

Shop Manual MT 26/31

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0 General

0.1 Introduction

This Shop Manual is an aid for planning and performing quality repairs of your dumper truck, and giving the service personnel information to obtain good overall knowledge on the dumper truck.
This manual will also serve as a useful reference for other personnel involved in the service of the dump truck.
Study, and make sure that you understand the manual and use it at every maintenance task you are going to accomplish.
When using this manual, always have the Operation and Maintenance Manual at hand for references, and be familiar with both manuals

0.1.1 Important information on Industrial Safety

Generally, the persons maintaining MOXY products are responsible for their own safety.
The observation of all valid safety regulations and legal impositions is the pre-condition for avoiding damage to persons and to the product during maintenance and repair works.
Persons performing repair works must familiarize themselves with these regulations.
The proper repair of MOXY-products requires the employment of suitably trained and skilled personnel.
The mechanic is obliged to perform the training.



WARNING!_____

Symbols like this followed by a written warning serves as an attention to special working procedures where care must be taken not to cause injury to people, or damage to equipment !

Caution
Illustrations do not always represent the original equipment, just the working procedure is shown.
The illustrations are not always drawn to scale, and conclusions regarding size and weight must not be drawn (not even within one representation).
The tasks must be performed according to the description.

0.2 Workshop Safety

Purpose
This section is intended as general information about dangers of various types of workshop activities.

Follow the workshop manual
This shop manual provides instructions for work methods and equipment that reduces the risk of accidents.

Mechanical skill
This is a very important factor. The Moxy-mechanic is skilled and well trained for his job.
Without these qualities, risks are much greater and more difficult to anticipate.

Common sense
This characteristic should form the basis of activities in the workshop.
Negligence and carelessness cannot be allowed.

Work with a safety margin
Always expect that something can go wrong during the work.
Always work with a safety margin where there are risks.

Legislation and local rules
In most countries there are legislation and local practices that apply to safety at work. Follow them at all times.

Warnings (parts or packages)
Always read and follow warnings and instructions.
Do not trust your own knowledge of the risks. The properties of a part or the chemical composition of a product could have been changed during transit.

You have to know where the risks are
In this way you can avoid them. In many cases, risks are so obvious that you do not have to search for them, e.g. carbon monoxide - true it is invisible, but you know that it is lethal. Therefore protect yourself.

The hidden dangers
Dangers are found in all work environments and the most serious danger is in not being aware of them.

The three demands of safety

* **Knowledge**: You have to know your job and also where the risks are.

* **Apprehension**: You must be aware that you are exposed to risks.

* **Caution**: You have to protect yourself, do not take chances.

0.2.1 Incidents are warning signals

An incident is an unforeseen event without injury or damage.
The next time the consequence of the same event may be worse.
An incident demonstrates that there is a risk. Every incident must be taken as a warning signal - exactly as if there had been an accident or someone had been taken ill.
Look out
Do not trust others to point out the hazards. It is difficult to remember all pointers and exhortations. New and unexpected risks may also occur.

Therefore; look out!
As a guide, a number of examples follow. They are not to be regarded as a comprehensive listing.

0.2.2 Vibrations



When using vibrating tools e.g. chisel hammer, impact drill, impact nut runner, grinder injuries may be sustained by transition of tool vibrations to the hands.

Risks
Vibrations may cause vascular spasms (prickling and pain) in the surface veins. The fingers turn white, cold and senseless. Also nerves, muscles, bones, sinews and joints may be injured.

The risk of injury is believed to increase by smoking and also by low temperatures e.g. if the tools are cold or if the hands are exposed to chilling air.



The injuries become apparent especially when the fingers are cold, often when not working.
Vibration injuries are curable if taken care of in time.

Protective measures
Use heavy gloves. Gloves provide some protection against vibrations and low temperatures.
Alternate between vibration-free and vibrating jobs to provide the body with a possibility to rest from vibrations. By varying the work posture and grips, the body is not one-sidedly exposed to vibrations.
Avoid smoking before and during the work to help the blood circulation as much as possible. If you notice any signs of vibration injury consult a doctor.



