ST14A) | 1165 |
| 14 | Signal indicating programmable speed threshold (PST) for bodybuilders (ST14B) | 5542 |
| 15 | Ground controlling starter motor relay | 0008 |
| 16 | Positive controlling starter motor relay | 8888 |

Connector X2

| Pin | Description | Cable color code |
|---|---|---|
| 7 | Positive 5 V for distance control with ACC (Adaptive Cruise Control) at great distance | 8179 |
| 8 | Return from distance selector with ACC (Adaptive Cruise Control) | 6178 |
| 9 | Ground cable for ACC distance control | 0139 |

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## Pin - out

Connector X3

| Pin | Description | Cable color code |
|---|---|---|
| 1 | CAN L line (VDB) | White |
| 2 | CAN H line (VDB) | Green |
| 3 | - | - |
| 4 | Ground from coolant pressure indicator switch (22 bars) | 0583 |
| 5 | Ground from coolant pressure indicator switch (18 bars) | 0582 |
| 6 | - | - |
| 7 | Control cable for activating ACC | 0179 |
| 8 | Ground from switch indicating gearbox in neutral | 8050 |
| 9 | - | - |
| 10 | Ground from engine brake wiring switch (associated with accelerator pedal release) | 0082 |
| 11 | - | - |
| 12 | Positive from ignition key terminal 50 (ignition control) | 8888 |
| 13 | Second speed limiter engagement signal from body builders (ST14B) | 0172 |
| 14 | Positive from brake indicator switch (brake pedal pressed - main brake lights) | 8153 |
| 15 | Positive from brake indicator switch (brake pedal released - secondary brake lights) | 8158 |
| 16 | - | - |
| 17 | Positive for accelerator pedal sensor | 5158 |
| 18 | - | - |
| 19 | Can H line (ECB) | White |
| 20 | Can L line (ECB) | Green |
| 21 | - | - |
| 22 | - | - |
| 23 | Ground from switch (N) for neutral position gear with automatic gearbox | 0147 |
| 24 | Ground from switch (D) for forward gears with automatic gearbox | 0125 |
| 25 | Ground from switch (D) for forward manoeuvre gears with automatic gearbox | 0127 |
| 26 | Engine stop signal ( ST14A pin 2) | 0151 |
| 27 | Engine start-up signal from diagnostic interface/body builders (ST14A) | 8892 |
| 28 | Ground from start-up enablement switch | 8892 |
| 29 | Signal from cab release indicator switch | 0096 |
| 30 | Ground from Cruise Control cut-out switch (OFF) | 8154 |
| 31 | Ground from Cruise Control resume switch (RESUME) | 8155 |
| 32 | Ground from Cruise Control speed increase switch (SET+) | 8156 |
| 33 | Ground from Cruise Control speed decrease switch (SET-) | 8157 |
| 34 | Signal from switch indicating engine idling | 0159 |
| 35 | Signal from accelerator pedal sensor | 5157 |
| 36 | - | - |
| 37 | CAN H Line (FMB) | White |
| 38 | CAN L Line (FMB) | Green |
| 39 | - | - |
| 40 | - | - |
| 41 | Ground from switch (R) for reverse gears with automatic gearbox | 0126 |
| 42 | Ground from switch (D) for reverse manoeuvre gears with automatic gearbox | 0128 |
| 43 | - | - |
| 44 | - | - |
| 45 | Ground for power take-off 3 request from body builders (ST14A) | 0123 |
| 46 | Ground for power take-off 2 request from body builders (ST14A) | 0123 |
| 47 | Ground for power take-off 1 request from body builders (ST14A) | 0131 |
| 48 | Ground from signalling switch connection of slow gears (9 gear changes) | 0117 |
| 49 | Cruise Control selection signal (INT / EXT) from body builders (ST14A) | 0158 |
| 50 | Signal from switch (SL) for speed limiter with automatic transmission | 9968 |
| 51 | Signal from switch on clutch for VCM (clutch cylinder 20% compressed) | 0160 |
| 52 | Ground from accelerator pedal idle switch | 0158 |
| 53 | Ground for accelerator pedal sensor | 0157 |
| 54 | VCM control unit K line (diagnostic connector pin 12) | 2292 |

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# IMMOBILIZER

## Description and operation

Vehicles are provided with an immobilizer engine lock that is activated automatically by removing the starter key, to increase protection against theft. Keys are provided with an electronic transponder that transmits a coded signal to an ICU centre that only enables engine start at code recognition.

IMMOBILIZER central unit on Euro 4 vehicles is integrated into VCM.
Main technical features are:

- D IMMO central unit integrated into VCM
- D New keys (colour BLUE)
- D Min 2 max 7 programmable keys
- D New antenna connector

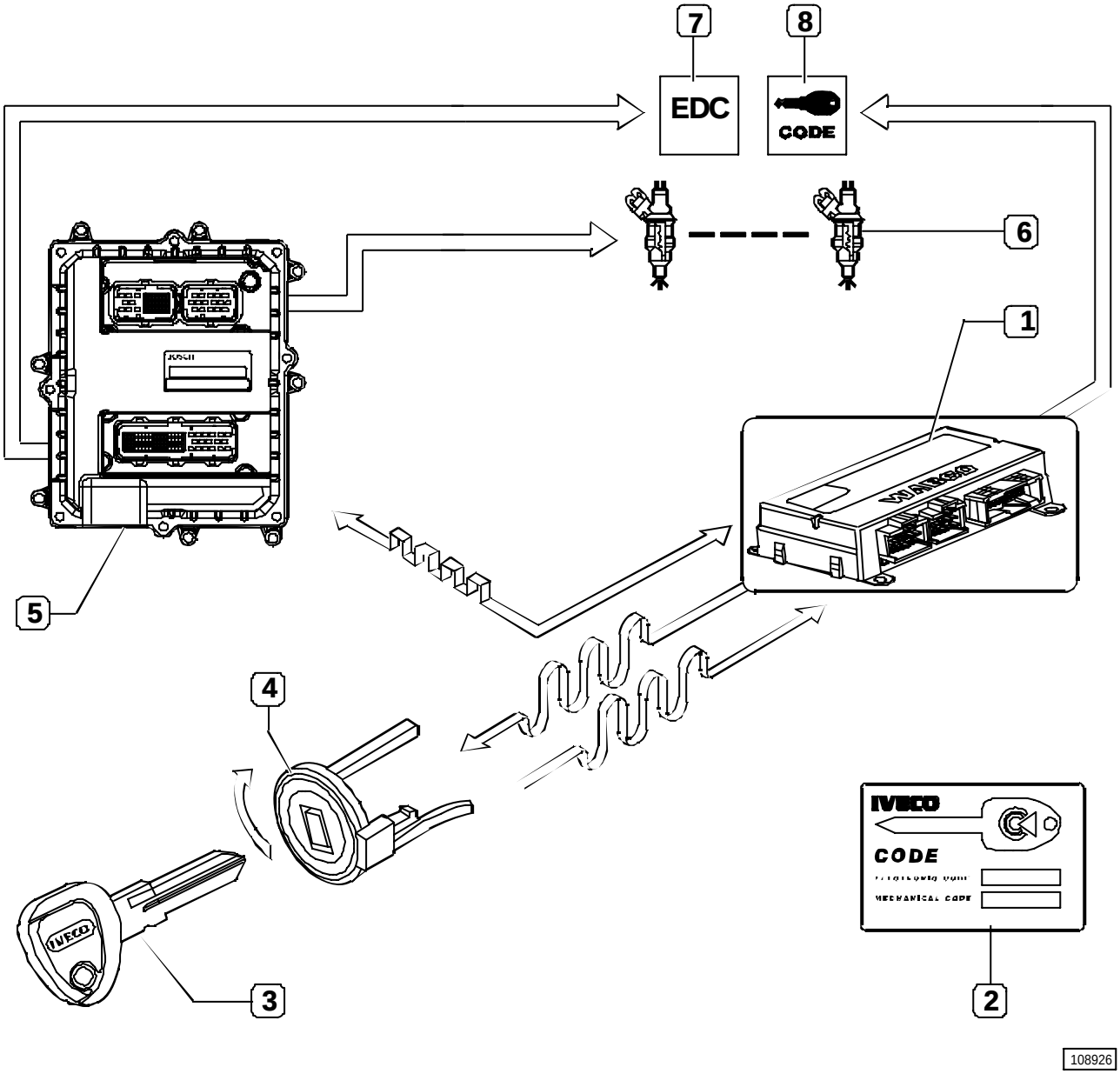
VCM / Immobilizer procedures

| | |
|---|---|
| Replacing a key<br>Adding a key | 1) Cut the key into based on existing mechanical profile<br>2) Provide yourself with Code card<br>3) Go to environment ENGINE / VCM-IMMOBILIZER / SPECIFIC FUNCTIONS / KEY STORING |
| Replacing all keys<br>(loss) | CAUTION!<br>In this procedure, also add working remaining keys, otherwise they will not be enabled any more at start-up.<br>Order the new keys and program them as described above.<br><br>(Replacing or Adding a key) |
| Replacing VCM-IMMOBILIZER central unit<br>(NOT COMMUNICATING WITH DIAGNOSIS DEVICE) | 1) Replace ECM central unit.<br>2) Go to environment ENGINE \ ECM-EDC7 UC31 / SPECIFIC FUNCTIONS / ACKNOWLEDGING NEW ECM<br>(enter the electronic code that is present on code card).<br><br>N.B:This operation is necessary to have the new ECM central unit acknowledge the VCM that is present on the vehicle.<br><br>D If old VCM is out of order and is not communicating any more, ECM must also be either replaced or re-programmed through remote services (Immo code erased).<br><br>N.B:Only for VCM 5.4 versions<br>D If old VCM is out of order and is not communicating any more with the other vehicle communication BUSes, the emergency start via electronic code insertion is not possible. |
| Replacing VCM-IMMOBILIZER central unit<br>(NOT COMMUNICATING WITH DIAGNOSIS DEVICE) | 1) Cut the keys into based on existing mechanical profile.<br>2) Perform following operations:<br>a) Go to environment / ENGINE \ VCM IMMOBILIZER / PROGRAMMING / OTHER / REPLACING VCM<br>b) Go to environment ENGINE / VCM IMMOBILIZER / SPECIFIC FUNCTIONS / KEY STORING (2 new keys)<br>c) Mount the old VCM to make VCM / ECM disconnection (present 5.4 version )<br>d) Go to environment ENGINE / VCM IMMOBILIZER / SPECIFIC FUNCTIONS / ACKNOWLEDGING NEW VCM<br>e) Remount the new VCM and perform the start-up operation. |

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## Componentry

Figure 204




## Componentry

| Ref. | Description |
|---|---|
| 1 | Central unit VCM |
| 2 | Code-card |
| 3 | Electronic key |
| 4 | Antenna |
| 5 | EDC injecton control eletronic centre |
| 6 | Electro injectors |
| 7 | Indicator light EDC |
| 8 | IMMOBILIZER down warning light |

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## ABS-EBL ANTI–LOCK BRAKE SYSTEM - ELECTRONIC BRAKE LIMITER SYSTEM

The ABS – EBL braking system is available as an alternative to the EBS system on 4x2 e 6x2 vehicles.

### ABS Anti – Lock Brake System

Braking a moving vehicle and is deceleration and stopping distance are essentially dependant on adherence between tire and road surface. Improved braking with an efficient braking system can only be achieved by acting on tire friction features or road surface quality.

Improved braking with an efficient braking system can only be achieved by acting on tire friction features or road surface quality.

Even in optimum conditions, absolutely safe braking is not guaranteed when critical situations have to be coped with, such as low adherence due on a wet or iced road surface, which obliges the vehicle operator to moderate braking action to prevent possible wheel locks and consequent dangerous loss of vehicle control.

The ABS therefore has the function of ensuring vehicle stability in any braking condition by preventing wheel locks independently of road surface conditions and guarantee full exploitation of available adherence.

In essence, the ABS system:

- prevents wheel locks during vehicle braking in and road adherence conditions
- reduces stop distances
- offers operator safety for stability and vehicle control maintenance.

### Electronic Brakes Limiter EBL

The EBL function controls rear axle wheel skidding by comparing it with front wheel speed.

Data entering the center are wheel rpm and braking pressure measured by the pressure sensor installed upstream the rear axle ABS modulators.

The center uses these data to calculate vehicle speed and deceleration, rear axle wheel skid and minimum deceleration required.

The EBL function is activated with rear ABS modulators maintaining set pressure when the operators applies excess braking force than required for vehicle load conditions, in essence when vehicle deceleration and rear axle skid thresholds are passed.

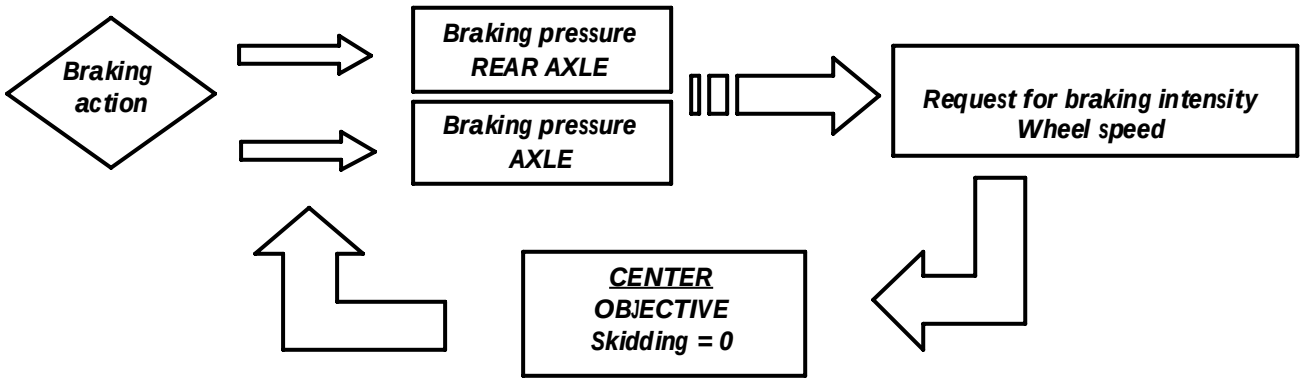
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## Operating logic

The objective of the electronic center is to slow down the vehicle as fast as possible, guarantee its stability and avoid the tendency to lock wheels. When braking, the center is informed of the following to reach these objectives:

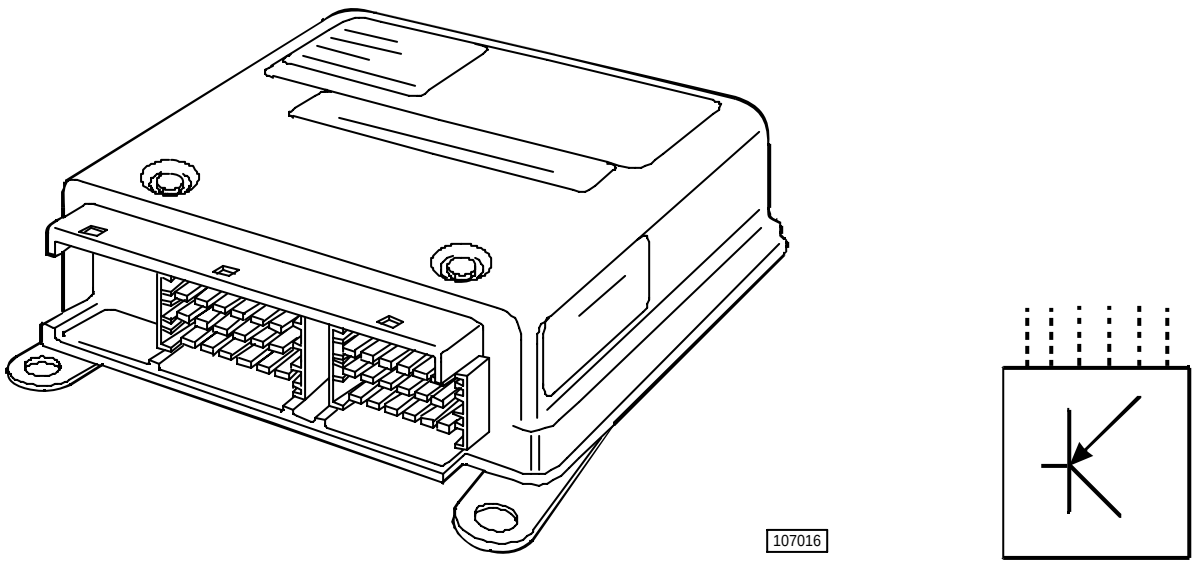
- braking intensity required by the operator via the rear axle pressure sensor
- slowing reaction due to pressures made available via signals from the speed sensors.

Ongoing monitoring and processing of these data referred to the objective set required activation of rear axle modulating valves and consequent braking optimization.




## ABS electronic center

Figure 205




Manages the braking system by setting deceleration to the parameters measured by the various system components.

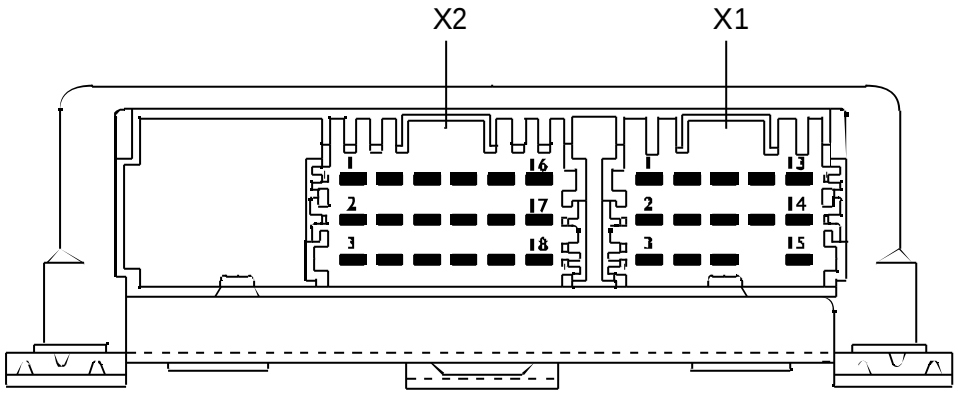
It communicates with on-board electronic systems via a CAN line and is connected through two polarized connectors.

Though offering the possibility of a blink code displayed via the ASR warning light for preliminary diagnosis, the electronic center is provided with an advanced self-diagnosis system capable of identifying and storing any intermittent anomaly to an operating system subject to environmental conditions, and ensuring proper and reliable repair.

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## Pin – out ABS center

Figure 206




Connector X1

| Pin | Description | Cable color code |
|---|---|---|
| 1 | CAN L line (VDB) | Green |
| 2 | Safety signal sensor for maximum braking bridge with axle failure with ABS | 6245 |
| 3 | CAN H line (VDB) | White |
| 4 | Ground | 0000 |
| 5 | Ground from switch for ABS exclusion | 0049 |
| 6 | Ground from switch ASR exclusion | 0048 |
| 7 | Positive +15 | 8847 |
| 8 | Positive +30 | 7710 |
| 9 | Ground | 0000 |
| 10 | K line (4-pin diagnosis connector) | 2299 |
| 11 | - | - |
| 12 | 9/15-pin safety bridge (only when connected X1 is not connected) | - |
| 13 | - | - |
| 14 | - | - |
| 15 | - | - |

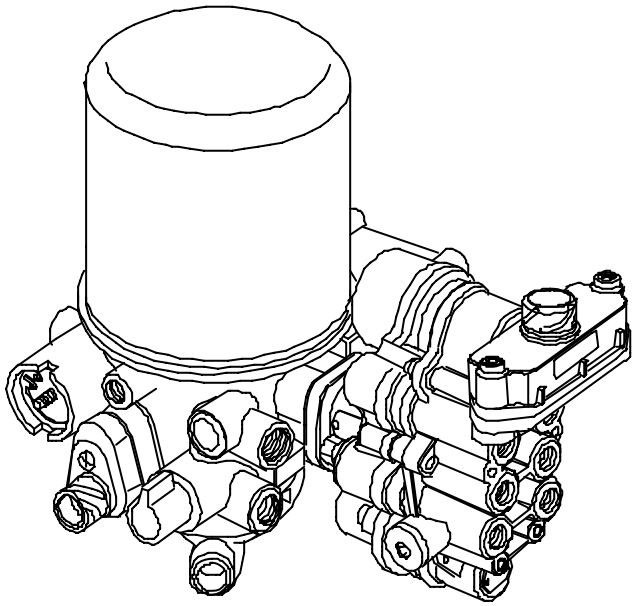
Connector X2

| Pin | Description | Cable color code |
|---|---|---|
| 1 | Positive "EV" (unloaded)electro valve command front right wheel | 9920 |
| 2 | Positive "EV" (unloaded)electro valve command front left wheel | 9931 |
| 3 | Positive "EV" (unloaded)electro valve command front left wheel | 9921 |
| 4 | Positive "AV" (loaded)electro valve command front right wheel | 9918 |
| 5 | Positive "AV" (loaded)electro valve command front left wheel | 9929 |
| 6 | Positive "AV" (loaded) electro valve command front left wheel | 9919 |
| 7 | Ground for ASR electro valve | 0260 |
| 8 | Positive "EV" (unloaded) electro valve command rear right wheel | 9930 |
| 9 | Positive "AV" (loaded) electro valve command rear right wheel | 9928 |
| 10 | ABS speed sensor front right wheel | 5571 |
| 11 | ABS speed sensor rear left wheel | 5572 |
| 12 | ABS speed sensor front left wheel | 5570 |
| 13 | ABS speed sensor front right wheel | 5571 |
| 14 | ABS speed sensor rear left wheel | 5572 |
| 15 | ABS speed sensor front left wheel | 5570 |
| 16 | Positive ASR electro command valve | 9260 |
| 17 | ABS speed sensor rear right wheel | 5573 |
| 18 | ABS speed sensor rear right wheel | 5573 |

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## COMMON COMPONENTS
## A.P.U. (Air processing unit)

Figure 207



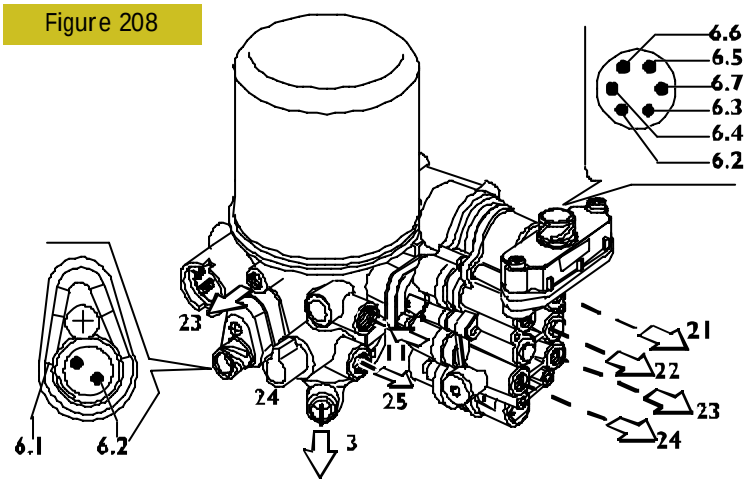
107020

It consists of a drier provided with a filter regeneration timer and a 4-way protection valve incorporating a pressure reducer.
The purpose of the drier is to purify and dry compressed air by adjusting system pressure to its rated value.
The 4-way protection valve distributes air con the various circuits ensuring their operating pressure even in the event of breakdowns.
This component is used in all systems and is rated at 10.5 + 0.2 bars; for mobile bowl CM vehicle setting is 12.5 + 0.2 bars.
The APU contains two sensors connected to the MUX system for axle pressure display on the Cluster.

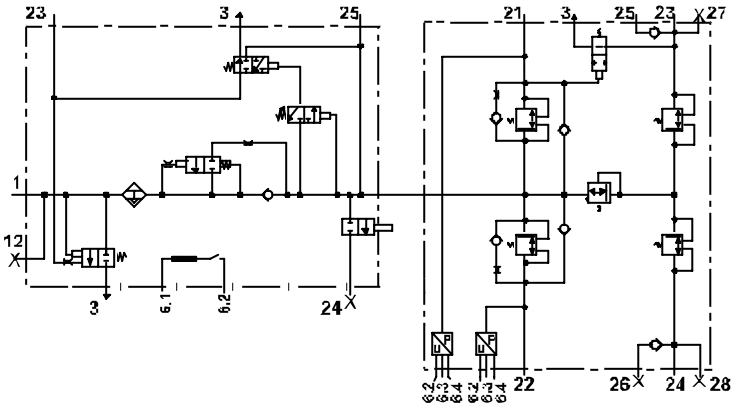
| Pneumatic connections | | Electric connections | | |
|---|---|---|---|---|
| 11 - | From air tank to trailer | 6.1 - | Positive | Pressure sensor |
| 21 - | To automatic coupling joint | 6.2 - | Ground | Pressure sensor |
| 22 - | To moderable coupling joint | 6.3 - | Signal | Pressure sensor |
| 42 - | From (drive) CBU | 6.4 - | Positive | Solenoid |
| 3 - | Exhaust | 6.5 - | Negative | Solenoid |

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Figure 208




TECHNICAL VIEW




WIRING DIAGRAM

## Compressed air connections

1 - Power from the compressor
24 - PTO
25 - Output for 10.5 bar compressed air suspension
23 - To the compressor for Energy Saving control
3 - Venting to outside air
21 - To the 10.5 bar axle reservoir
22 - To the 10.5 bar axle reservoir
23 - To the 8.5 bar parking brake manual distributor and trailer recharge and parking air reservoir
24 - To the 8.5 bar service reservoir

## Drier electrical connections

6.1 - Negative for thermostatic resistance
6.2 - Positive for thermostatic resistance

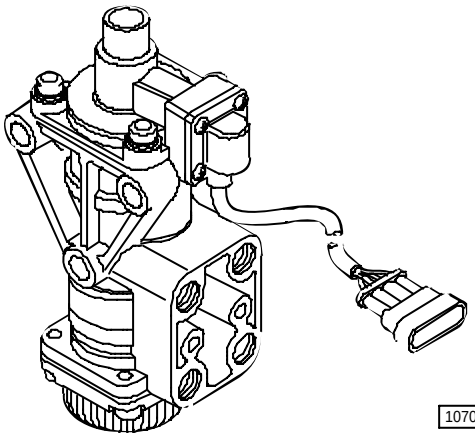
## 4-way protection valve electrical connections

| | | |
|---|---|---|
| 6.2 - | Rear circuit air pressure signal | 5561 |
| 6.3 - | Positive for power | 5560 |
| 6.4 - | Negative | 0000 |
| 6.5 - | Front circuit air pressure signal | 5562 |
| 6.6 - | Positive for power | 5560 |
| 6.7 - | Negative | 0000 |

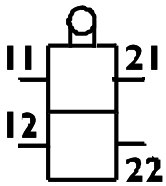
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## Duplex distributor (ABS/EBL systems)

Figure 209



107024

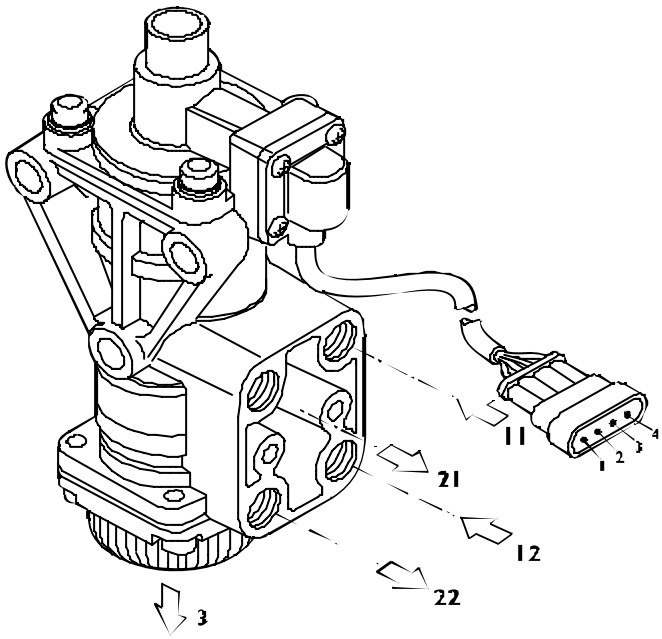



107025

This non self-limited coaxial component consists of a compressed air and an electrical section, the former distributing braking control pressure to the front axle, the rear axle and the trailer control servo distributor.

The electrical section ensures sending the braking signal to the EDC center and to the stop light control relay.

Figure 210




107026

Compressed air connections:

11 - Power from the axle reservoir
12 - Power from the axle reservoir
21 - Valve output to servo distributor relay valve and trailer control
22 - Valve output to axle relay
3 - Vent to outside air

Electrical connections:

1 - Positive for stop lights/EDC
2 - Input positive
3 - Positive for EDC
4 - Input positive

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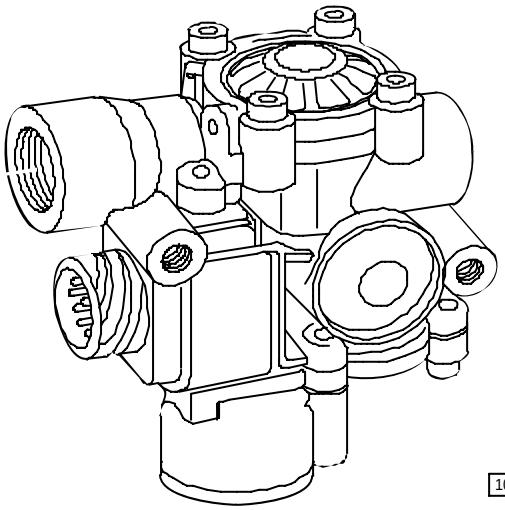
## Electro valve ABS 78052

This normally open electro valve consists of a power coil and a discharge.

It is used to modulate braking pressure when wheel tendency to lock is detected by the speed sensor.

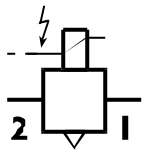
Vehicles with the EBS system feature two of them to control the front axle.

Figure 211



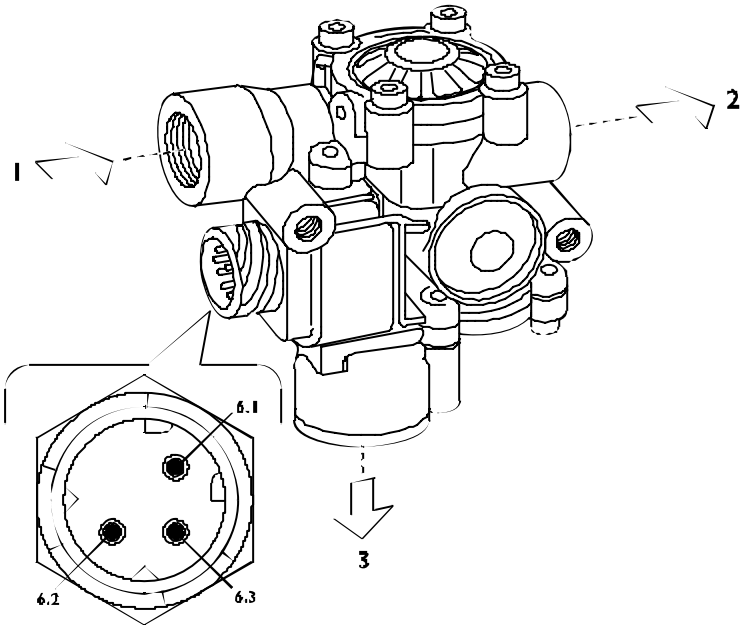
107030

PERSPECTIVE VIEW




107031

WIRING DIAGRAM




107032

### Compressed air connections

1 Proportional relay power

2 Axle brake cylinder output

3 Discharge

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## Electric connections

| Wheel | Solenoid valve pin 78052 | ABS | | EBS | |
|---|---|---|---|---|---|
| | | Cable code | ABS pin | Cable code | EBS pin |
| Left-hand front LHF | 1 | 9919 | X2/6 | 9919 | X4/10 |
| | 2 | 0000 | - | 0122 | X4/12 |
| | 3 | 9921 | X2/3 | 9921 | X4/11 |
| Right-hand front RHF | 1 | 9918 | X2/4 | 9918 | X3/1 |
| | 2 | 0000 | - | 0118 | X3/3 |
| | 3 | 9920 | X2/1 | 9920 | X3/2 |
| Left-hand rear LHR | 1 | 9929 | X2/5 | - | - |
| | 2 | 0000 | - | - | - |
| | 3 | 9931 | X2/2 | - | - |
| Right-hand rear RHR | 1 | 9928 | X2/9 | - | - |
| | 2 | 0000 | - | - | - |
| | 3 | 9930 | X2/8 | - | - |

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## Phonic wheel and speed sensor 88001

Sensors continuously supply the electronic center with all the data it requires to properly pilot the electro valves.

Signals are obtained from magnetic flow lines that close through the teeth of a teethed wheel facing the sensor and rotating together with the wheel.

Passage from full to empty due to the presence or absence of the tooth causes sufficient magnetic flow variation to create induced electromagnetic force at sensor terminals and thus an alternating electrical signal that is sent to the electronic center.

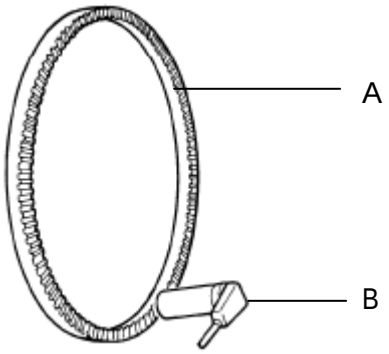
The clearance between the sensor and wheel, called air gap, must obviously be at a pre-set value of 0.8 ÷ 1.6 mm for proper signals to be sent. Resistance of each sensor at connection terminals is between 1 and 2 kΩ.

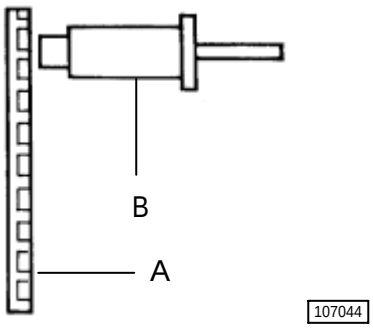
The toothed wheel is called phonic wheel because the signal it generates has the same frequency as a sound wave.

The frequency of this signal serves to define wheel rotation speed.

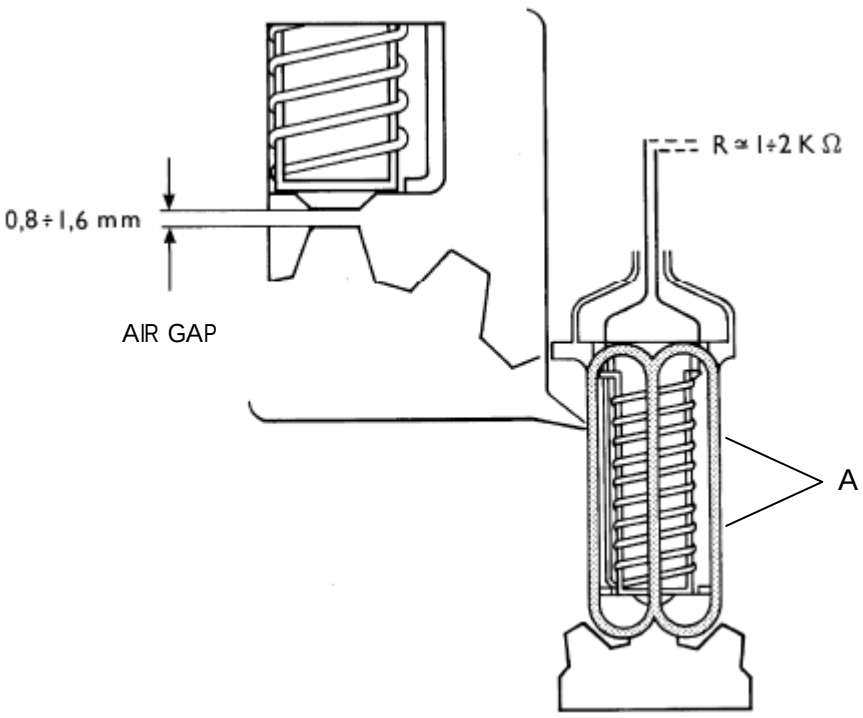
Frequency variations, or the speed at which signals follow one another, define acceleration and deceleration rates.

Figure 212




PHONIC WHEEL (A) AND SENSOR (B) PERSPECTIVE VIEWS

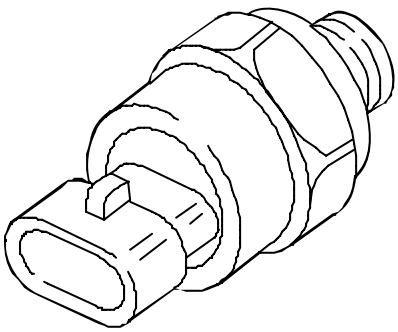



A. Magnetic flow lines

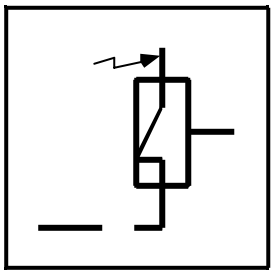
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## Low pressure switch

Figure 213



107046



107047

It warns the driver, by the warning lights on the CLUSTER, of low pressure in the following systems:

- Hand brake engaged - N.C. 6.6 ± 0.2 bars
- Low trailer pressure recharge - N.C. 6.6 ± 0.2 bars

A normally closed 6.6 ± 0.2 bar switch is also mounted on the axle reservoir to inform the electronic center of any axle circuit low pressure so as to inhibit differentiated axle braking in the ASR function.

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## ECAS SUSPENSIONS

### Compressed air suspensions

Compressed air suspensions feature high flexibility, high vibration damping and with system self-adjustment constant frame to road level clearance independently of vehicle load, that can be changed as well as vehicle load height with a special push button provided for this purpose.
In addition to the known advantages offered by compressed air suspension, the ECAS system also features:

- minimized air consumption
- prompt response to adjustment
- simple systems
- top safety level
- complete system diagnosis.

The Electronically Controlled Air Suspension ECAS system provides automatic vehicle compressed air suspension rated level monitoring.

All the above operations are subject to operating conditions and connected system safety devices.

The ECAS electronic provides automatic frame ground clearance control via the real values supplied by the sensors, which are compared with stored rated data. In the event of setting deviations or variations, the electronic center pilots the electro-pneumatic units through which it corrects real levels versus those stored previously by the operator.

The system is provided with remote control for frame lifting/lowering and leveling and operations are possible both with the vehicle stationary and moving.

This unit also enables other frame setting level storage and retrieval when required by operating conditions.

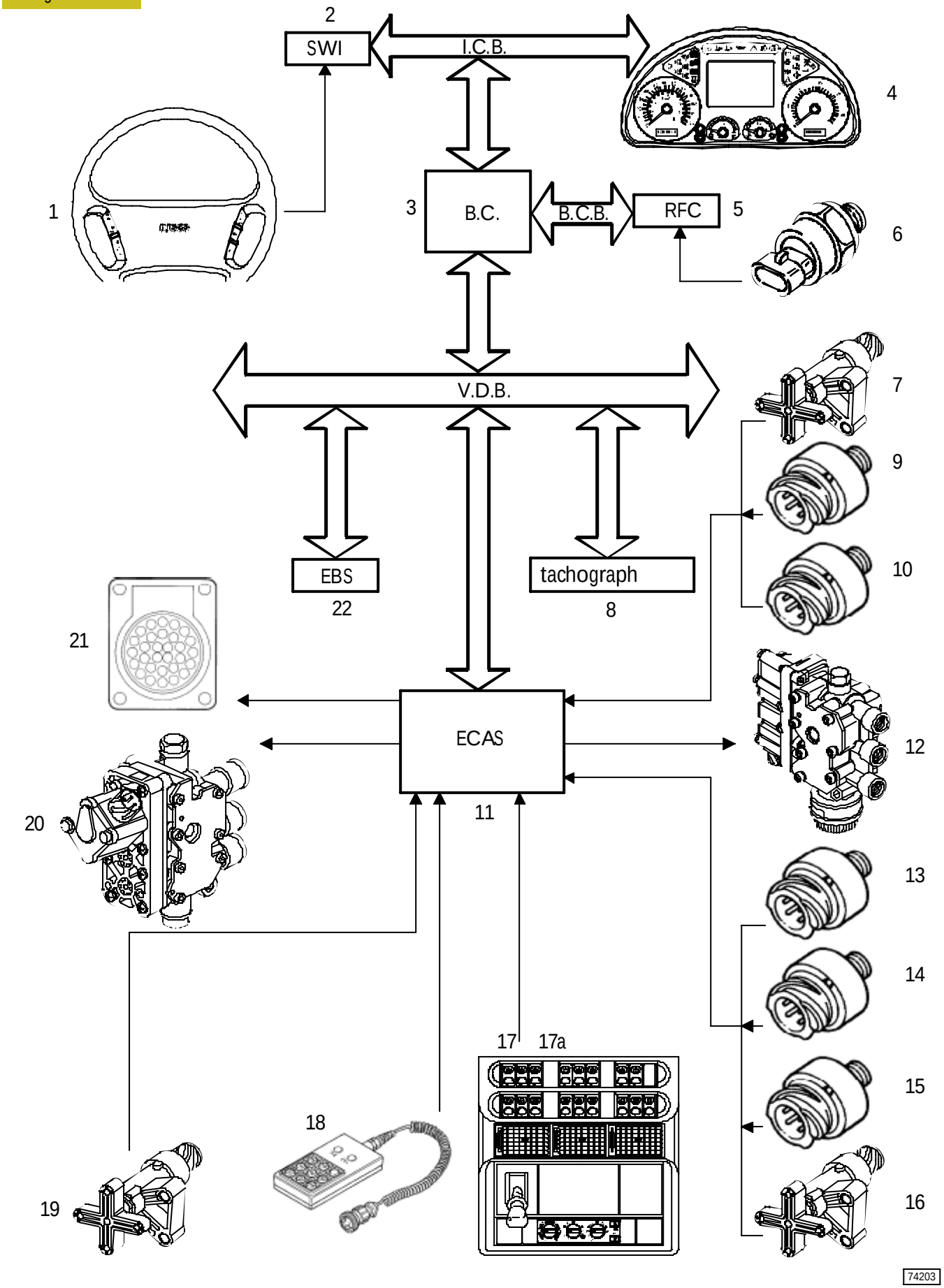
Vehicle lifting, lowering and leveling before load and unload operations are via the remote control located on the operator seat side.

The remote control can be extracted from its support so these operations can also be performed from ground level.

When unloading heavy loads or containers with a crane, the frame can be lowered completely.

Aquila Trucks Centres

Figure 214



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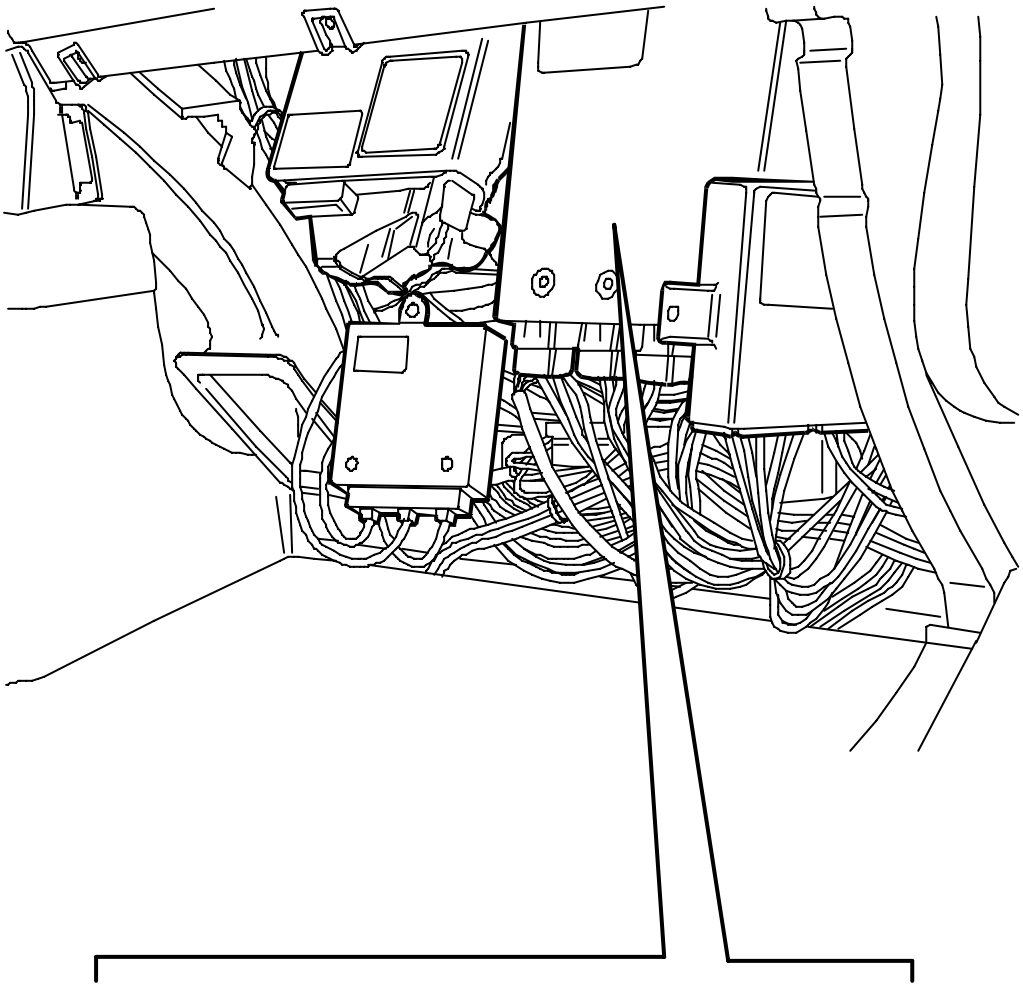
| Ref. | Description | Component code |
|---|---|---|
| 1 | Steering wheel | - |
| 2 | Steering Wheel Interface | 86123 |
| 3 | Body Computer | 86116 |
| 4 | Cluster | 50005 |
| 5 | Rear Frame Computer | 86118 |
| 6 | Low pressure sensor | 42200 |
| 7 | Right rear axles level sensor | 40046 |
| 8 | Electronic tachograph | - |
| 9 | Right drive axle sensor | 42381/A |
| 10 | Left drive axle sensor | 42381/B |
| 11 | ECAS electronic control unit | 86023 |
| 12 | Axle solenoid valve unit | - |
| 13 | 3rd axle compressed air lift sensor | 42389 |
| 14 | Right 3rd axle air pressure sensor | 42382/A |
| 15 | Left 3rd axle air pressure sensor | 42382/B |
| 16 | Left axle level sensor | 40046/B |
| 17 | Start support control switch | 53030 |
| 17a | 3rd axle left switch remote control | 53309 |
| 18 | Suspension remote control | 85065 |
| 19 | Axle level sensor | 40046/A |
| 20 | Axle solenoid valve unit | 78239 |
| 21 | Diagnosis connector | 72021 |
| 22 | EBS electronic control unit | 88005 |

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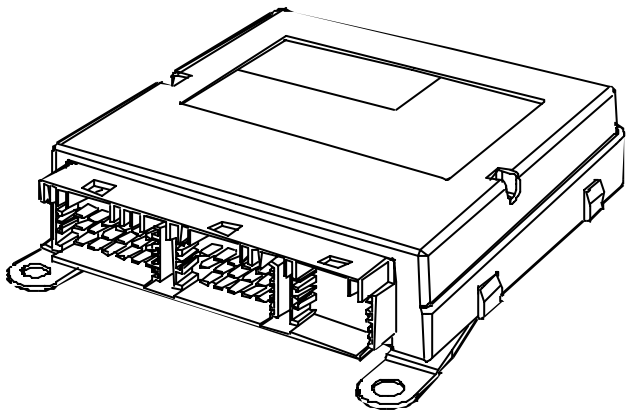
## ECAS electronic control unit

| | |
|---|---|
| Vendor | WABCO |
| Voltage | 18 ÷ 30 Vdc |
| Heat range | -40 to 75 _C |

Figure 215



73667



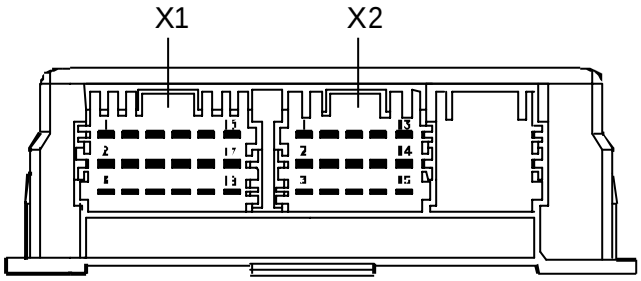
107052

ECAS electronic control unit

Aquila Trucks Centres

## Ecas control unit for air suspension system

Figure 216




Connector X1

| Pin | Description | Cable color code |
|---|---|---|
| 1 | CAN L line (VDB) | Green |
| 2 | Ground | 0000 |
| 3 | CAN H line (VDB) | White |
| 4 | - | - |
| 5 | Positive for manual levelling key (ST14 fitters connector) | 8445 |
| 6 | - | - |
| 7 | Positive +30 | 7440 |
| 8 | CLOCK line on ECAS remote-control set | 6402 |
| 9 | K line(14-pin diagnosis connector) | 2294 |
| 10 | Positive +15 | 8810 |
| 11 | Data line on ECAS remote-control set | 6403 |
| 12 | Ground | 0000 |
| 13 | Positive for ECAS remote-control set | 8810 |
| 14 | - | - |
| 15 | Ground for ECAS remote-control set | 0050 |
| 16 | - | - |
| 17 | - | - |
| 18 | - | - |

Connector X2

| Pin | Description | Cable color code |
|---|---|---|
| 1 | Positive for load pressure sensors on axles (opt.) | 8403 |
| 2 | Load pressure sensors on axles signal - right axle (opt.) | 5443 |
| 3 | - | - |
| 4 | Positive for rear axle electro pneumatic distributor | 9400 |
| 5 | Rear left axle level sensor signal (only truck) | 5422 |
| 6 | Load pressure sensors on axles signal-left axle (opt. - only truck) | 5444 |
| 7 | Ground for load pressure on axles sensors | 0400 |
| 8 | Rear right sensor level signal | 5421 |
| 9 | - | - |
| 10 | Ground for electro pneumatic distributor rear axle left valve command (only truck) | 9425 |
| 11 | Ground for electro pneumatic distributor rear axle load/unload valve command | 9423 |
| 12 | - | - |
| 13 | Ground for electro pneumatic distributor rear axle right valve command | 9424 |
| 14 | - | - |
| 15 | - | - |

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## Electro-pneumatic axle distributor

It consists of three control electro valves "A", "B" and "C" and the same number of compressed air distributors.

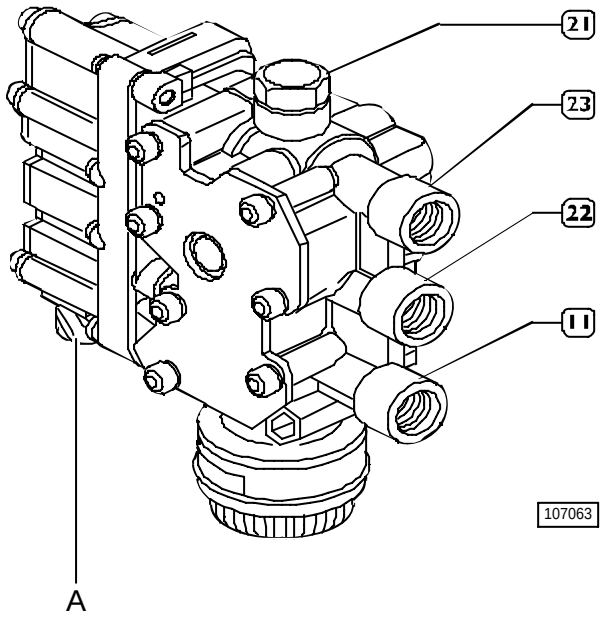
Electro valve "A" manages the input/output distributor.

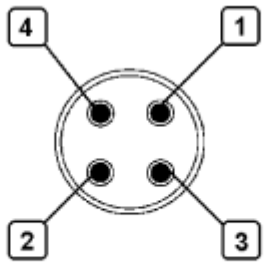
Electro valve "B" manages the right frame setting distributor.

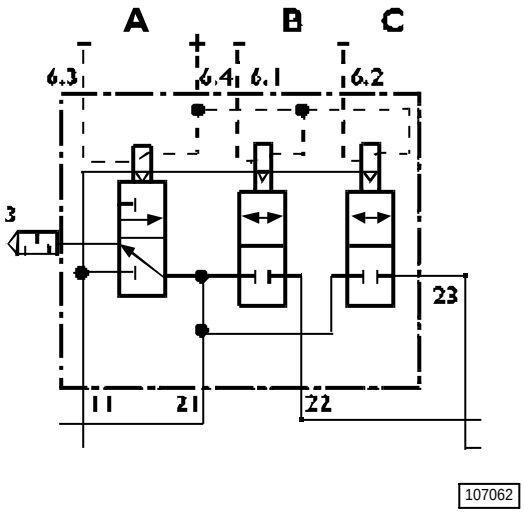
Electro valve "C" manages the left frame setting distributor.

The electro-pneumatic distributor is connected to the system via a 4-pole connector (A).

Figure 217




| Ref. | Description |
|---|---|
| 1 | Electro valve "A" control negative |
| 2 | Electro valve "B" control negative |
| 3 | Electro valve "C" control negative |
| 4 | Common positive |

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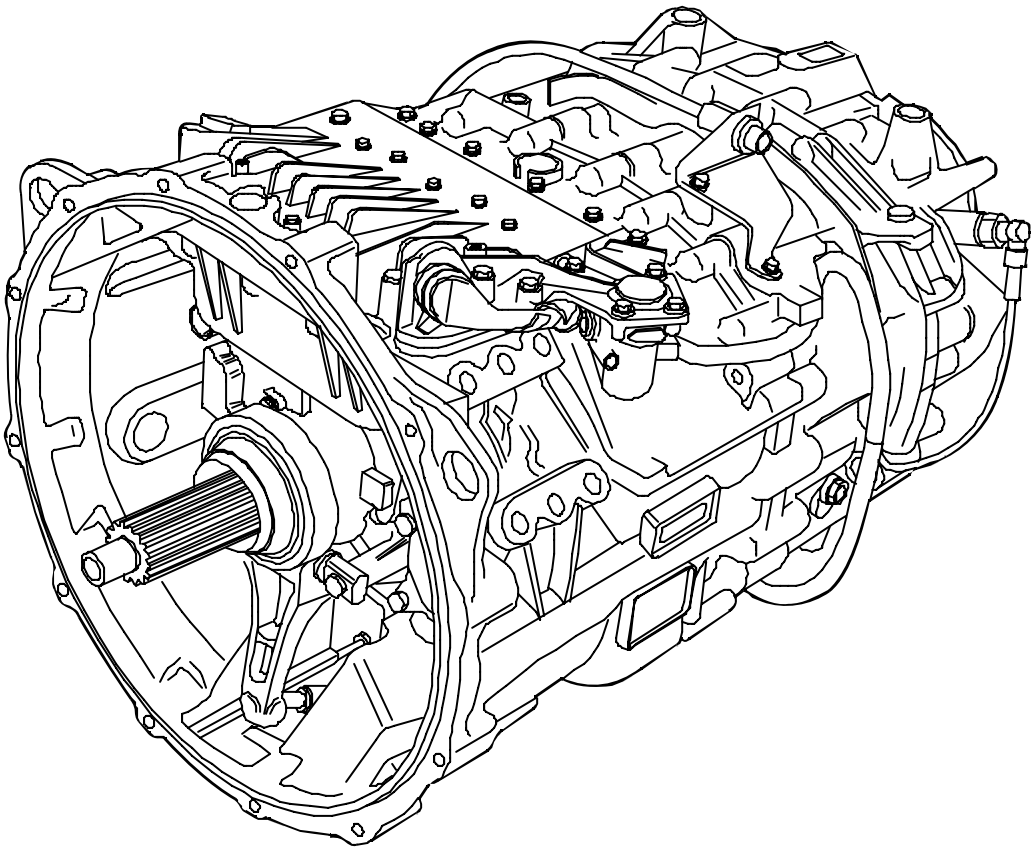
## EUROTRONIC AUTOMATIC TRANSMISSION

### General

The new generation of Automated EuroTronic transmissions is IVECO's response to new Customer expectations and changed needs. The design of gearshifts with a new inspected and test transmission technology concept combined with advanced electronics has generated a system that guarantees:

- Economic efficiency
- Reliability
- Environmental acceptability

Figure 218



107070

VIEW OF THE AUTOMATED EUROTRONIC TRANSMISSION

These modern and completely automated transmission systems with highly integrated components have already been developed for EDC M6.2 center ELECTRONIC CONTROL DIESEL ENGINES.

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The system automates gear selection and meshing by automatically controlling the clutch and engine during gear shifting.

The operator decides when to shift gears by actuating a selector lever with no need to release the accelerator pedal.

Unlike previous versions, the Automated EuroTronic enables the operator to use COMPLETELY AUTOMATIC gear shifting management.

The system enables automatic vehicle star and completely eliminates the clutch pedal. On receipt of vehicle and operator signals, the electronic center controls all components involved, optimizes maneuvers and manages safety.

| | PRODUCTIVITY | | | | Comfort | Safety |
|---|---|---|---|---|---|---|
| | Consumption | Average commercial speed | Maintenance courses | Payload | | |
| Operating comfort and less physical and mental stress | • | • | | | • | • |
| Precise and fast gear shifting | • | • | | | • | |
| Optimized use | • | | • | | | |
| No use errors | • | • | • | | • | • |
| Selection of maximum rpm for engine brake use | • | • | | | • | • |
| Reduced tare | | | | • | | |
| Longer linkage line life (the clutch especially) | | | • | | | |
| Noise abatement (Db) | | | | | • | |
| Automatic gear shifting | • | • | | | • | |

## Design features

The entire transmission shaft and universal joint assembly is relieved of considerable load as gear shifting operations and procedures are automated. The main Automated EuroTronic countershaft gearbox consists of the following:

- A couple of low and high speed gears (SPLITTER)
- 4 forward speeds + 1 reverse

The auxiliary box consists of a G.R.E. epicyclical reduction gear mounted at the back to double the number of gear ratios of the main gearbox and enable 16 forward and 2 reverse speeds.

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## Description

Automated EuroTronic is a completely automatic transmission featuring a regulated dry clutch that eliminates the clutch pedal.

It consists of a reduced noise emission main gearbox with a planetary and split group.

The main unit meshes with front teeth and only the planetary and split group are synchronized.

The 16-speed Automated EuroTronic features sixteen forward and two reverse speeds.

The Instrument cluster supplied the operator with all necessary system information, such as gear meshed, disturbances and the like.

The insert module and the clutch regulator unit are the most important structural elements for complete transmission automation.

The former consists of the transmission electronic system, switching valves, cylinder and sensors.

The transmission electronic system processes all input signals and inserts the speed via the electromagnetic valve and the switching cylinder.

The clutch regulator is set electro-pneumatically and performs all friction actuation operations. In the manual mode, the operator can easily select speeds with the speed selector lever.

In the automatic mode, the operator only has to actuate the accelerator or brake pedal.

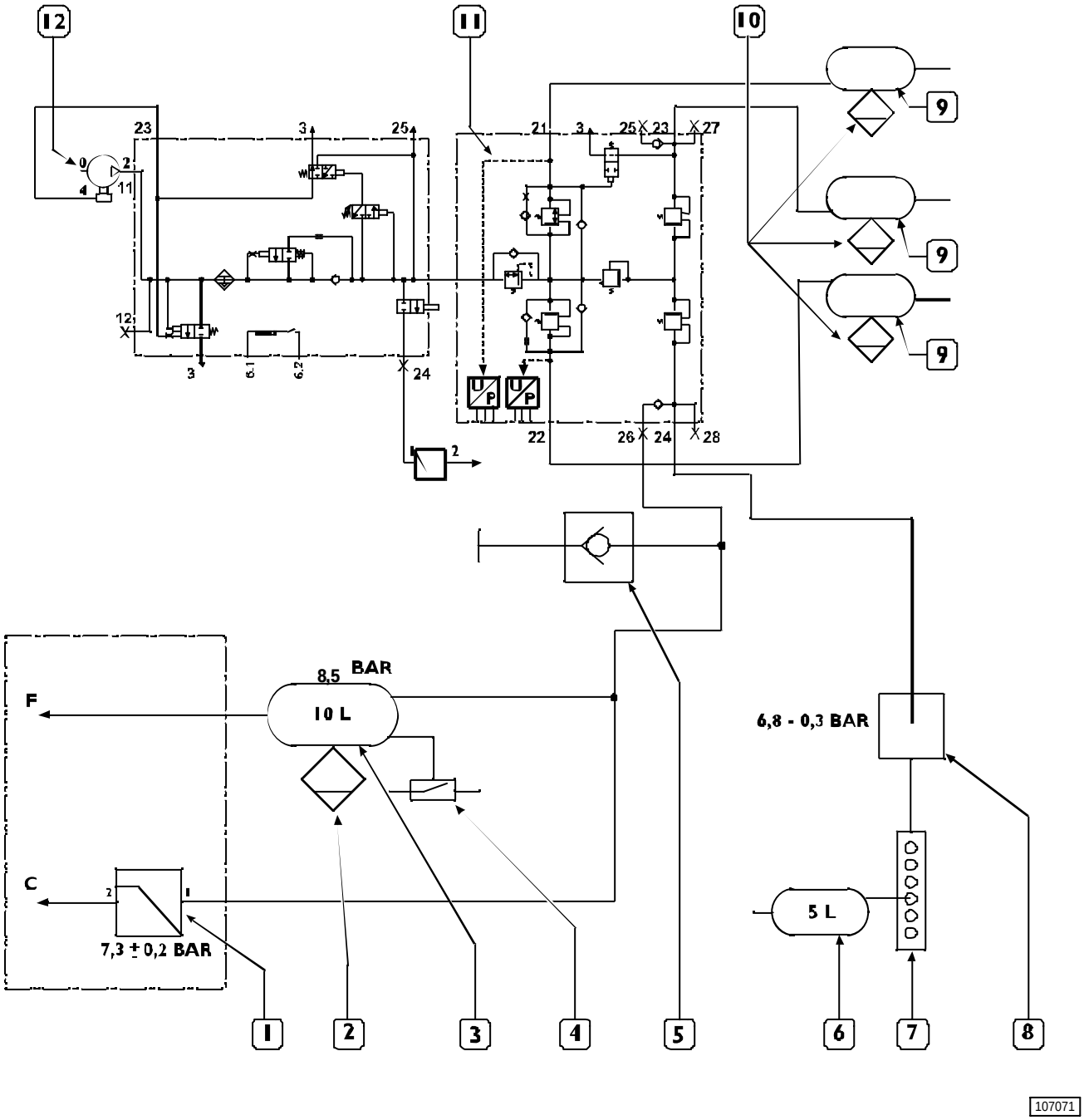
Speeds are selected automatically by the system.

To respect anti-pollution regulations, all gears are helical teeth, which enabled abating noise level about 79 db.

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## Transmission/clutch connection diagram with the compressed air system

Figure 219



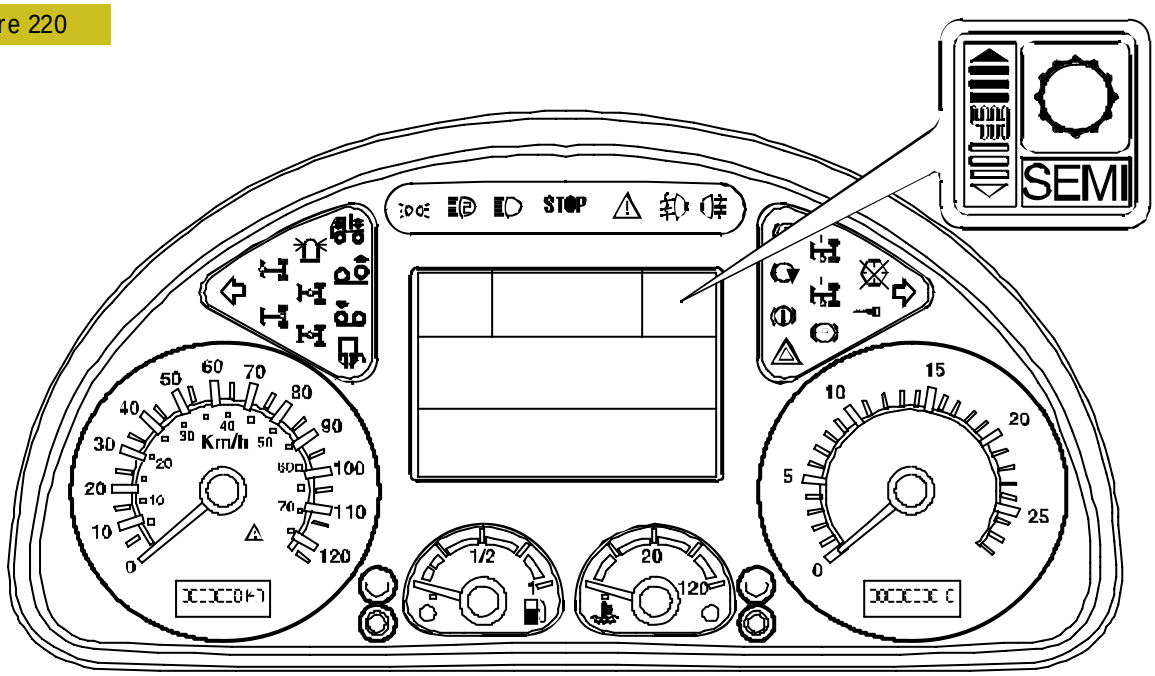

1. Pressure limiter valve - 2. Normal purge valve - 3. 10-l reservoir - 4. Air pressure switch - 5. Pressure control socket - 6. 5-l reservoir - 7. Distributor element - 8. Controlled pressure valve - 9. Reservoir - 10. Normal purge valve - 11. APU Air Processing Unit - 12. Compressor.
F = Clutch
C = Transmission

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## Display on the Instrument Cluster

The information required by the operator is displayed by the system on the Instrument Cluster central display.

Figure 220




The symbols displayed by the system are as follows:

| | | | |
|---|---|---|---|
| | System self-diagnosis | CL | Clutch overload |
| N | Gear in neutral | CW | Duct disc wear |
| AP | Accelerator pedal pressed before turning the ignition key | SEMI | Transmission in the manual mode |
| RL | Slow reverse selected | AUTO | Transmission in the automatic mode, with clear display<br>Transmission with the automatic mode pre-selected but not active with shadowed display (moving at low speed) |
| RH | Fast reverse selected | 12 | Speed number selected (12th) |
| AL | Low system air pressure | | Transmission in the manual mode, lower speeds recommended by the system<br>Recommended ratios (as many as 3) are displayed with bars |

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## LIMP - HOME

The Limp Home function enables removing the vehicle when the system presents serious anomalies it cannot manage automatically. It cannot move the vehicle when purely mechanical anomalies are present. The operator can activate the Limp Home function as follows:

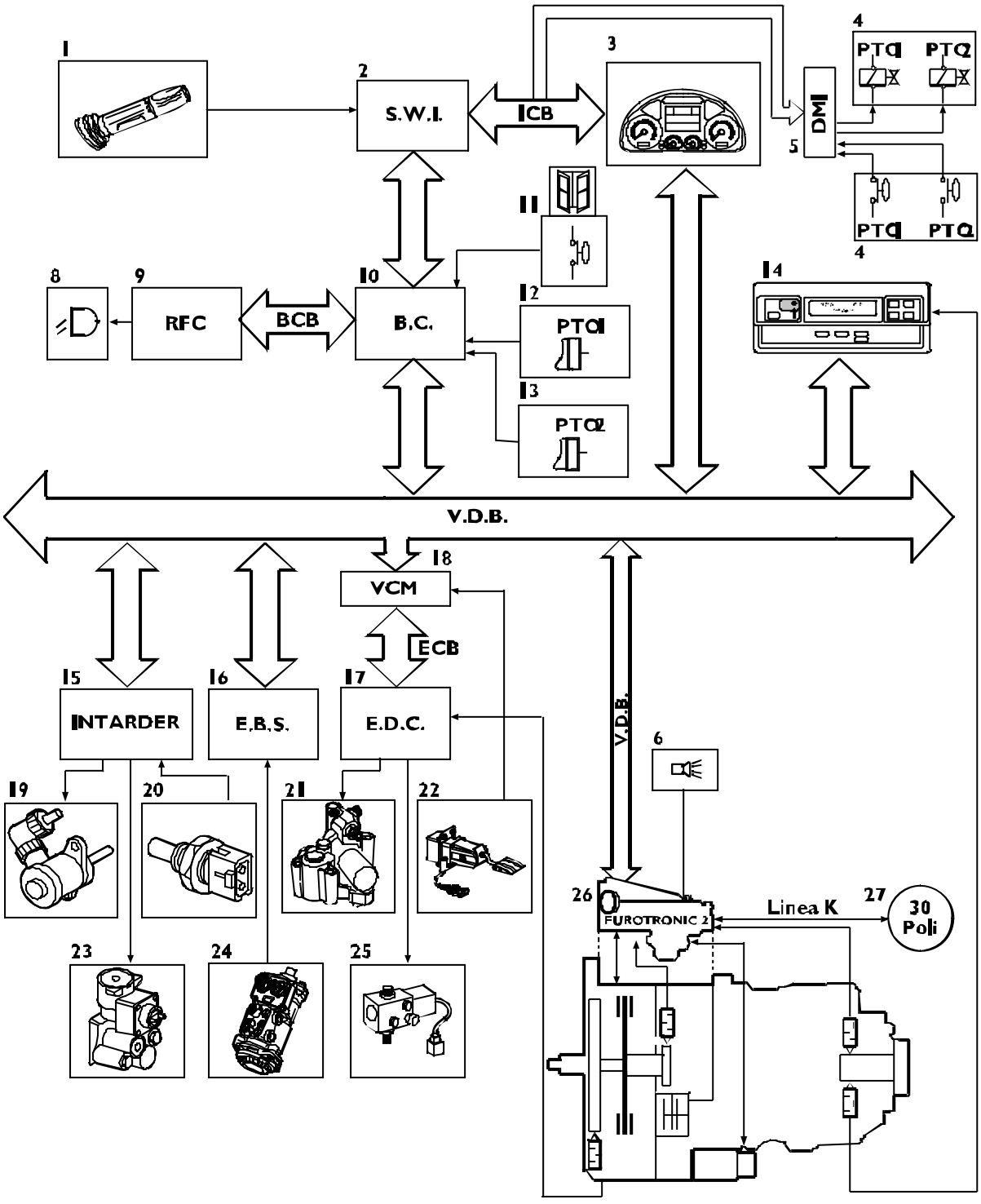
1. Key switch on stop
2. Key switch on +15
3. Press the blue color push button on the gear shift lever within 5 seconds
4. Keep the blue color push button pressed for at least 5 seconds.

The operator can select the speed at which to start with gearshift lever, and can select as many as 7 speeds forward and 2 reverse with the 16 speed transmissions and 5 and 2 respectively with the 12-speed one. Selection is managed by the system via an internal delay reaction time and not through the speed with which the gearshift lever sensors identify lever movements.
Speed selection must be slow to allow the system to implement each individual speed, as the Cluster displays individual speeds with a delay of a few seconds.
The speeds that can be set with the Limp Home function can only be selected with the vehicle stationary.
After start speed selection, pressing the function push button for at least 2 seconds makes the system control timed clutch engagement.
To prevent the engine from stopping, the clutch disengages automatically when the speed output from the transmission is below a reference threshold. Is the clutch sensor is not operating properly, the clutch can only be engaged/disengaged manually with the Function push button.
The system disregards any gearshift lever movement during vehicle movement. In particular, push button function operation is excluded when engine rpm is over 950 and reactivated at under this rating.
Clutch management can thus also be manual with the function push button on the gearshift lever of the brake pedal when engine rpm is under/equal to 950. When the vehicle is stopped with the Limp Home function, the clutch is managed automatically if possible or manually as described above.
At vehicle stop, the system keeps the Limp Home function active with the start speed set previously and the function remains active until system RESET is completed.

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## Eurotronic Automated transmission operation diagram

Figure 221

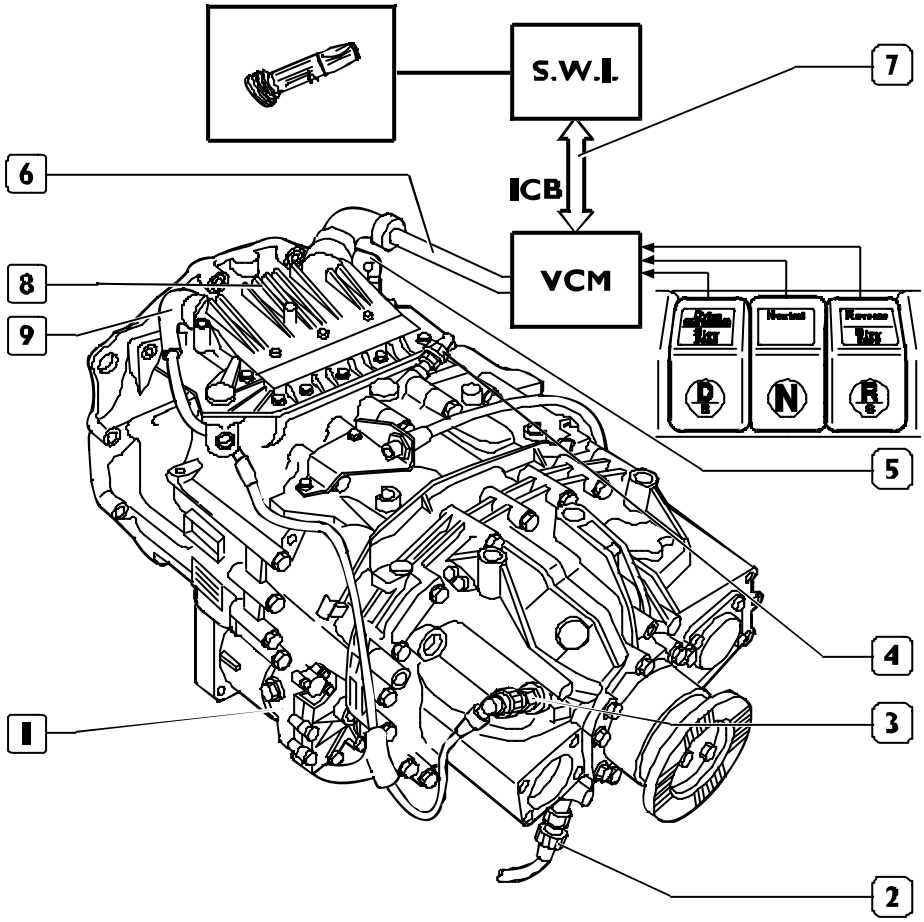



1. Multi-function lever - 2. Steering Wheel Interface - 3. Instrument Cluster - 4. PTO solenoid valves - 5. DMI - 6. External buzzer - 7. PTO on warning switches - 8. Reverse lights - 9. Rear Frame Computer - 10. Body Computer - 11. Door open switch- 12. Switches for PTO1 on request - 13. Switches for PTO2 on request - 14. Tachograph - 15. Intarder Control Unit - 16. EBS Control Unit - 17. EDC Control Unit - 18. VCM - 19. Proportional solenoid valve- 20. Water temperature sensor - 21. Engine stop solenoid valve - 22. Accelerator pedal - 23. ON/OFF solenoid valve - 24. Duplex Distributor (brake pedal) - 25. VGT solenoid valve - 26. Gearbox Electronic Control Unit - 27. Diagnosis socket

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## Location of main components

Figure 222




1. Clutch actuator - 2. Tachograph gearshift/transmission outgoing speed sensor - 3. Gearshift/transmission outgoing speed sensor for sensor - 4. Gearshift idling position sensor - 5. Frame side centre connector - 6. Vehicle Data Bus VDB CAN line - 7. System internal CAN line - 8. Gearshift/transmission electronic centre - 9. Gearshift/transmission side centre connector

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## ELECTRONIC CONTROL UNIT

It is integrated into the gearshift actuator.

Automatic transmission management enables automating speed selection and meshing with automatic clutch and engine control.

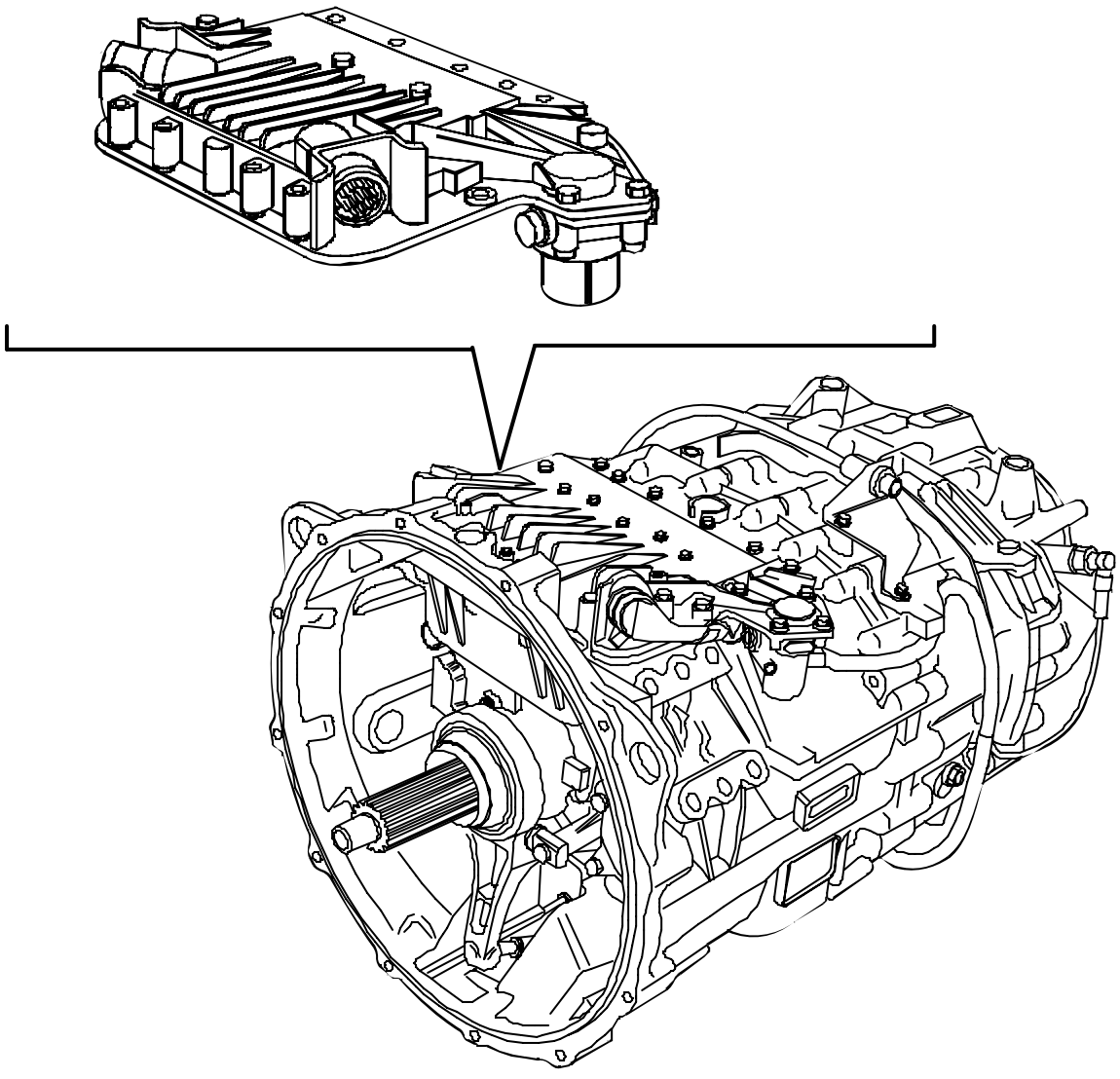
It interfaces with the other on-board electronic systems such as the EDC, EBS, INTARDER and Instrument Cluster via a CAN V.D.B. Vehicle Data Bus line.

From connection with the EDC system the transmission electronic control unit can detect accelerator pedal position, fuel delivery, engine rpm and engine brake and kick-down activation.

The control unit inside houses control unit temperature, transmission oil temperature and low air pressure sensors to improve system operation.

Function AL is enabled at <5.8 bar pressure and disabled at> 6 bars. The Automated EuroTronic transmission electronic control unit offers the possibility of a Cluster displayed error code for preliminary diagnosis and is also provided with an advanced self-diagnosis system capable of identifying and storing any even intermittent anomaly dependent on environmental condition the system may have encountered during operation, to ensure more correct and reliable repair.

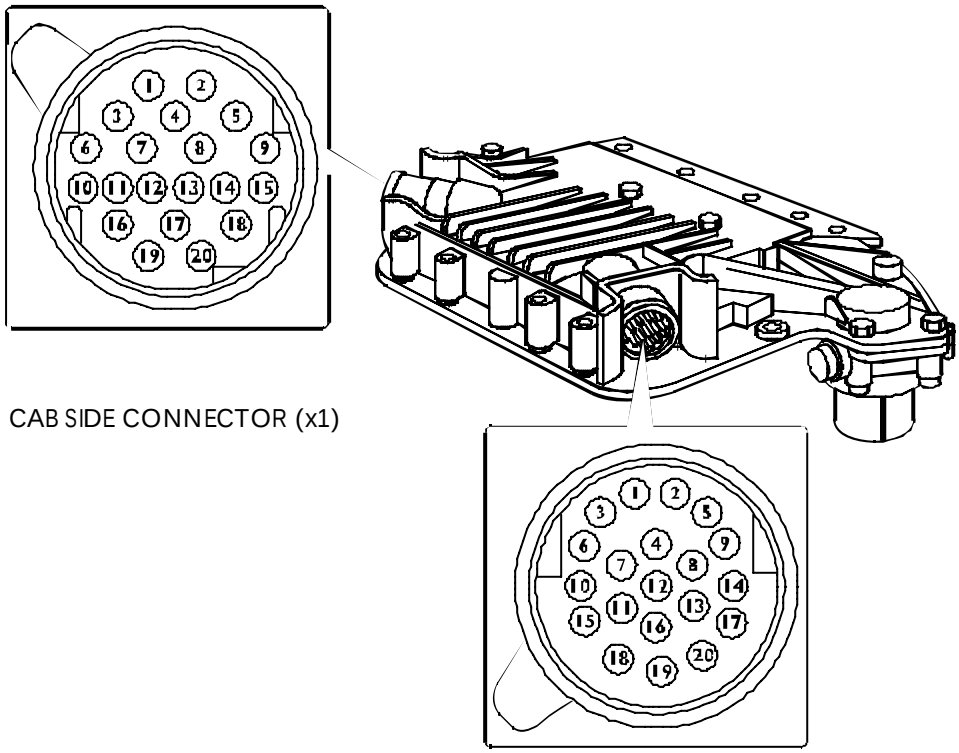
Figure 223



107075

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Figure 224




| Pin | Cable | Description x1 | Pin | Cable | Description x2 |
|---|---|---|---|---|---|
| 1 | 8801 | Power from Body Computer (J 3/6) | 1 | – | – |
| 2 | 2297 | Positive 30-pole connector for ground diagnosis | 2 | – | – |
| 3 | – | Free | 3 | – | – |
| 4 | 7101 | Positive from fuse 70602/2 (+30) | 4 | – | – |
| 5 | 7101 | Positive from fuse 70602/2 (+30) | 5 | – | – |
| 6 | – | Free | 6 | – | Gearshift speed sensor mass (pin2) |
| 7 | – | Free | 7 | – | Signal electrovalve Y17 (slow opening) (pin A) |
| 8 | WS/BI | CAN VDB line | 8 | – | Signal electrovalve Y16 (fast opening) (pin B) |
| 9 | – | Free | 9 | – | Signal electrovalve Y15 (slow closing) (pin E) |
| 10 | 1101 | Gearbox malfunction beeper earth | 10 | – | Clutch position sensor analogic signal (pin F) |
| 11 | 6100 | Gearbox malfunction beeper positive | 11 | – | Gearshift/transmission outgoing speed sensor signal (pin 4) |
| 12 | GN/VE | CAN L VDB line | 12 | – | Signal electrovalve Y14 (fast closing) (pin 0) |
| 13 | – | – | 13 | – | – |
| 14 | – | – | 14 | – | – |
| 15 | – | – | 15 | – | Clutch position sensor power supply (pin G) |
| 16 | 0000 | Negative | 16 | – | Y15 - Y17 electro valve mass (pin 3) |
| 17 | 0000 | Negative | 17 | – | Y14 - Y16 electro valve mass (pin C) |
| 18 | – | – | 18 | – | Gearshift/transmission speed sensor power supply (pin 1) |
| 19 | – | – | 19 | – | – |
| 20 | – | – | 20 | – | Clutch position sensor mass (pin H) |

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## TRANMSISSION ACTUATOR

The transmission actuator is mounted on the top of the main gearbox. It consists of a series of electro valves, control cylinder and sensors. The electronic control unit powers the various electro valves to selected gear ratios available by using sensor signals as a feedback. Actuator operating pressure is 7 bars.

### Actuator components

Y1 Inertia brakes control electro valve
Y2 Fast Splitter control electro valve
Y3 Slow Splitter control electro valve
Y4 Speed selection control electro valve
Y5 Speed selection control electro valve
Y6 Gear meshing control electro valve
Y7 Gear meshing control electro valve
Y8 Downshifted speed epicyclical unit control electro valve
Y9 Normal speed epicyclical unit control electro valve
Y10 Cmpressed air supply electro valve
B2 Transmission input rpm sensor
B4 Selected speed sensor
B5 Selector position sensor
B6 Normal and downshifted speed epicyclical unit position sensor
B7 Splitter position sensor



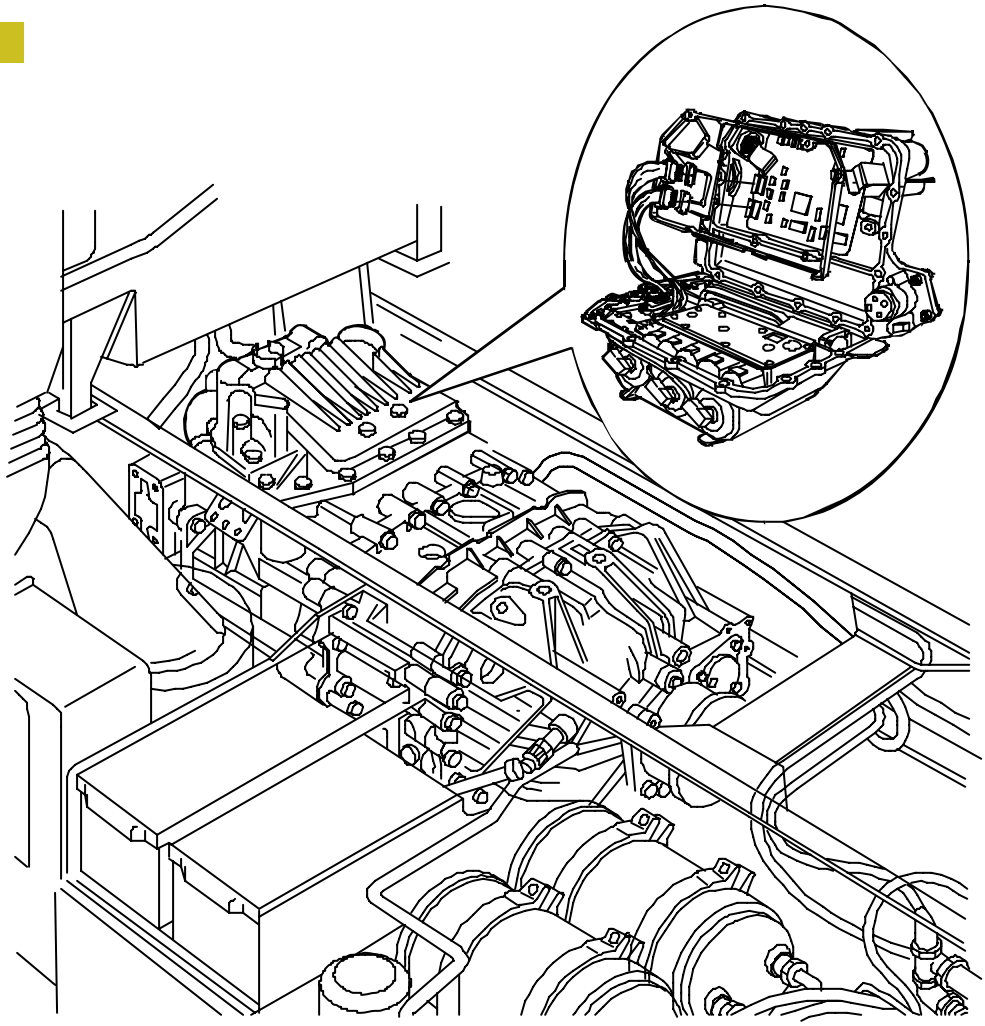
The actuator cannot be overhauled.
For actuator removal, transmission must be on NEUTRA.
The transmission neutral warning switch is located on the gearshift.

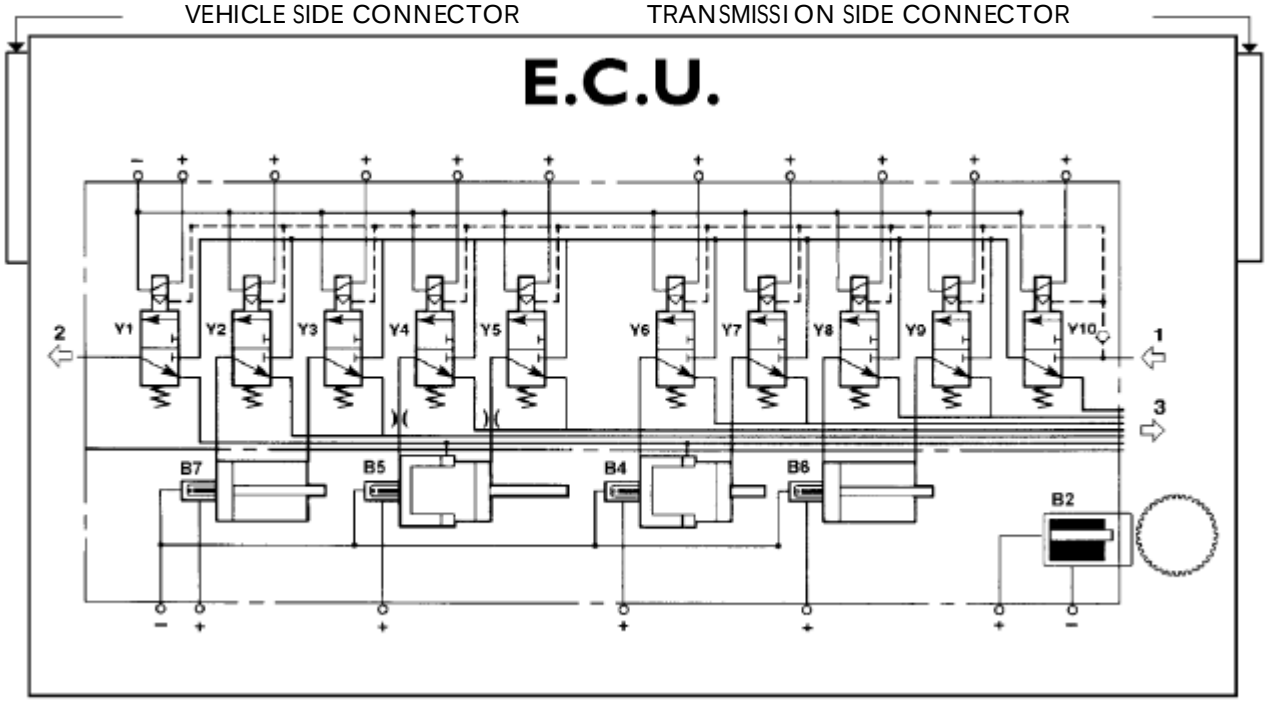
Electro valves are of the N.C. on/off type powered at 24 Volt with ~64.2 Ohm resistance at 20 °C.
Induction type transmission input rpm sensor B2 features ~1 Kohm resistance and identified rpm with a 40-teeth sound wheel. This signal is compared with the engine rpm measured by the E.D.C. control unit; if the two values are NOT identical the transmission control unit is enabled to detect clutch slide.
Induction type sensors B4, B5, B6 and B7, respectively selector position, epicyclical unit and splitter, are an integral part of the control cylinders and feature ~ 69 Ohm resistance at 20 °C.
The automatic system pressure sensor located downstream the reduction gear is also integrated inside the control unit.

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## LOCATION ON THE VEHICLE

Figure 225






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## CLUTCH ACTUATOR

The clutch actuator is located on the lower part of the clutch bell.

It consists of four electro valves, an actuator cylinder and a clutch run position sensor and is suitable to actuate 17.5" single-disc clutches via a 2.09 ratio lever.

In the load mode as detected by the accelerator pedal sensor signal from the E.D.C. center, the electronic center powers the various electro valves for slow or fast clutch engagement and release.

The center uses the clutch run position sensor to calculate clutch wear at each vehicle start, to enable fast approaches and overcome empty runs.

### Actuator components

Y14 - Fast clutch engagement electro valve
Y15 - Slow clutch engagement electro valve
Y16 - Fast clutch release electro valve
Y17 - Slow clutch release electro valve
S - Clutch run position sensor
T - Air vent cap

Actuator operating pressure is 11 bars.

Internal channel diameters are as follows:

- 2.5 mm for fast engagement/release;
- 1.5 mm for slow engagement/release.

Actuation times at start, subject to load, slope and accelerator pedal position, are as follows:

- Initial engagement: ~ 1 sec.
- Modulated release: ~ 4 sec.

The times change as follows during gear changes to enable fast and precise synchronization:

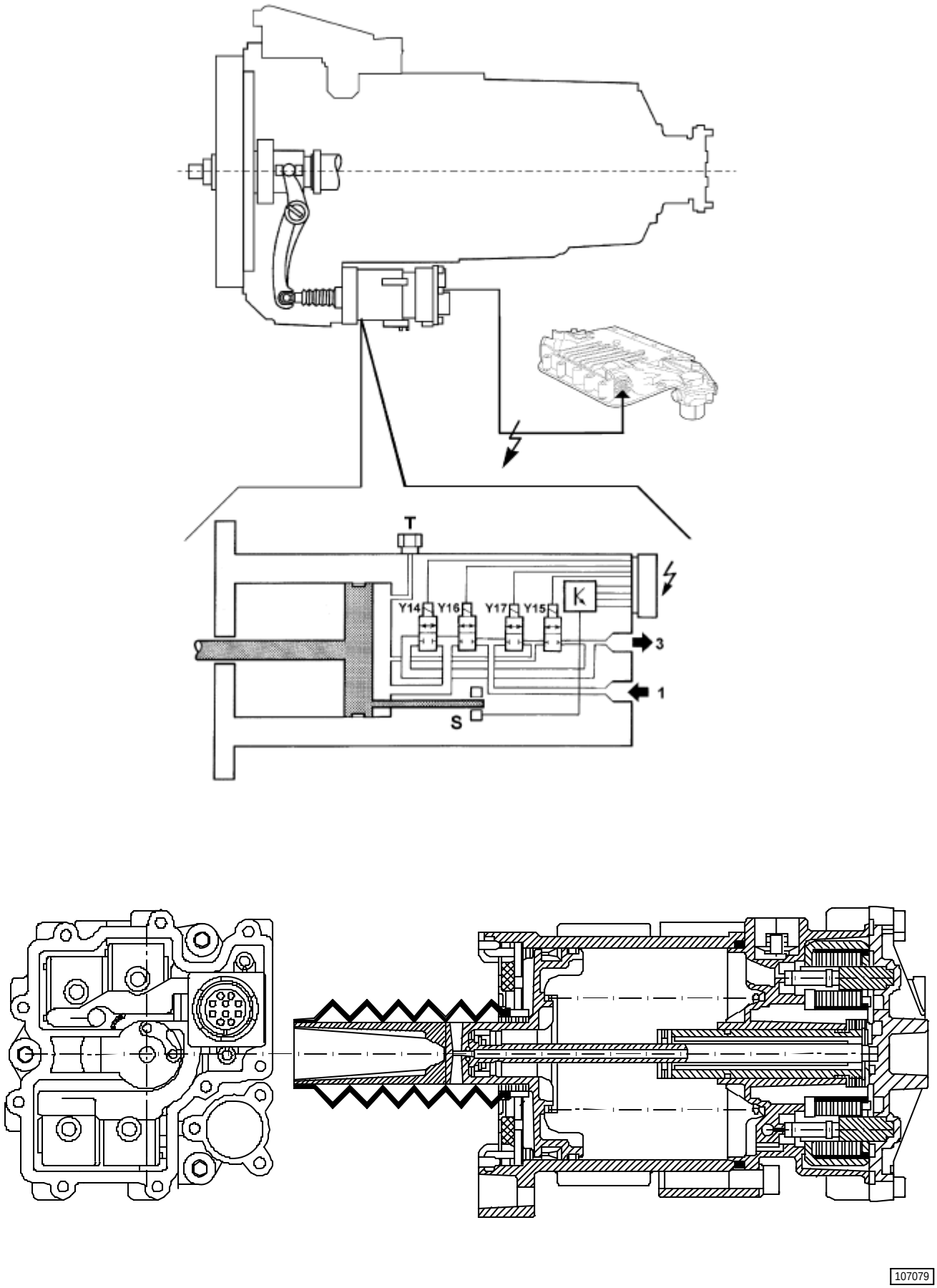
- Modulated opening: ~ 0.6 sec.
- Complete opening: ~ 0.3 sec.
- Modulated closing: ~ 1 sec.

### Actuator features

| | |
|---|---|
| - Operating fluid: | air (min. 6 bar max 11.5 bar) |
| - Power: | 24 Volt |
| - Load on lever in operating conditions: | 382 kg |
| - Operating temperature: | 40 °C + - 120 °C |
| - Cylinder diameter: | 100 mm |
| - Piston travel: | 70 mm |

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Figure 226



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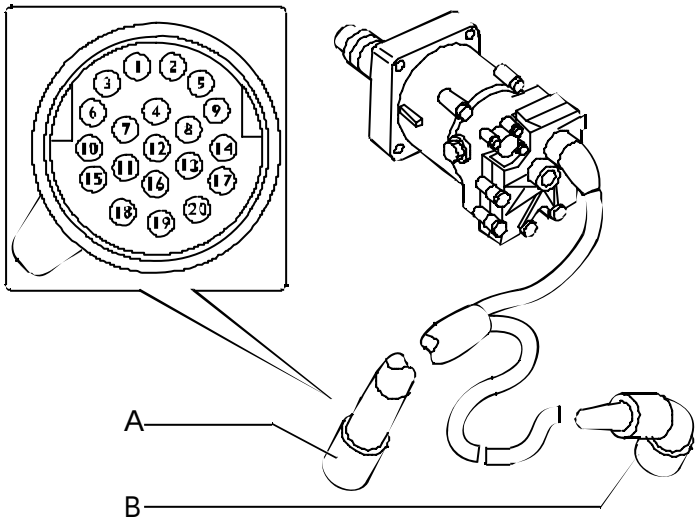
## Clutch actuator Pin-out

The N.C. on/off type electro valves are powered at 24 Volt with ~ 14 ÷ 20 Ohm resistance.

The sensor is powered by the center at 5 Volts and the return signal is between 0.5 and 4.5 Volt.

The clutch actuator is connected to the system via a 20-pole connector.

Figure 227




A. 20-pole connector - B. Output transmission rpm sensors

| Pin | Function |
|---|---|
| 1 | - |
| 2 | - |
| 3 | - |
| 4 | - |
| 5 | - |
| 6 | Transmission speed sensor mass (pin 2) |
| 7 | Y17 electro valve signal (slow opening) |
| 8 | Y16 electro valve signal (fast opening) |
| 9 | Y15 electro valve signal (slow closing) |
| 10 | Clutch position sensor analogic signal |
| 11 | Transmission output speed sensor signal (pin 3) |
| 12 | Y14 electro valve signal (fast closing) |
| 13 | - |
| 14 | - |
| 15 | Clutch position sensor power |
| 16 | Y15 - Y17 electro valve mass |
| 17 | Y14 - Y16 electro valve mass |
| 18 | Transmission speed sensor power (pin 1) |
| 19 | - |
| 20 | Clutch position sensor mass |

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## Accelerator pedal

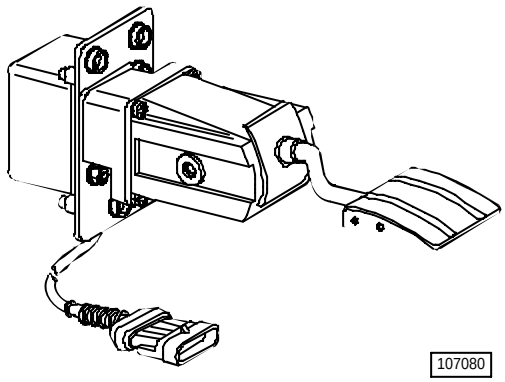
Release pedal NA integrated into the position sensor is used to detect engine idling position and enable clutch engagement at vehicle start.