Protection against vibration
• Heavy gloves
• Alternate jobs
• Do not smoke before and during the work

0.2.3 Injurious Noise



Rule of thumb: Noise that is louder than 85 dB (A) and that prevails for more than 8 hours is classed as injurious. (Some countries have other limits.) High frequency noise (high-pitched) is more injurious than low frequency noise (low-pitched) of the same amplitude.

Risks
Partial deafness, in difficult cases impaired hearing beyond cure. It is impossible to train your tolerance to noise. You may believe that you are doing that if you notice less of the noise after some time.
IN THAT CASE YOU ARE REALLY IN DANGER.
Probably your sense of hearing is already impaired.



Protective measures
With noise absorbers on roof and walls and screens between work places it is easier to limit the propagation of noise. Against injurious noise you have to protect yourself with ear muffs. Ear muffs must be tested and approved.

Protection against noise:
• Use ear muff

0.2.4 Organic Solvents

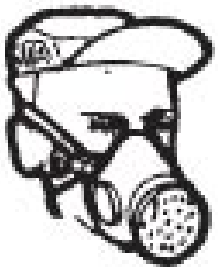
Organic solvents are mixtures of organic liquids (different from e.g. water) that dissolve grease, paint, varnish, wax, oil, glue, rubber etc.



Examples:
- Petroleum spirit
- Toluene
- Trichlore ethylene
- Thinner
- Petrol
- Alcohols
- Xylen
- Plastics and appertaining glues

Risks
Solvents release fumes. Fumes may cause dizziness, loss of balance, headache and nausea. Fumes may also irritate the windpipe.
Solvent exposure may also lead to injury to the central nervous system. This may result in insomnia, depressions, nervousness, poor memory and a general sense of feeling tired.
When solvents come in direct contact with the skin, it will become dry and cracked. The risk of skin allergies increases and, additionally, there is a risk of a solvent causing dermatitis.
Many solvents are flammable.

Protective measures
As a first measure, arrange for ventilation that prevents fumes from mixing with the air you breath. Note that the ventilation has to be fire-proof if a solvent is flammable.
If a problem cannot be resolved with ventilation it is necessary to wear either a face mask or breathing protector with filter against dust and organic fumes.
Never leave tins with paint or solvent uncovered.
Use solvent with low content of aromatics. This reduces the risk.
Ensure that solvents do not come into contact with the skin and do not use them as detergent.
Use gloves when working. Gloves of certain materials can be penetrated by the solvent or even dissolved by such solvents. Make certain that the gloves give sufficient protection.



Protection against organic solvents:
- Fireproof ventilation
- Face mask or breathing protection with filter
- Replace caps/lids
- Use as harmless solvents as possible
- Avoid contact with the skin
- Do not wash the skin with solvent
- Use gloves

0.2.5 Coolant

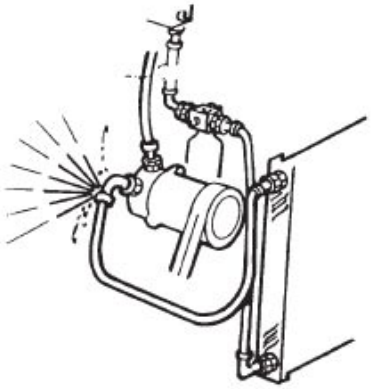
Coolant is used in the engine cooling system.



Risks
The cooling system is pressurized when hot.
Coolant that leaks or bursts out may cause scalding. Coolant consists of water and corrosion inhibitor, and if necessary, anti-freeze. The anti-freeze may consist of ethylene glycol.
Ethylene glycol and corrosion inhibitor are injurious and dangerous to consume. Splashes in the eyes are dangerous and, in contact with the skin, such substances can penetrate and cause dermatitis. Coolant may also consist of other mixtures that may imply other risks.



Protective measures
If possible, avoid working with coolant lines and containers when coolant is still hot. Remove the filler cap carefully to release the pressure. Hot steam and coolant may burst out.If there is a risk of splashing you must use rubber gloves and protective goggles. Change clothes if coolant has splashed on them. Contact with the skin may be dangerous.
Use special equipment for draining and filling e.g.a. cart with container and pump. It is not permitted to dump coolant in sewer systems or on the ground.