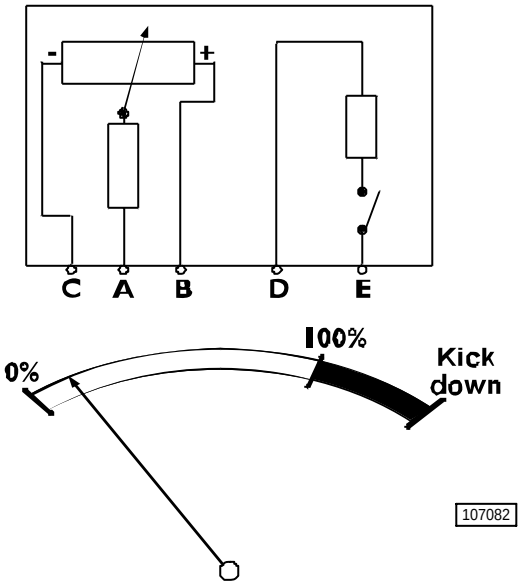
The signal reaches the VCM electronic center via the CAN VDB Vehicle Data Base line and is sent to the Automated EuroTronic transmission center.

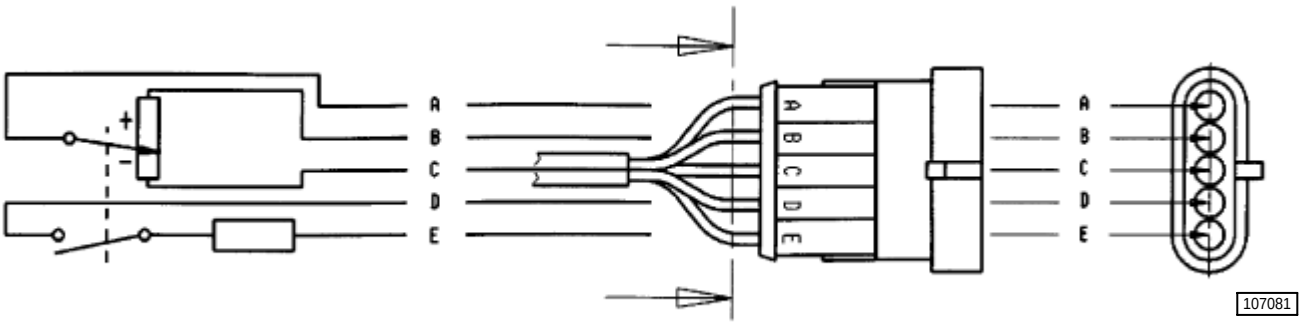
Kick Down is activated with the accelerator pedal in automatic function mode travel. The Kick Down function is activated when accelerator pedal lever (1) move the potentiometer to position 100%, which does not correspond to pedal mechanical travel end.

Stiffened travel end is only mechanical and is used to transmit the feeling Kick Down inserted to the operator.

Figure 228



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## INTARDER
## Operation

The intarder is operated with the 7-position sector located in the right direction indicator (1). INTARDER cut-in indication is managed by the CLUSTER (2) via a specific warning.

The system is provided with a Brensomat constant velocity function used for vehicles without EBS. This function enables keeping a vehicle on a downhill slop moving at the speed as selected by the operator. In this case, the intarder electronic centre automatically selects the braking torque required.

The constant velocity function is only activated in position "0" after storing the speed desired.

Storage can be at any of the 7 selector positions by briefly pressing the push button provided; with higher pressure storing speed at that moment and lower pressure decrease of speed set. The speed programmed previously is restored as soon as the selector is returned to position "0".

Pressing the push button once again disenables the constant velocity function. The oil contained in the sump is sent to the intarder hydraulic circuit via a filter and the circuit is protected by a safety valve.

By acting on selector (1), electronic centre (4) receives via SWI (3) an electrical signal that it processes and sends to electro valve (7) controlling the accumulator and proportional electro valve (5).

The accumulator control electro valve switches and lets air under pressure pass through its piston to send oil to the hydraulic circuit and reduce action time.

The proportional electro valve acts on the control valve to set its pressure. The adjustment valve is piloted by control valve oil pressure. The rotor is connected to the rear axle via the transmission shaft and the stator is connected to the frame through the intarder case.

The oil contained in the areas between the rotor and the stator is moved by the rotor blades to create a closed circuit oil flow between mobile and fixed parts.

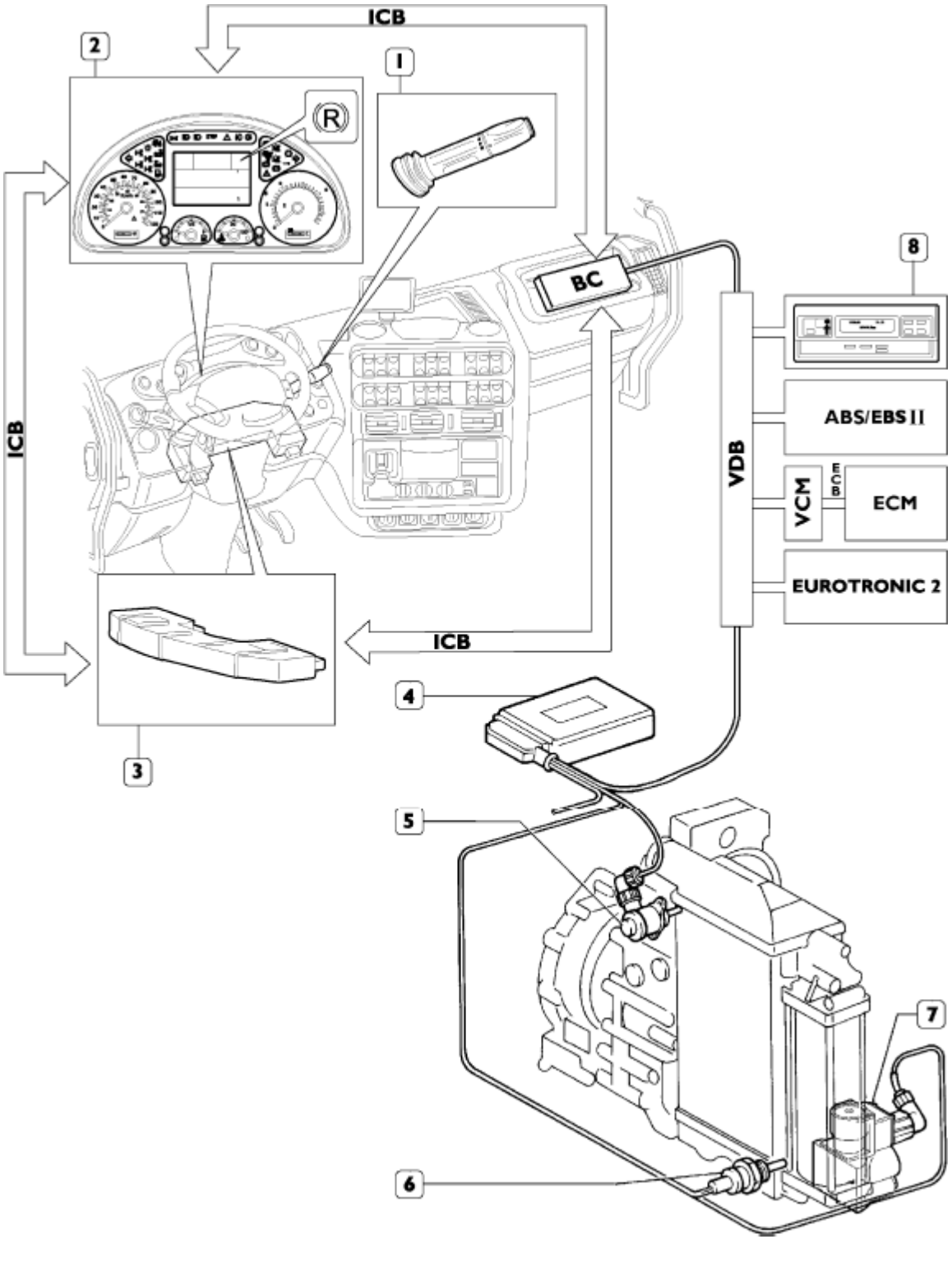
By impacting the stator blades, oil causes rotor and therefore vehicle braking. Reduced oil flow speed between the rotor and the stator transforms kinetic energy into heat, to dissipate which oil passes through an oil/water heat exchanger, where oil heat is transmitted to cooling water and dissipated through the vehicle cooling system.

The heat exchanger water discharge pipe is provided with a temperature sensor (6) that continually sends cooling water temperature data to the electronic centre to ensure maximum temperature allowed for proper engine operation is not exceeded.
If water temperature rises to reach the safety limit for any reason whatsoever, the centre pilots sump control air adjustment to reduce braking torque.
The electronic centre receives a signal from the ABS/EBS system that causes intarder cutout when actuated and it also receives a signal from electronic tachograph (8) enabling constant velocity function use. This signal is sent via a VDB can line.

Switching to position "0" cuts the intarder off and deactivates the proportional and accumulator control electro valves.

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Figure 229




1. Engine brake/Intarder selector - 2. Instrument Cluster - 3. Steering Wheel Interface centre - 4. Intarder electronic centre - 5. Proportional electro valve - 6. Water temperature sensor - 7. Accumulator on/off control electro valve - 8. Electronic tachograph

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## Hydraulic system diagram
## Description

The oil contained in the sump is sent to the intarder hydraulic circuit by a pump through a filter and a 12.5 bar pressure limiter valve.

## Intarder on

When the intarder is actuated with control (2), the centre supplies electro valve (19) controlling accumulator (10), whose piston is piloted by the service air system at 9.5 bar pressure to send oil faster to the rotor/stator unit.

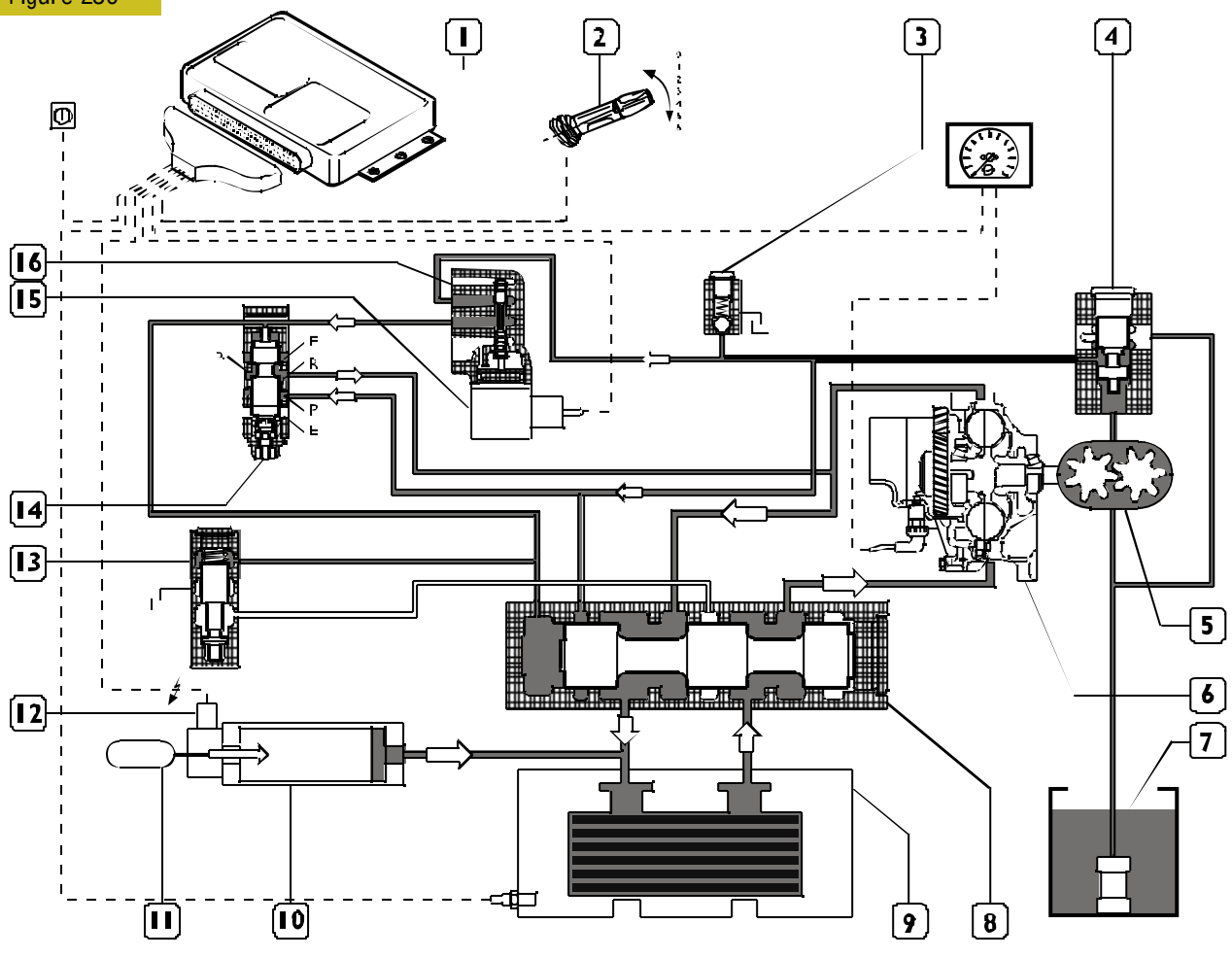
When excited, proportional electro valve (16) acts on valve (16) by moving its hydraulic spool and moves function control pressure to braking level.

Pressure acts on adjustment valve (14), to create communication between input duct P and output ducts P 1 - R.

Thus, oil from pressure limiter electro valve (4) moves the hydraulic spool of valve (8) and puts duct $R_1$ 0into communication with the motor/stator via heat exchanger (9).

Pressure (13) is not affected by oil pressure and closes oil discharge into sump (7).

Figure 230

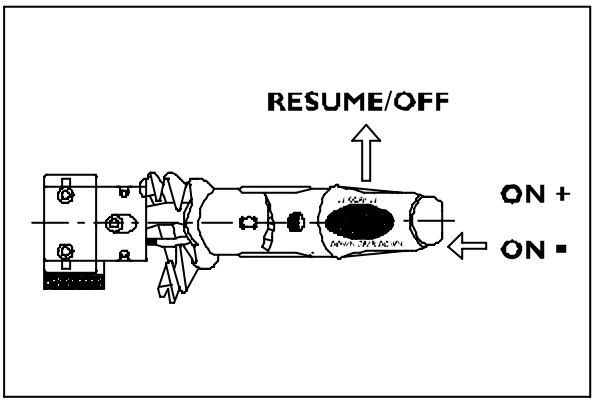


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## Speed storage and use

By inserting Cruise Control, the system automatically maintains vehicle advance speed without having to use the accelerator pedal. If vehicle speed increases over 2 Km/h more than the speed set, such as when travelling downhill for instance, the engine brake is activated automatically to slow the vehicle down and maintain the speed reached. The intarder is also activated if speed increases by over 3 Km/h.

Figure 231




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Its function can only be activated when the following conditions are satisfied:

- engine brake/intarder lever cut out;
- vehicle on the move with gear selected;
- vehicle speed over 20 Km/h;
- brake pedal released;
- clutch pedal released.

| Control | Vehicle speed adjustment |
|---|---|
| ON+ | Speed increase |
| ON- | Speed decrease |
| RESUME | Last stored speed selection |
| OFF | Speed adjustment cancellation |

Adjustment is cut out when the brake or clutch pedal is actuated. The same applies when the minimum speed set is not reached. Top speed is stored in the programme inside the electronic control module and cannot be changed.

1 Basculating push button ON has the following functions:

a)when pressed once, it activates the function and keeps the speed set at that moment by the accelerator pedal. The accelerator pedal can then be released and the vehicle keeps moving at the cruise speed set.

b)with the function already activated, it increases vehicle speed without having to use the accelerator pedal.

2 Basculating push button ON has the following function: with the function activated, it decreases vehicle speed.

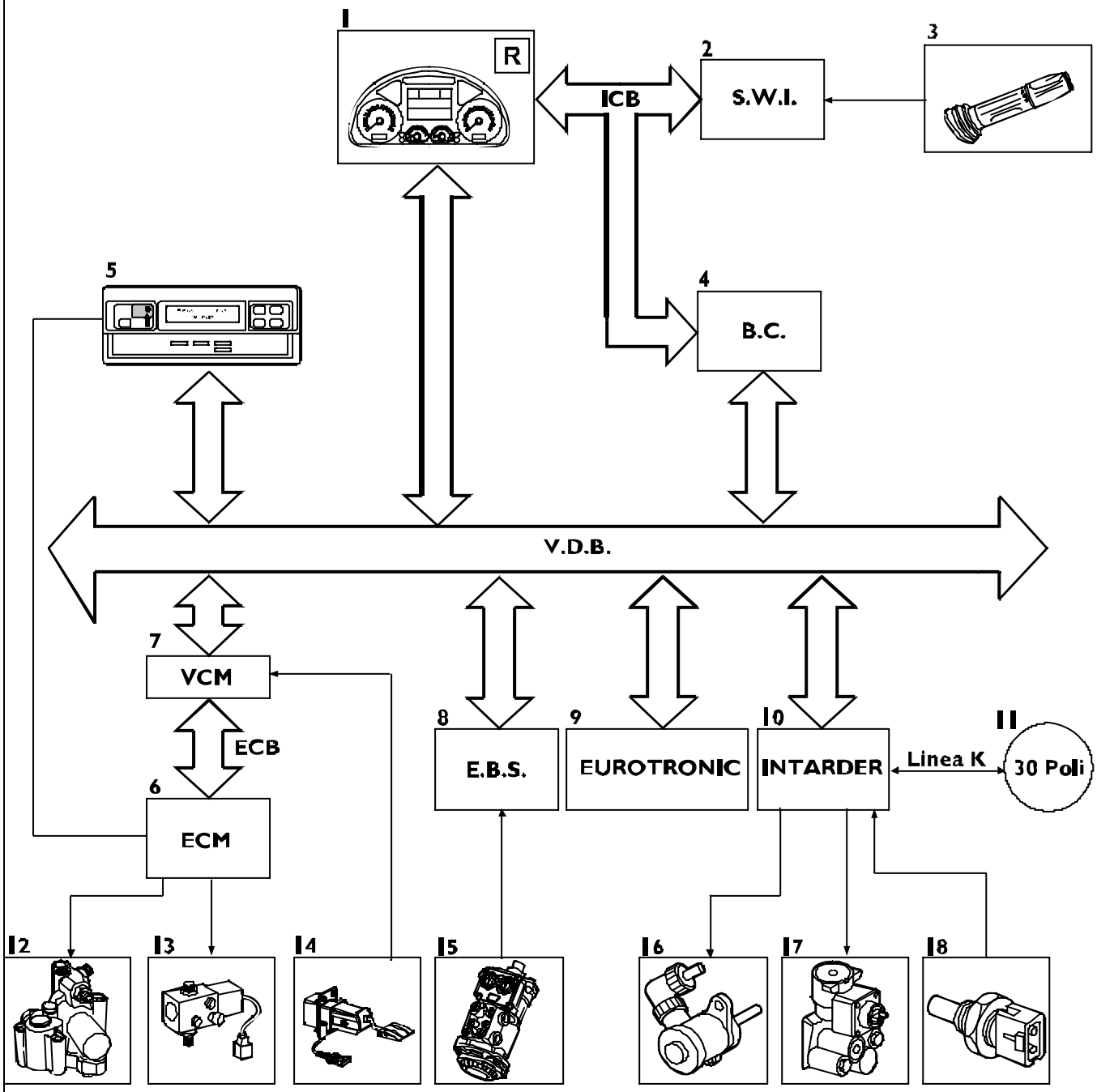
3 The Cruise Control lever actuated OFF towards the steering wheel deactivates the function (CC display shaded).

4 Actuating the steering wheel lever once again (RESUME) the value stored is reactivated (CC display clear).

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## Assembly

Figure 232

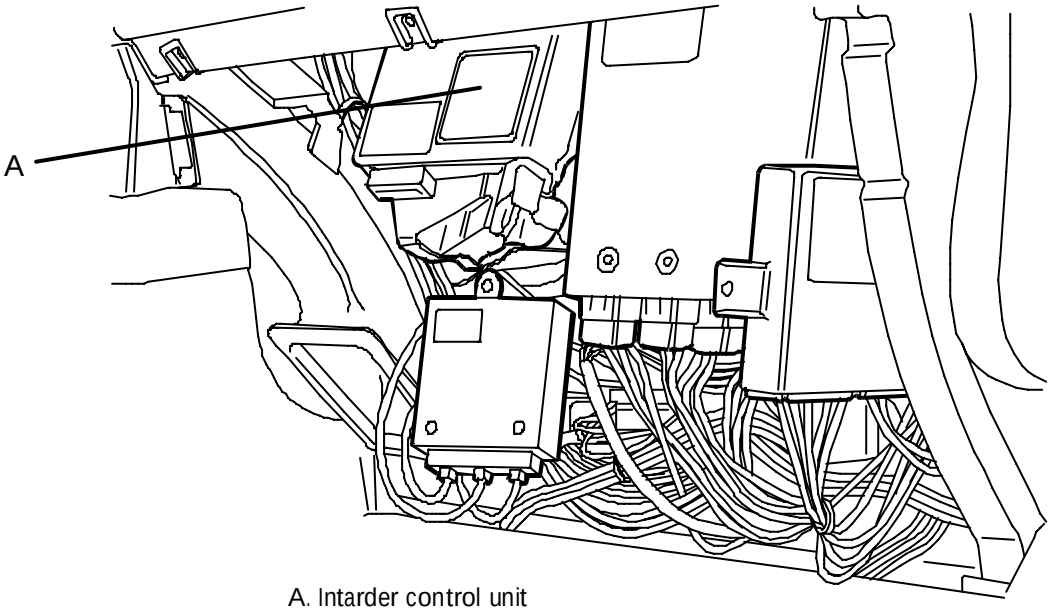



1. Instrument Cluster - 2. Steering Wheel Interface - 3. Engine brake on multi function lever - 4. Body Computer - 5. Tachograph - 6. EDC centre - 7. VCM centre - 8. EBS centre - 9. EuroTronic centre - 10. Intarder centre - 11. Diagnosis connection - 12. Engine brake electro valve - 13. VGT electro valve - 14. Accelerator pedal - 15. Brake pedal Duplex distributor - 16. Proportional electro valve - 17. ON-OFF electro valve - 18. Water temperature sensor

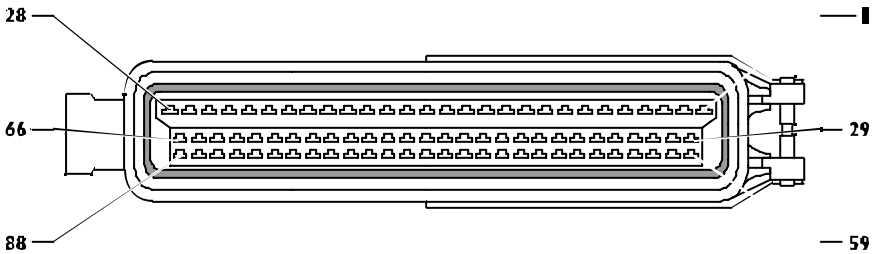
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## Control unit disposition

Figure 233




A. Intarder control unit




73667

107088

| Pin | Cable | Function |
|---|---|---|
| 1 | 9311 | Oil accumulator solenoid valve positive |
| 3 | 0310 | Proportional solenoid valve negative |
| 4 | 9310 | Proportional solenoid valve positive |
| 8 | 5541 | Cluster |
| 9 | 5309 | Water temperature transmitter positive |
| 12 | 3393 | 30-pole diagnosis connection (pin 20) |
| 14 | 2293 | 30-pole diagnosis connection (K line - Pin 6) |
| 22 | | CAN VDB (H) line |
| 27 | 0000 | Cab mass |
| 28 | 0000 | Cab mass |
| 34 | 0311 | Oil accumulator solenoid valve negative |
| 37 | 0309 | Water temperature transmitter negative |
| 49 | | CAN VDB (L) line |
| 53 | 8300 | +15 power supply |
| 54 | 7300 | +30 power supply |

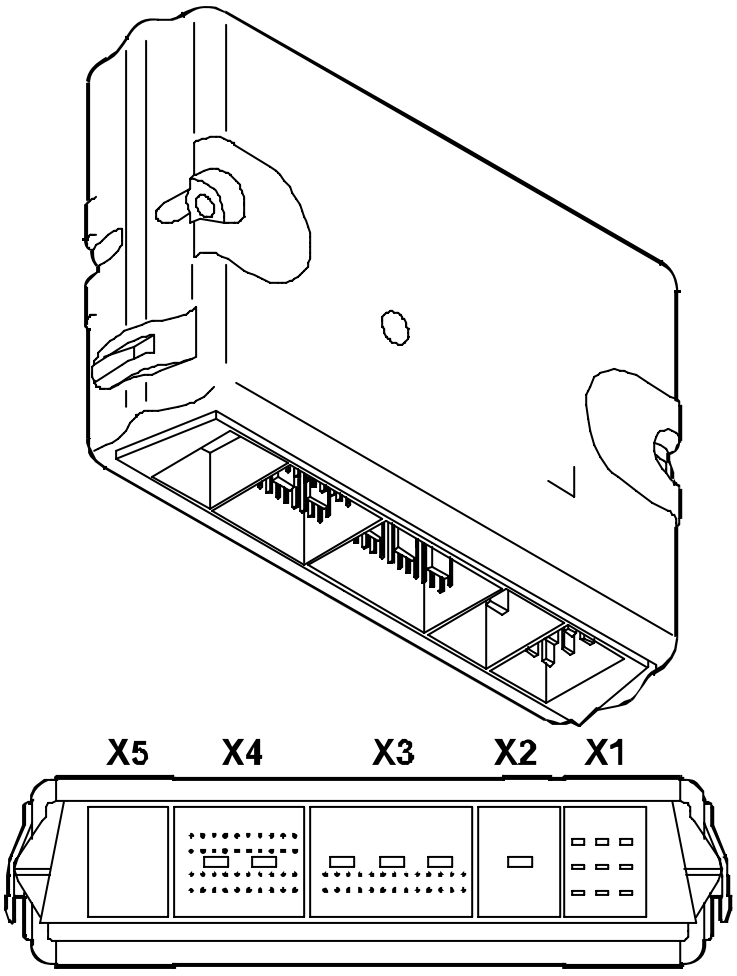
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## EM (EXPANSION MODULE) ELECTRONIC CONTROL UNIT (PTO)

The EM (Expansion Module) control unit located in the cabin control unit compartment (passenger's side) controls the power takeoffs and, unlike the DMI, makes it possible to carry out complicated applications such as:

- transmission (gearbox) control from external source (TCI message)
- engine control from external sources, like request and limitation of engine rev number, vehicle speed limit, start up and engine stop
- safety logics for waste collection applications
- optimization of braking system for waste collection applications
- additional headlight control
- interface with CAN_open network

Figure 234




112596

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## Pin - out

Connector XI

| Pin | Description | Cable colour code |
|---|---|---|
| 1 | PTO1 solenoid valve power supply | 9131 |
| 2 | Positive +30 | 7772 |
| 3 | Signal for operators (72072B - pin 6) | 6985 |
| 4 | PTO2 solenoid valve power supply | 9132 |
| 5 | Earth | 0000 |
| 6 | PTO3 solenoid valve power supply | 9132 |
| 7 | Clutch solenoid valve signal (72072A - pin 4) | 9995 |
| 8 | Signal for operators (72072B - pin 7) | 6986 |
| 9 | Positive +30 | 7166 |

Connector X3

| Pin | Description | Cable colour code |
|---|---|---|
| 1 | CAN - H line (VDB) | Sw/Bi |
| 2 | CAN - L line (VDB) | Gn/Ve |
| 3 | Free | - |
| 4 | Line K (diagnosis connector pin 6) | 2996 |
| 5 | PTO1 request | 0131 |
| 6 | PTO2 request | 0132 |
| 7 | PTO3 request | 0123 |
| 8 | Signal of PTO1 engaged | 6131 |
| 9 | Signal of PTO2 engaged | 6132 |
| 10 | Signal of PTO3 engaged | 6133 |
| 11 | PTO1 consensus signal | 0391 |
| 12 | PTO2 consensus signal | 0392 |
| 13 | Positive +15 | 8166 |
| 14 | Free | - |
| 15 | Free | - |
| 16 | PTO3 consensus signal | 0393 |
| 17 | Signal from operators (72072A - pin 3) | 0991 |
| 18 | Signal from operators (72072A - pin 1) | 0992 |
| 19 | Signal from operators (72072A - pin 2) | 0993 |
| 20 | Signal from operators (72072B - pin 3) | 0994 |
| 21 | Signal from operators (72072B - pin 4) | 0995 |
| 22 | Pin 24 jumper | 8990 |
| 23 | Pin 26 jumper | 0990 |
| 24 | Pin 22 jumper | 8990 |
| 25 | Free | - |
| 26 | Pin 23 jumper | 0990 |

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Connector X4

| Pin | Description | Cable colour code |
|---|---|---|
| 1 | Signal for operators (72072B - pin 8) | 6987 |
| 2 | Signal for operators (72072B - pin 9) | 6988 |
| 3 | Signal for operators (72072B - pin 10) | 6989 |
| 4 | Parking brake signal (72072A - pin 1) | 6981 |
| 5 | Neutral gear signal (72072A - pin 2) | 6983 |
| 6 | Signal from operators (72072B - pin 5) | 0996 |
| 7 | Free | - |
| 8 | Free | - |
| 9 | Signal from operators (72072C / 72072D - pin 5) | 0999 |
| 10 | Free | - |
| 11 | Free | - |
| 12 | Line CAN - H (SB) - (trailer) | Ws/Bi |
| 13 | Line CAN - L (SB) - (trailer) | Gn/Ve |
| 14 | - | 5981 |
| 15 | - | 5982 |
| 16 | - | 5991 |
| 17 | Line CAN - H (SB) | Ws/Bi |
| 18 | Line CAN - H (SB) | Ws/Bi |
| 19 | Line CAN - L (SB) | Gn/Ve |
| 20 | Line CAN - L (SB) | Gn/Ve |
| 21 | Signal for operators (72072B - pin 11) | 6990 |
| 22 | Signal for operators (72072B - pin 12) | 6991 |
| 23 | Signal for operators (72072B - pin 13) | 6992 |
| 24 | Free | - |
| 25 | Free | - |
| 26 | Free | - |
| 27 | Free | - |
| 28 | Signal from operators (72072C / 72072D - pin 3) | 0975 |
| 29 | Signal from operators (72072B - pin 18) | 5983 |
| 30 | Free | - |
| 31 | Signal for operators (72072B - pin 14) | 6993 |
| 32 | Signal for operators (72072B - pin 15) | 6994 |
| 33 | Free | - |
| 34 | Free | - |
| 35 | Free | - |
| 36 | Free | - |
| 37 | Free | - |
| 38 | Signal from operators (72072B - pin 20) | 5992 |
| 39 | Free | - |
| 40 | Free | - |

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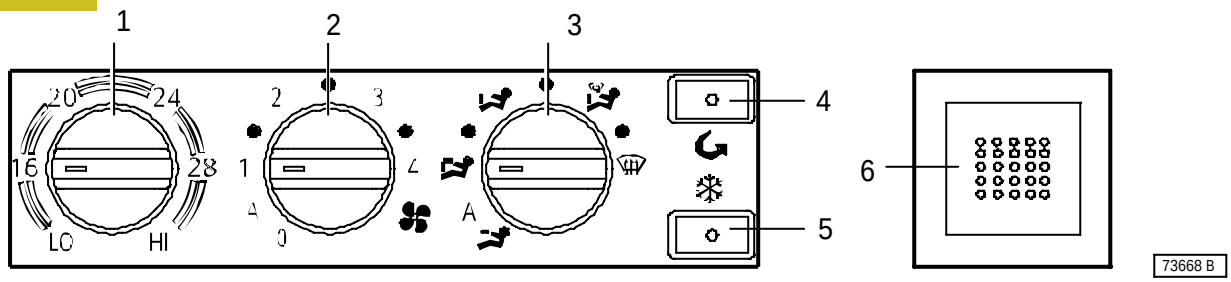
## AUTOMATIC AIR CONDITIONER

In automatic version the system is managed by an electronic unit placed in the lower part of central dashboard and integrates control knobs.

The electronic unit is connected to vehicle CAN BCB line and is equipped with a very advanced diagnostic system.

The main objective of the unit is adjusting internal cabin temperature (set by the driver) depending on external temperature measured by a suitable sensor.
The system provides for the chance of a completely automatic management, but anyway for the user it is always possible, if he so wishes, to modify the main system operating parameters.

Figure 235




1. Required temperature adjusting knob
2. Fan speed adjusting knob
3. Air flow distribution knob
4. Recirculation function button with embedded led
5. Compressor control button with embedded led
6. Internal temperature sensor

After having set the desired internal temperature, by placing the other two knobs next to letter A, the unit is able to automatically check the following functions:

- Air temperature to unions.
- Fan speed
- Air flows distribution
- Supplementary heater connection if external temperature is < 5 °C.

In this position the unit does NOT automatically activate either compressor or recirculation function: connection of both of them is manually managed by the driver.

### "RECIRCULATION" FUNCTION

Connection of this function is completely manual and is obtained through a suitable button that allows closing the external air intake by placing the baffle at 95% of internal air and 5% of external air.
The unit automatically deactivates this function after about 20 minutes if the compressor is disconnected and after 30 minutes is the compressor is connected.

### "COMPRESSOR CONTROL" FUNCTION

Connection of this function is completely manual and is obtained through a suitable button that allows connecting the compressor clutch after a quality check of fluid in the system through safety pressure switches and evaporator temperature by means of the suitable sensor.
The unit does NOT automatically connect the compressor.

### "SUPPLEMENTARY HEATER CONTROL" FUNCTION

With moving engine the unit automatically connects the supplementary AIR and/or WATER heater only if the external temperature is < 5 _C.
With off engine the heater connection depends on driver's setting.

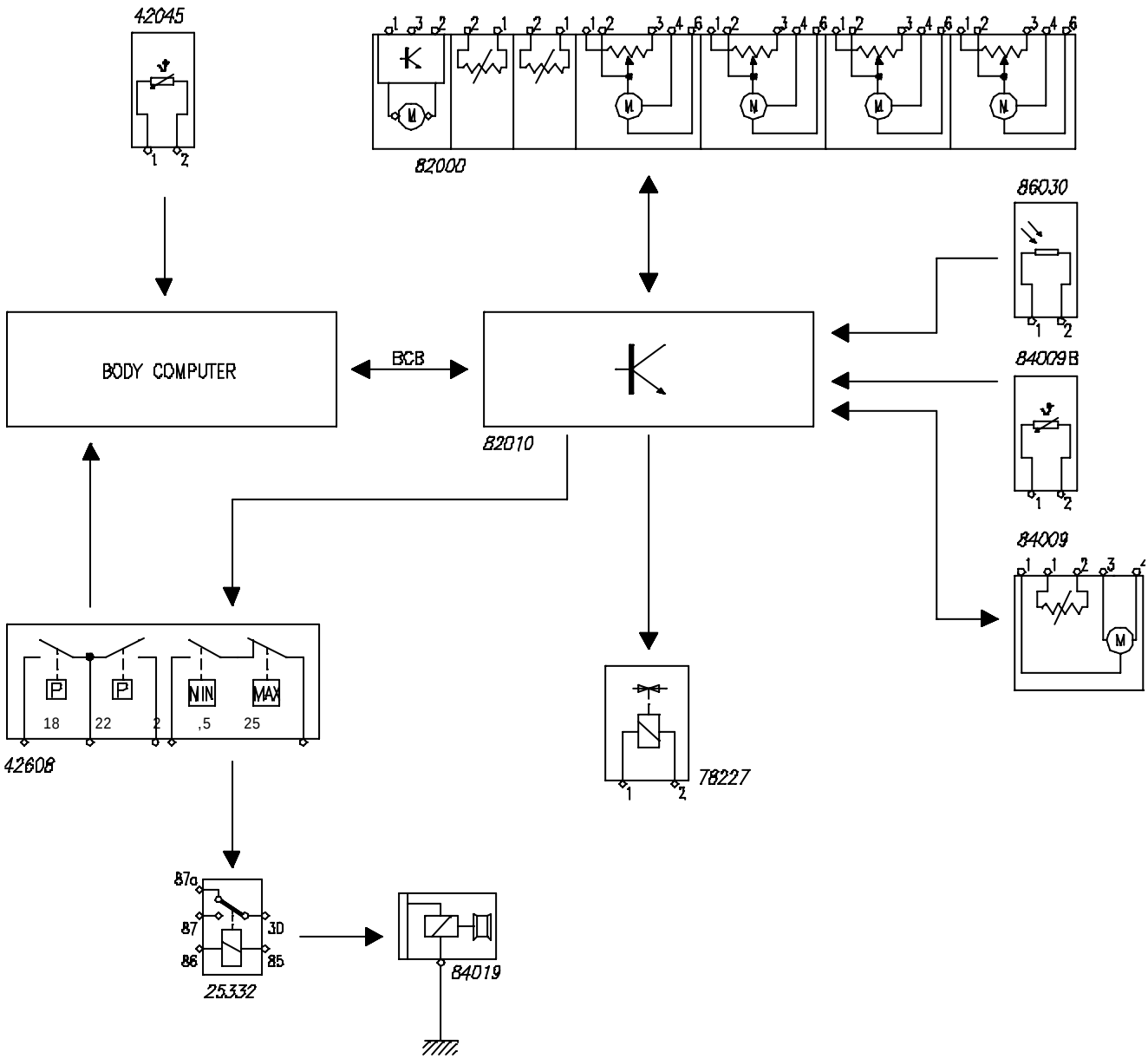
In both cases, the supplementary heater connection is signalled to the driver on Cluster display.

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## AUTOMATIC AIR CONDITIONER

### Automatic air conditioner block diagram

Figure 236



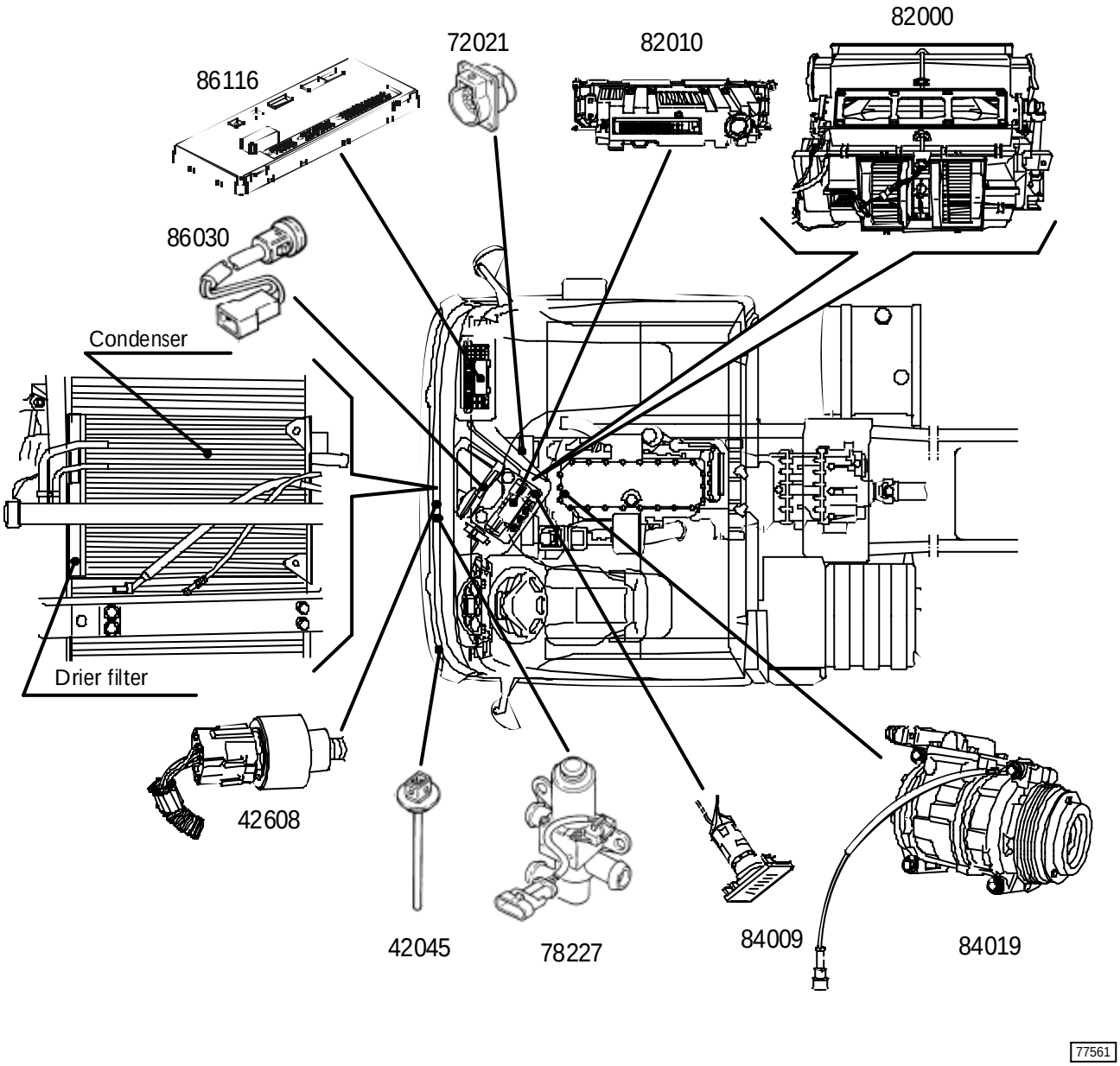

42045. Water temperature transmitter - 82000. Windscreen electric defroster assembly - 82010. Air conditioner control electronic unit - 86030. Sun radiation measuring sensor - 84009. Vented internal temperature measuring sensor - 84009B. Inner temperature detection sensor - 42608. Cooling liquid pressure signaling pressure switches - 25332. Compressor connection remote control switch - 78227. 3-way solenoid valve for radiator water recirculation - 84019. Compressor

Components 82010 - 82000 are placed in the same control assembly.

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## Component location

Figure 237

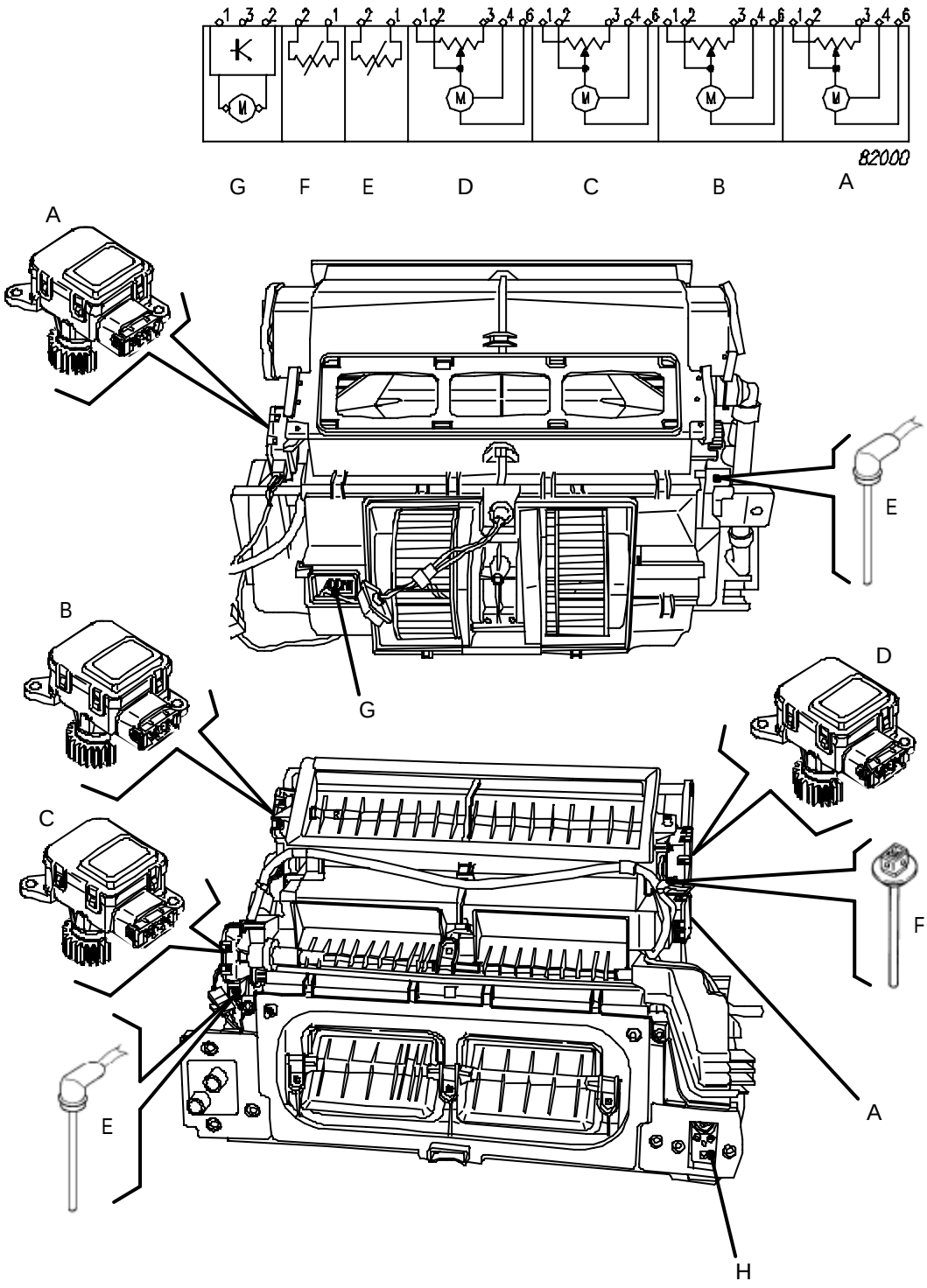



42045. External temperature transmitter - 82000. Windshield defroster unit - 82010. Conditioner electronic control centre - 86030. Sun ray detection sensor - 84009. Internal temperature detection sensor - 42608. Coolant pressure warning pressure switches - 25332. Compressor on remote control switch - 78227. Radiator coolant recirculation electro valve - 84019. Compressor - 86116. Body Computer - 72021. 30-pole connector for diagnosis

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## Windscreen electric defroster assembly components location

Figure 238



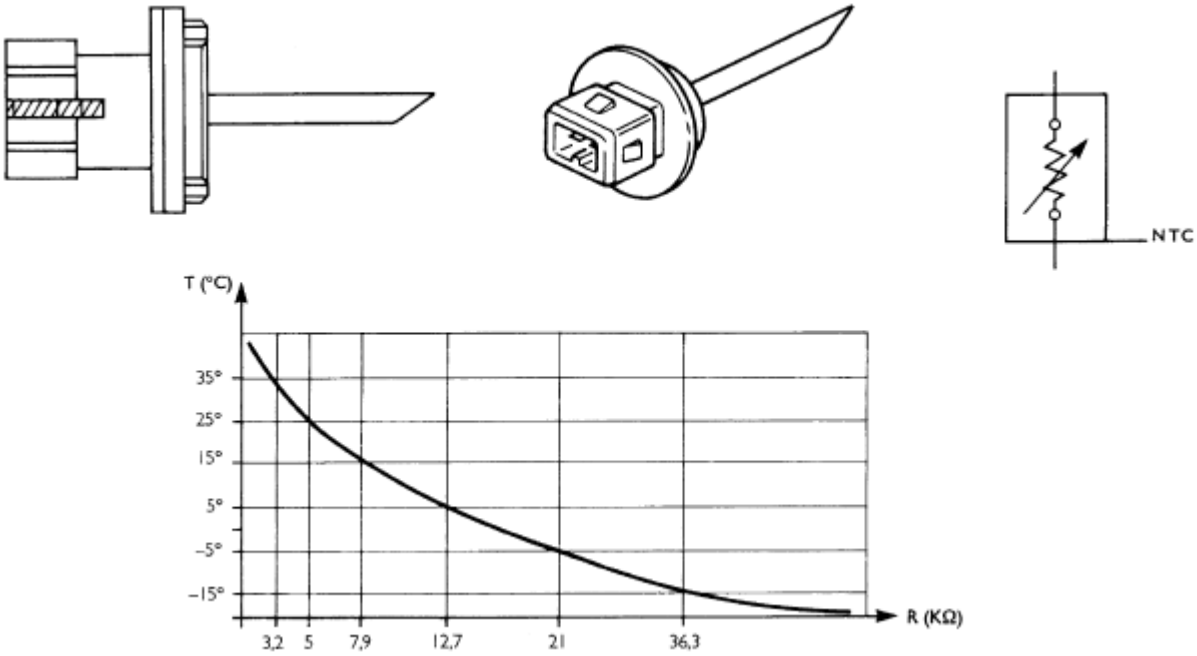

A. Floor reduction gear - B. Windshield defrost reduction gear motor - C. Recirculation reduction gear motor - D. Mixing reduction gear motor - E. Blown temperature sensor - F. Evaporator temperature sensor - G. Blower control module - H. Expansion valve

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## External temperature sensor

Located on the driver side vehicle front so it is invested by external temperature, as close as possible to reality. Its resistance at 25 °C = ~ 10 Kohm

Figure 239

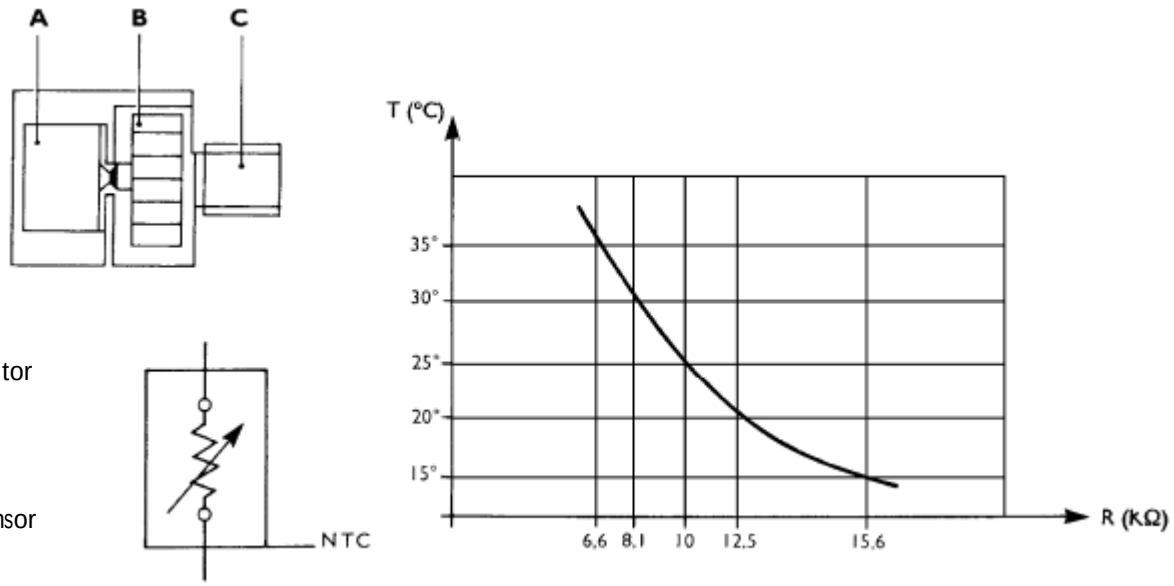



77566

## Main interior temperature sensor

Located on the right inside the control module and ventilated by a motor enabling air circulation and preventing erroneous temperature readings between values measured and the cab. Its resistance at 25 °C = ~ 10 Kohm

Figure 240




A) Motor

B) Fan

C) Sensor

77567

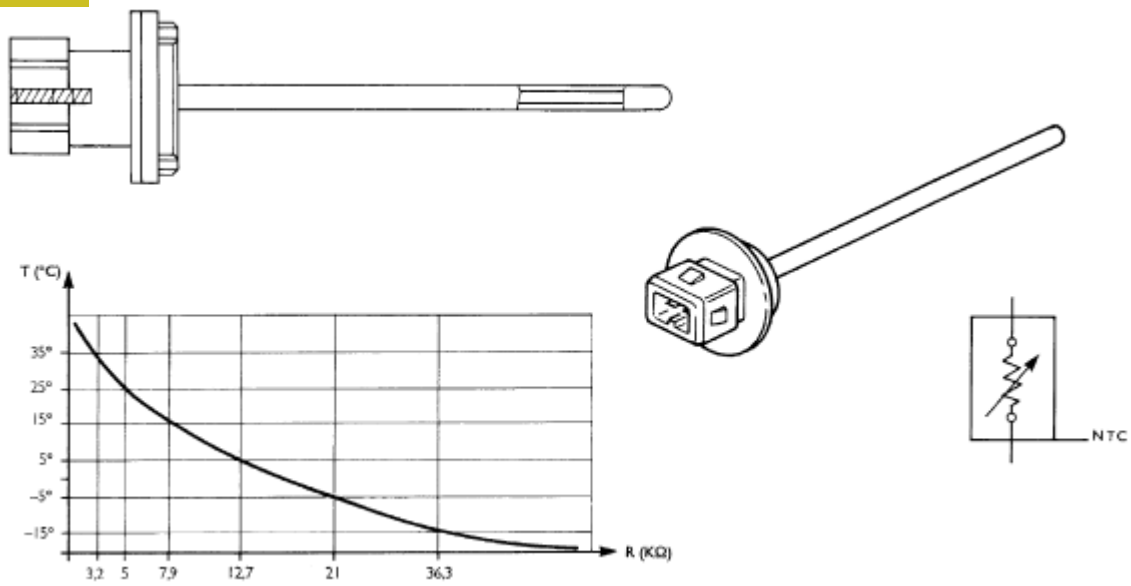
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## Evaporator temperature sensor

The sensor placed inside the evaporator generates compressor connection and disconnection.