Protection against coolant
- Preferably wait until coolant has become cold
- Remove filler cap carefully
- Use rubber gloves and protective goggles
- Use special equipment for draining and filling

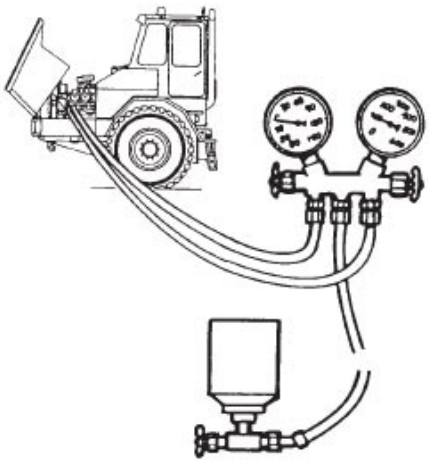
0.2.6 Refrigerant

Refrigerants are used in various thermal equipment e.g. the air conditioning.

Risks
Refrigeration equipment operates under pressure. A refrigerant that is leaking may cause frost-bite.
A refrigerant that is leaking and exposed to heat e.g. by a welding flame or cigarette, evaporates and is very dangerous to breath.



Protective measures
Always use special equipment when draining or filling refrigeration equipment. This reduces the risk of leakage. Do not loosen connections on refrigeration equipment without first draining the system or reducing the pressure. Avoid welding and smoking when carrying out work that implies a risk of leakage.
Leaking refrigerant is not noticed as the gas is practically odourless. The gas is heavier than air and therefore a portable air evacuator at floor level is suitable.



Protection against refrigerant
- Use special equipment for draining and filling
- Drain system before loosening connections
- Avoid smoking and naked flame
- Use portable air ventilator

0.2.7 Air Pollution

Examples:
- Carbon monoxide present in exhaust fumes
- Nitric oxide - present in exhaust fumes
- Welding fumes, especially from galvanized or painted metals.
- Oil mist (e.g. in anti-corrosion treatment)
- Sulphuric acid mist (e.g. when charging batteries)
- Grinding dust and fumes formed when grinding and heating plastic, varnish, anti-corrosive, lubricants, paint etc.

Risks
Carbon monoxide reduces the ability of the blood to supply the brain and other parts of the body with oxygen.
Carbon monoxide poisoning = “Internal asphyxiation”.
Nitric oxides and gases and the fumes from plastic, varnish, anti-corrosive, lubricants, paint etc. may damage the lungs.
Oil mist from certain oils may cause skin problems such as blemishes, boils and eczema.
Sulphuric acid mist is erosive and may damage the windpipe.

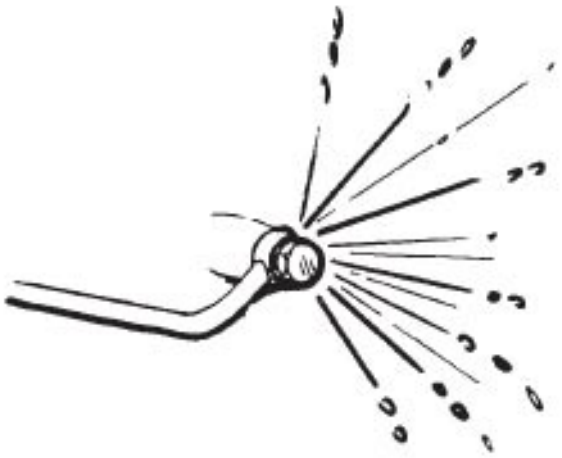


Protective measures
Avoid running engine indoors. Immediately attach evacuation equipment to the exhaust pipe if an engine has to be kept running indoors.
Also parking heaters admit exhaust fumes when in operation (portable air evacuator is suitable).
Use plastic gloves and breathing protection if there is a risk of oil mist (e.g. anti-corrosion treatment). Before start of work, treat unprotected skin with protective cream that does not dissolve in oil.
Ensure that the ventilation is satisfactory where you weld, charge batteries or apply anti-corrosives.
If necessary, also complemented with portable air evacuator.
When working with eroding substances (e.g. when charging batteries) there must be a possibility for rinsing the eyes.

Protection against air pollution
- Ventilate properly. Use portable air evacuator when welding.
- Preferably avoid running engines indoors.
- Use evacuation equipment if engines have to be run indoors.
- Use protective gloves and breathing protection if there is a risk of oil mist.
- Avoid contact with the skin.
- Ensure that there are facilities to rinse the eyes when working with eroding substances.

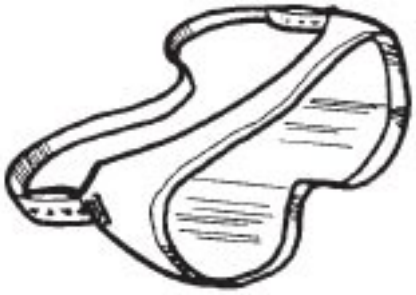
0.2.7 Liquid Or Gas Under High Pressure

Risks
There are risks, for instance, when working with:
- Fuel system
- Hydraulic system
- Brake system
- Compressed air



Dangerous - in what way?
- Spray can penetrate the skin and cause serious tissue injury
- Eyes may sustain serious injury
- Many substances may cause poisoning
- Air and other gases blown into the rectum may cause serious, sometimes fatal injuries
- Leak testing or test pressurizing with compressed air or other gas may cause explosion

Protective measure
Do not work with pressure in the system unnecessarily. First stop the pump and release remaining pressure carefully.
Use goggles. Gloves are preferred.
Never use compressed air or other gas to blow dirt from the clothes.
Use liquid for testing leaks (of e.g. oil cooler).



Protection against gas and liquid under pressure
- Use goggles and gloves.
- Do not work with pressure in the system if not absolutely necessary.
- Be careful when handling compressed air.

Pipes etc. may become damaged when working and liquid or gas may burst out. Liquid or gas may also burst out when loosening a connection.
High pressure may remain in the system even if a pump has stopped.
Gas containers for e.g. welding gases may explode if exposed to rough handling e.g. when dropped on a hard surface.
Valves may be damaged and gas leak out if a gas tube is dropped.



0.2.8 Fire And Explosion Risks

Examples of flammable and explosive substances are:



- Oil
- Petrol
- Diesel fuel
- Organic solvents (varnish, plastic, detergents)
- Anti-corrosive
- Acetylene and other gas for welding and heating

Actions causing fire and explosions:

- Welding, cutting
- Smoking
- Machine grinding
- Sparks caused by static electricity or electric equipment
- Heat generated in waste and rags soaked with certain types of oil and paint (linseed oil)
- Oxygen increases the risk of ignition. Containers, pipes and valves for oxygen therefore have to be free of oil and grease



Special cases:

- Battery charging
  When charging batteries the water content in the battery acid is split into oxygen and hydrogen. This makes a gas mixture that is very explosive.
  The risk is especially acute when using an auxiliary battery or a speed charging unit.
- Diesel fuel
  The flash point may have been lowered by mixing with petrol. Such a mixture is then explosive in normal room temperature
  If diesel fuel is heated it is more explosive than petrol.



Protection against fire and explosion

- Store dangerous substances in approved con ainers and ensure that it is closed.
- Keep ignition sources removed from or completely screened from the dangerous substances.
- Ventilation, evacuation.

0.2.9 Asbestos



The dust that is emitted by brake and clutch linings partly consists of asbestos fibres.

Risks
Asbestos dust that is inhaled may cause lung diseases and cancer in various organs. The risk of contracting lung cancer is considerably more acute for people who smoke. This risk remains many years after giving up smoking.

Protective measures
Bind the dust with water before starting to work with brakes and clutches. Wash brake and clutch parts with water or clean with special vacuum cleaner.
Never blow off with compressed air.
Use breathing protection with suitable dust filter.
A simple paper mask does not suffice.

Protection against asbestos
- Clean with water or special vacuum cleaner
- Use breathing protection



0.2.10 Lead

The dust that is formed when grinding lead filler and certain paints that contains lead.

Risks
Lead may be absorbed by the blood by skin contact and cause poisoning.