Disconnection to avoid dispenser freezing occurs at a temperature < 2 °C, while connection at a temperature > 5.5 °C. Its resistance at 25 °C = ~ 3.28 Kohm

Figure 241

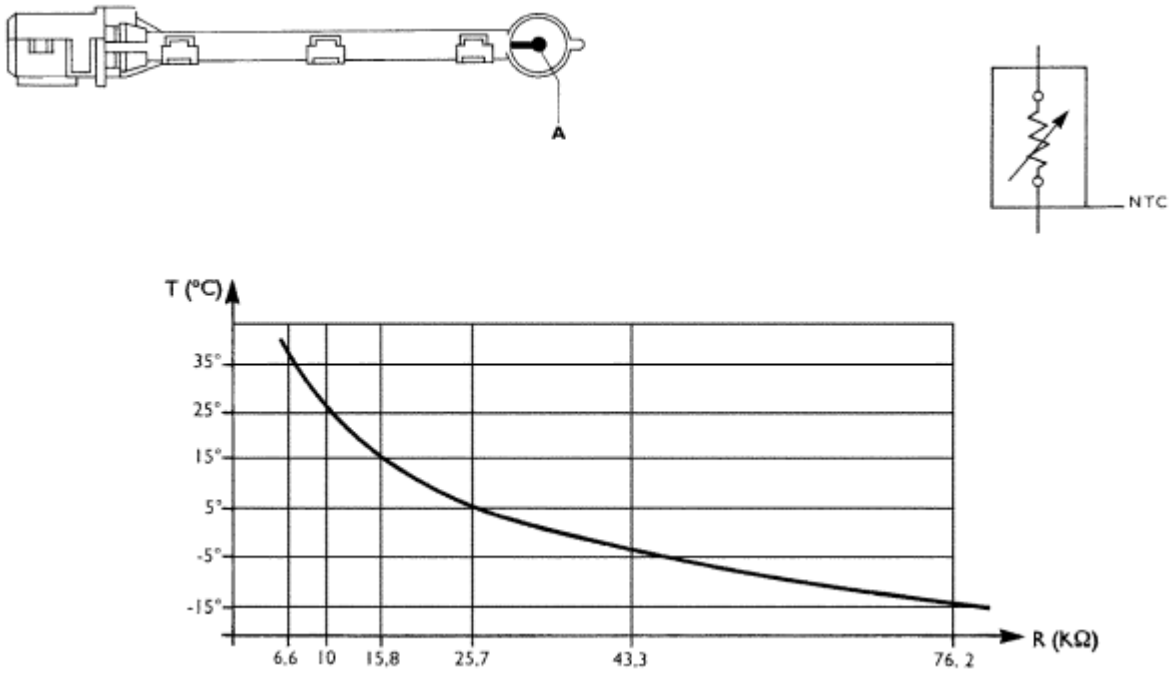



77559

## Blown air temperature sensor

Located downstream the heat exchanger, it gives the temperature of air inlet into the cab and enables the centre to adjust more properly. Its resistance at 25 °C = ~ 10 Kohm

Figure 242



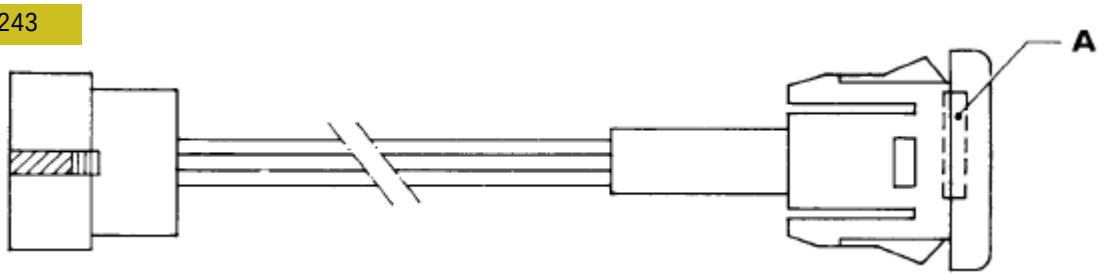

77574

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## Sun ray sensor

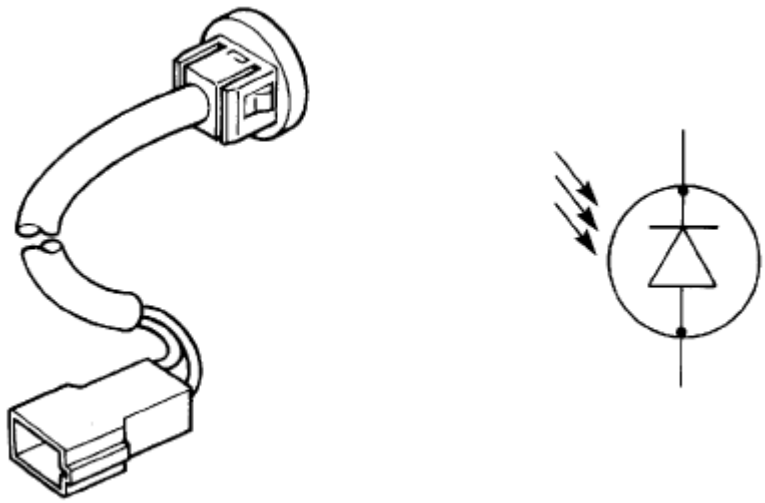
It is a photodiode placed on vehicle dashboard to point out luminous intensity that the cabin receives from outside.

Figure 243



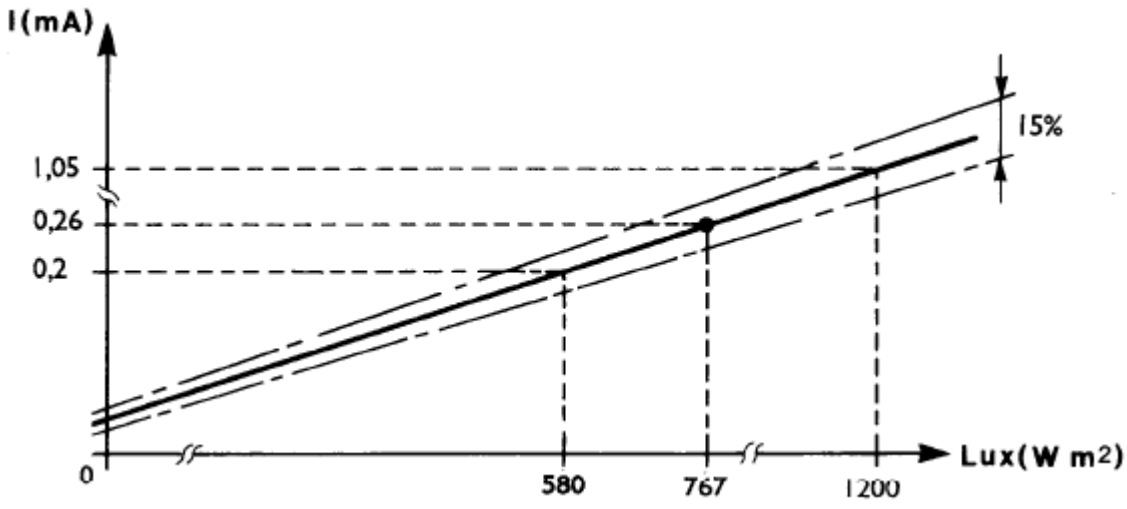

A) Sensor

77563



77564

Figure 244




77565

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## Reduction gear motors

The four automatic system units are located in the heater/conditioner inside the cab, according to their functions.

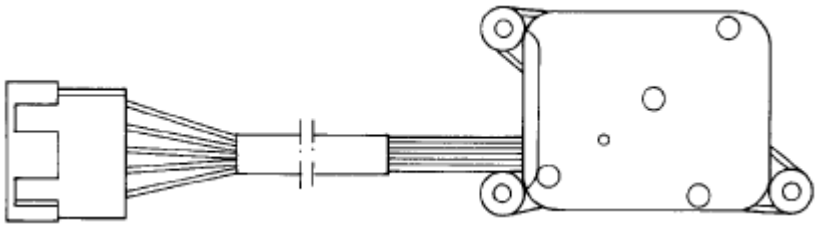
Their electrical features are the same.

They are activated directly by the electronic centre at 24 V rated voltage and absorb from 20 to 40 mA.
Motor resistance = ~ 112 Ohm.

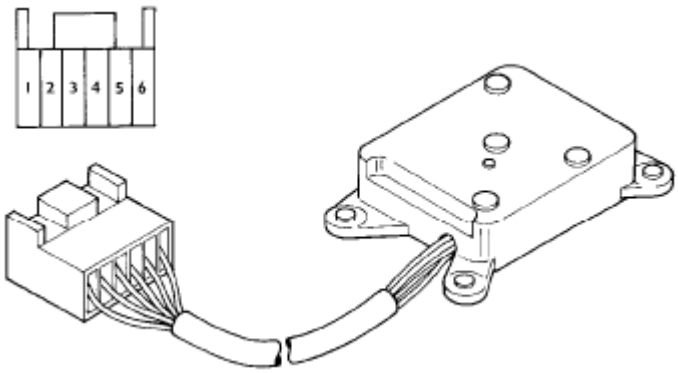
Maximum absorption at travel end is 200 mA, when the centre cuts supply off.

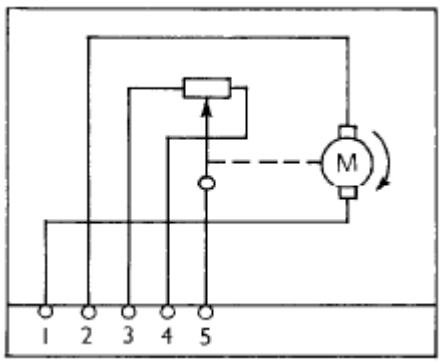
Their potentiometer is used as a return signal and when first lit, the centre detects and stores end travel values to divide the operating field. It is supplied at 5V, its resistance = ~ 5 Kohm.

Figure 245



77571




77573

## Pin-out

| Pin | Cable colour | |
|---|---|---|
| 1 | White | +/- 24V |
| 2 | Violet | +/- 24V |
| 3 | Blue | 0V |
| 4 | Orange | 0 ÷ 5V |
| 5 | Green | + 5V |
| 6 | - | Free |

**NOTE** If a stepper motor is replaced, it is MANDATORY to carry out the system RESET by disconnecting and reconnecting vehicle batteries.

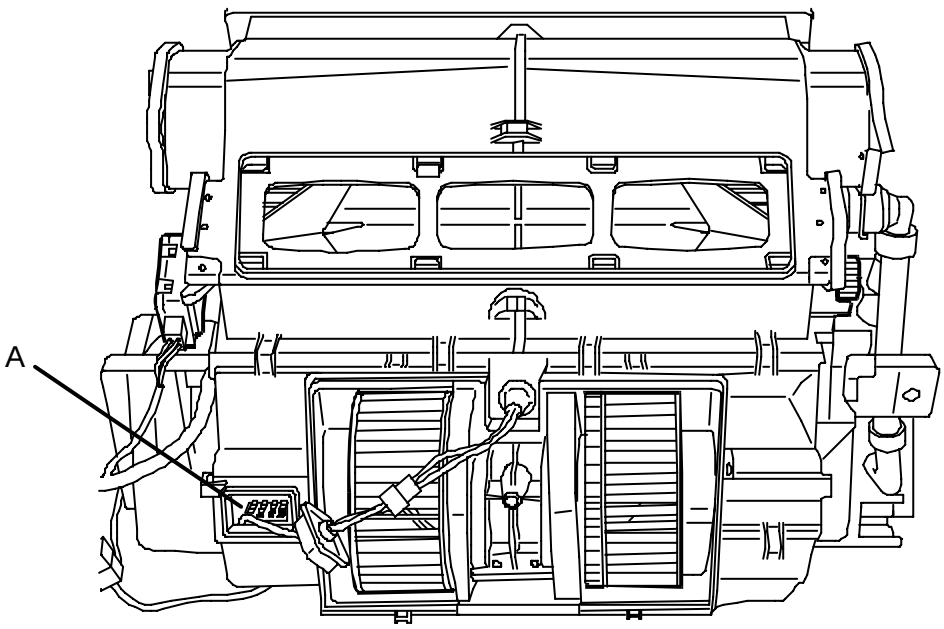
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## Blower control module

This electronic circuit located in the heater/conditioner unit adjusts double fan radial blower speed with some 200 different rates in the automatic mode and 8 in the manual mode.

The module is driven by the unit with a signal from 0 to 5 Volts while fans with a voltage from 0 to 24 Volts.

Figure 246




74244

A. Blower control module

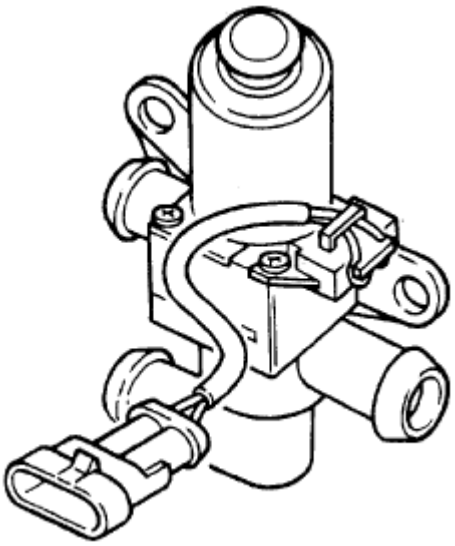
| Pin | Cable | Function |
|---|---|---|
| 1 | 0000 | Negative direct from the battery |
| 2 | 7555 | Centre control positive |
| 3 | 7551 | Positive direct from the battery |

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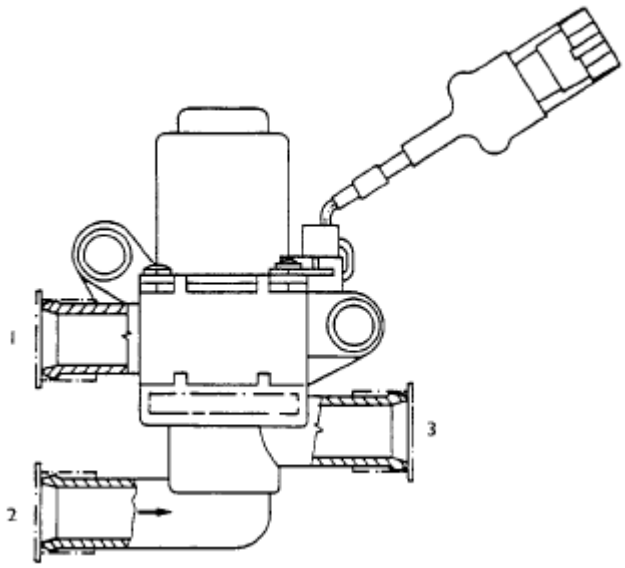
## Solenoid valve (3 ways)

This one-directional NA unit is supplied by a battery-directed positive.
The electronic centre adjusts its duty cycle by supplying a mass.
This three-way valve performs all dosing and by-pass functions.
It is supplied by a battery-directed positive and is piloted by the negative supplied by the centre monitoring the duty cycle.

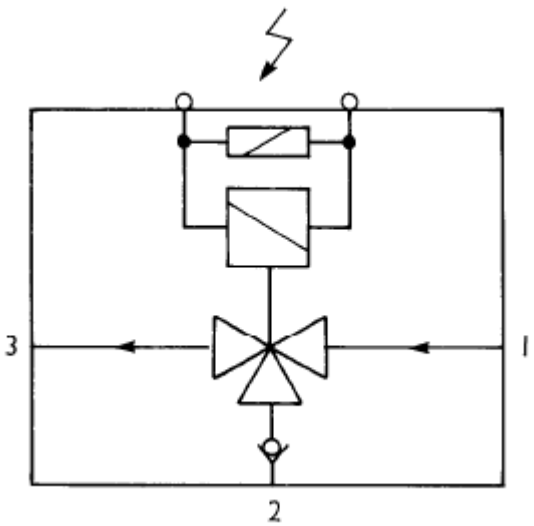
Figure 247



77569




77568

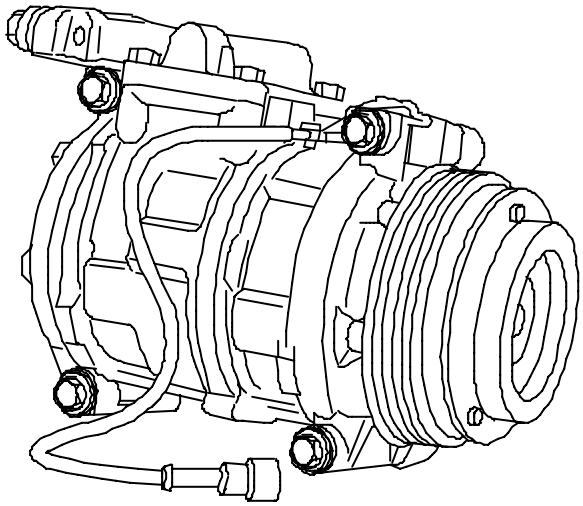



77570

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## Compressor

Figure 248



106393

| | NIPPODENSO |
|---|---|
| | ND 10 PA 17 |
| Coolant | R134a |
| Lube oil | ND80 |
| Quantity of coolant | 700g |
| Quantity of oil | 200cc. |

R134a coolant is anyhow exclusively used in the STRALIS range

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## Drier filter and safety pressure switches

The drier filter is integral with the condenser located on the vehicle front.

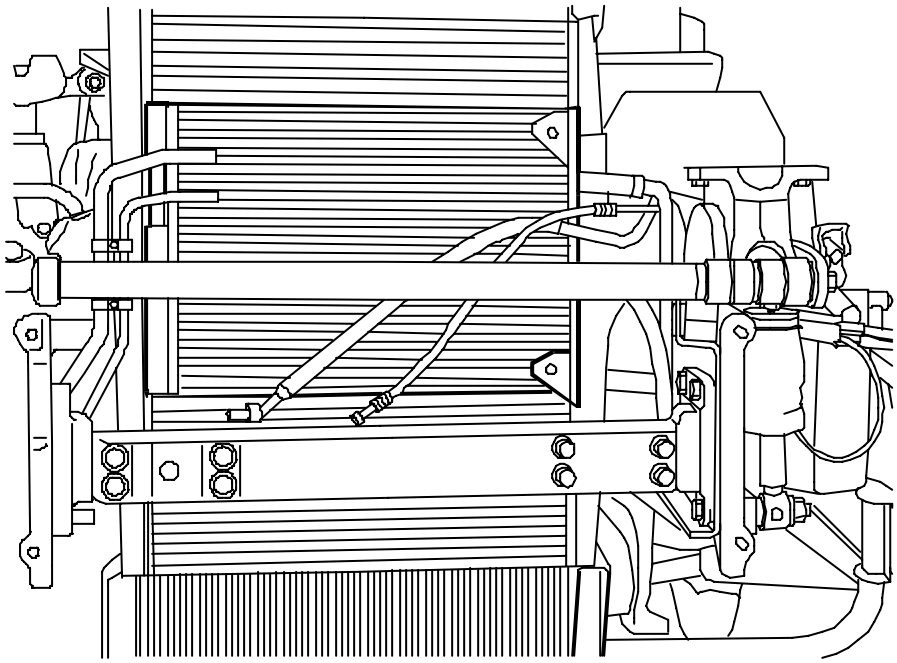
The cooling system uses R134a coolant as specified on its cover plate.

The 4-level safety pressure switch unit is installed on the condenser return line.

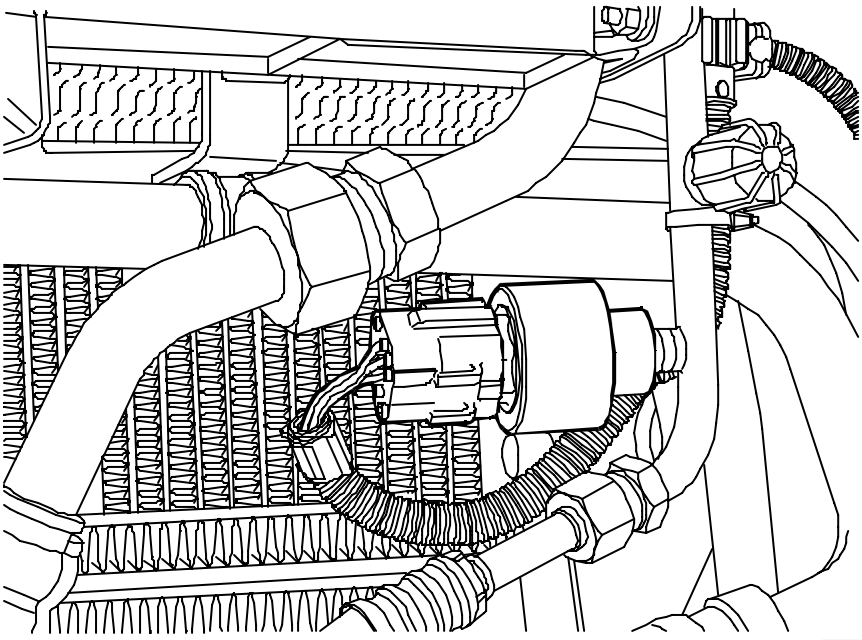
The two type NC and NA pressure switches keep system pressure constant from a minimum of 2.5 (for the NA) to a maximum of 25 bars (for the NC). The system is cut off when values are outside this range.

The two NA pressure switches are to cutout the engine cooling fan coil when system pressure is between 18 and 22 bars. This is achieved by means of a mass signal the two switches transmit to the Body Computer control centre.

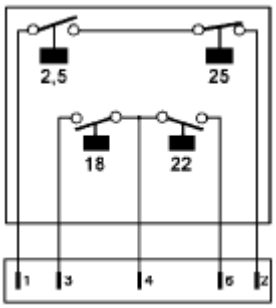
Figure 249



74245



74247




77560

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## Expansion valve

Its function is to lower liquid pressure from the condenser to a preset value so by circulating inside the evaporator the coolant can be sucked as a gas by the compressor.

It thus completes three basic functions:

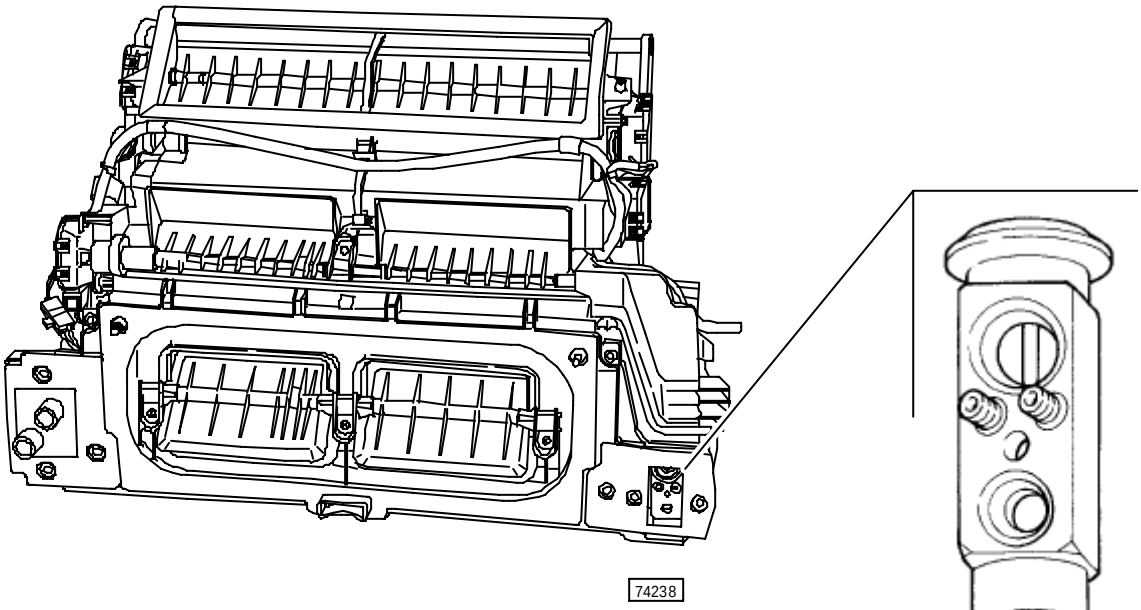
D DOSING

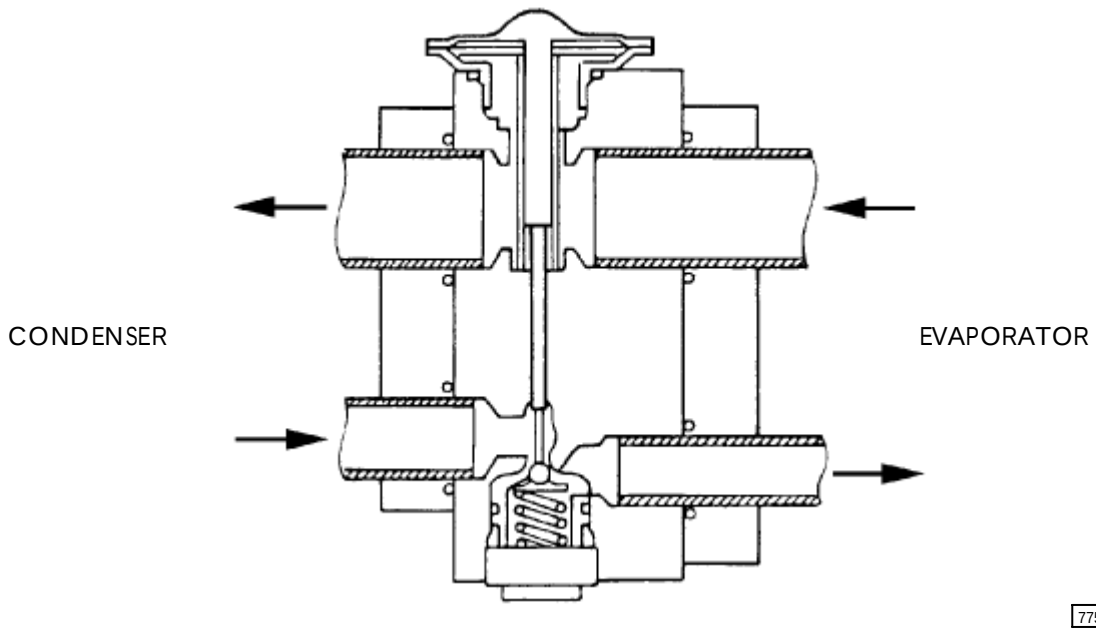
D MODULATING

D MONITORING

It is installed on the heater/conditioner unit close to the blower control module.

Figure 250



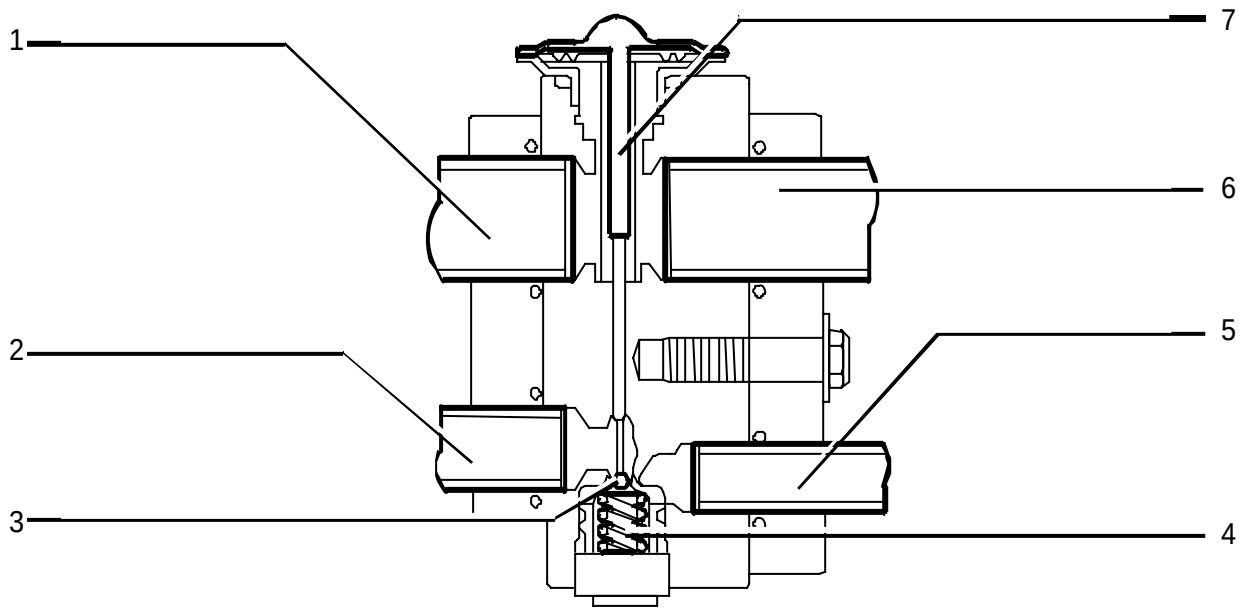
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The expansion valve is of the union type and is placed between drier filter and evaporator.

Its task is checking and batching the cooling fluid flow in order to obtain the maximum refrigerating power from the system and to lower the cooling liquid pressure (upon exiting the filter) to a pre-established value, so that the fluid itself, by then circulating into the evaporator, can be sucked by the compressor in a completely gaseous state.
In this valve there are two cooling fluid passages:

- The lower one that allows the cooling fluid to pass from drier filter (5) to evaporator (2). Along this path a spring (4) is placed that, suitably calibrated, allows obtaining such a temperature jump (overheating) as to ensure that the cooling fluid, upon entry the evaporator, is completely in a gaseous state. Moreover there is also a modulating element, in this case a ball (3) housed in the calibrated duct, that checks the cooling fluid flow rate to the evaporator.
- The upper one that allows the cooling fluid to pass from evaporator (1) to compressor (6). Along this path instead there is a temperature sensor (7) that, depending on the temperature upon exiting the evaporator, allows obtaining a control action on the cooling fluid flow rate, through the modulating and overheating checking element (3), through the spring (4).

Figure 251

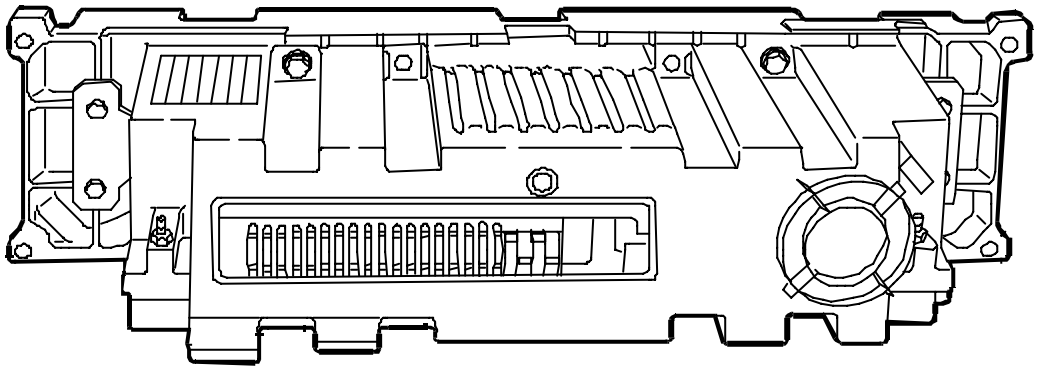



77565

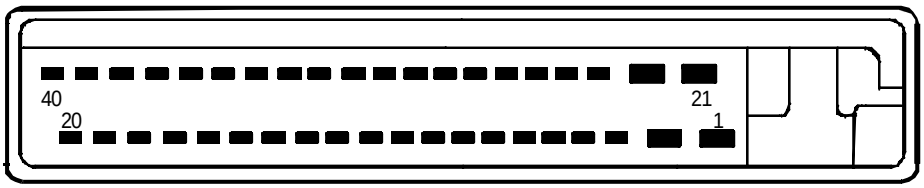
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## Conditioner control unit

Figure 252



74239




74248

| Pin | Cable | Function |
|---|---|---|
| 1 | - | - |
| 2 | 7550 | Positive direct from the battery |
| 3 | - | - |
| 4 | 2296 | K line for diagnosis |
| 5 | Ws/Bi | CAN - H (BCB) line |
| 6 | 9993 | Outgoing positive compressor electromagnetic clutch signal |
| 7 | 7568 | Mixer reduction gear motor power supply |
| 8 | 7566 | Recirculation reduction gear motor power supply |
| 9 | 0562 | Floor reduction gear motor power supply |
| 10 | 7564 | Windshield defrost reduction gear motor power supply |
| 11 | - | - |
| 12 | 0550 | Sensor and reduction gear motor mass |
| 13 | 7572 | Evaporator temperature reference signal |
| 14 | 7574 | Sun ray sensor signal |
| 15 | 7565 | Recirculation potentiometer reference voltage |
| 16 | 7561 | Floor potentiometer reference voltage |
| 17 | - | - |
| 18 | 2290 | Internal temperature sensor motor signal |
| 19 | - | - |
| 20 | 7555 | Outgoing positive blower control module signal |
| 21 | 0000 | Negative direct from the battery |
| 22 | 9552 | Outgoing negative electro valve signal |
| 23 | - | - |
| 24 | - | - |
| 25 | Gn/Ve | CAN - L (BCB) line |
| 26 | 0568 | Mixer reduction gear motor power supply |
| 27 | 7569 | Internal temperature sensor motor power supply |
| 28 | 0566 | Recirculation reduction gear motor power supply |
| 29 | - | - |
| 30 | 0564 | Windshield defrost reduction gear motor power supply |
| 31 | 7562 | Floor reduction gear motor power supply |
| 32 | 7575 | Internal temperature sensor signal |
| 33 | 7571 | Blow air temperature reference signal |
| 34 | 7567 | Recirculation potentiometer reference voltage |
| 35 | 7563 | Windshield defrost potentiometer reference voltage |
| 36 | 7560 | 5-Volt Mix / Floor / Rec / Defrost potentiometer signal |
| 37 ÷ 40 | - | - |

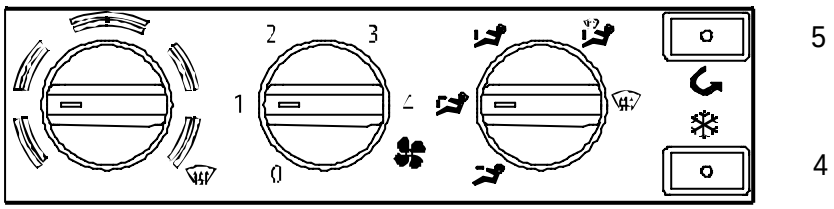
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## MANUAL AIR CONDITIONER

In the manual version the refrigerating circuit and heater checks occur by means of a device with leverages and knobs placed in the lower part of the central dashboard.

The system is checked by an electronic unit but by means of knob controls used for the following functions:

Figure 253




1. Heating water cock control
2. Internal fans speed
3. Air flows distribution
4. Compressor control switch
5. Recirculation function switch

## CONTROLS DESCRIPTION

### Water cock control

The knob rotation adjusts water cock position and consequently the amount circulating inside the cabin radiator.
If supplementary WATER heater is present, this knob controls three microswitches used for the following functions:

20% supplementary heater water pump activation
60% top flap closing motor activation (TOP FLAP)
80% supplementary heater connection

If supplementary AIR heater is present, this knob controls two microswitches used for the following functions:

60% top flap closing motor activation (TOP FLAP)
85% supplementary heater connection

**NOTE** The motor for TOP FLAP function is present only in manual version, since in automatic version this function is performed through a bowden cable connected to air mixing motor (MIX).

- Maximum heating = TOP FLAP closed
- Maximum cooling = TOP FLAP open

### Internal fan speed

This knob is composed of a multiple switch that controls three adjusting resistances for different motor speeds.

### Air flows distributions

This control through bowden cables allows distributing the air flows in the desired cabin areas.

### Recirculation function switch

This button allows, through a specific motor, closing the external door with a percentage of 95% of internal air and 5% of external air.
The motor has no position sensors since it works only under the two all-closed or all-opened conditions.
On the button there is a yellow-coloured led that signals its connection.
There is no time limit for this function.

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## Compressor control switch

This button allows connecting the air conditioner compressor.
The cluth closure is constrained by safety system pressure switches and by fixed-calibration evaporator thermostat
Such thermostat, of the mechanical type, adjusts the temperature inside the evaporator in order to disconnect the compressor clutch upon reacihing ~ 2 _C and reconnect it at ~ 5.5 _C
The compressor operation is constrained by the manual connection of at least one fan speed.
A yellow-amber-coloured led is present on the button and signals the compressor connection.

## STEPPER MOTORS

In manual system there are two stepper motors placed on heater assembly
They are composed of a motor without potentiometers ahd have the same electric characteristics.

The ratio motors are used to perform the following functions:

## RECIRCULATION ( RIC )

## TOP FLAP (TOP FLAP)

## MOTORS

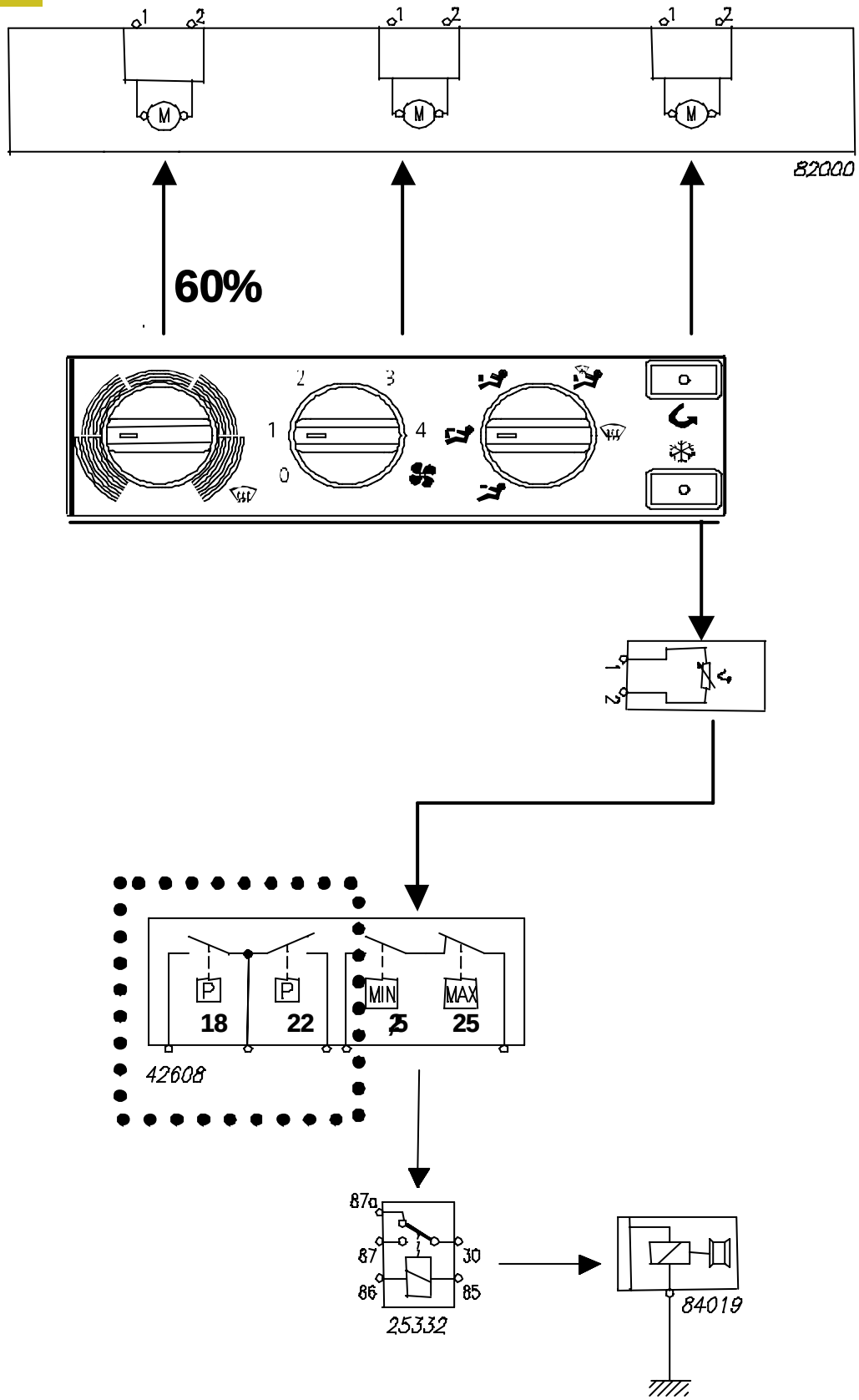
- They are supplied at 24 V.
- Motor resistance is ~112 Ohm.
- No-load absorption is about 30 mA.
- Limit absorption is about 200 mA.

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## Block diagram

Figure 254

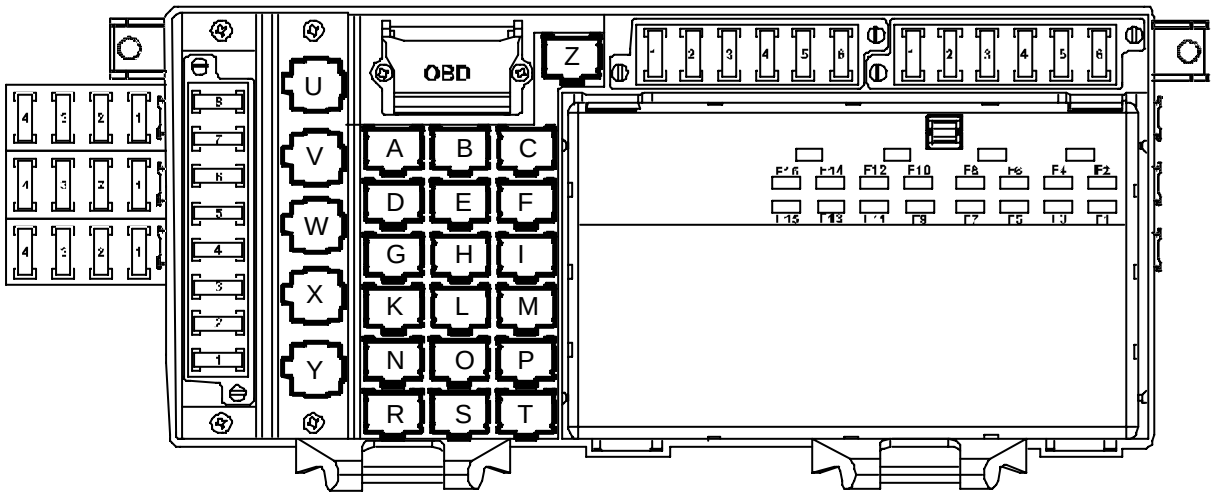



42045. External temperature sensor - 82000. Windscreen defroster assembly - 84009. Internal temperature sensor - 42608. Cooling fluid safety pressure switches - 25332. Compressor connection remote control switch - 84019. Compressor

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## Air conditioner fuses remote control switches

Figure 255




## Black-coloured fuse-holder (70604)

| Position | Description | Delivery A |
|---|---|---|
| 2 | Air conditioning system | 10 |
| 3 | Air conditioning system | 5 |
| 4 | Supplementary heating | 15 |
| 5 | Supplementary heating | 5 |

| Ref. | Description | Component code |
|---|---|---|
| B | Water heated remote control switch (opt.) | 25337 |
| E | Heated remote control switch (opt.) | 25325 |
| H | Manual conditioner remote control switch | 25310 |
| I | Manual conditioner remote control switch | 25874 |
| L | Manual conditioner remote control switch | 25332B |
| M | Manual conditioner remote control switch | 25322 |
| O | Manual conditioner remote control switch (opt.) | 25332A |
| P | Manual conditioner remote control switch (opt.) | 25327 |

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## HYDRONIC D 10 WATER HEATER
### System operation

By connecting the burner, the electronic unit controls water pump, fuel batching pump, burner motor and ignition spark plug.

The water pump circulates the cooling liquid in the cooling circuit of the engine to be heated.

The burner motor sucks and inserts the right amount of air necessary for combustion.

The ignition spark plug heats air and burns fuel injected by the batching pump.

Purpose of the batching pump is taking and injecting fuel onto spark plug.

After 90 seconds, the unit, through the flame sensors, checks that the exhaust gases temperature value is included between 500 and 600 °C, (ignition has correctly occurred).
Upon reaching about 700 °C the unit disconnects the spark plug and the burner works in self-combustion.

If the flame sensor does not measure the above temperature, thereby the burner is not turned on, the unit repeats the ignition procedure. If it does not start again, the unit turns the burner off and it will then be mandatory to manually switch it on again.

If the heater does not start for three consecutive times, it is blocked.

The unit checks, through water temperature sensor and overheating sensor, whether combustion and burner correctly operate.

The water temperature sensor is used by the unit to adjust the burner working power (maximum, medium, minimum and stand by).
In the manual version, upon reaching 55 _C, the system connects the fans inside the cabin.

The overheating sensor is used by the unit to turn the burner off in case of excessive water temperature (about 115 _C).

The burner operating time is determined by driver's settings.
Upon turning off, the burner performs a washing phase that lasts for about 3 minutes in order to be ready for the following starting.

The heater is connected with its own control logic in the air conditioning system and is therefore equipped with an electronic unit with related connector.

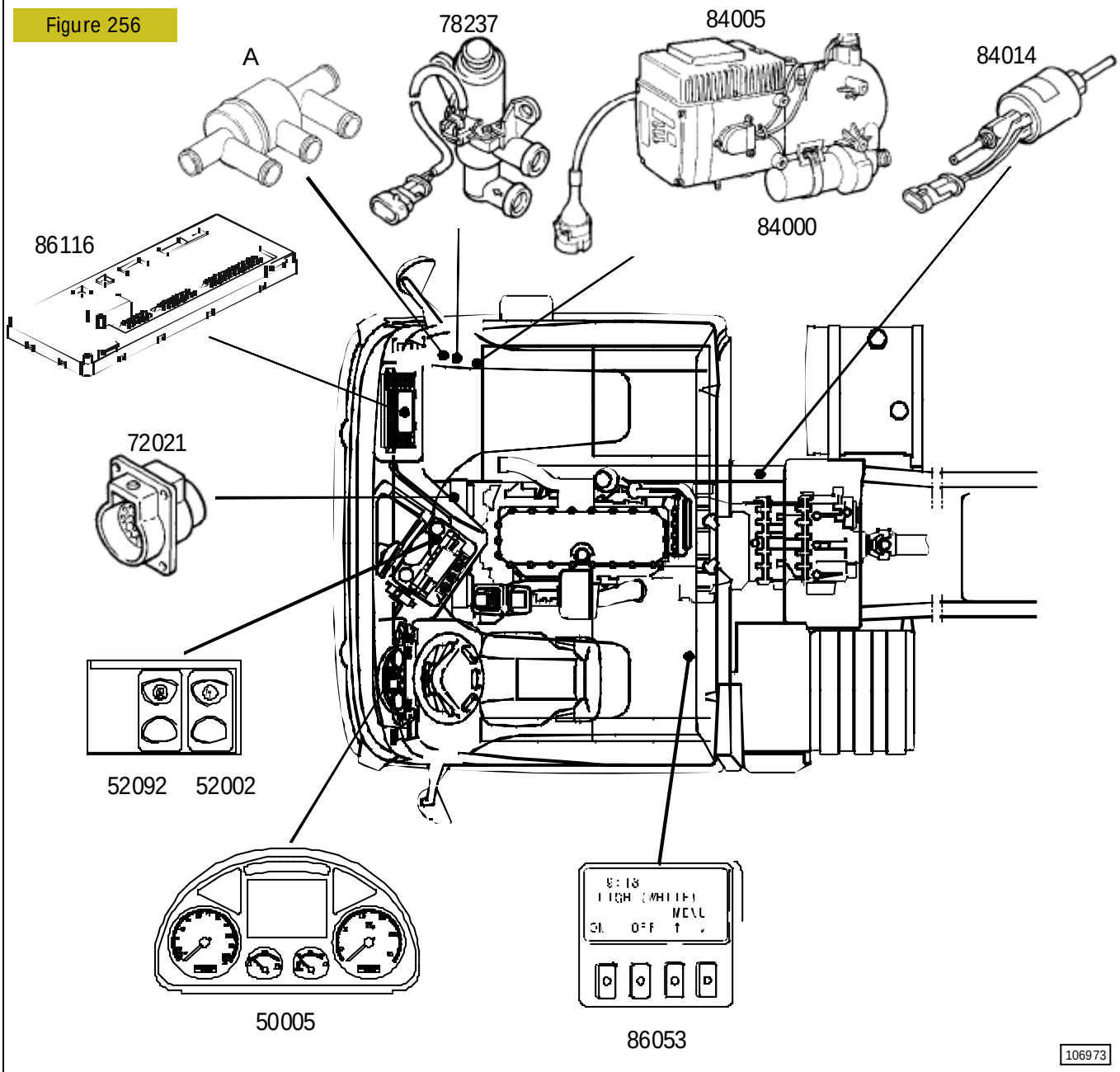
The unit is directly assembled onto the heater.

The heater can be directly driven by the automatic air conditioning system, by the version with manual control or through the Bed Module unit.

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## COMPONENTS LOCATION

Figure 256




### Legenda

| | |
|---|---|
| A | Thermostat 65 _C |
| 50005 | Cluster |
| 52002 | Heater connecting switch |
| 52092 | Cabin/engine heating swtich |
| 72021 | 30-pole diagnosis connector |
| 78237 | Two-way solenoid valve (D+) |
| 84000 | Supplementary water heater |
| 84005 | Heater control electronic unit |
| 84014 | Fuel batching pump |
| 86053 | Bed Module |
| 86116 | Body Computer |

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## SYSTEM COMPONENTS

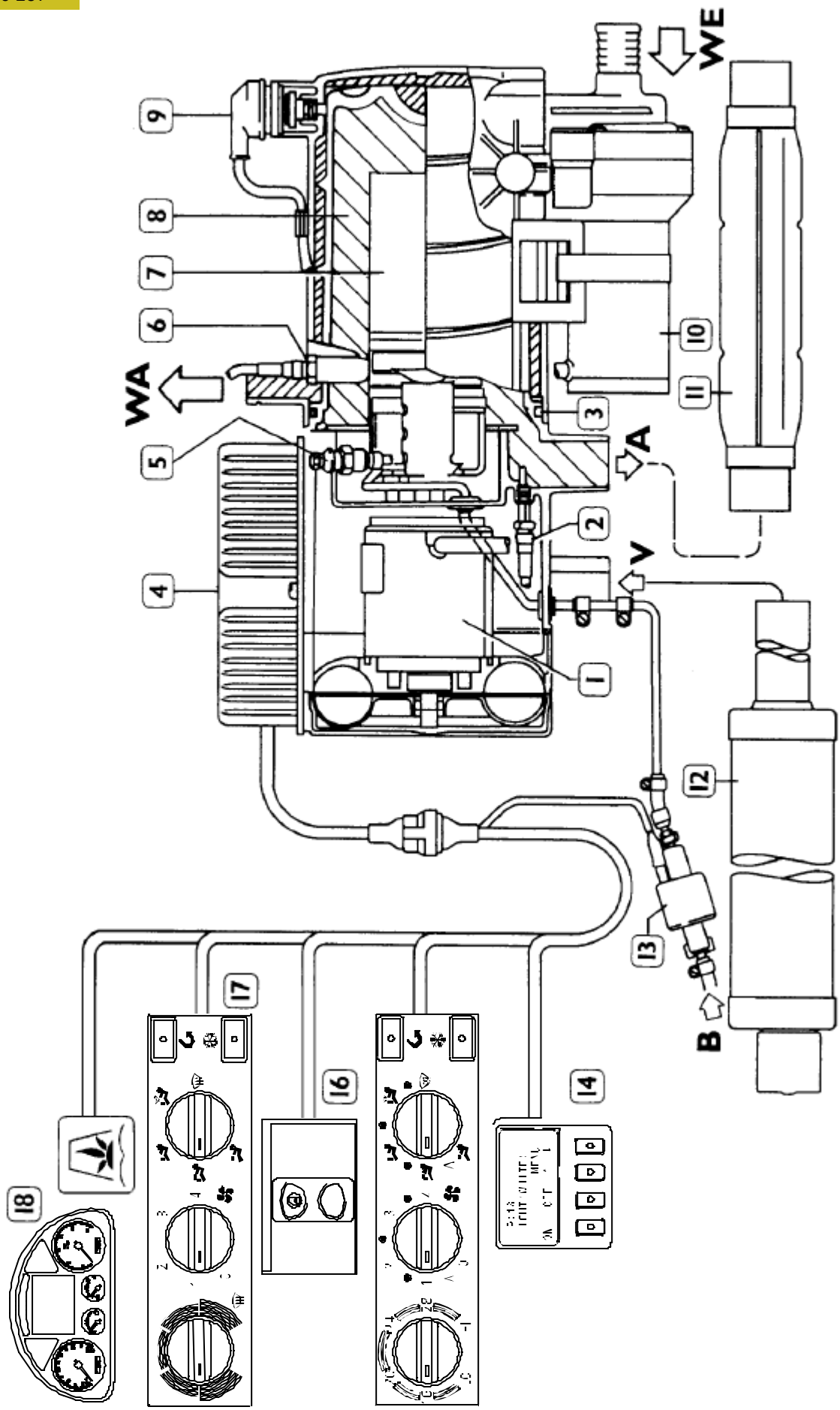
1) Burner motor
2) Flame sensor
3) Combustion chamber
4) Burner control unit
5) Ignition spark plug
6) Water temperature sensor
7) Flame pipe
8) Heat exchanger
9) Overheating sensor
10) Water pump
11) Silencer
12) Air suction pipe
13) Fuel batching pump
14) Bed Module unit
15) Automatic Webasto air conditioner electronic unit
16) Cabin/engine heating and heater connecting switch
17) Air conditioner control dashboard for manual version
18) Cluster

### Connection to circuit

WE. Water inlet
WA. Water outlet
V. Comburent air inlet
B. Fuel supply
A. Exhaust gases outlet

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Figure 257



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## 65 _C THERMOSTAT

It is assembled on the right vehicle side near the burner and has been inserted in order to allow quickly heating the cabin when the engine is off.

It is equipped with a temperature-sensitive membrane calibrated at 65 °C.

With temperature < 65 _C water will only circulate in cabin (small circuit).

With temperature > 65 _C the thermostat switches its position, allowing water to circulate both in cabin and in engine, heating them both (big circuit).

## 3-WAY SOLENOID VALVE

In the WEBASTO air conditioning system there is a single 3-way solenoid valve that performs the function of batching and bypassing cooling water from engine to radiator inside the cabin.

The valve is placed next to the front left side of the engine (driver side).

It is of the Normally Open type at rest and is supplied by a direct battery positive.

The electronic unit, by providing it with a mass, adjusts its working cycle (Duty-Cicle).

## WATER PUMP

The water pump is directly assembled on the lower part of the burner.

It is used to circulate the engine cooling water in the circuit.

The supply voltage is 24 Volt.

The minimum flow rate is about 500 l/h.

## FUEL BATCHING PUMP

It is assembled on the chassis next to fuel tanks with a slant of 15° to facilitate air drain. It is used to take and inject gas oil inside the burner.

The unit supplies the pump with a pulse signal.

For a correct operation the internal delivery pipe diameter must be 2 mm and must not exceed the length of 5 meters.

It embeds a small fueld filter and a unidirectional check valve.

The fuel flow rate is about 0.2 l/min.

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## WATER TEMPERATURE SENSOR

It is a PTC sensor assembled on heat exchanger; it measures different water temperatures in order to adjust the burner power and, only in manual version, upon reaching 55 °C, it allows connecting the fans.

The sensor resistance at 20 _C is ~950 Ohm.

## FLAME SENSOR

It is a PTC sensor assembled inside the combustion chamber next to the exhaust gas outlet and measures the current temperature, in order to disconnect the spark plug in case the burner has not been turned on.

It disconnects the spark plug at an exhaust gas temperature of about 700_C

The sensor resistance at 20 _C is ~1080 Ohm.

## IGNITION SPARK PLUG

It is a resistance placed inside the combustion chamber.

The unit supplies it with pulses through an internal electronic regulator.

The rated operating voltage is 18 Volt to allow its operation also with battery voltages of ~ 22 Volt.

The resistance at 20 _C must be < 2 Ohm.

## OVERHEATING SENSOR

It is a temperature sensor assembled on the heat exchanger, it measures the different water temperatures to possibly disconnect the burner upon reaching about 115 °C

In case of intervention the sensor restores itself autonomously. It is not of the manual restoring type.

The sensor resistance at 20 °C is ~ 10 K Ohm.

## BURNER MOTOR

It is embedded into the assembly in the rear burner part.

The rotation speed is managed by the unit by means of an integrated electronic regulator.

It embeds an inductive sensor that measures the engine rotation speed.

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## ELECTRONIC UNIT

It is directly assembled on heater body and is interfaced with vehicle through a 14-pin connector.

It is connected to CAN BCB line.

It has a very advanced diagnostic system and transmits possible error codes on vehicle Cluster.

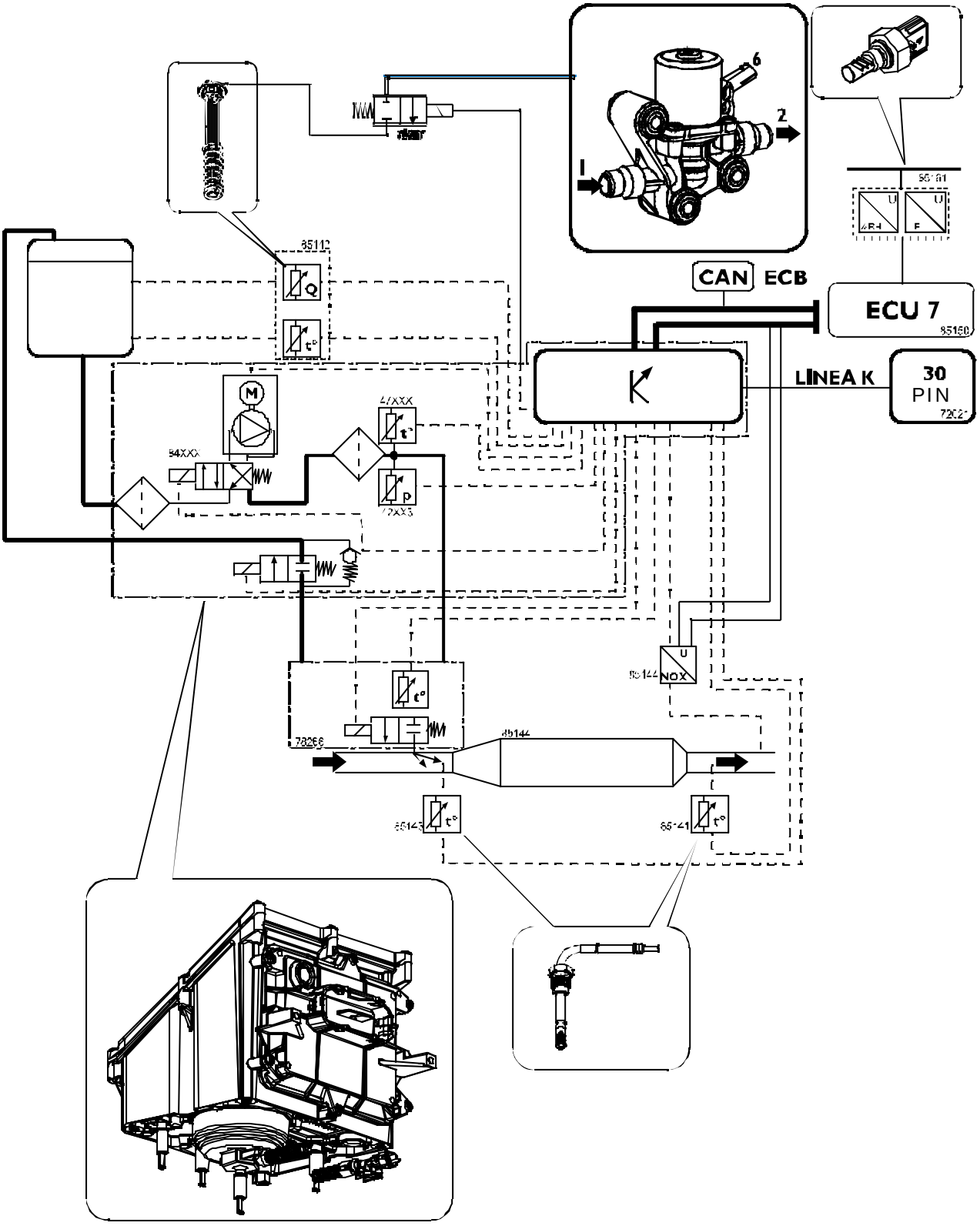
| Pin | Cable | Function |
|---|---|---|
| A1 | 7506 | Positive from water cock knob manual version (25% position) |
| A2 | 7711 | Positive from boiler activating switch |
| A3 | Ws/Bi | CAN H line |
| A4 | 7775 | Positive for ambient thermostat control (manual version) |
| B1 | Gn/ve | CAN H line |
| - | - | - |
| B3 | 2296 | Diagnosis K line |
| B4 | 6605 | Positive for cabin/engine heating key warning light |
| - | - | |
| C2 | 7708 | Direct positive from battery |
| C3 | 0000 | Direct negative |
| C4 | 7783 | Positive for fuel batching pump control |
| - | - | - |
| - | - | - |

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## SCR (SELECTIVE CATALYTIC REDUCTION) SYSTEM - DENOX 2

The system operation is described in the "Engine" section of this manual.

Figure 258




SCR SYSTEM OPERATION DIAGRAM

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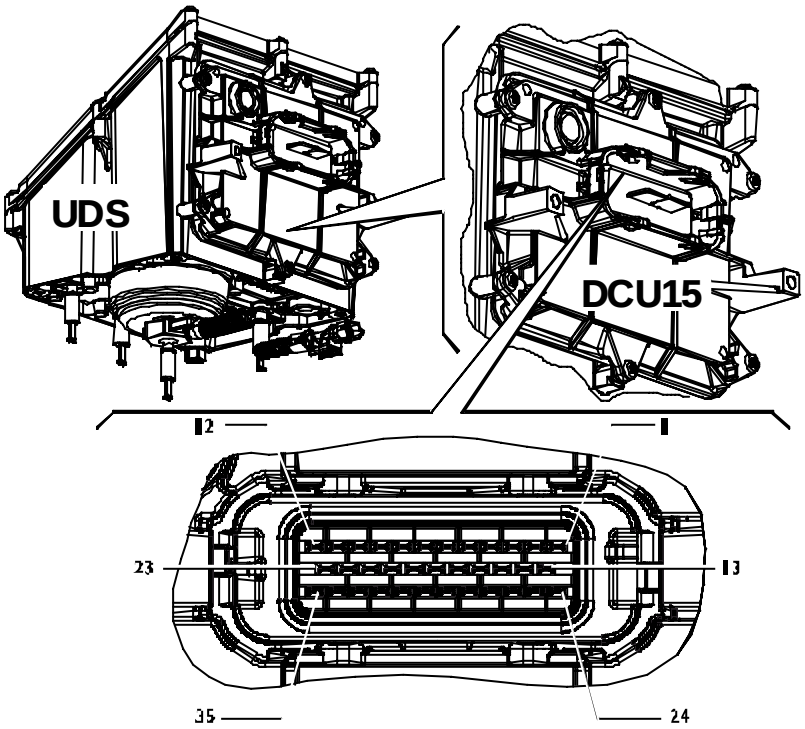
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| Name | Description |
|---|---|
| 42XX3 | AD-Blue solution pressure sensor |
| 47XXX | AD-Blue solution temperature sensor |
| 72069 | 16-pole joint for OBD (on-board diagnosis) |
| 78266 | Measuring module solenoid valve with SCR |
| 78267 | Engine water circulation switch valve for UREA tank heating with SCR |
| 84XXX | Electric displacement pump with pressure control valve and circulation valve |
| 85140 | Electronic control for SCR pumping module |
| 85141 | Catalyst output temperature sensor with SCR |
| 85142 | UREA tank level and temperature sensors with SCR |
| 85143 | Catalyst input temperature sensor with SCR |
| 85144 | Nitric oxide (NOx) measuring sensor with SCR |
| 85150 | EDC control unit |
| 85161 | Combustion air relative humidity and temperature sensors with EDC |

Aquila Trucks Centres

## Pin - out

Figure 259




CONNECTOR VIEW (CABLE SIDE)

113576

| Ref. | Description | Cable colour code |
|---|---|---|
| 1 | + for engine water circulation solenoid valve for urea tank heating | 7542 |
| 2 | + for urea filter outlet heater | 7546 |
| 3 | Direct battery + (+ Bat) | 7540 |
| 4 | Urea filter output heater control | 7540 |
| 5 | CAN - H (ECB) line | White |
| 6 | CAN - L (ECB) line | Green |
| 7 | Spare | - |
| 8 | Spare | - |
| 9 ÷ 10 | Spares | - |
| 11 | Metering module solenoid valve control ground | 9541 |
| 12 | + for metering module solenoid valve | 7541 |
| 13 | Spare | - |
| 14 | Ground | 0000 |
| 15 | Ground | 0000 |
| 16 | Spare | - |
| 17 | Inlet catalyst temperature sensor ground | 0544 |
| 18 | Urea tank level sensor signal | 6543 |
| 19 | Urea tank temperature and level sensor ground | 0543 |
| 20 ÷22 | Spares | - |
| 23 | Engine water circulation solenoid valve control ground for urea tank heater | 9542 |
| 24 | +15 | 8540 |
| 25 | Outlet catalyst temperature sensor ground | 0541 |
| 26 | Outlet catalyst temperature sensor signal | 6541 |
| 27 | Spare | - |
| 28 | Outlet catalyst temperature sensor signal | 6544 |
| 29 | Urea tank temperature sensor signal | 6542 |
| 30 | Spare | - |
| 31 | K line (16-pin test connector) | 2257 |
| 32 | Spare | - |
| 33 | Urea filter outlet heater control ground | 9546 |
| 34 ÷ 35 | Spares | - |

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## CENTRAL LOCKING WITH REMOTE CONTROL

The system consists of one or several (max. 8) transmitters and a receiver.

### Transmitter

The transmitter has a special container of its own, equipped with an eyelet and ring.. The shock-proof transmitter container is also waterproof.
The transmitter sends the receiver a variable code (rolling code) by means of a radiofrequency signal at 433.92 MHz (EC Directive 95/56).
It is equipped with two buttons for door opening and closing, respectively.
By keeping the button pressed down for 50 msec, the variable code will be fully transmitted. If the button is actuated continuously, however, transmission will be interrupted after 5 seconds (± 10%).
The transmitter operating range is 10 m.
The battery guarantees a 2 years' service life. Following the replacement, the transmitter may be briefly actuated twice in order to restore synchronism with the receiver. This sequence is also permitted at any time other than battery replacement

### Receiver

The receiver is housed inside a container with a white cover, which includes a transmitter programming button (easily accessible and protected against unintentional actuation), a programming check green LED, and a 8-way connector.
It is housed in instrument panel upper side, in front of passenger's seat.
The receiver antenna is housed inside the container, too.
The receiver receives and decodes the code that was sent by the transmitter, and can store up to eight codes. Doors locking and unlocking commands go from the transmitter to the receveir, which sends the signal to Body Computer central unit, which in turn via CAN line sends a message to Door Modules to activate the locks.
If the vehicle is in the key-ON condition (+15 is available), the receiver will perform no actuation through the remote control.
The receiver manages synchronization between the locks, and resumes correct alignment through a sequence of two or several transmitter or lock key drives.

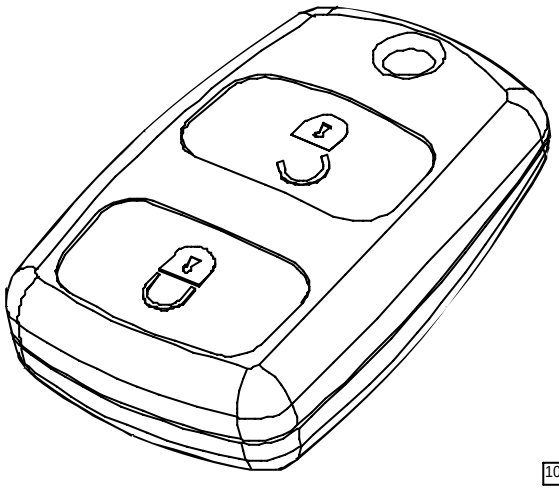
### Blinker control

Door lock locking and opening will be signalled by the lighting of the indicator lights. Therefore, the receiver need be interfaced with the Body Computer control unit that manages the above-mentioned lights.
The receiver features an output (to the ground) that is connected in parallel with the emergency light switch. The latter consists of an unstable button that actuates and deactivates the blinking sequence (blinker signal).

Description of blinker controls:

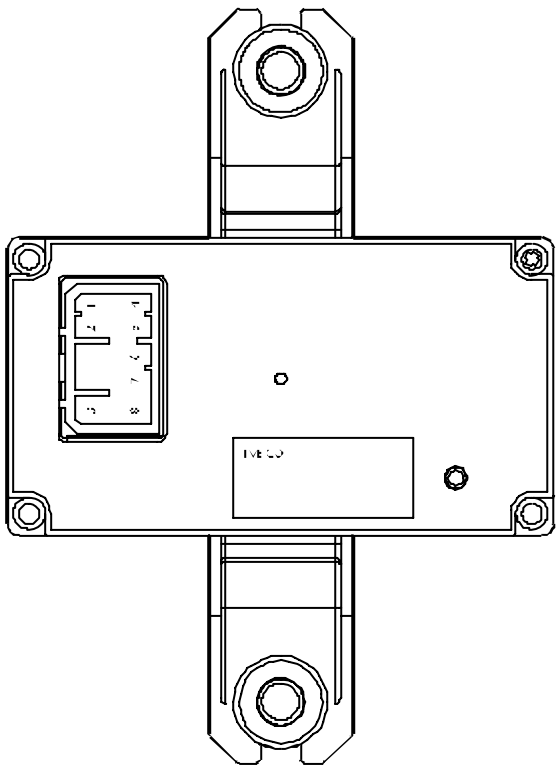
- T1 = 120 msec (Start)
- T2 = 700 msec (Delay - Lock)
- T2 = 1550 msec (Delay - Unlock)
- T3 = 120 msec (Stop)

Figure 260




TRANSMITTER

Figure 261




CENTRAL LOCKING CONTROL UNIT (RECEIVER)

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## Control unit pin-out (receiver)

| Pin | Function | Cable colour code |
|---|---|---|
| 1 | Blinker control | 1113 |
| 2 | Engine power supply for centralised closure (door closure)- (without DDM, PDM) | 9965 |
| 2 | Battery positive | 7772 |
| 4 | Ground | 0000 |
| 5 | Central locking control (door closing) | 0064 |
| 6 | Central locking control (door opening) | 0065 |
| 7 | +15 power supply | 8871 |
| 8 | Engine power supply for centralised closure (door opening) - (without DDM, PDM) | 9964 |

## Programming

The programming status makes it possible to get the receiver to recognize the transmitters enabled to control the respective functions.
Programming is accessed through the rest state when the +15 signal is not available.
The receiver may be controlled by a transmitter with a universal code as long as at least one transmitter is not programmed.
After a variable code (other than the universal code) has been programmed, the latter will not be recognized any longer.
Transmitters are programmed in the FIFO mode.
Two transmitter programming modes are available:

- simplified programming: it allows you to program the transmitters quickly. It can be actuated until 128 actuations are performed after the first programming, or until it is disabled.
- Protected programming: it guarantees the customer against the risk of other transmitters being programmed without the knowledge of the customer themselves. It involves using a password (shown on the tag enclosed with the transmitter) that can be obtained from the transmitter code.

## Simplified programming

The first code (and the subsequent ones as well) are programmed as follows:

- press the button on the receiver: the LED will light up and blink;
- the operator presses, while keeping the button on the receiver pressed down, any of the key of the transmitter, which sends out the code;
- the receiver stores, after detecting three subsequent transmission instances (with the current checksum), the code into the memory;
- the receiver LED will, at the very time when it recognizes the code, light up steadily, thus signalling that the code has been received: now the operator may release the transmitter button to end the programming.

Simplified programming disable
Simplified programming may be disabled by entering the password as follows:

- press the small button on the receiver: the LED will light up and blink;
- release the small button: the LED will blink once;
- enter, by means of the small button, a 4-digit code (password): each digit shall be included between 0 and 9 (code written on the label delivered together with the transmitter). An optical feedback will be generated on the LED every time the small button is pressed;
- after each digit has been entered, wait for the LED to blink again to request the next digit, up to the fourth digit;
- the procedure will be over after the last digit is entered.

## Protected programming

Every time a new transmitter is to be recognized after firstly entering the password, you will need to enter the password of any of the transmitters previously stored into the memory. Correct recognition of the password will be signalled by the LED blinking after the password has been entered (if the password is not recognized, the LED will remain ON for 10 seconds). When the LED is blinking, keep the receiver button pressed down, then transmit with the new remote control to be stored into the memory, by following the simplified programming instructions.

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## DIAGNOSTIC

MODUS

Computer-assisted diagnosis station used for diagnosis of braking systems, pneumatic suspensions, electronically-controlled systems and engines.

The station is equipped with auxiliary functions such as electronic control unit programming, spare list catalogue referencing, time-charts, etc.

IT 2000

The IVECO electronic tester makes it possible to immediately intervene on the vehicle, by recognizing the latter by means of the chassis number.

This tester stores the results of the diagnostic operations carried out.

It can also be used as a portable PC, and is set for remote diagnosis.

By using MODUS as a mother station, IT 2000 can be updated and configured.

IT 2000 is interfaced with the vehicle by means of a 30-pole diagnosis takeoff.

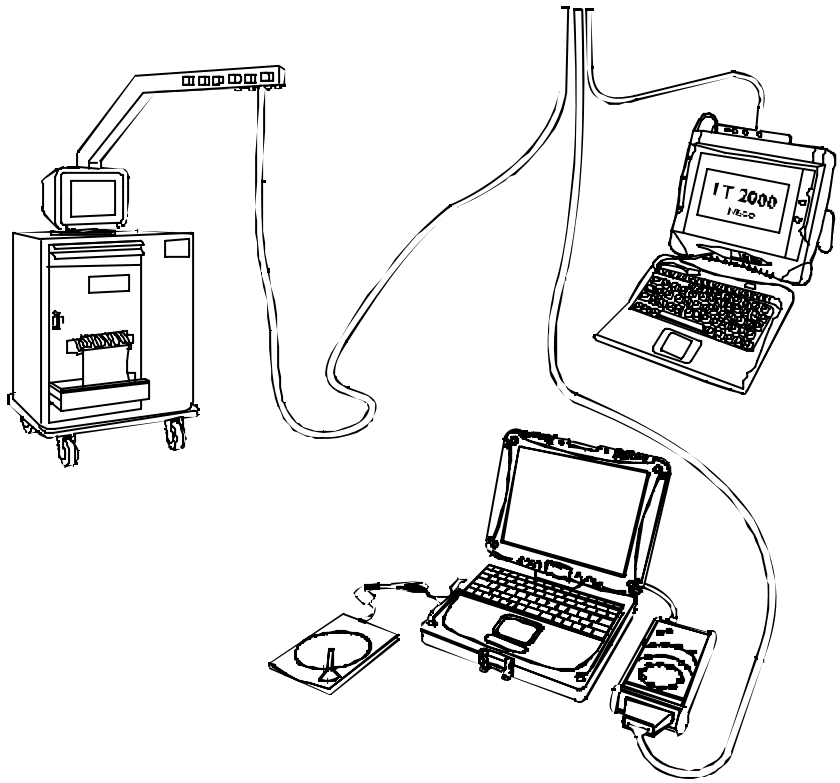
E.A.SY.

E.A.SY. system allows to simply make the diagnosis and programming of the various electronic central units aboard the vehicle.

E.A.SY. system is made up of ECI module communicating with the electronic central units and of a Panasonic PC.

ECI module, exploiting the Panasonic PC, also allows easy on the road interventions: in particular, thanks to Panasonic PC wireless technologies (e.g. GPRS), diagnostic interventions can be assisted by a remote expert centre.

Figure 262



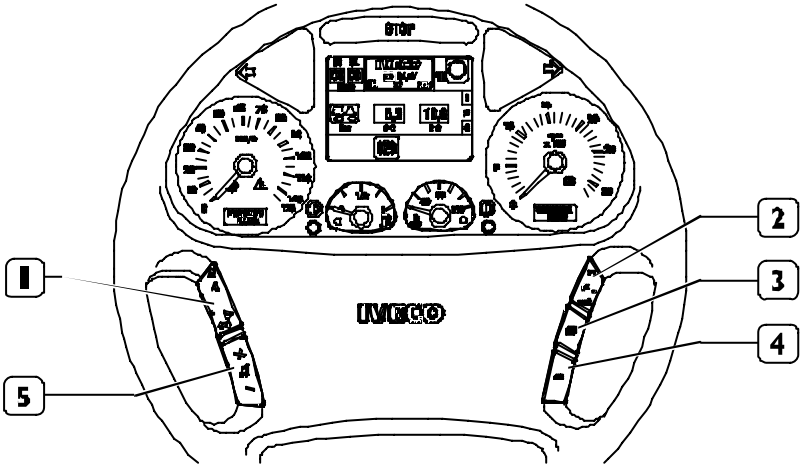

101586

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## Diagnosis on Cluster

Access to the fault memory is possible through the "menu" function key (2) available on the steering wheel.

Figure 263




1. Button y or b - 2. Button MENU/OK - 3. Page button - 4. Escape button - 5. Button + and –

Turn key switch to MARCIA (+15), then press "menu" function button (2): the display will show the data exchange menu containing the list of available functions (e.g. HI-FI, telephone, diagnostic, etc.).

Select, by means of function y and b button (1), the diagnostic function, then confirm correct selection by means of function "OK" button (2).

The available electronic systems can be selected by means of select/confirm buttons (1) and (2).

The diagnosed systems are:

| | | | |
|---|---|---|---|
| 1 | EDC | 10 | FFC (Front Frame Computer) |
| 2 | EUROTRONIC | 11 | RFC (Rear Frame Computer) |
| 3 | INTARDER | 12 | DDM (Drive Door Module) |
| 4 | 0EBS (or ABS) | 13 | PDM (Passenger Door Module) |
| 5 | ECAS | 14 | CM (Cabin Module) |
| 6 | IMMOBILIZER* | 15 | 0ACLC (Automatic air conditioner) |
| 7 | 0MTCO (Tachograph*) | 16 | 0AHT_w (Auxiliary water heater) |
| 8 | DC (Body Computer) | 17 | 0AHT_a (Auxiliary air heater) |
| 9 | IC (Instrument Cluster) | | |

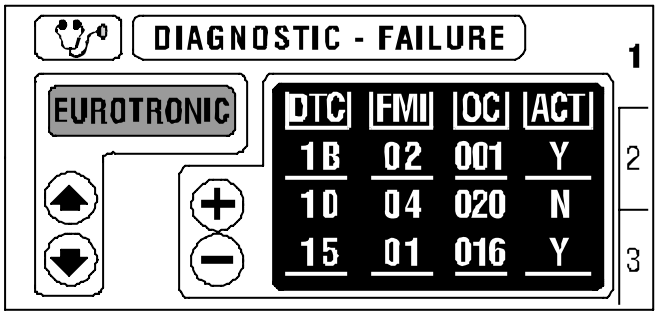
* Function not active

**NOTE** EDC control unit errors are not displayed after the engine has been started.

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- The anomaly-free system is displayed with a GREEN background.
- The faulty system is displayed with a RED background
- The systems not available on the vehicle or not diagnosed (tachograph and Immobilizer) are displayed with a GREY background.
- If several anomalies related to a system are available, the list can be run through by means of button (5, Figure 262) "+" and "–".

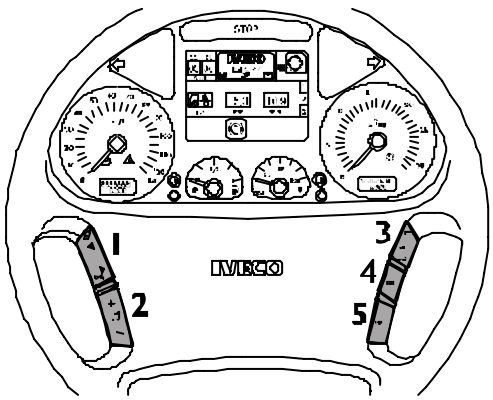
Figure 264




86029

The different codes shown allow you to identify the faulty component, the type of stored error (open circuit, short-circuit, etc.), the error occurrences and, finally, whether the error is currently present or intermittent.

Figure 265




86030

To display intermittent faults, press simultaneously buttons "OK" and "(–)" (2-5).

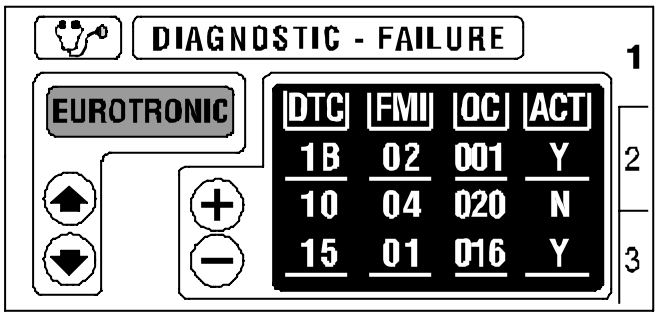
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## INFORMATION ON CLUSTER

The diagnosis information shown on the cluster is divided into three screens:

- the first screen allows you to display all the stored/currently present anomalies (if any);
- the second screen allows you to cancel intermittent errors (provided that the respective password is available);
- the third screen allows you to know the software version of the various Multiplex electronic control units.

Figure 266




73687

### First screen

If several anomalies are found, the respective list can be run through by means of buttons "+" and "–".
Information on every single fault is displayed on four columns with the following data:

| DTC | FMI | OC | ACT |
|---|---|---|---|
| Displays the anomaly code related to the fault | Indicates the type of fault | Anomaly rate counter | Active/not active anomaly condition |
| Two digits (hexadecimal) | Two digits (hexadecimal) | Three digits (decimal) | One character (Y-yes, N-no) |

### Second screen

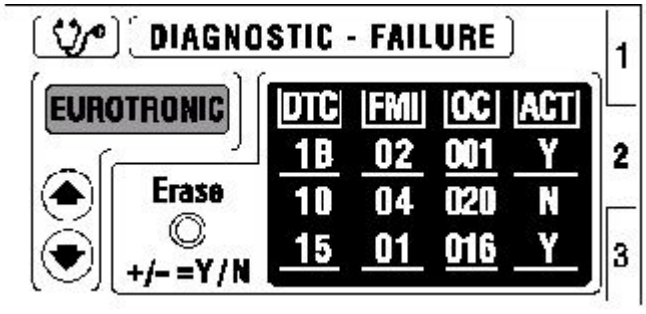
To select the second screen, press button "page" on the steering wheel.

### Cancelling errors

The system can be selected by means of buttons y and b available on the steering wheel.
Anomaly display can be cancelled as follows:

- Press "+"
- The display will show the deletion confirm request: press "OK" to continue.
- Enter the requested password (see next paragraph ENTERING THE PASSWORD), then press "OK" to confirm.

Figure 267

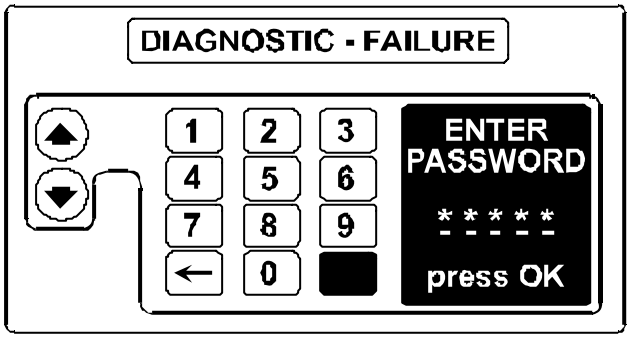



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## Entering the password

Figure 268




86031

- Select the first number of the password by means of buttons y and b.
- Press button OK to confirm each number.
- Press a to cancel the latest selected number.
- After the password has been completed, select the key symbol to confirm it.

## Third screen

To select the third screen, press button "page" available on the steering wheel.

## Software version

Figure 269




74227

The software version is displayed only for the Multiplex system control units.
The release of the following control units can be selected by means of buttons y and b:

1. Body Computer
2. Front Frame Computer
3. Rear Frame Computer
4. Driver Door Module
5. Passenger Door Module
6. Instrument Cluster
7. Cabine Module

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## Circuit charts

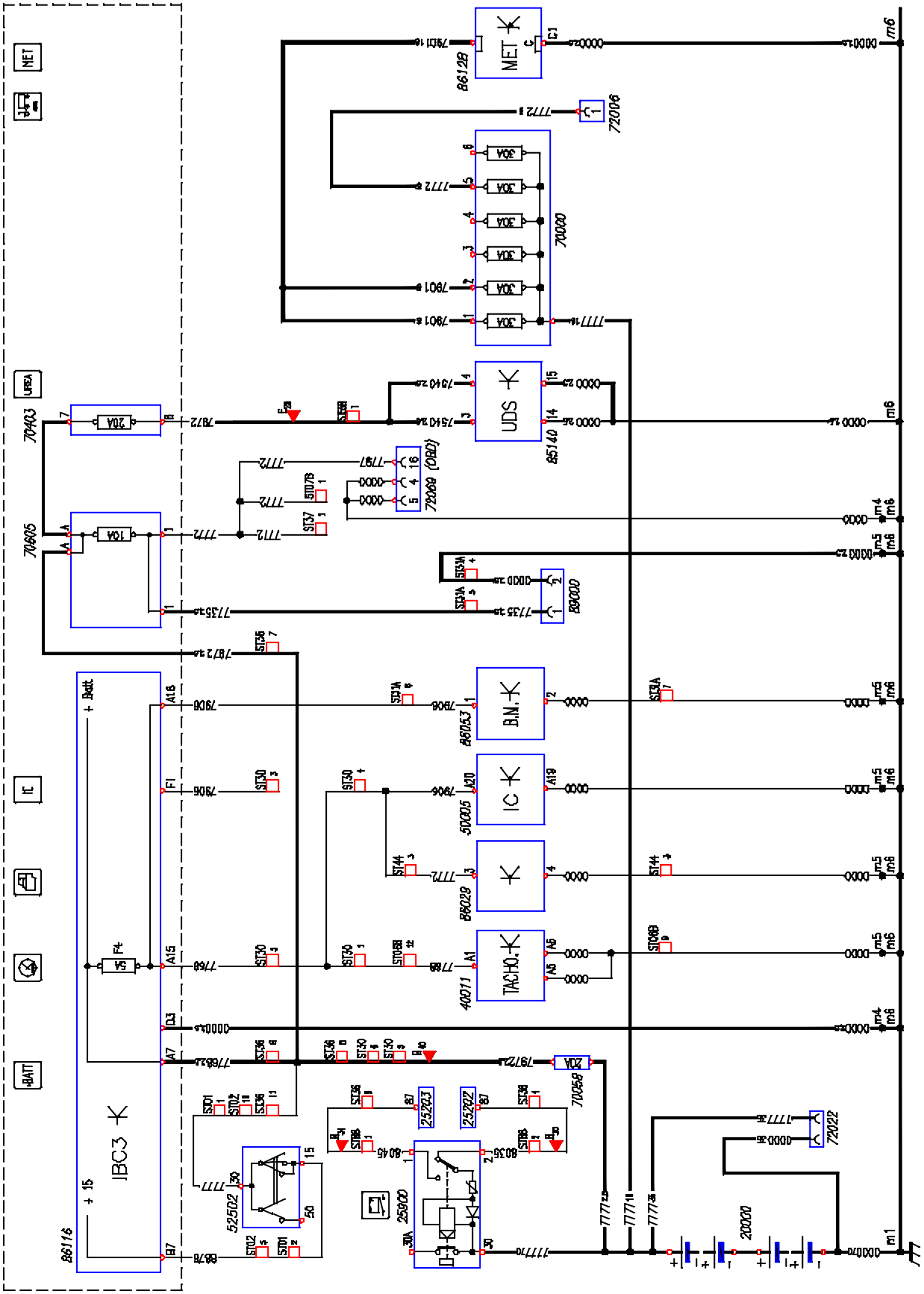

| | | Page |
|---|---|---|
| CHART 1 | DIRECT POSITIVE TO BATTERY | 247 |
| CHART 2 | POSITIVE AFTER TGC (+30) | 248 |
| CHART 3 | POSITIVE AFTER TGC (+30) | 249 |
| CHART 4 | POSITIVE AFTER TGC (+30) | 250 |
| CHART 5 | POSITIVE AFTER TGC (+30) | 251 |
| CHART 6 | POWER SUPPLY (+15) | 252 |
| CHART 7 | POWER SUPPLY (+15) | 253 |
| CHART 8 | POWER SUPPLY (+15) | 254 |
| CHART 9: | BODY CONTROLLER | 255 |
| CHART 10: | BODY CONTROLLER | 256 |
| CHART11: | BODY CONTROLLER | 257 |
| CHART 12: | BODY CONTROLLER | 258 |
| CHART 13 | IC CONTROL UNIT | 259 |
| CHART 14 | TACHOGRAPH / DIAGNOSIS SOCKET | 260 |
| CHART 15 | STEERING WHEEL INTERFACE (SWI) | 261 |
| CHART 16 | DDM-BM CONTROL UNIT | 262 |
| CHART 17 | PDM CONTROL UNIT | 263 |
| CHART 18 | THERMAL MIRRORS / CENTRALISED LOCKING / WINDOW WINDERS (WITHOUT DDM-PDM) | 264 |
| CHART 19 | VCM CONTROL UNIT | 265 |
| CHART 20: | EDC (CONNECTOR B) | 266 |
| CHART 21: | EDC (CONNECTOR A/C - F2B) | 267 |
| CHART 22: | EDC (CONNECTOR A/C - F3B) | 268 |
| CHART 23: | CONTROL UNIT UDS (DENOX 2) | 269 |
| CHART 24: | CONTROL UNIT MET | 270 |
| CHART 25: | CONTROL UNIT MET | 271 |
| CHART 26: | CONTROLI UNIT MET | 272 |
| CHART 27: | LINE CAN-IDB / FMB / CONTROL UNIT / TELEMATICS / NAVIGATOR | 273 |

https://truckmanualshub.com/
Aquila Trucks Centres


| | | Page |
|---|---|---|
| CHART 28: | LINE CAN-BCB | 274 |
| CHART 29: | LINE CAN-VDB | 275 |
| CHART 30: | LINE CAN-ECB | 276 |
| CHART 31 | ECAS 4X2 P TRACTOR | 277 |
| CHART 32 | ECAS 4X2P/4X4P/6X4P/8X4X4P (LORRY) | 278 |
| CHART 33 | ABS | 279 |
| CHART 34: | VENTILATION | 280 |
| CHART 35: | MANUALLY CONTROLLED CLIMATE CONTROL SYSTEM | 281 |
| CHART 36: | MANUALLY CONTROLLED ADDITIONAL AIR HEATER | 282 |
| CHART 37: | MANUALLY CONTROLLED ADDITIONAL AIR HEATER | 283 |
| CHART 38: | EUROTRONIC II | 284 |
| CHART 39: | RETARDER ZF | 285 |
| CHART 40: | CONTROL UNIT EM (PTO) | 286 |
| CHART 41: | RADIO RECEIVER | 287 |
| CHART 42: | GENERAL MECHANICAL POWER SWITCH (IGC) | 288 |
| CHART 43: | ADR (2001) | 289 |
| CHART 44: | ADR (OPT. 0129) | 290 |

Aquila Trucks Centres

## Chart 1: Direct positive to battery

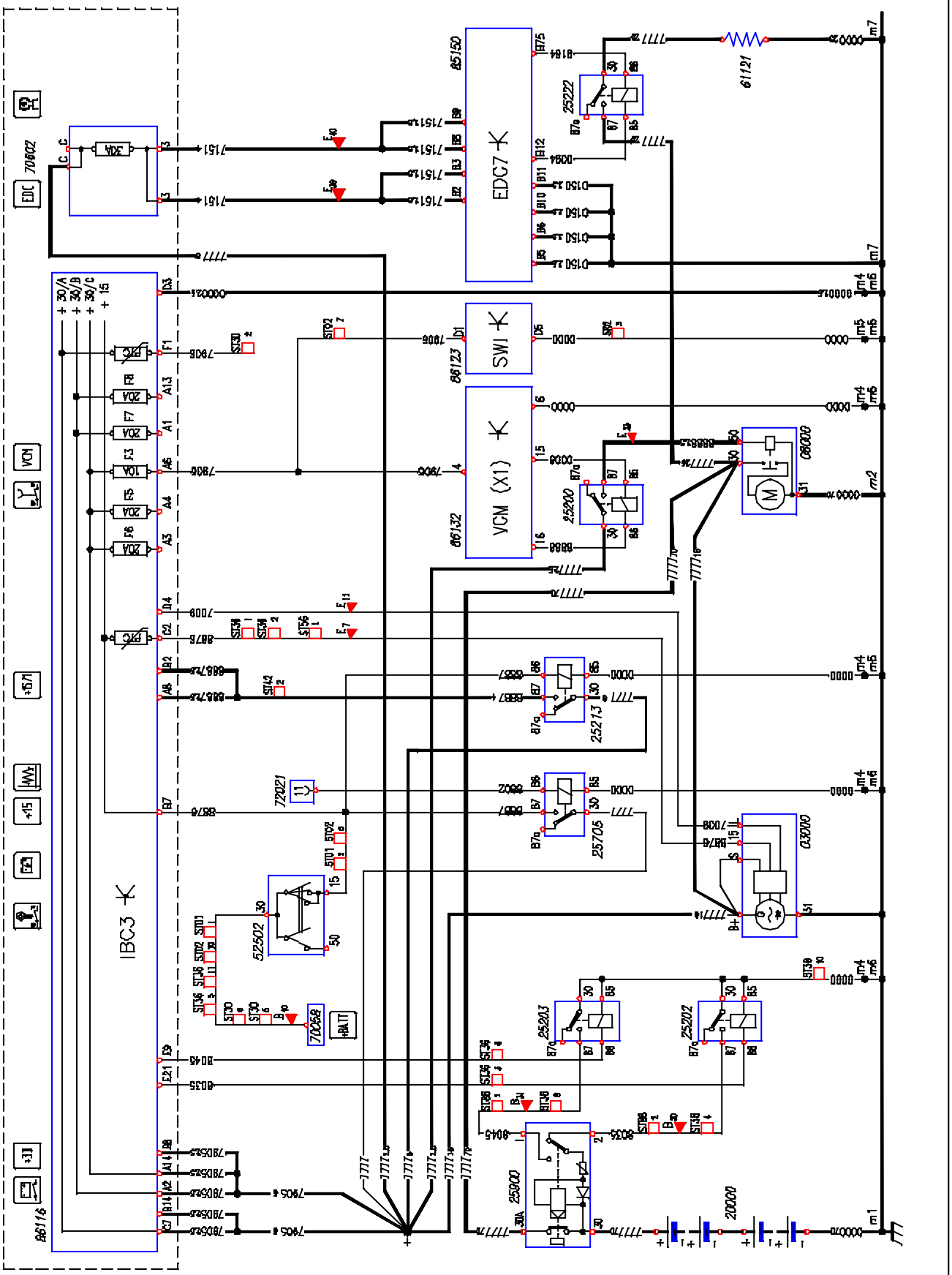



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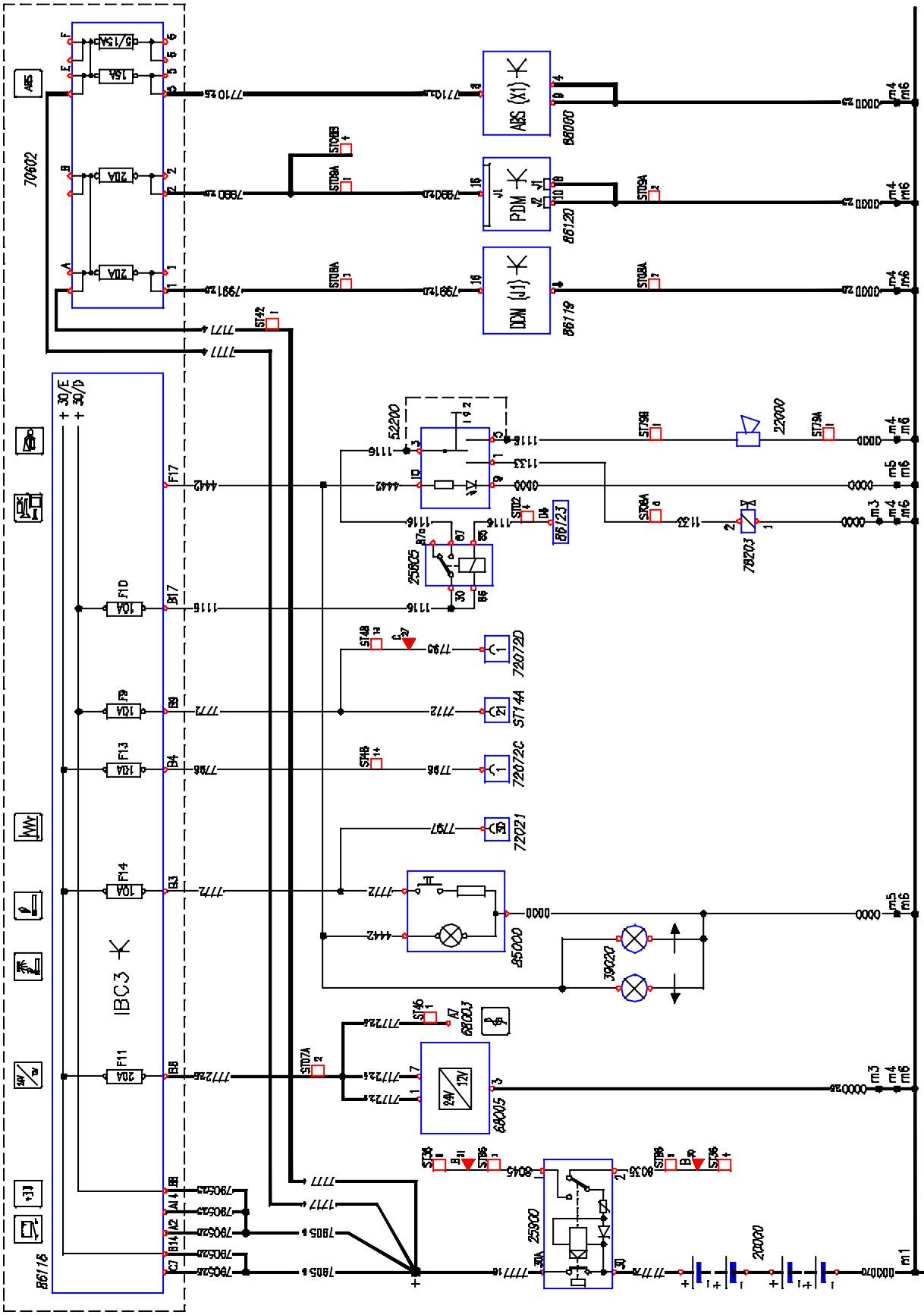
## Chart 2: Positive after TGC (+30)