Protection against lead
- Avoid contact with the skin and inhaling.
- Use gloves, breathing protection and face mask.

0.2.11 Jacked Up Vehicle Or Bodywork

Risks
Mechanical or hydraulic lifting equipment may topple and could also be lowered because of incorrect handling or interference.
Falling objects may also cause crushing.

Protective measures
Do not crawl underneath a vehicle that is jacked up without securely supported.
Check that the supporting surface is firm and level and use stands.



0.2.12 Heavy Objects

Risks
- Dropping a unit or letting it fall from a lifting device may cause both injury and damage.
- Unsuitable lifting device may break or cause unit to slip.

Protective measures
- Use lifting equipment.
- Ask for help, if needed.
- Use special equipment for handling wheels.
- Use purpose adapted lifting straps and leve blocks for lifting engine, transmission etc.
- Use stand with automatic locking (self-locking screw or brakes).

0.2.13 Protection Against Damage And Injury

When Handling Heavy Units By Hand

- Keep in mind the balance of the unit.
- Ask for help, when needed.
- If you have to lift alone:
  - Object near body
  - Bend your knees, not your back
  - Do not twist your body when lifting.

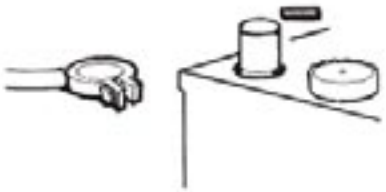
0.2.13 More than one person working on the same Vehicle

If more than one person is working on the same vehicle, involuntary movements could injure another person.

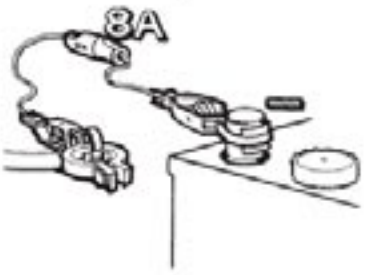


Protect others who work on the same vehicle
- Be aware of the risks.
- Warn those who work on the same vehicle or in its vicinity.
- Do not start working with more than one drive wheel at the same time until the half shaft has been removed.

0.2.14 Involuntary Start of Electric Equipment



Protective measures
Disconnect the battery main switch, or remove the negative (-) cable from the battery.
If power is needed from the electric system, connect a line fuse (8A) between the battery terminal and the cable clamp.
This precaution also reduces the risk of burns and fires caused by battery power.



0.2.15 Rotating Parts

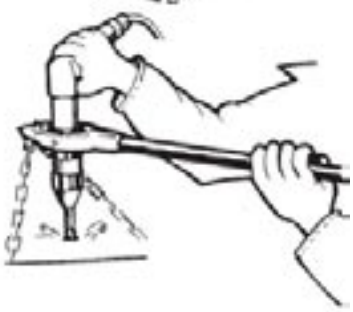
- Cooling fan
- Belts
- Injection pump coupling
- Propeller shaft
- Drills,and other machines with rotating parts.



Risks
Rotating parts may cause injury when touched.
Rotating parts may also cause a serious accident by catching clothes, gloves or long hair.
Even a completely smooth shaft may be dangerous.
When drilling large holes with a hand drilling machine, it can be turned out of your hands and begin to spin around. It may carry on spinning until its cable is torn off.



Protection against injuries from rotating parts
- Never use gloves when drilling.
- Never wear loosely hanging scarf or tie.
- Do not wear wide clothes.
- Ensure that your clothes are intact.
- Collect loose hair under a hair net.
- Do not wear rings or bracelets.
- Use hand drilling machine with long lever whe suitable.



0.2.16 Splinters, Flying Object When Using Certain Tools

Risks
Burr loosens from drift or chisel.
Hammer head loosens from handle.
Flying objects when using grinder, cutting discs etc.



Protective measures
Use goggles. Gloves are preferred.