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Aquila Trucks Centres

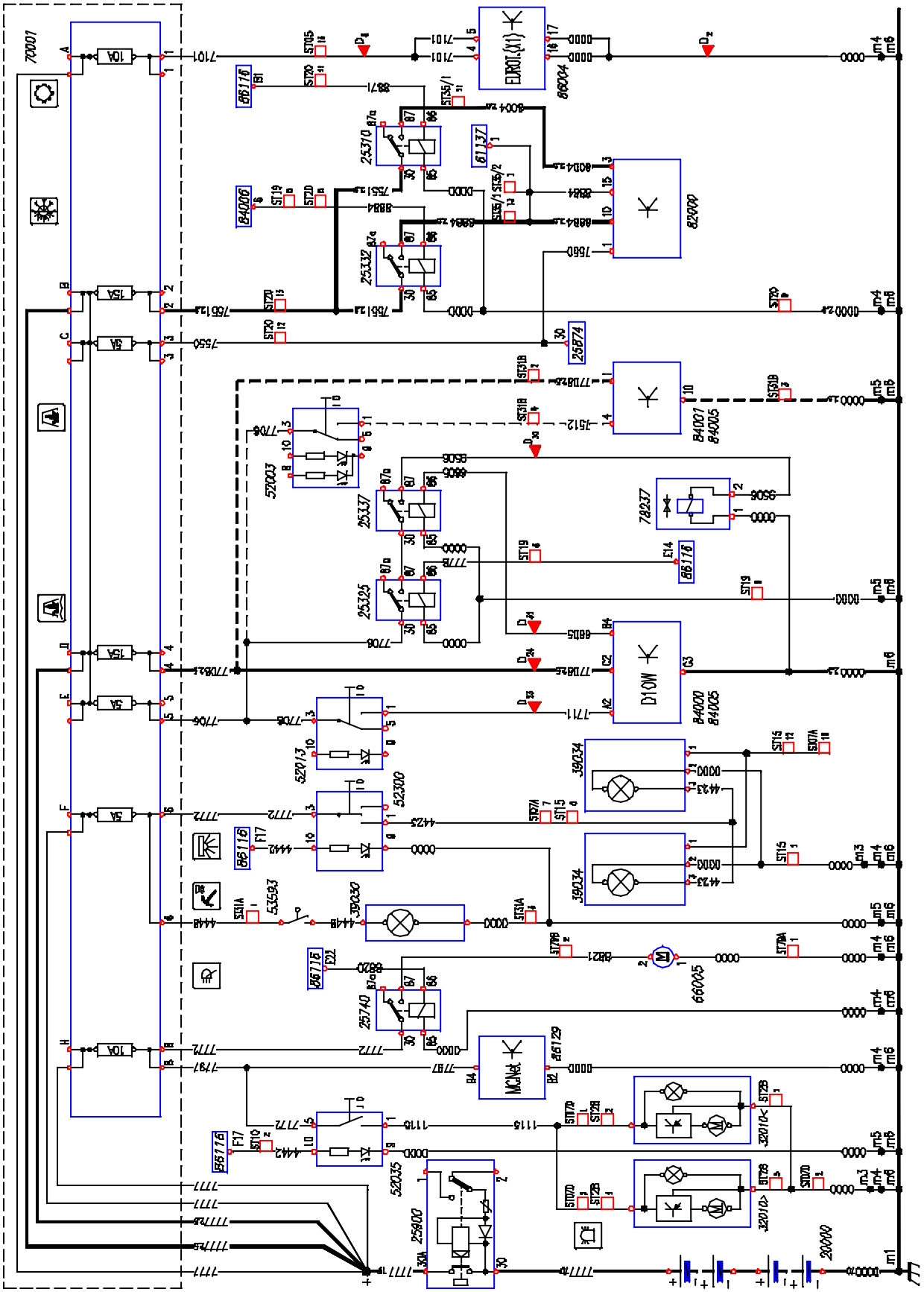
## Chart 3: Positive after TGC (+30)



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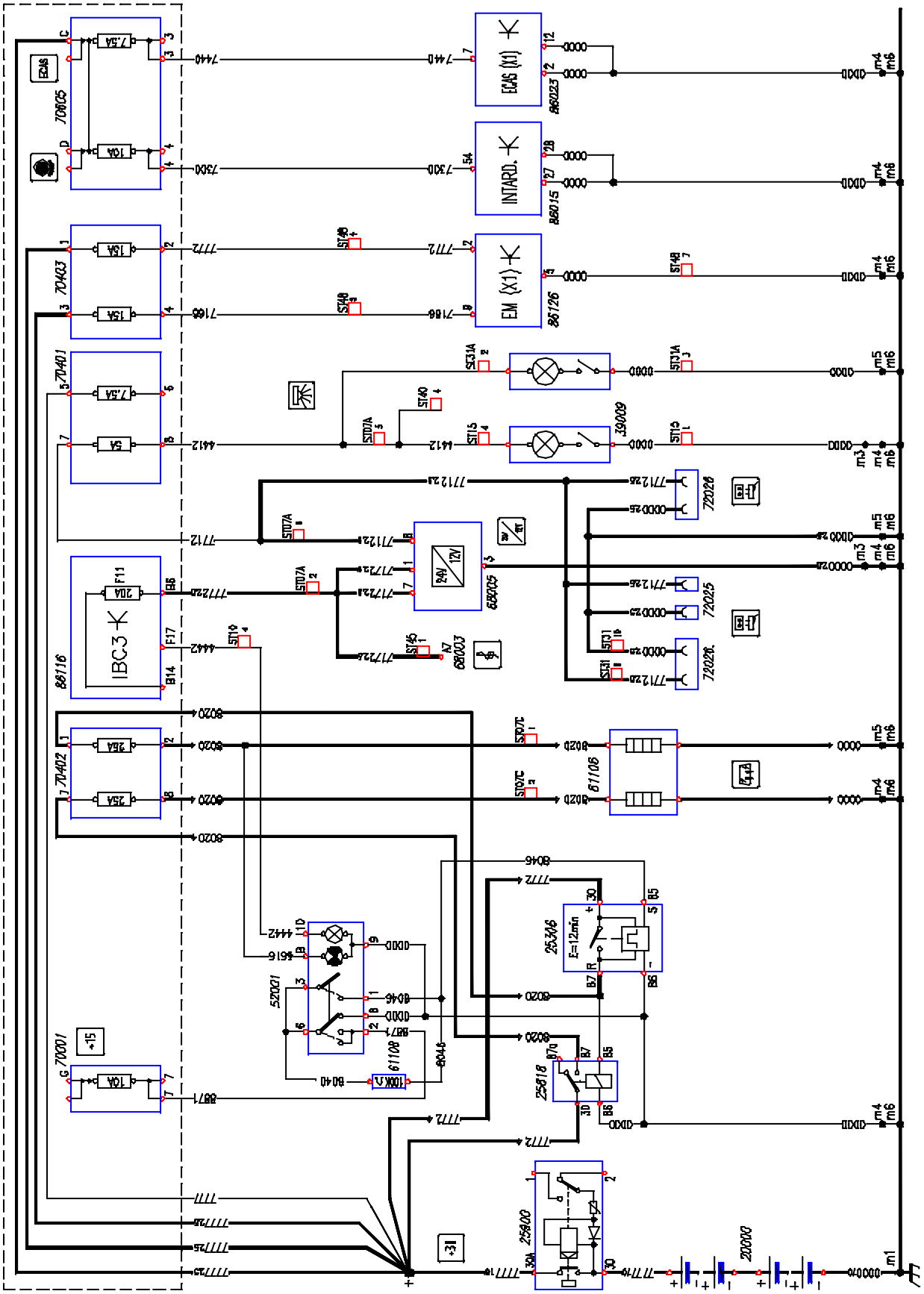

Aquila Trucks Centres

## Chart 4: Positive after TGC (+30)



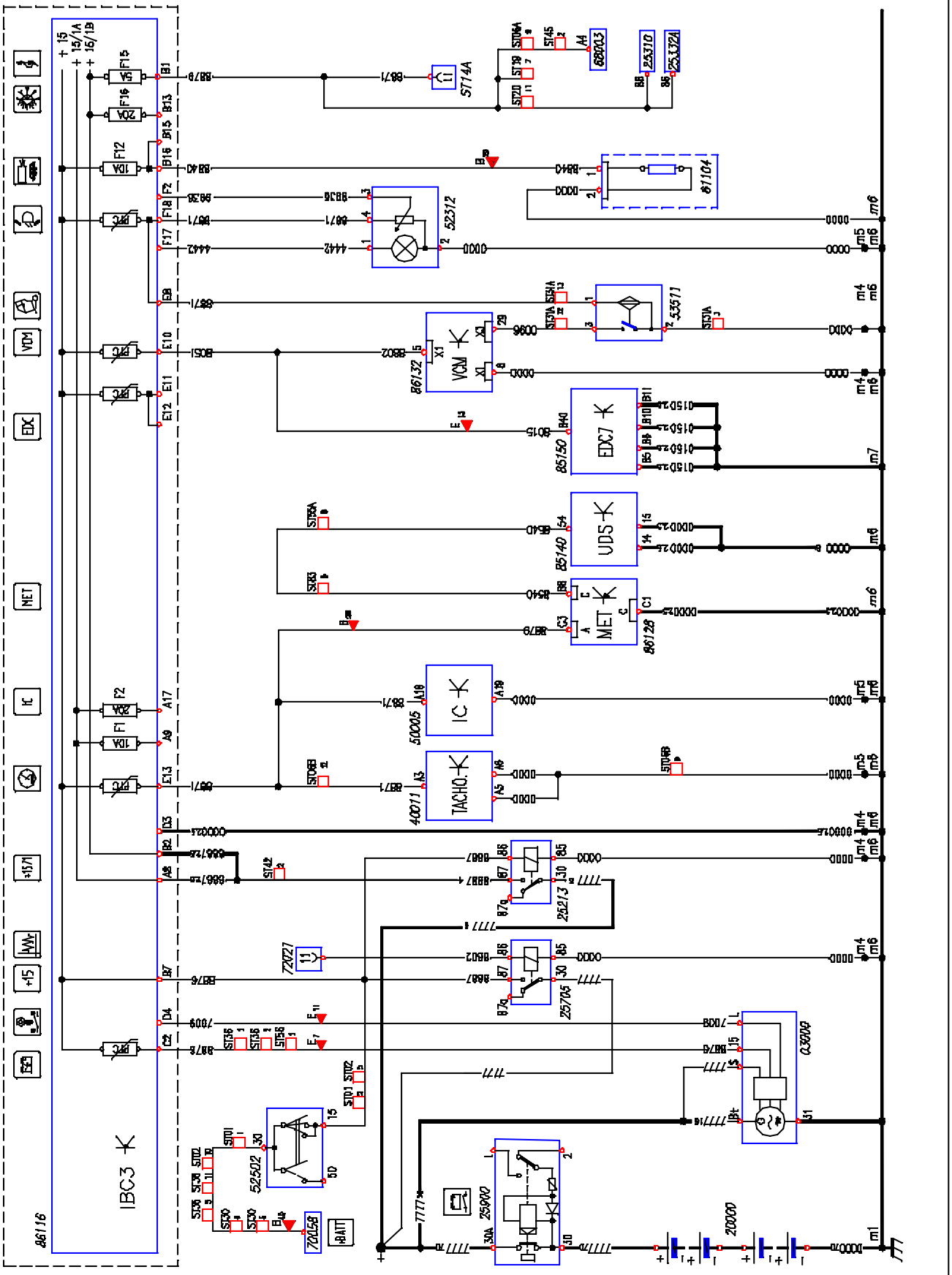
Aquila Trucks Centres

## Chart 5: Positive after TGC (+30)



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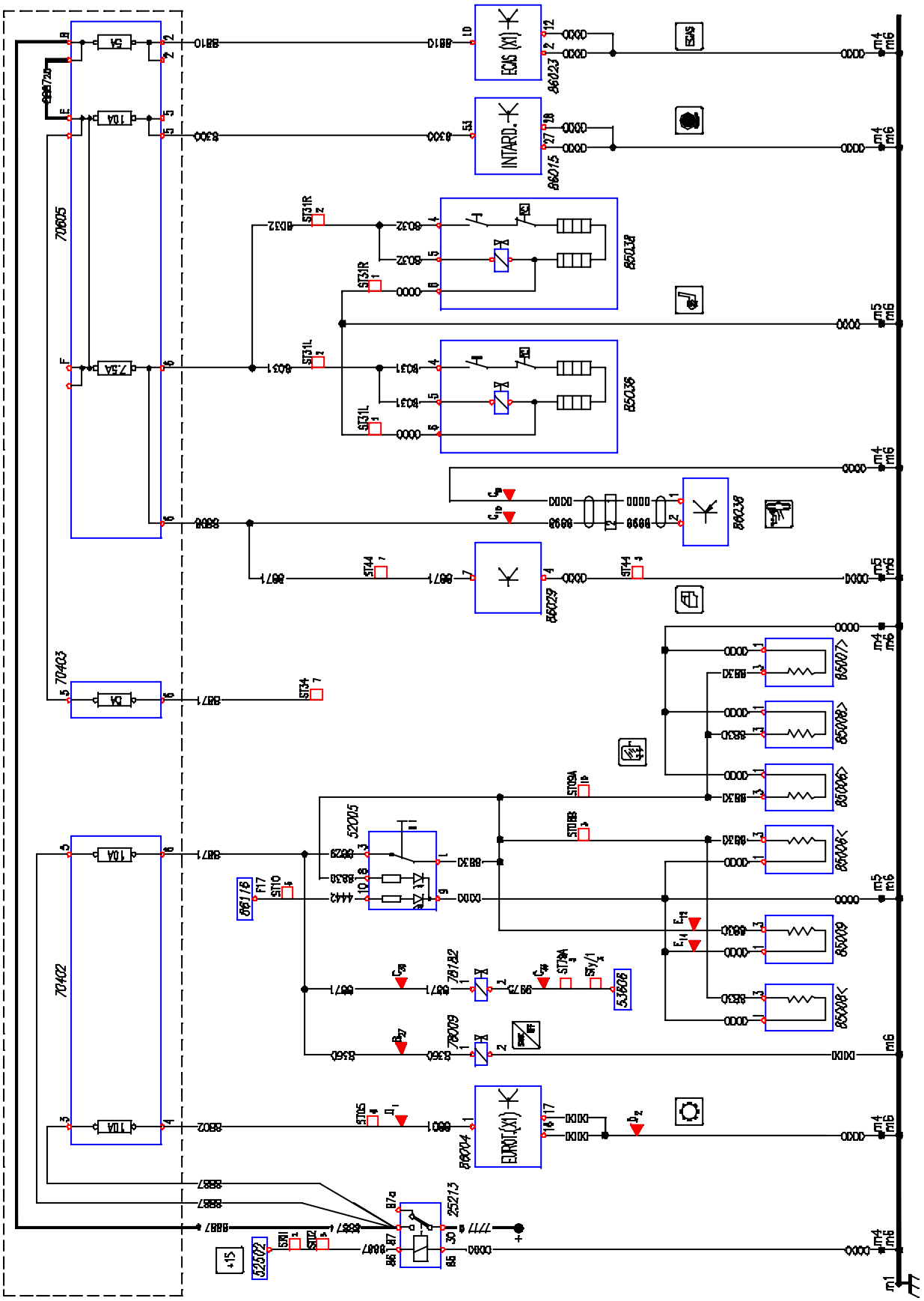
## Chart 6: Power supply (+15)




113361

Aquila Trucks Centres

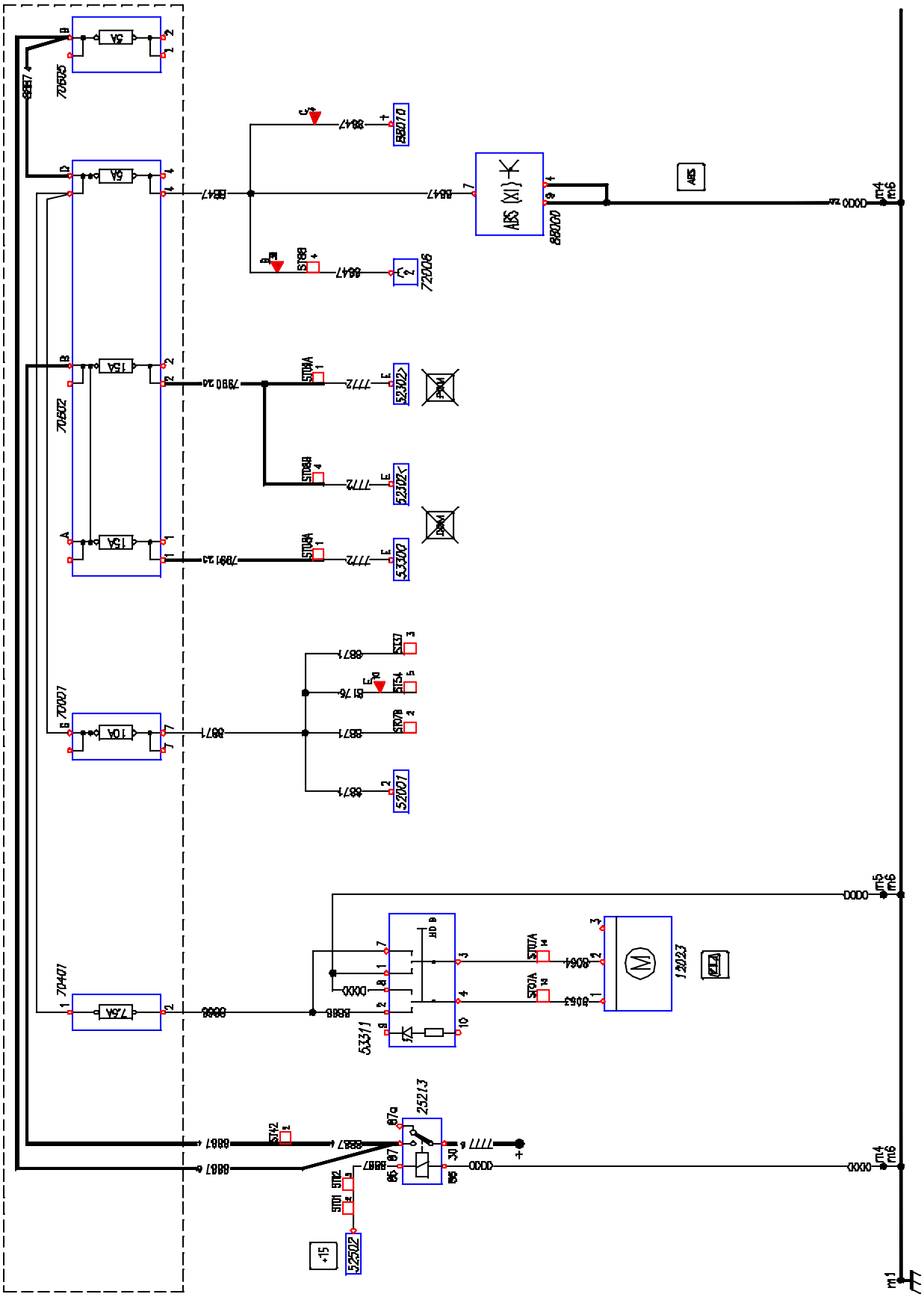
## Chart 7: Power supply (+15)



113362

Aquila Trucks Centres

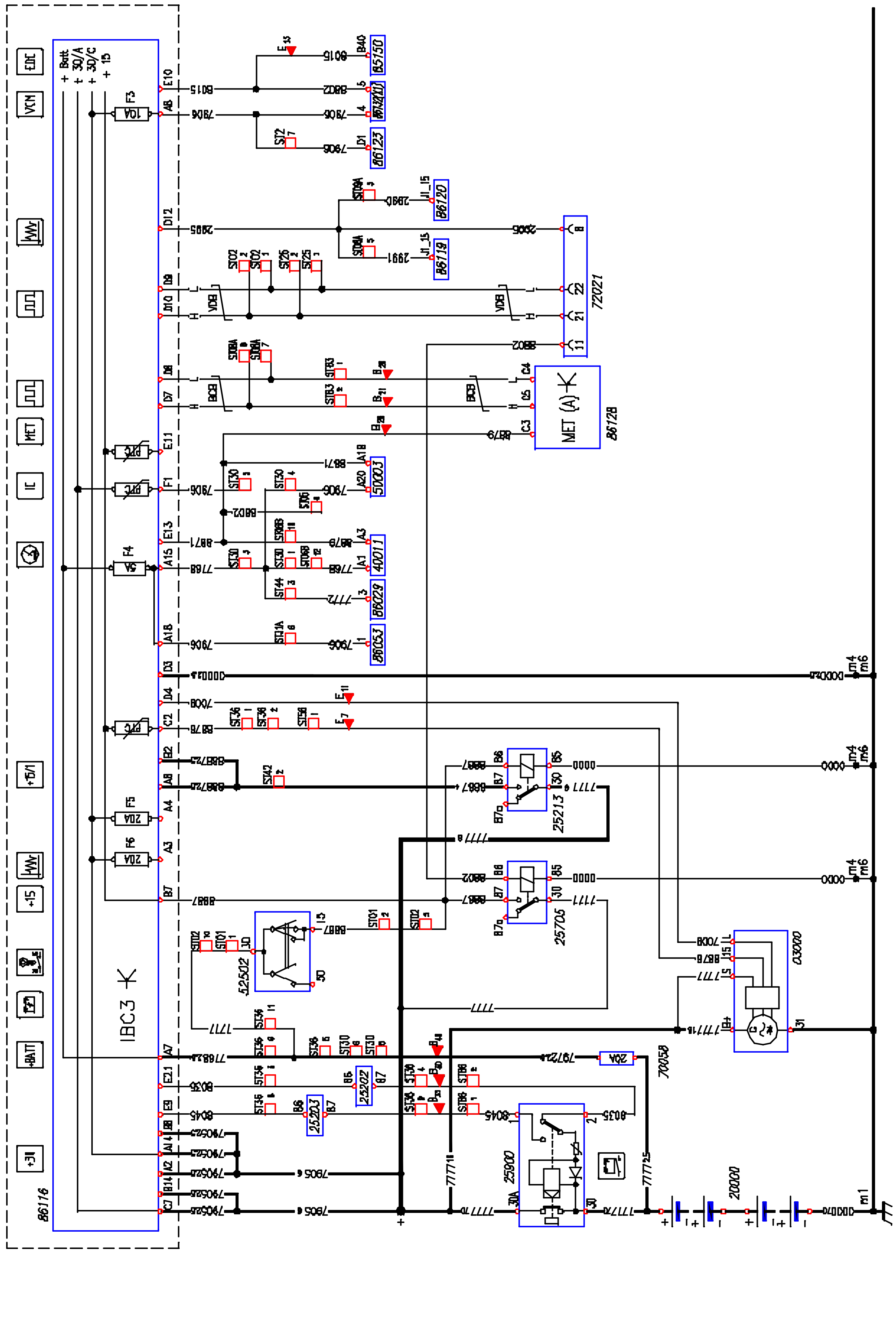
## Chart 8: Power supply (+15)




113363

Aquila Trucks Centres

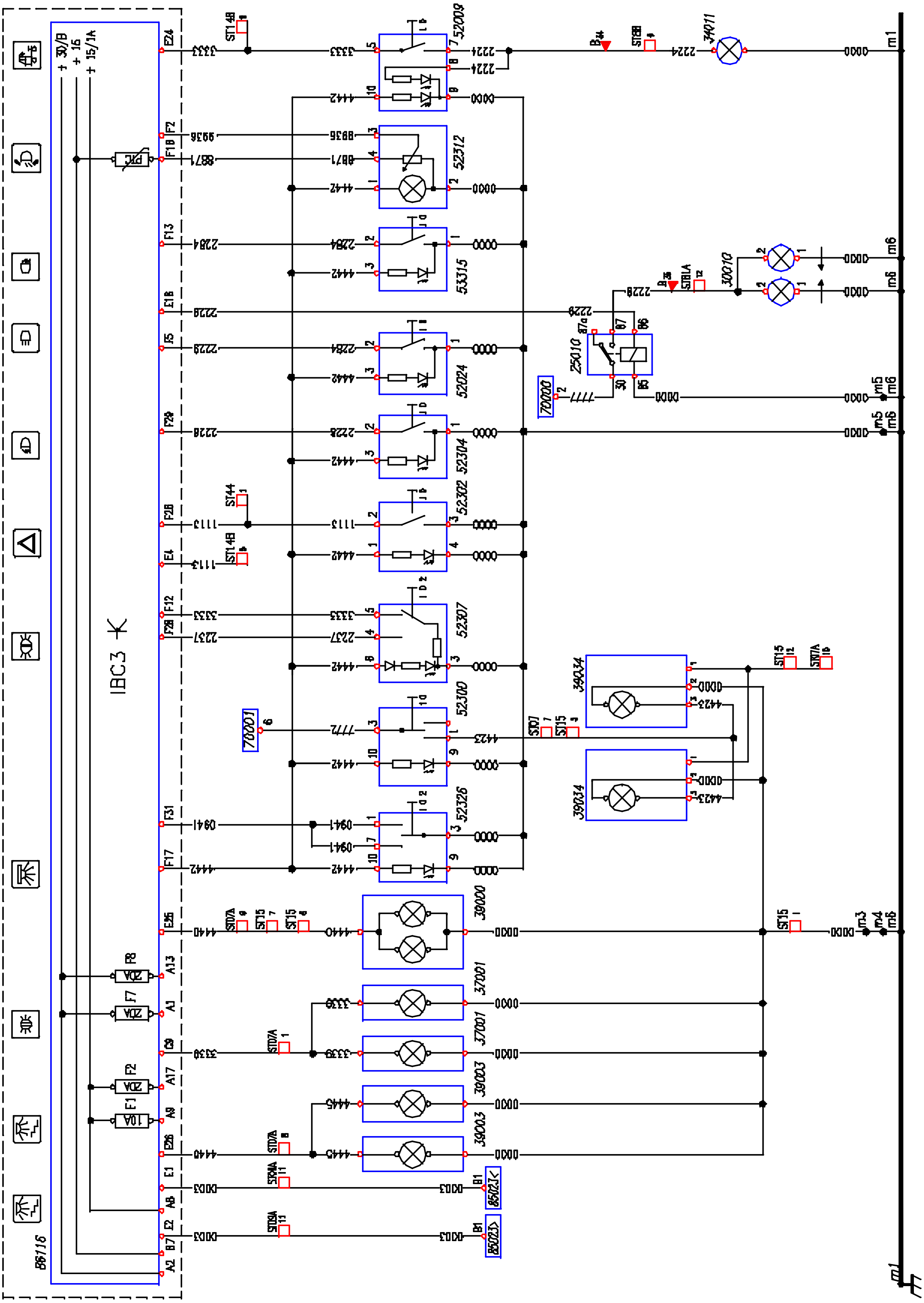
## Chart 9: Body controller




113364

Aquila Trucks Centres

**Chart 10: Body controller**



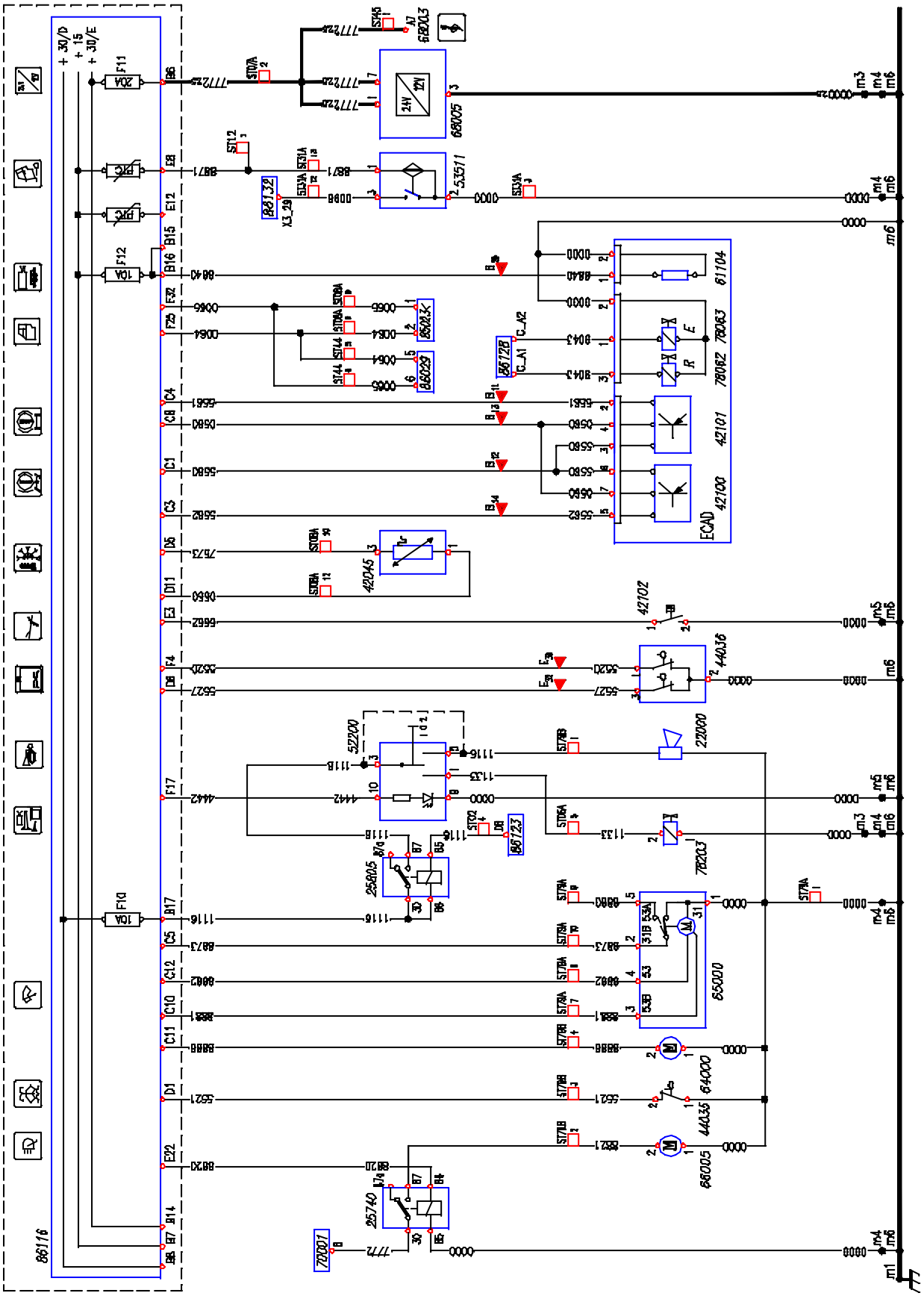

113365



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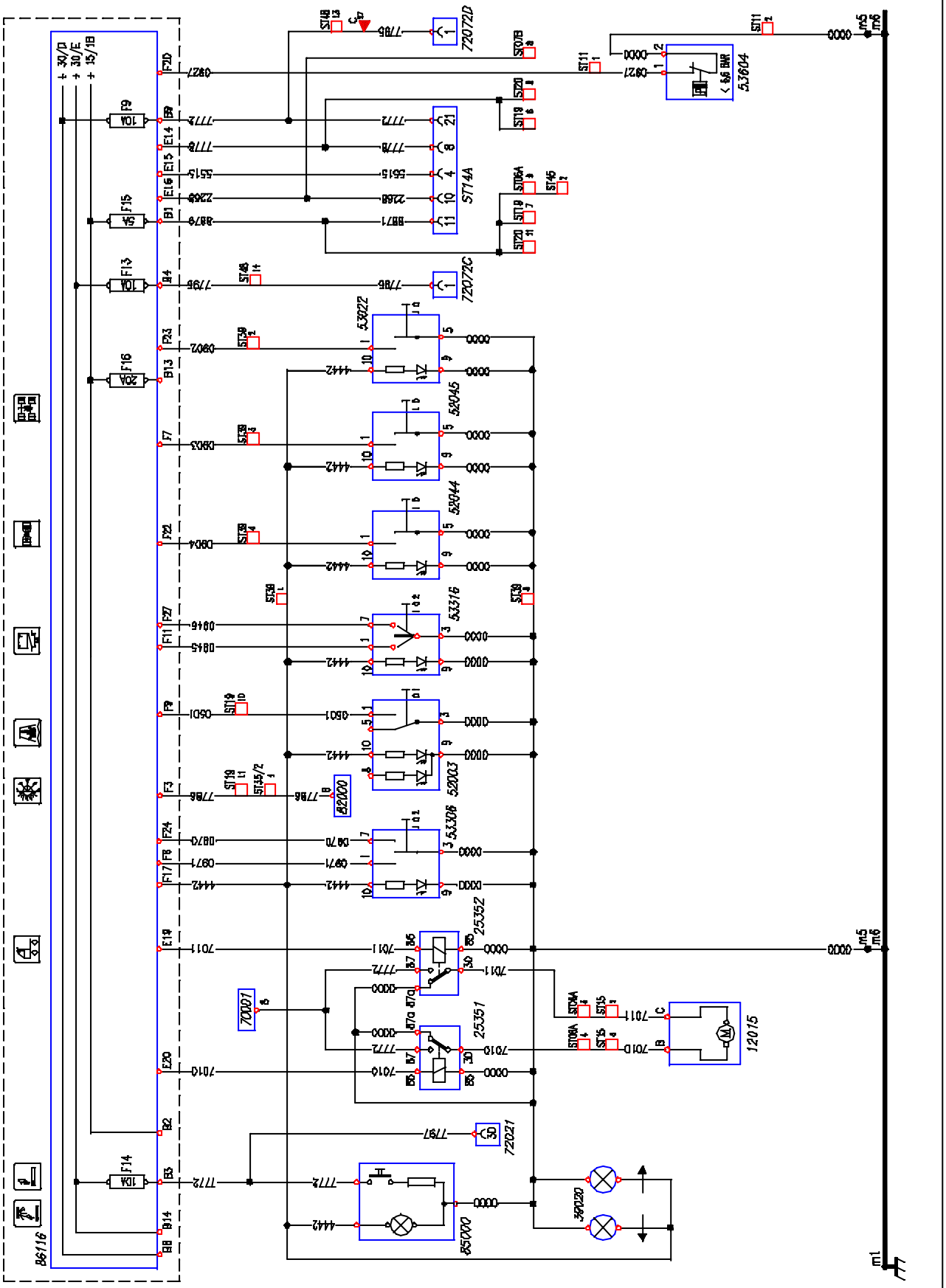
https://truckmanualshub.com/
Aquila Trucks Centres

## Chart 11: Body controller



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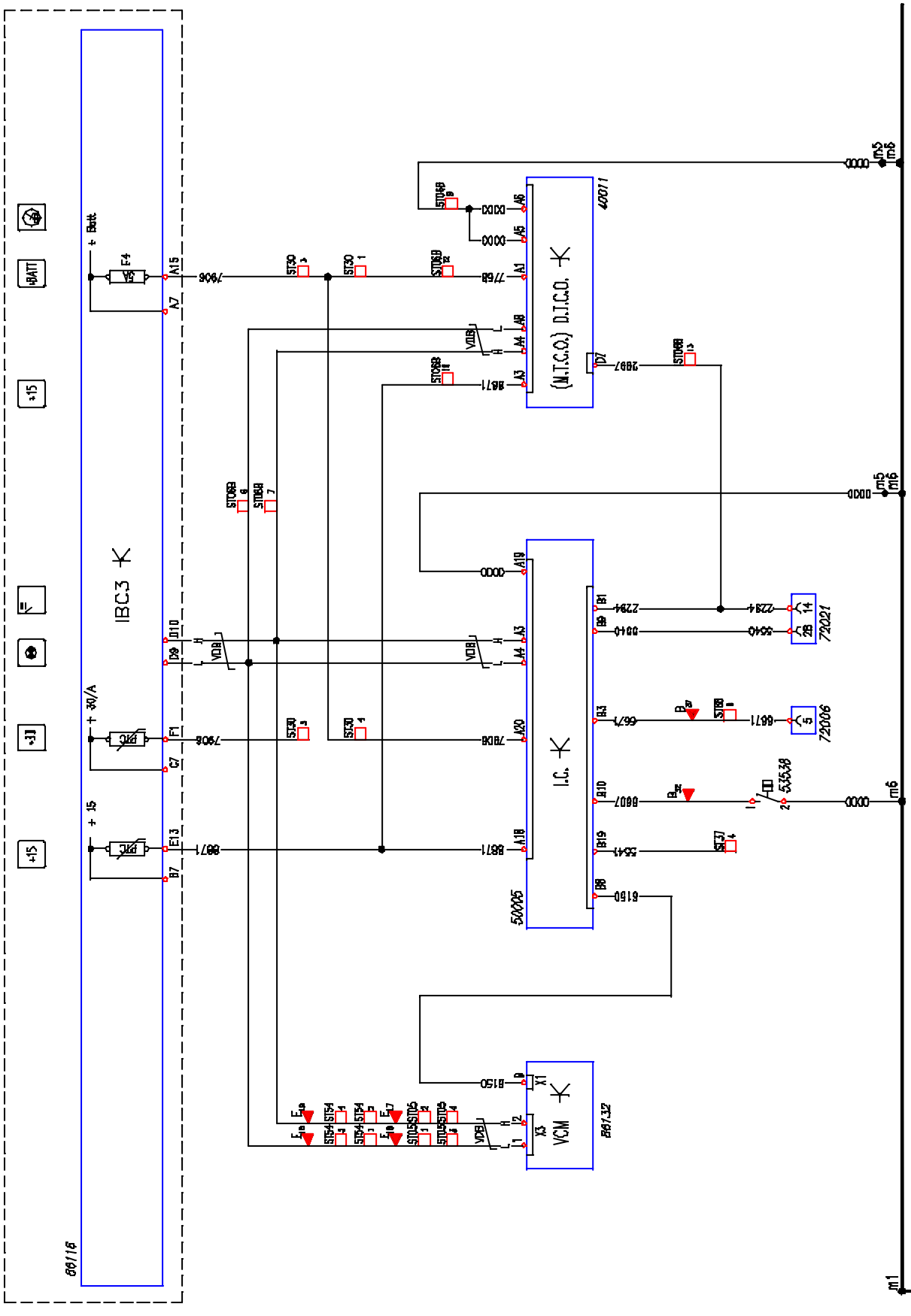
## Chart 12: Body controller



113577

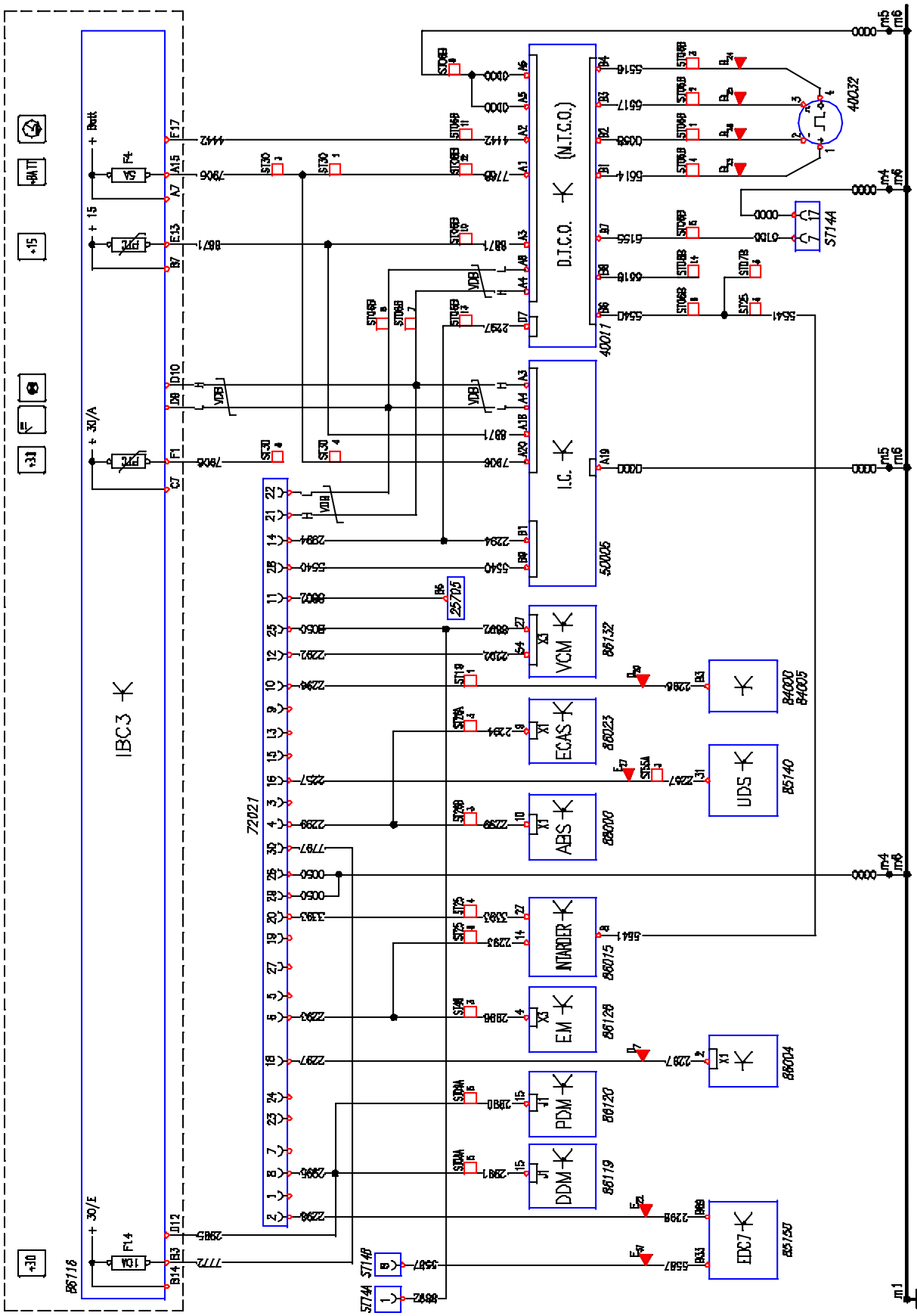
Aquila Trucks Centres

## Chart 13: IC central unit



Aquila Trucks Centres

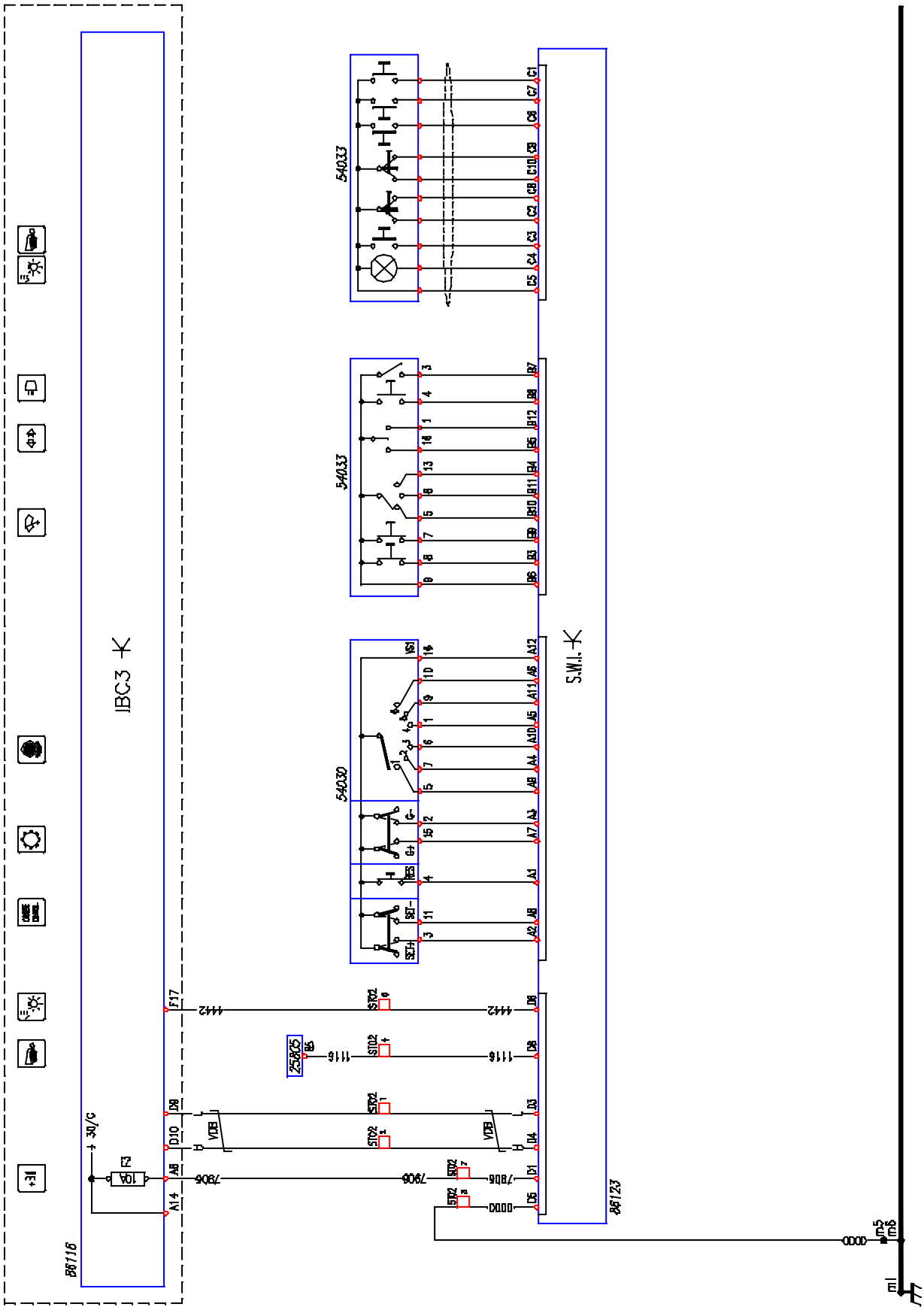
## Chart 14: Tachograph / Diagnosis socket




113369

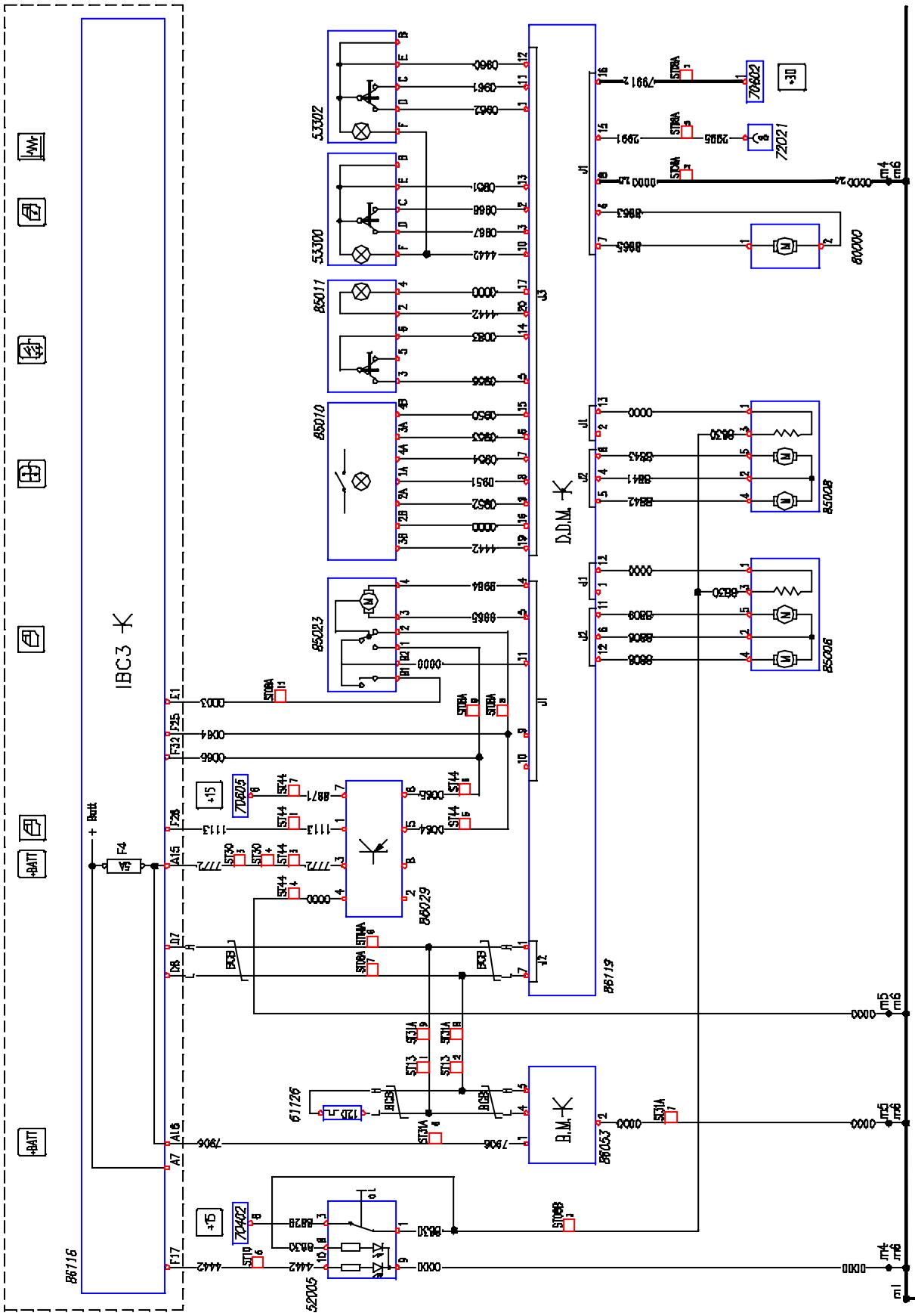
Aquila Trucks Centres

## Chart 15: Steering Wheel Interface (SWI)



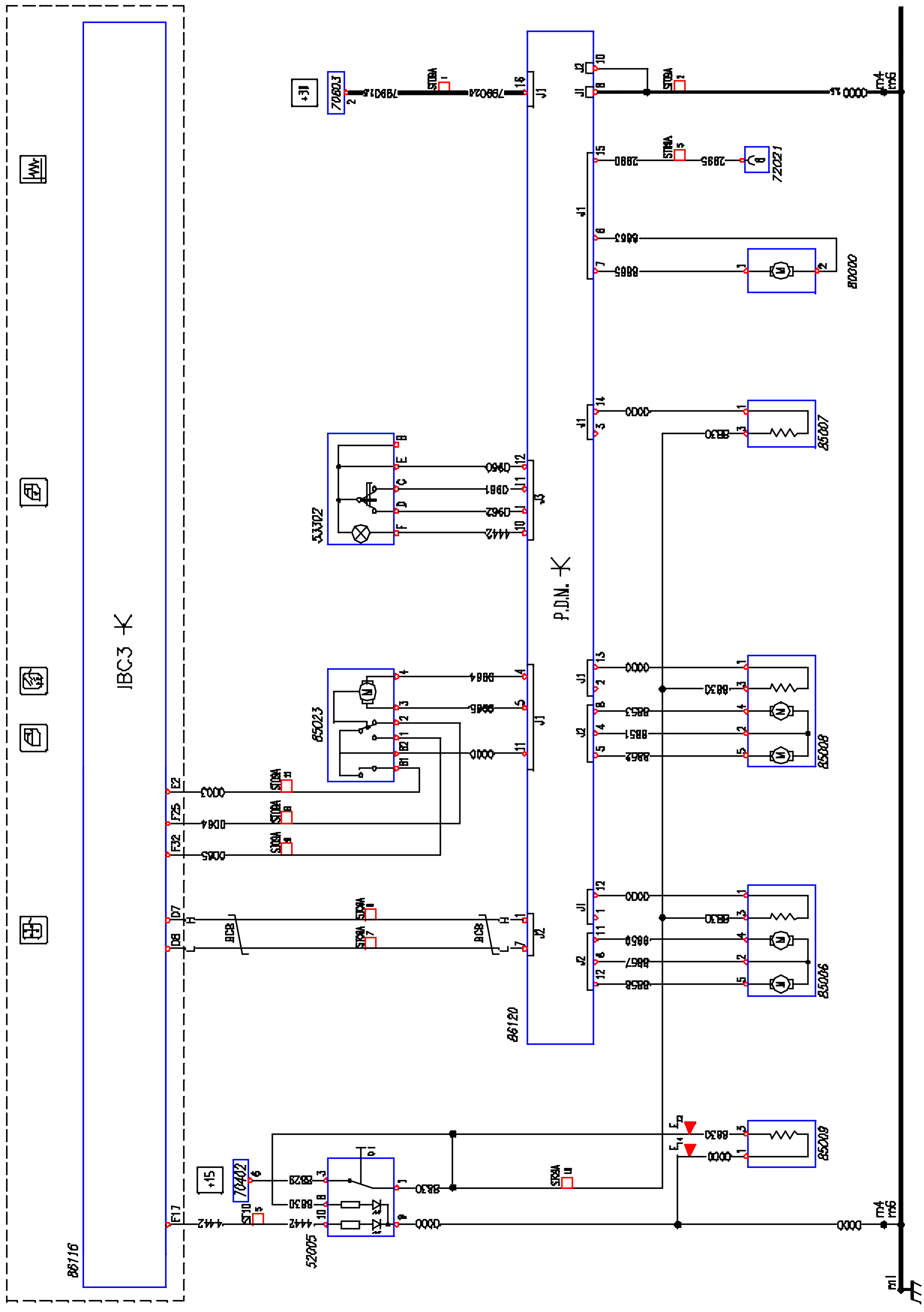
Aquila Trucks Centres

## Chart 16: DDM-BM control unit



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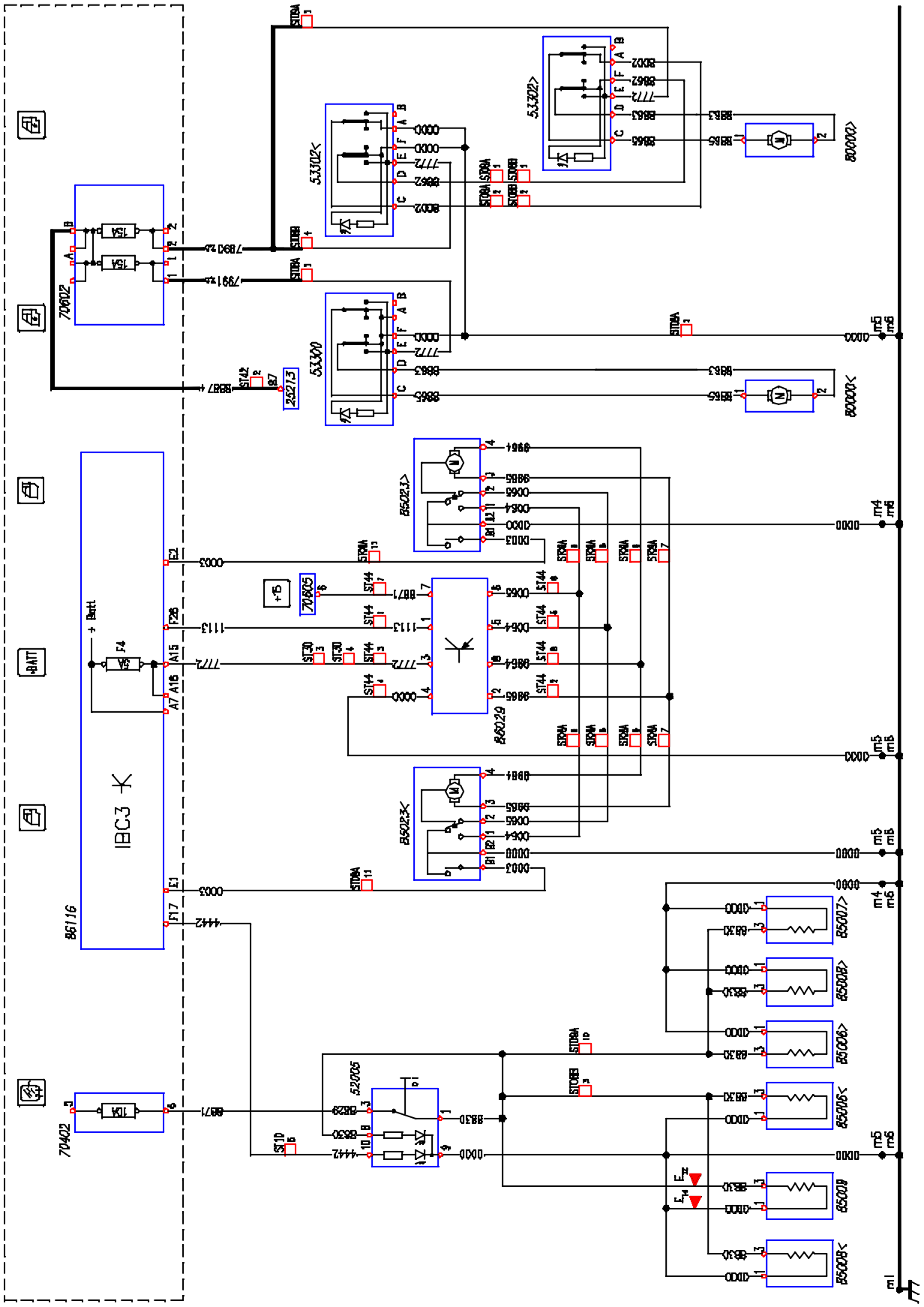
## Chart 17: Passenger Door Module (PDM)




113372

Aquila Trucks Centres

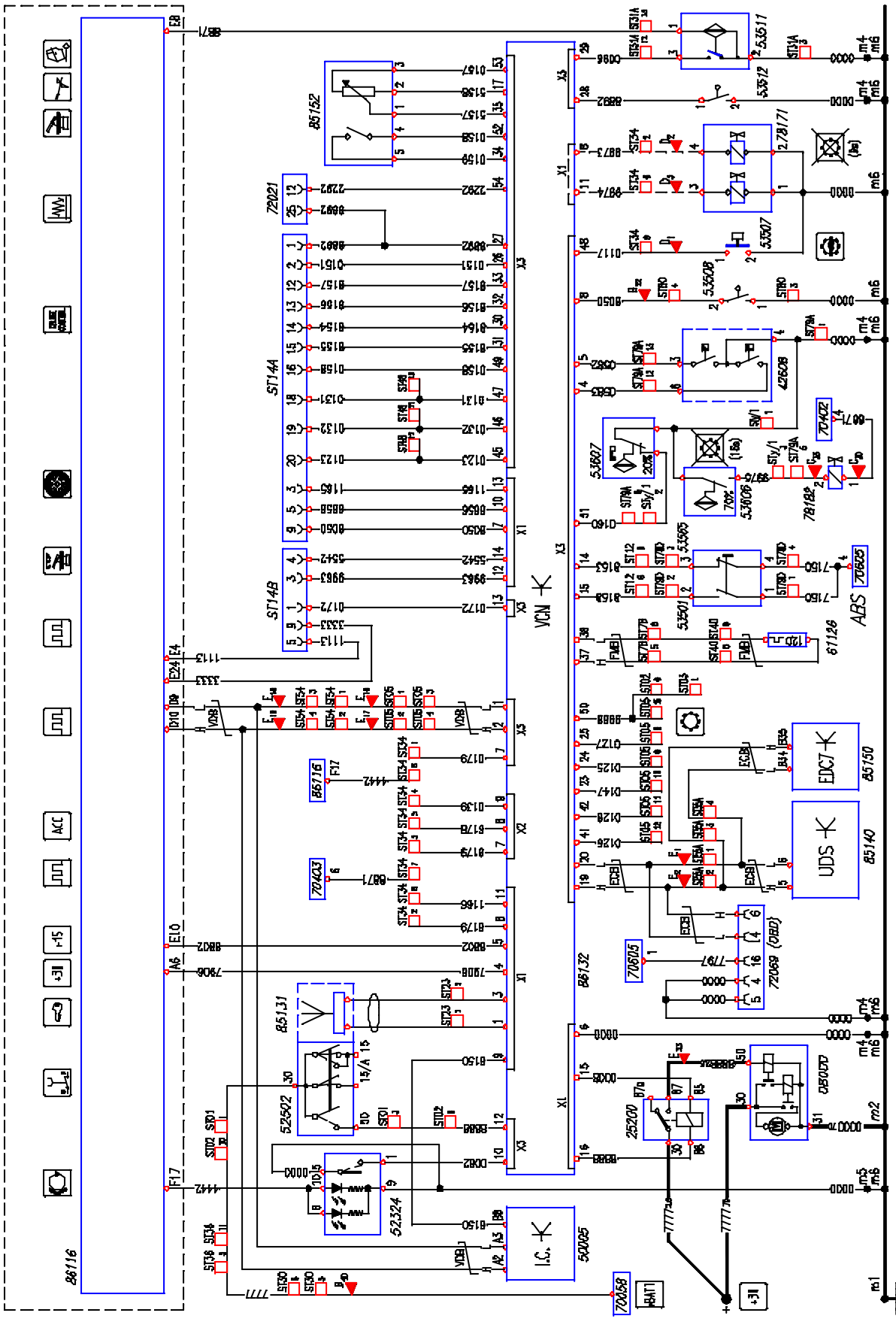
## Chart 18: Thermal mirrors / Centralised locking / Window winders (without DDM-PDM)




113373

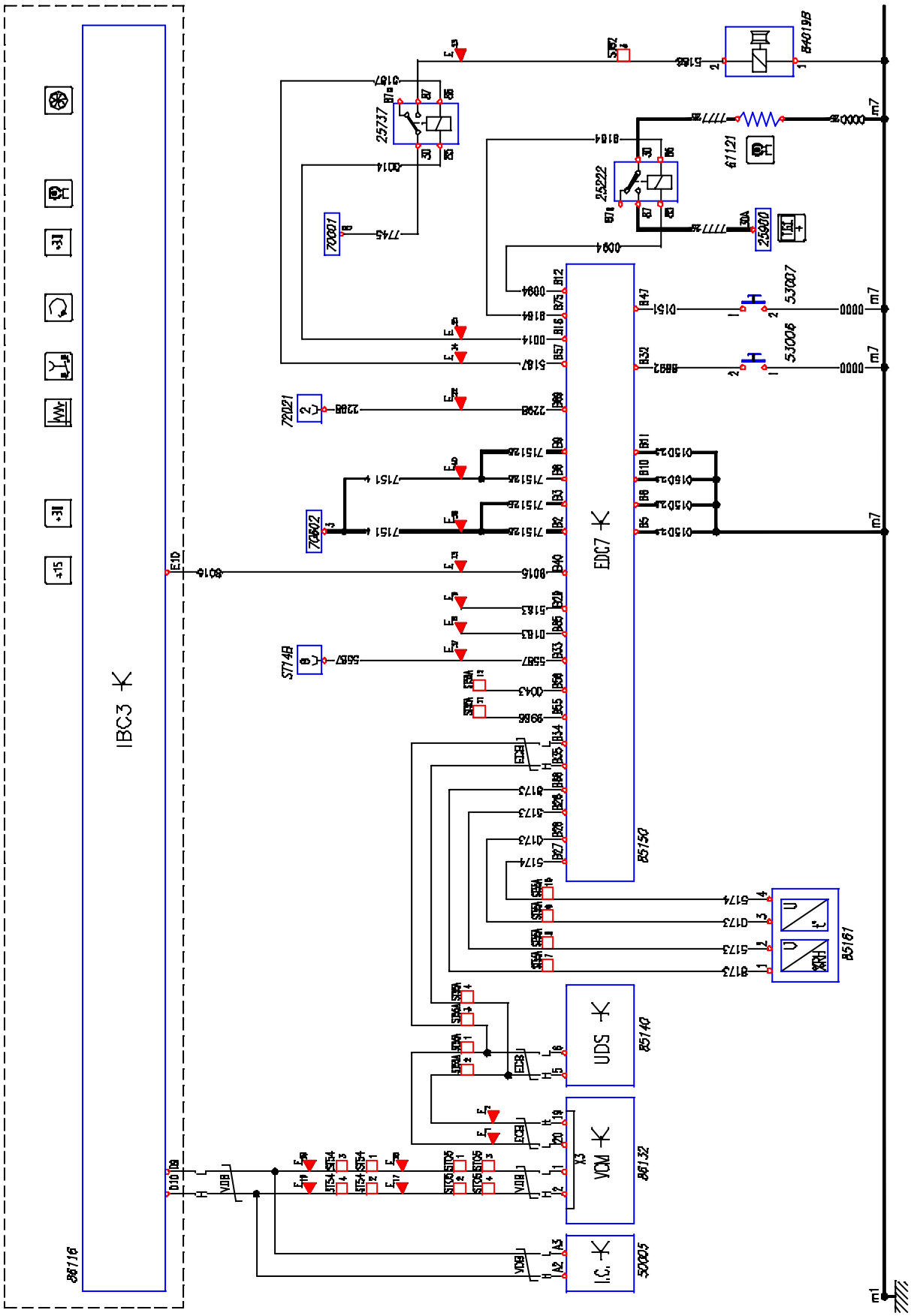
Aquila Trucks Centres

## Chart 19: Electronic Control Unit VCM



Aquila Trucks Centres

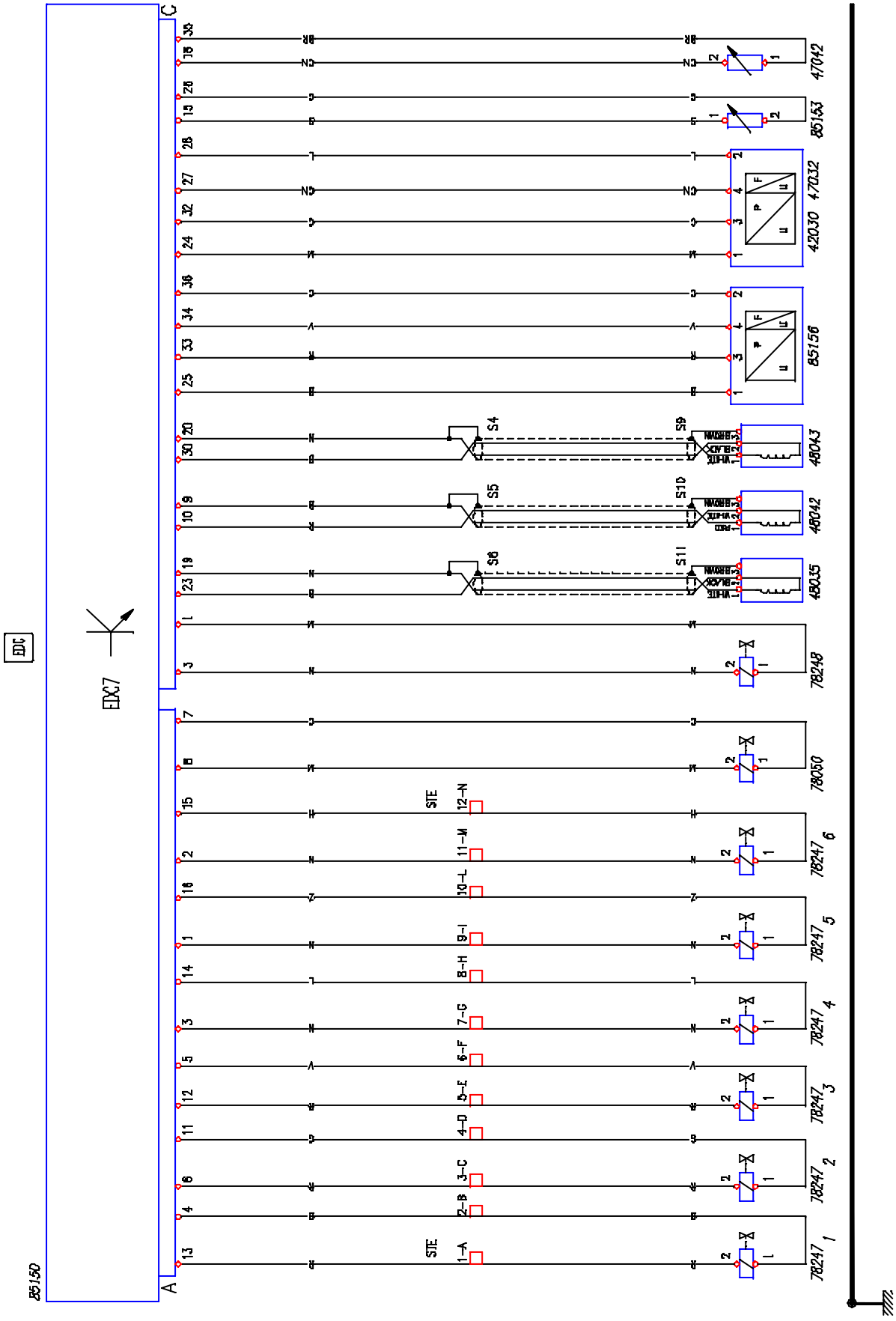
## Chart 20: EDC (Connector B)




113375

Aquila Trucks Centres

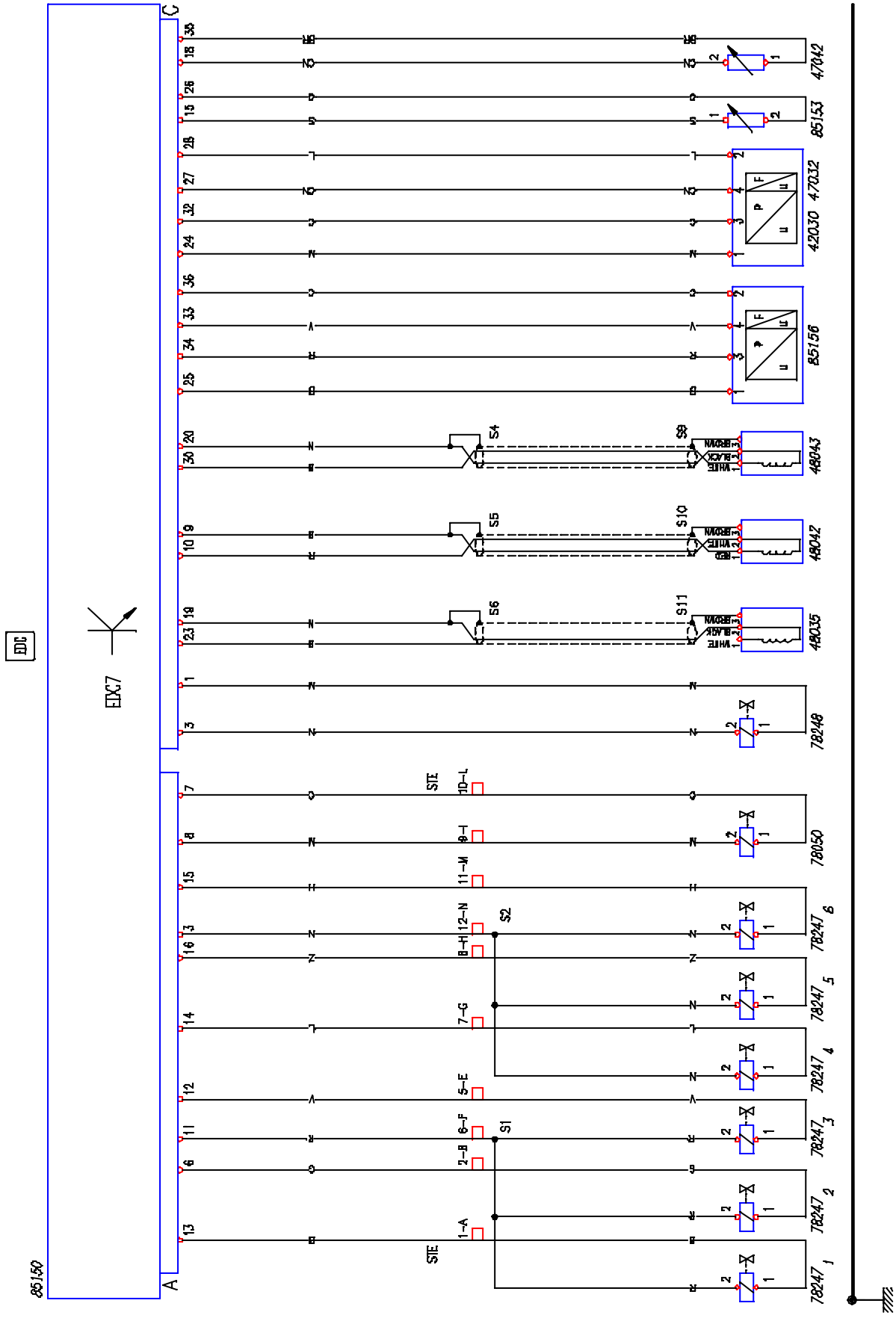
## Chart 21: EDC (Connector A/C - F2B)




113376

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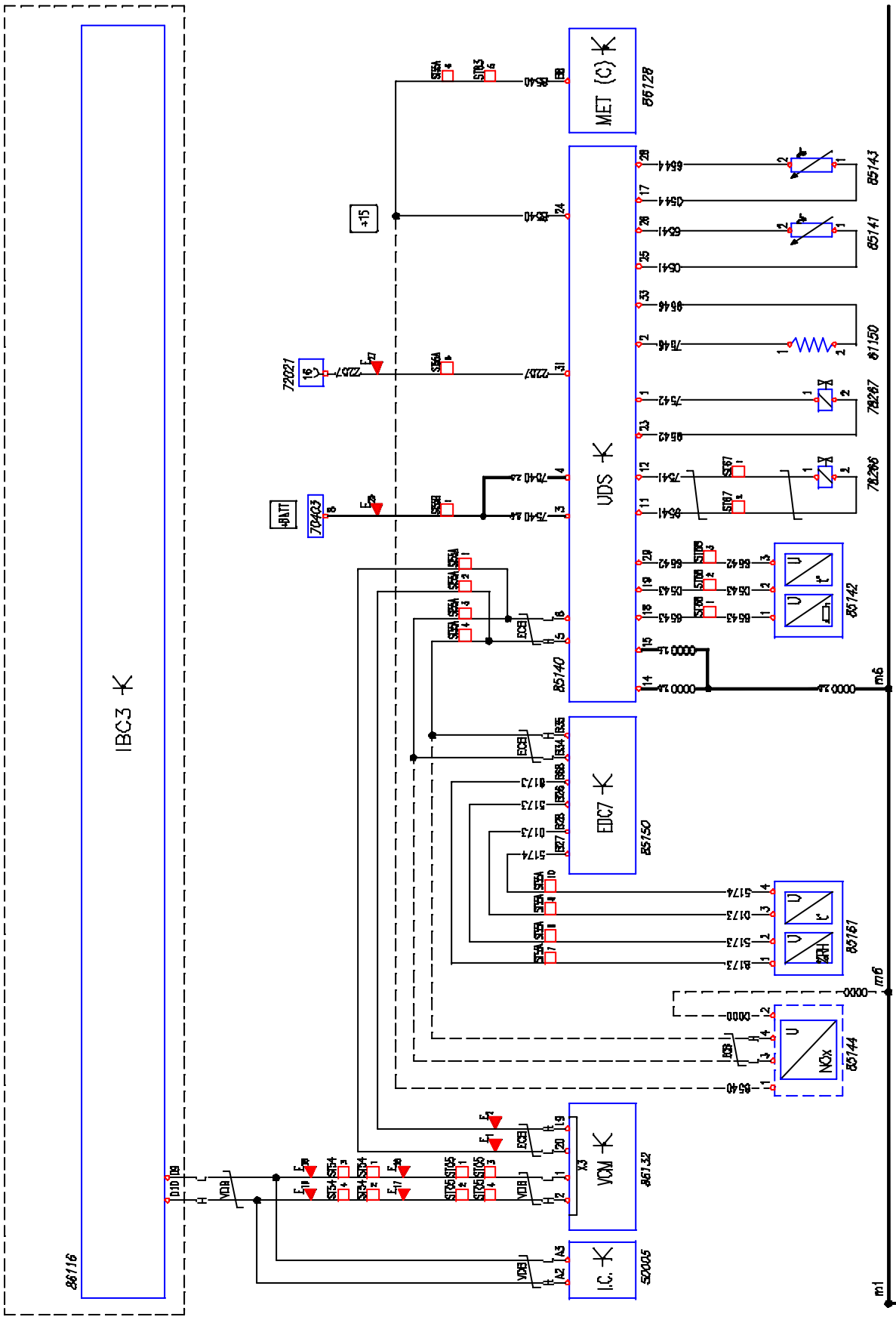
## Chart 22: EDC (Connector A/C - F3B)




113377

Aquila Trucks Centres

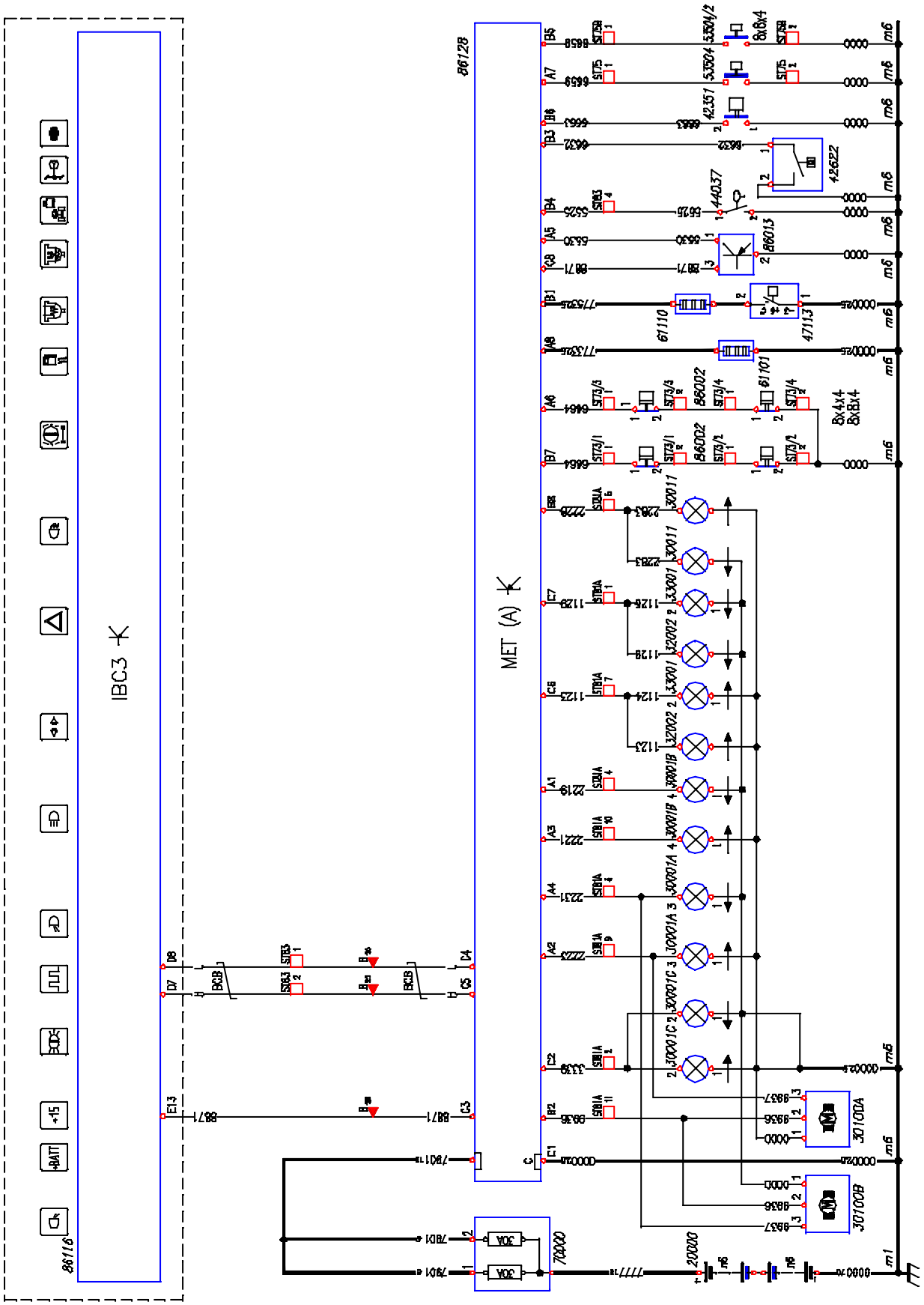
## Chart 23: Central unit UDS (DENOX 2)




113378

Aquila Trucks Centres

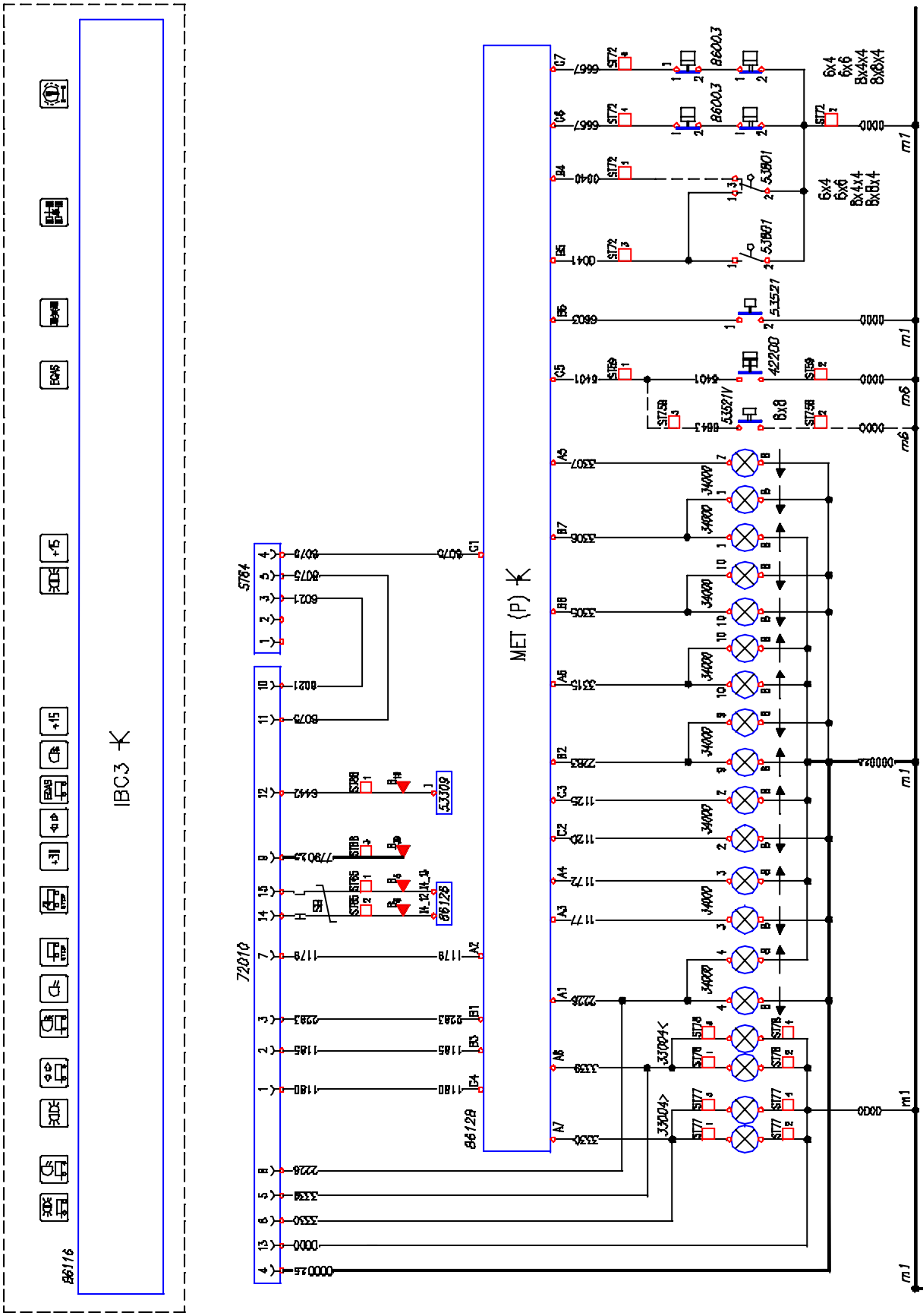
## Chart 24: Control unit MET




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Aquila Trucks Centres

## Chart 25: Control unit MET

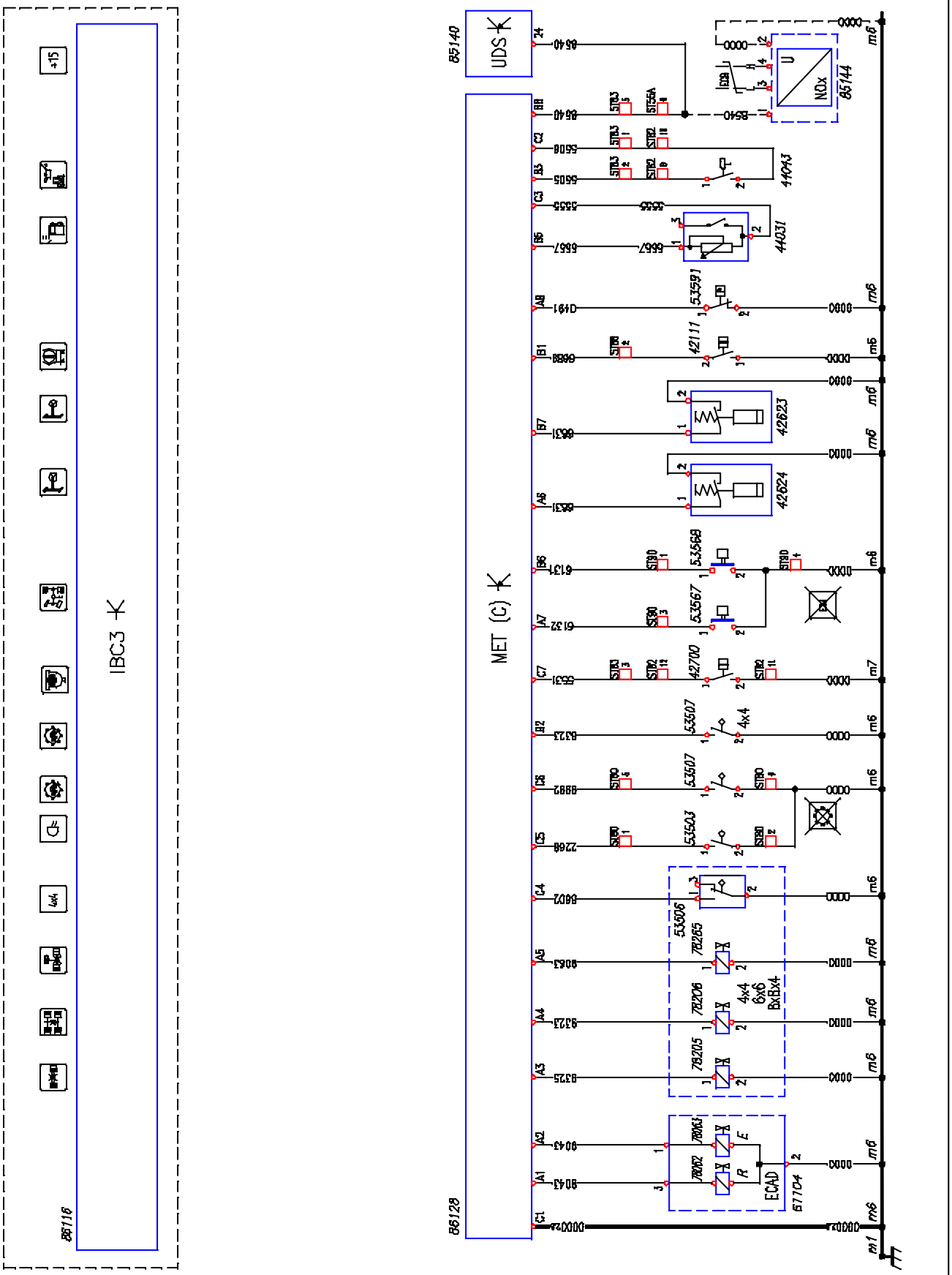



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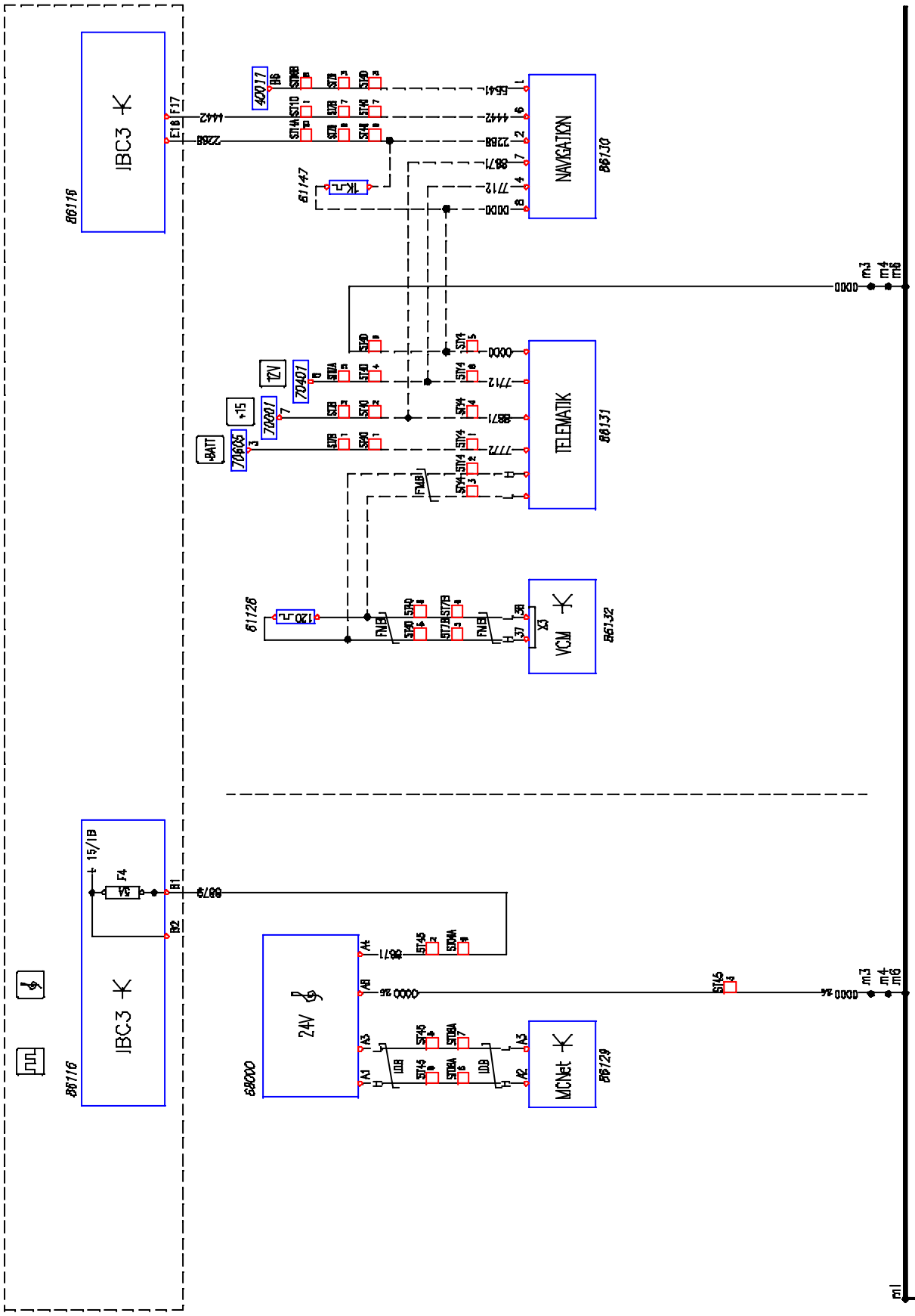
## Chart 26: Control unit MET




113381

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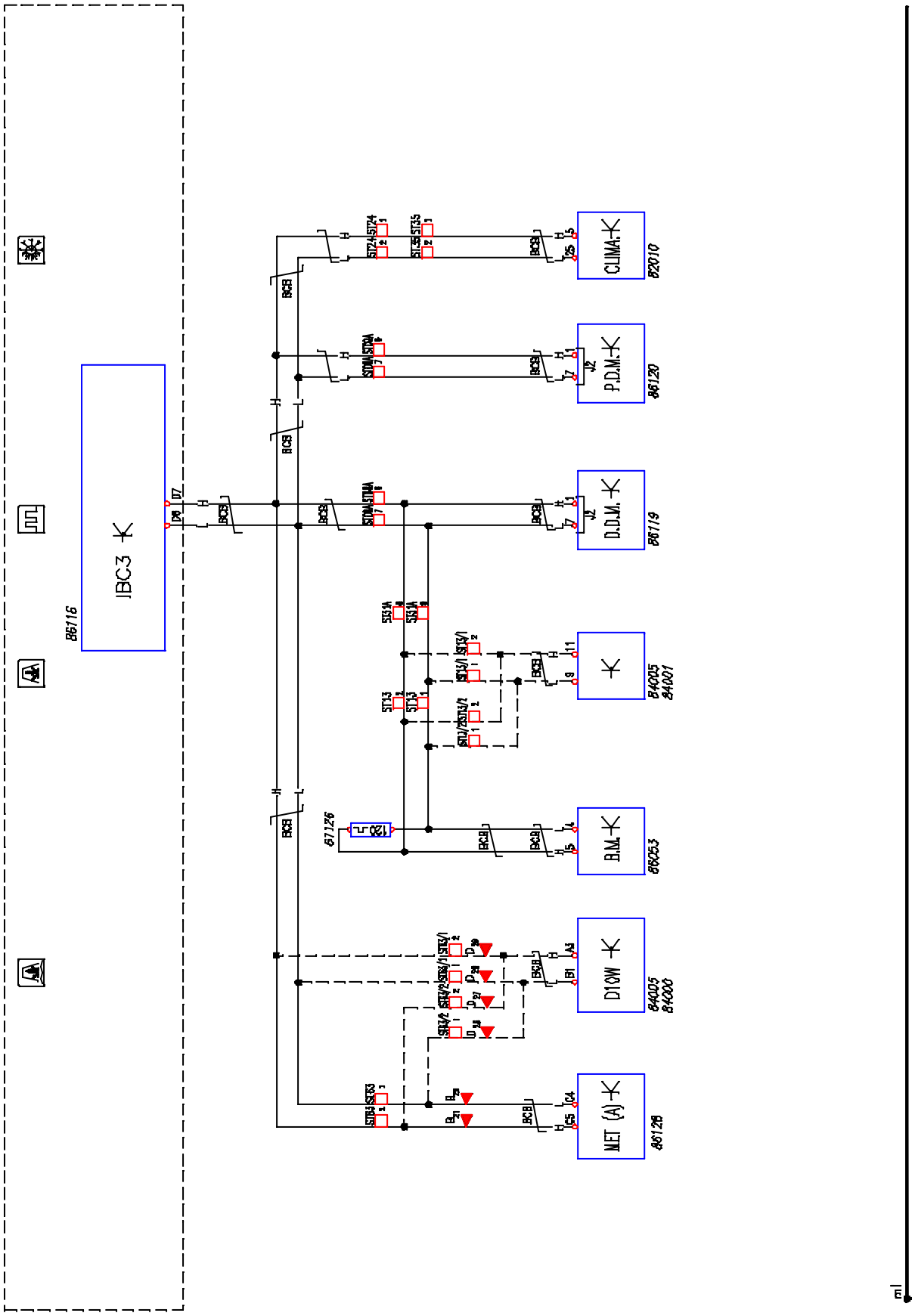
## Chart 27: Line CAN-IDB / FMB / Control unit / Telematics / Navigator




113382

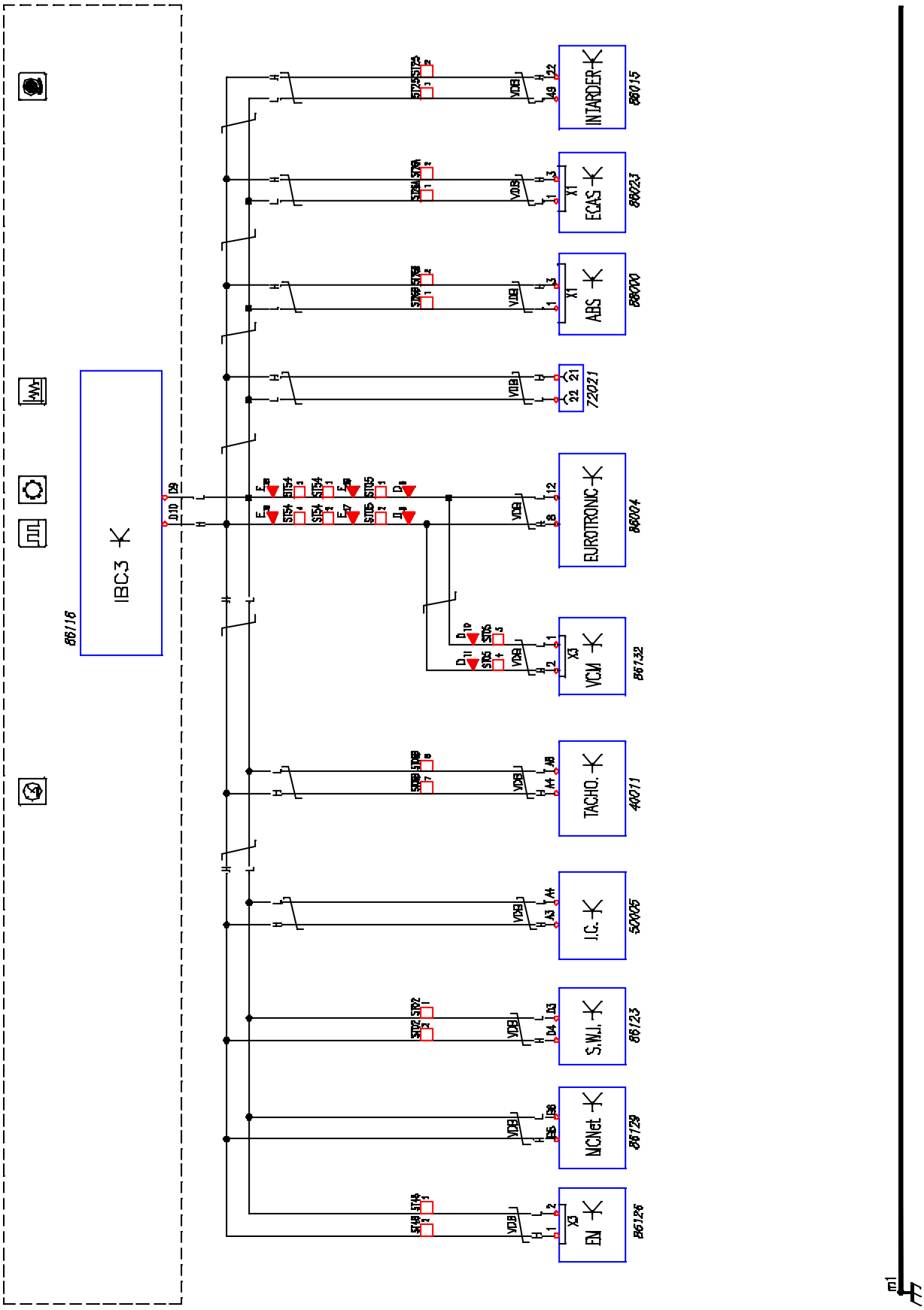
https://truckmanualshub.com/
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## Chart 28: Can line "BCB"



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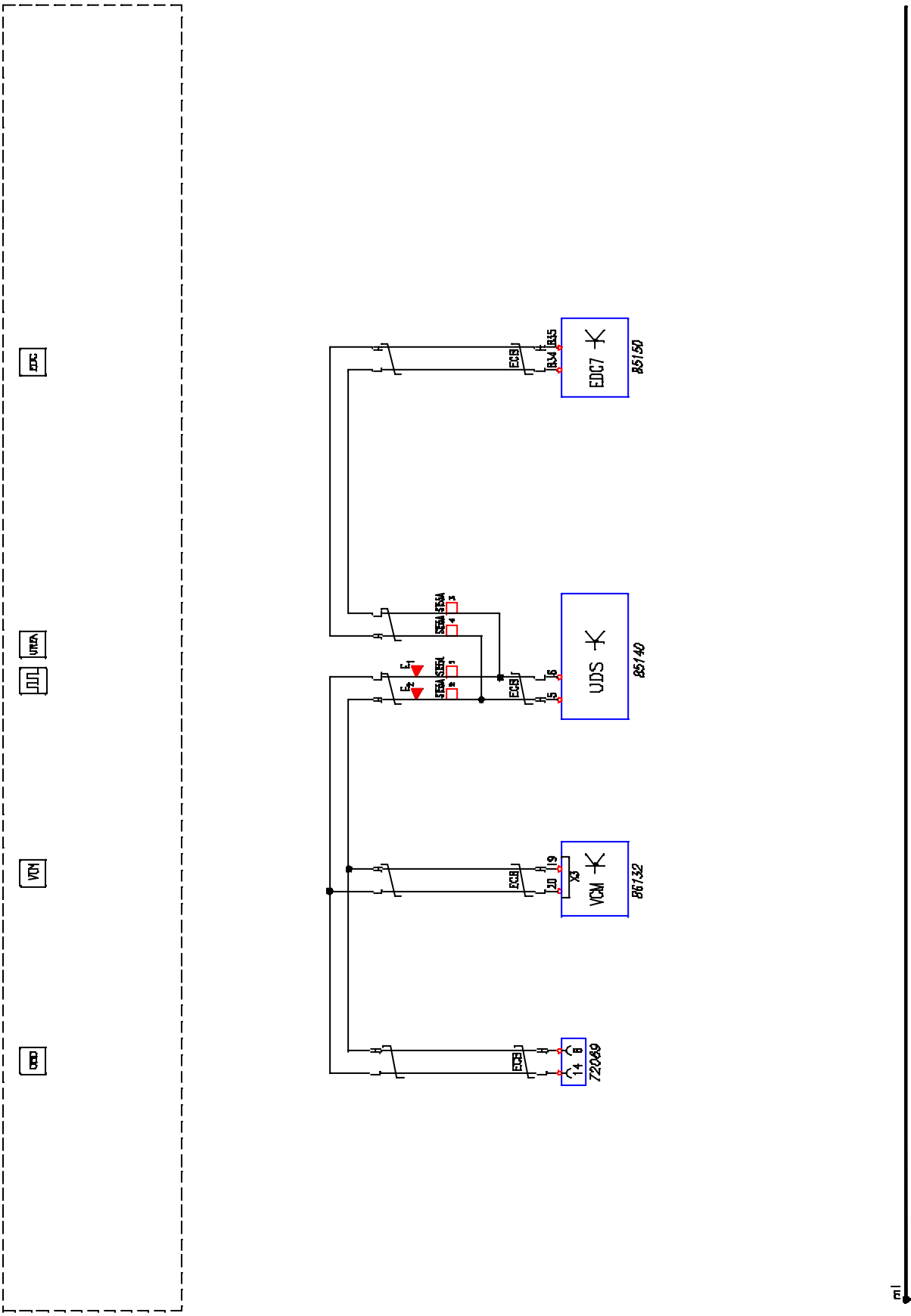
**Chart 29: Can line "VDB"**




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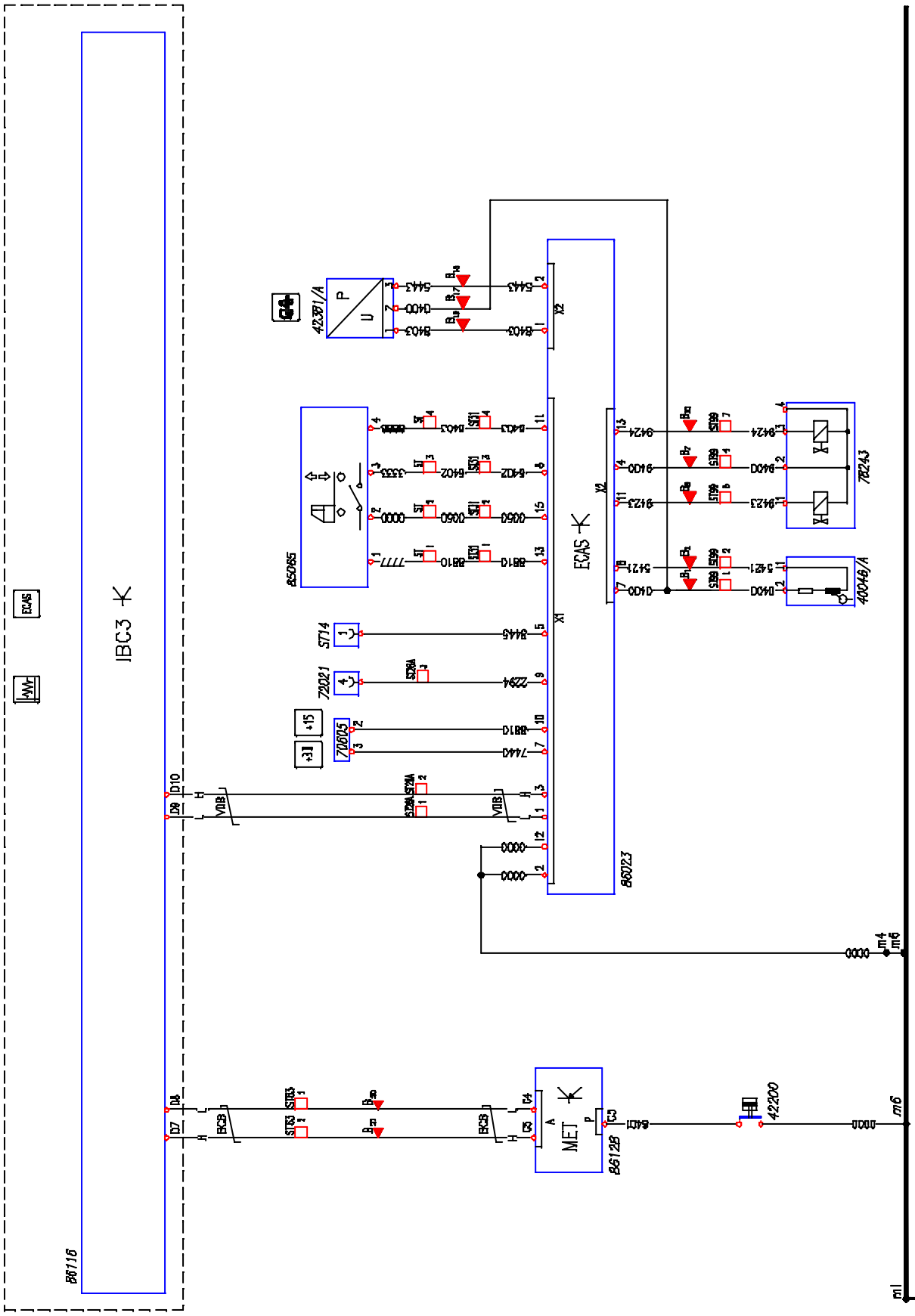
## Chart 30: Can line "ECB"




113385

Aquila Trucks Centres

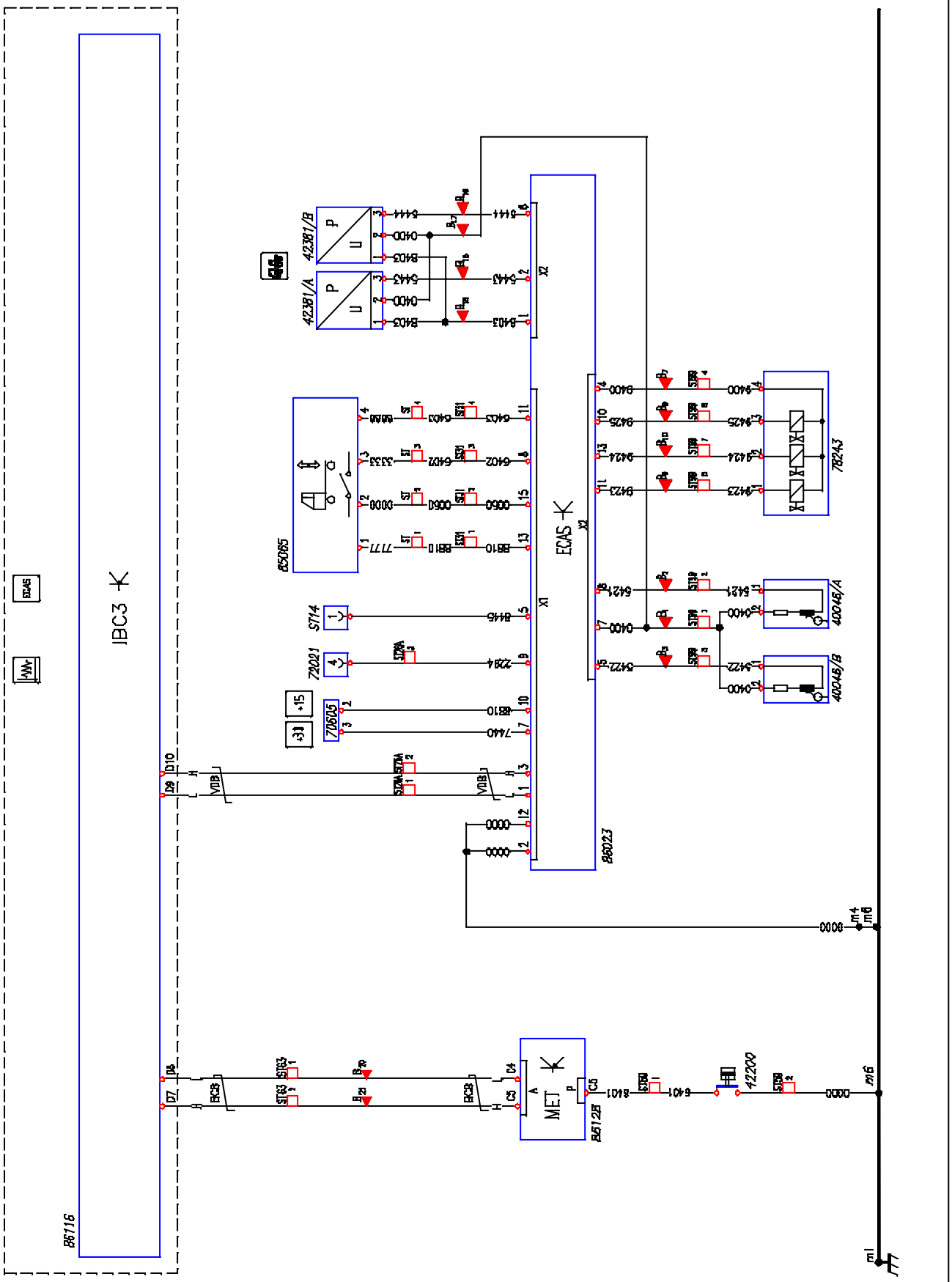
## Chart 31: ECAS 4x2 P (TRACTOR)



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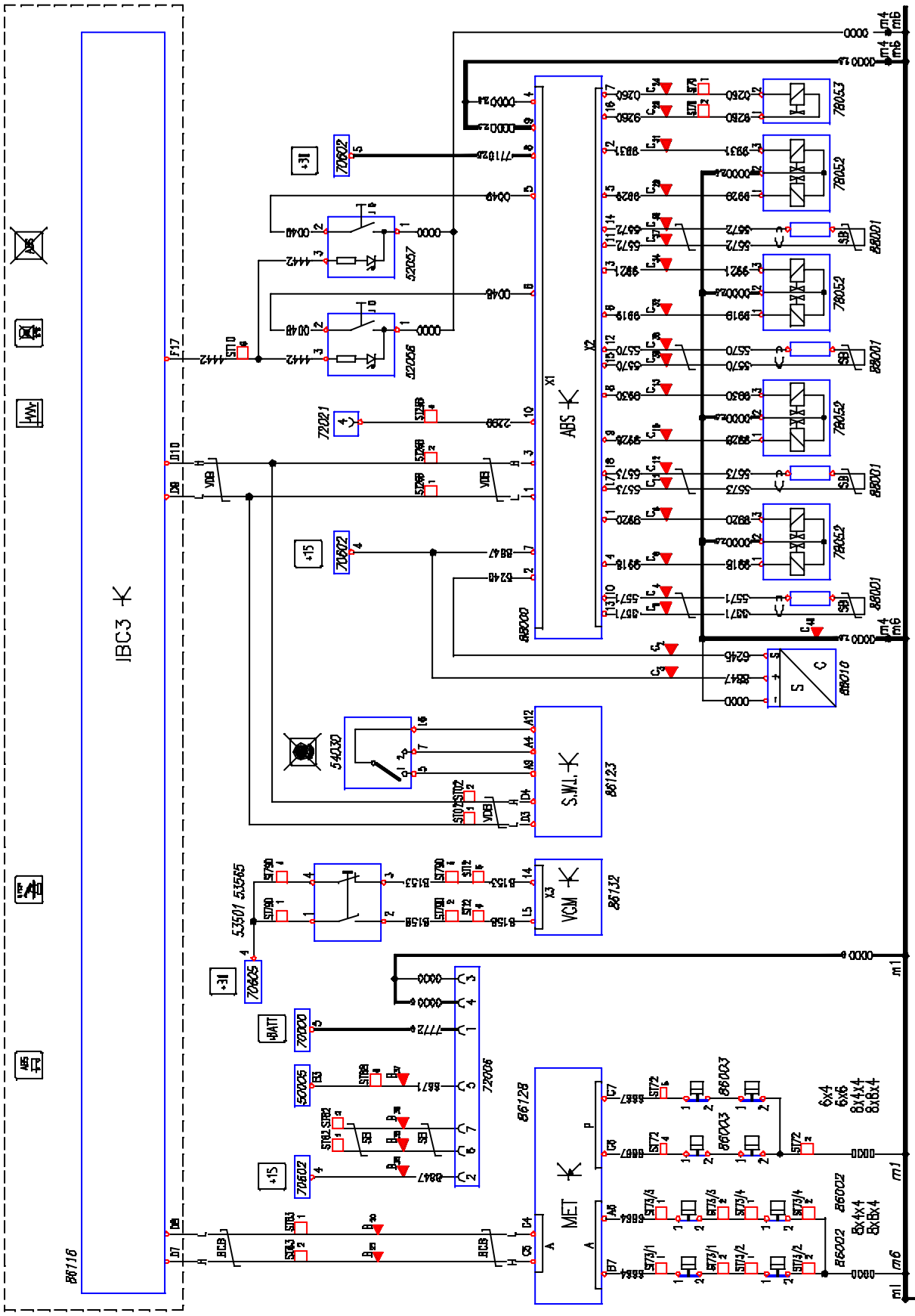

Aquila Trucks Centres

## Chart 32: ECAS 4X2P/4X4P/6X4P/8X4X4P (LORRY)



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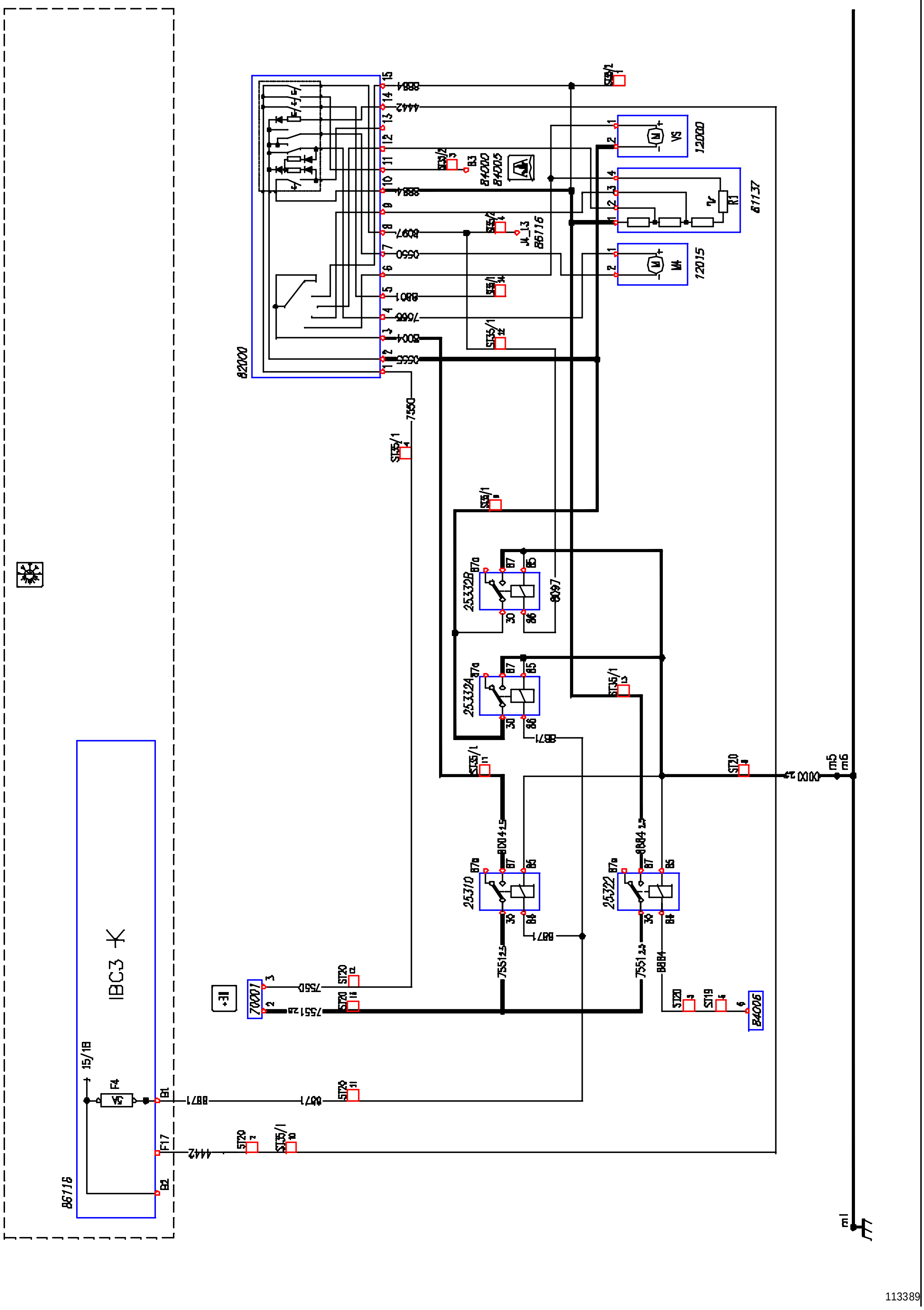
## Chart 33: ABS




113388

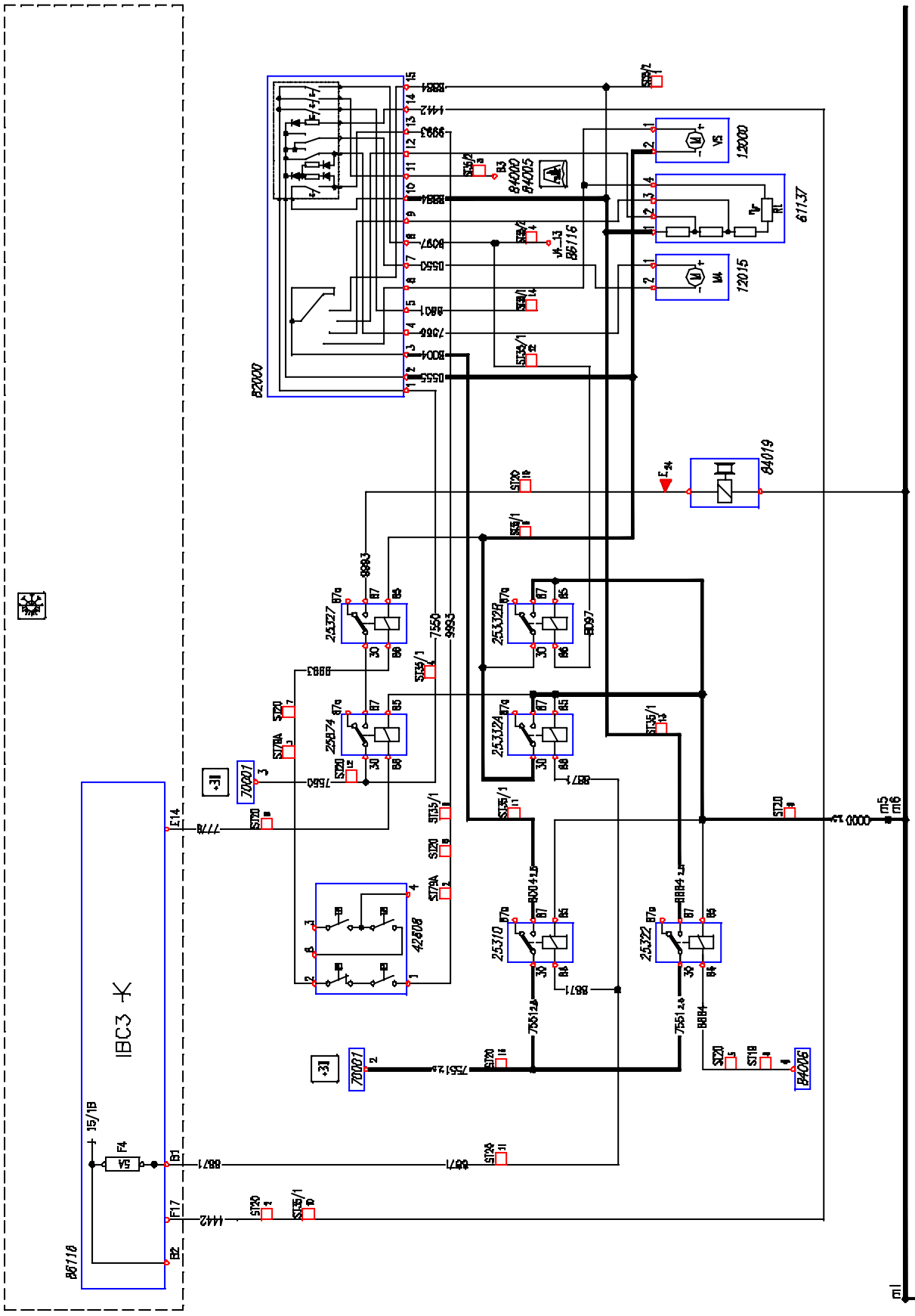
Aquila Trucks Centres

## Chart 34: Ventilation



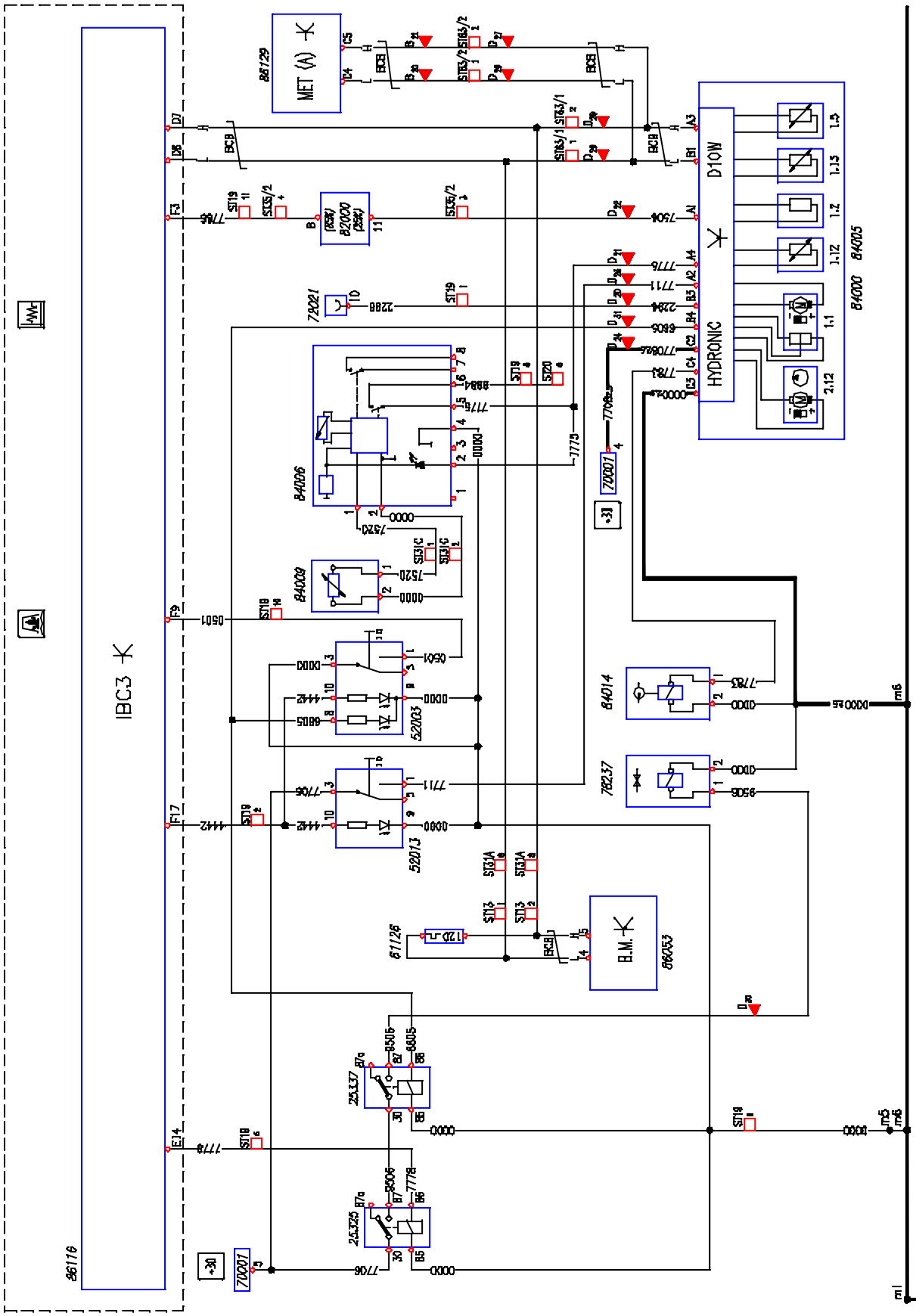
https://truckmanualshub.com/
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## Chart 35: Manually controlled climate control system



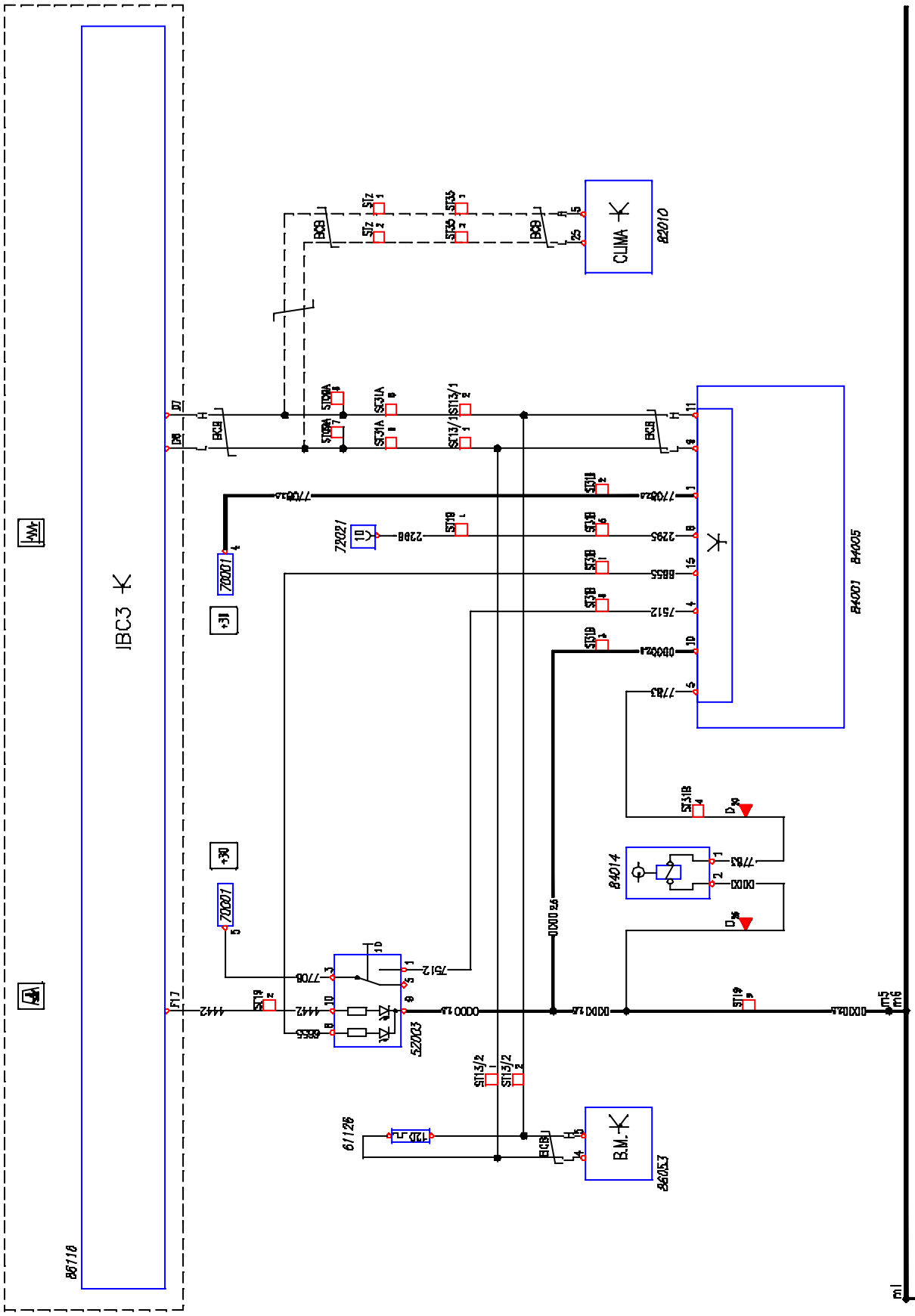
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## Chart 36: Manually controlled additional water heater



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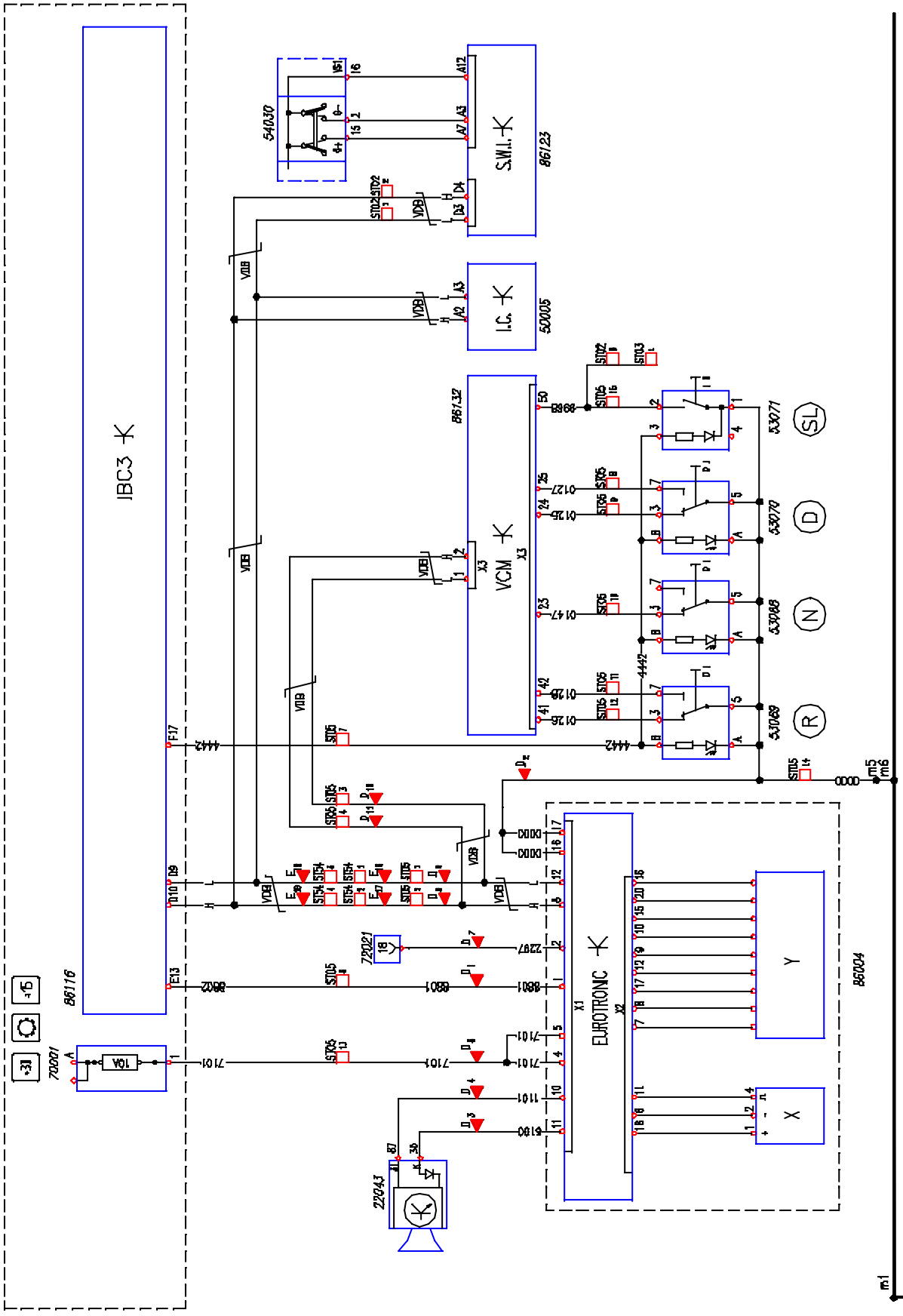
## Chart 37: Manually controlled additional air heater




113392

Aquila Trucks Centres

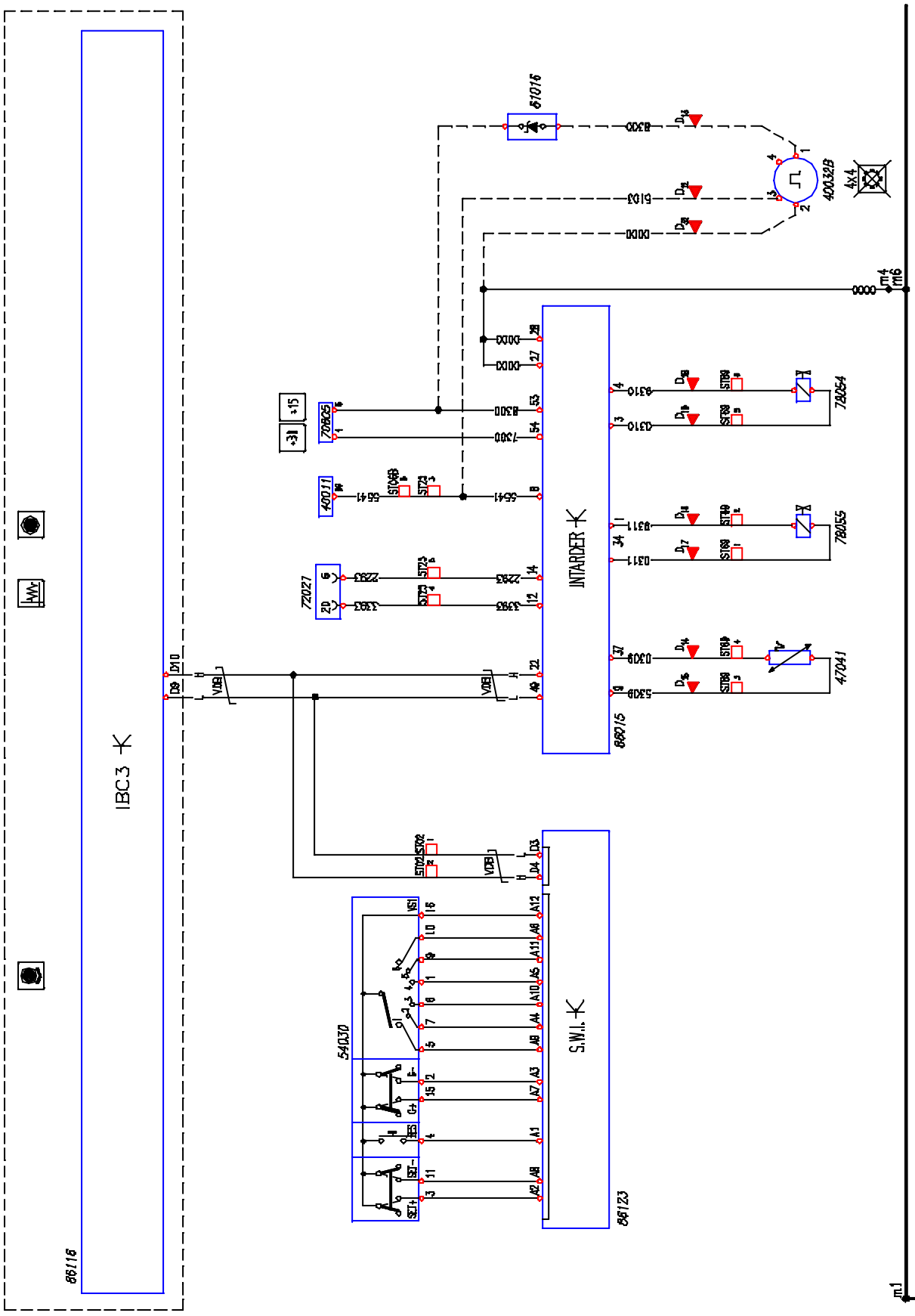
## Chart 38: EuroTronic II




113579

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Aquila Trucks Centres

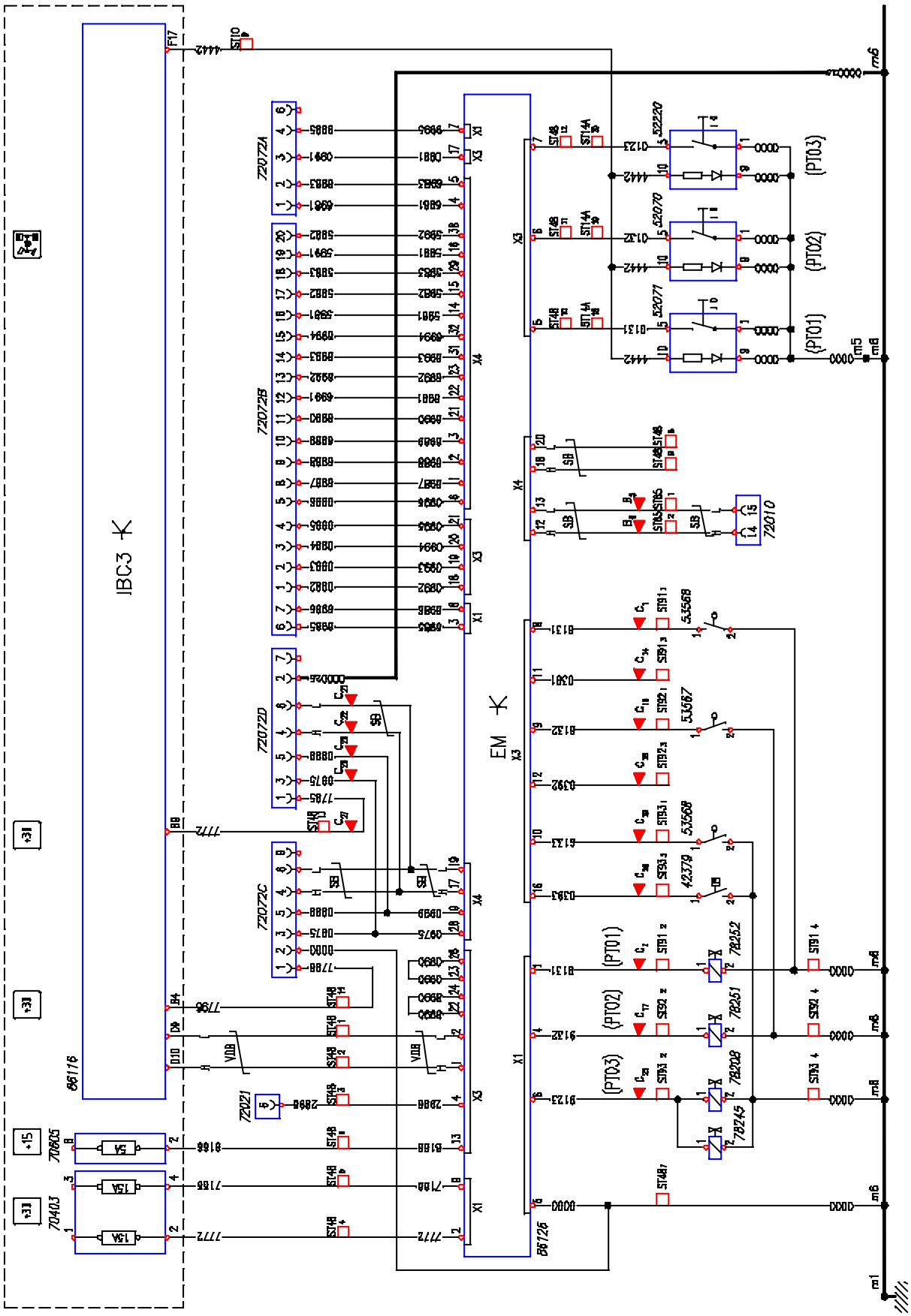
## Chart 39: Retarder ZF



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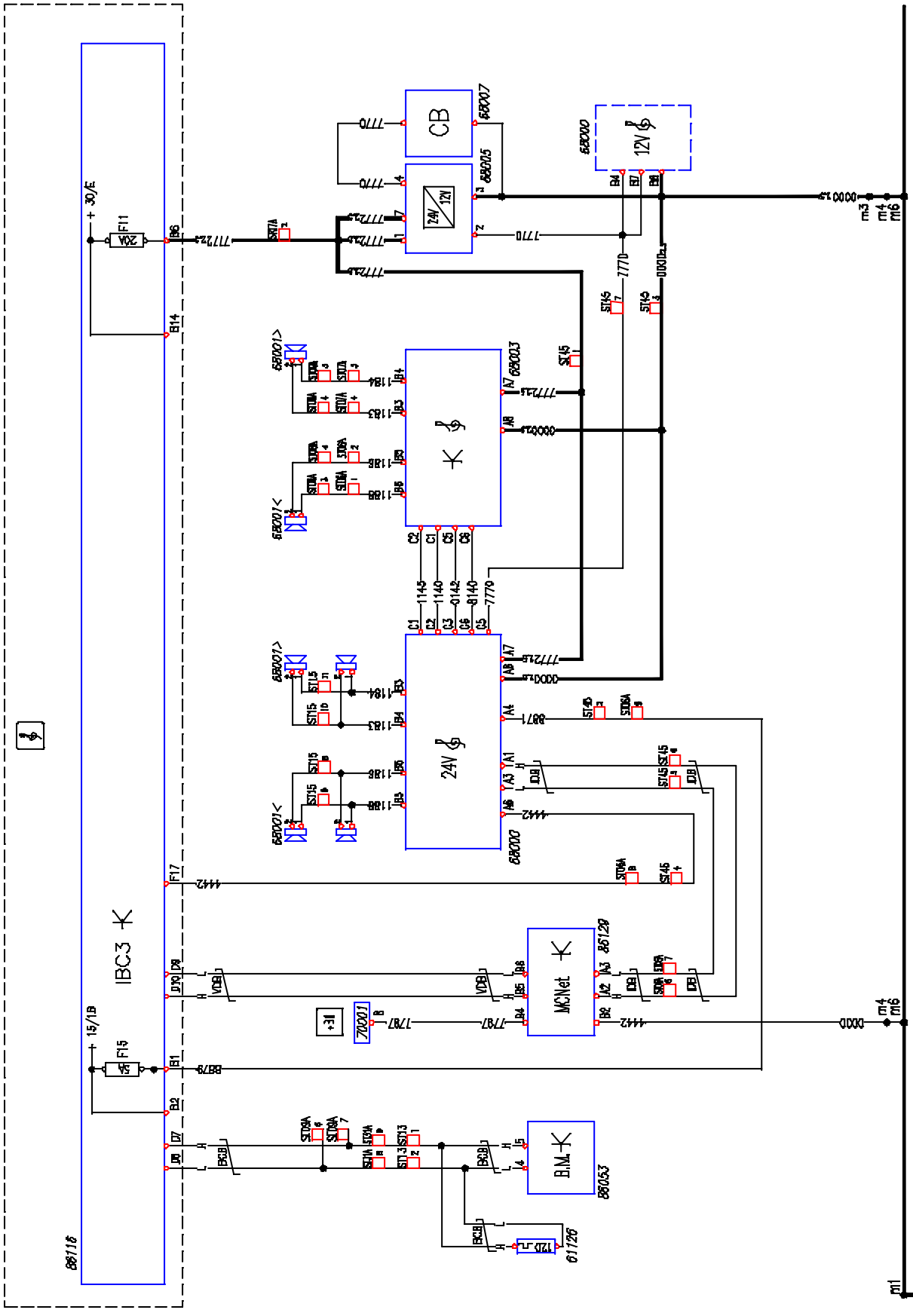

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## Chart 40: Control unit EM (PTO)



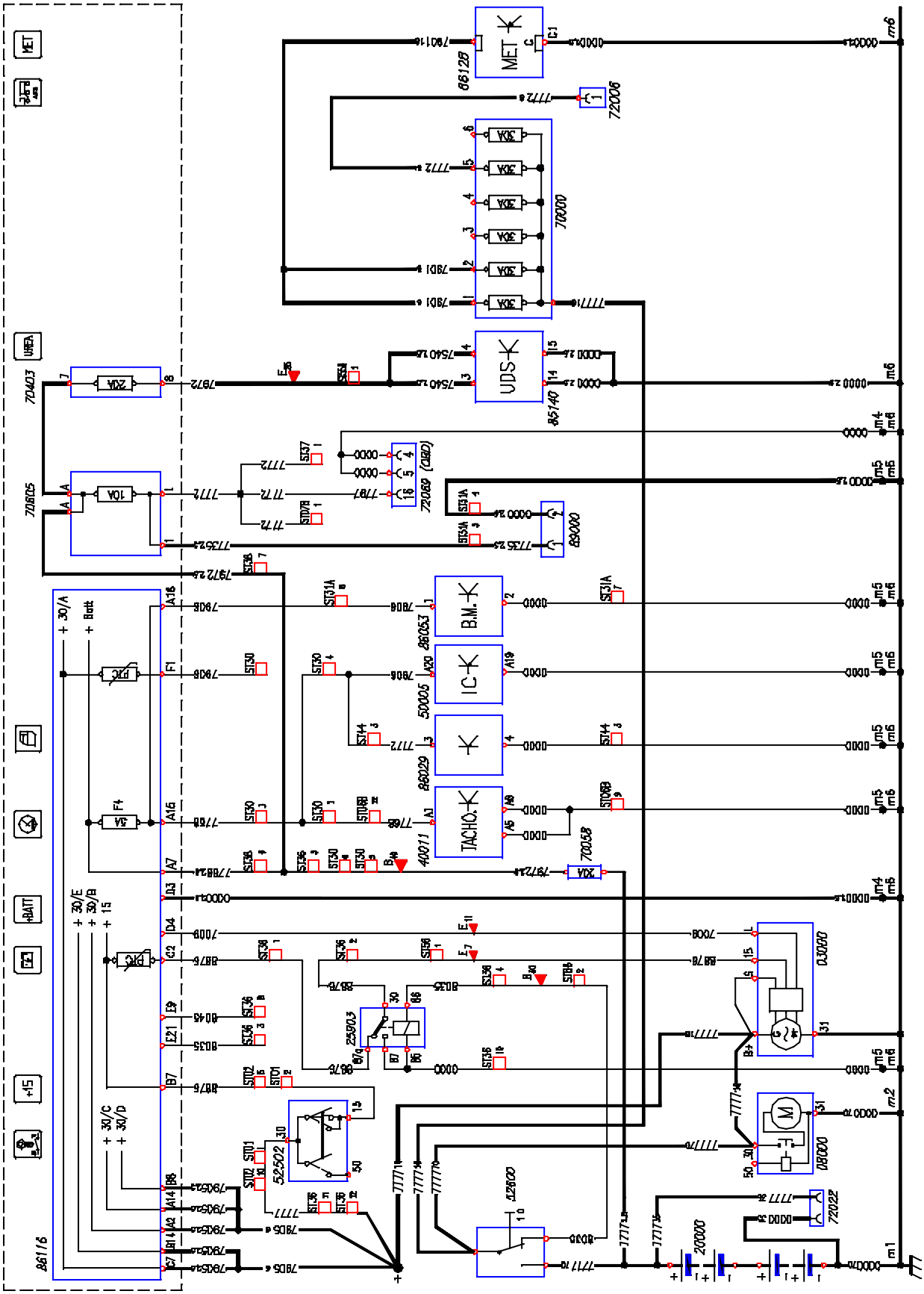
Aquila Trucks Centres

## Chart 41: Radio receiver



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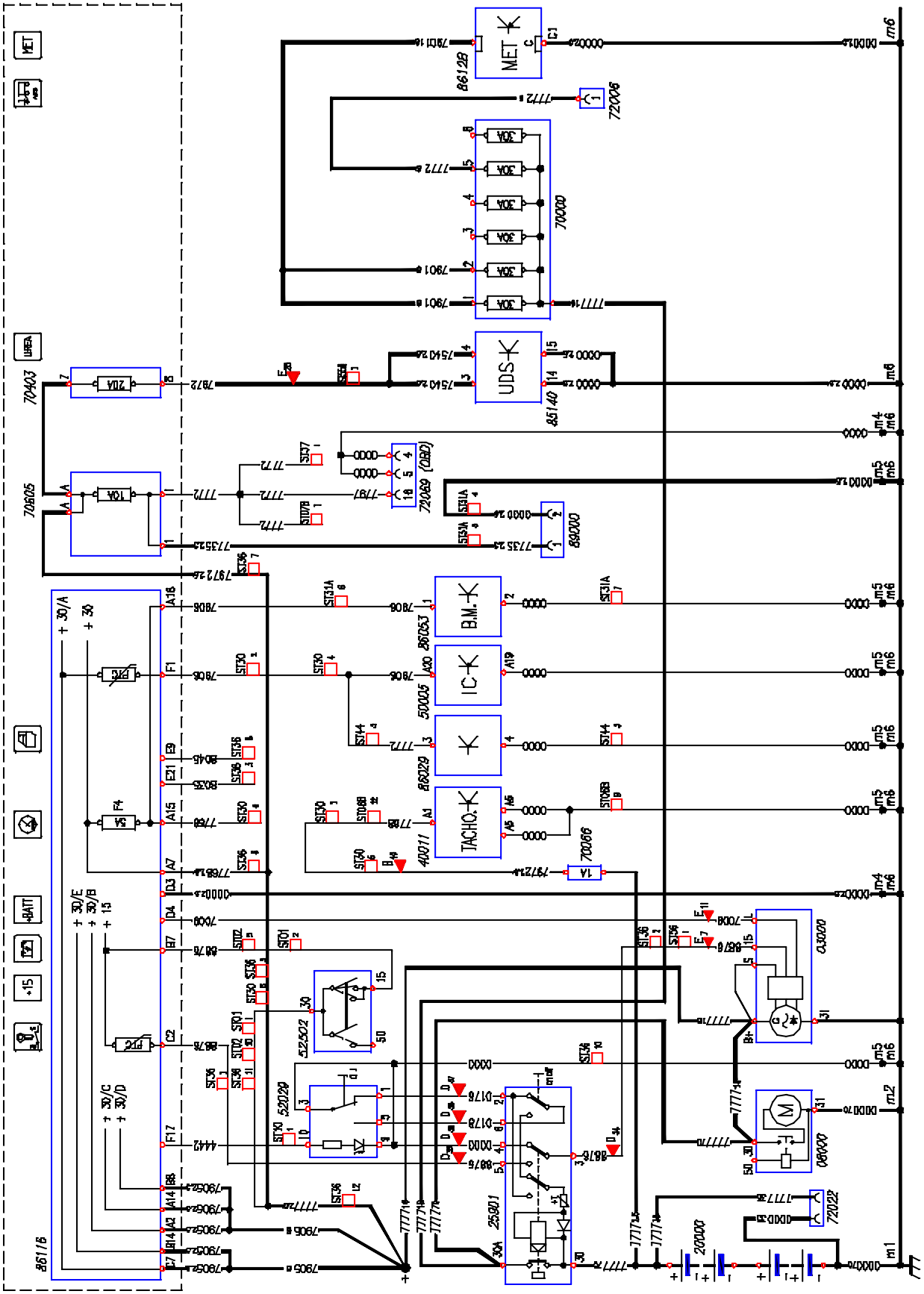
## Chart 42: General mechanical power switch (IGC)




113397

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## Chart 43: ADR (2001)




113398

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## Chart 44: ADR (OPT. 0129)