0.2.17 Springs Under Load

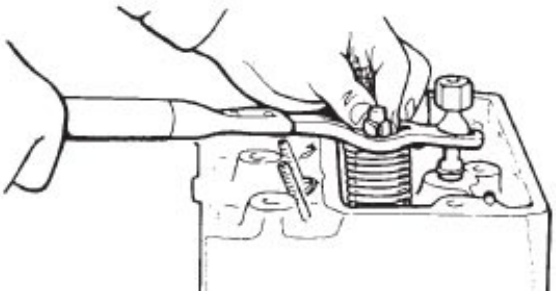
- Balancing springs for bonnets etc.
- Parking brake activator
- Retaining rings
- Valve springs

Risks
By loosing the grip a spring and flying parts may cause injury.
Even small springs and retaining rings are dangerous as they could injure the eyes.
The parking brake activator springs are under high compression and may cause very serious injury.
Also gas springs and absorbers may be under high load and are dangerous in the same way as “normal” springs.
Also scrapped gas springs and absorbers may be dangerous to handle.



Protective measures
Small springs and retaining rings
Retaining ring pliers must be of suitable type and size and in good condition. Remember that even small springs may be dangerous.
Use protective goggles.

Heavy springs
Always use recommended tools and safety devices. Follow the instructions in the work descriptions.



0.2.18 Tyres and Wheels

Handling of tyres and rims demand special equipment and trained personnel, if such not present on the premises, leave this to a tyre shop.

0.2.19 Precautions for Disassembly and Assembly Operations

Disassembly
Before attempting to disassemble, determine the cause of the trouble by systematically checking and analysing the symptoms. Needless disassembly will not only hinder troubleshooting, but will also result in losses through unnecessary replacement of parts and man-hour costs.

During disassembly, carefully check every sliding part for any sign of seizing, interference or contact, since these may reveal hidden faults which could be the actual cause of the trouble.

Unless major disassembly, based on definite reason is to be made, the related parts should be first briefly inspected, and disassembly started after confidence in the operation is established.

Thoroughly clean the part of the machine to be disassembled, before attempting to disassemble.

Proceed with the disassembly by confirming the fitting conditions of the relative parts; their position fore and-aft, left-and-right and upper-and-lower, and the proper sequence of their removal.

When draining lubricating oils, take note of their viscosity, color and state of contamination. Observation of used oils often provides clues to the wear condition of the lubricated parts (specially whit regard to gears and bearings).

Put match marks across mating joints where required before separating parts. The parts should be clearly marked to prevent confusion at the time of assembly.

For disassembly of certain parts, only use the special tools prescribed for this purpose.

When a part, after removal of fastening nuts and bolts, is still found to be unremovable, never force the parts; but carefully check for the cause of the tightness.

When looseness exists between force-fitted or taper-fitted, parts, check both of the mating surfaces for damage or wear. Repair or replace the part(s))))))) if necessary.

When removing a control-link assembly, be careful to maintain the original adjustment of the length of the rods unless any readjustment is necessary. Check the original length of each rod and record it before removal of the link assembly if it is necessary to remove the rod-end for disassembly.

Wash disassembled parts clean, neatly arrange the parts for each assembly, and keep in storage, free from dust and dirt. Use two vessels filled with detergent oil, one for washing dirty parts and two for rinsing them.

Keep each set of shims stacked in its original arrangement so that the same clearances as before disassembly can be obtained when the machine is reassembled.

Assembly
Thoroughly clean all parts before assembly. Wash clean those parts relating to the drive line. Also, check for scratches and nicks on the surfaces of the parts and repair, if any. Wash new parts to remove rust preventives, if coated, before assembly. Use triclorethylene or diesel fuel.

Employ a press or a driving tool when assembling bearings, bushings and oil seals. When installing a bearing, pay attention to keep the marking on the bearing facing outward, unless it is necessary to install otherwise because of the construction
(this permits easy identifying of the bearing installed).

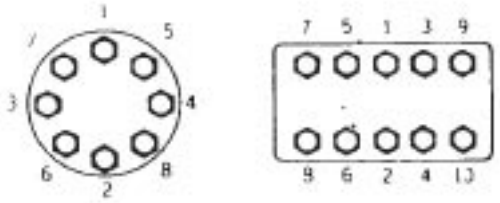
Be sure to positively lock bolts and nuts which are usually invisible from the outside or used for some important parts that require locking, by the use of wires, cotter pins or lockwasher.

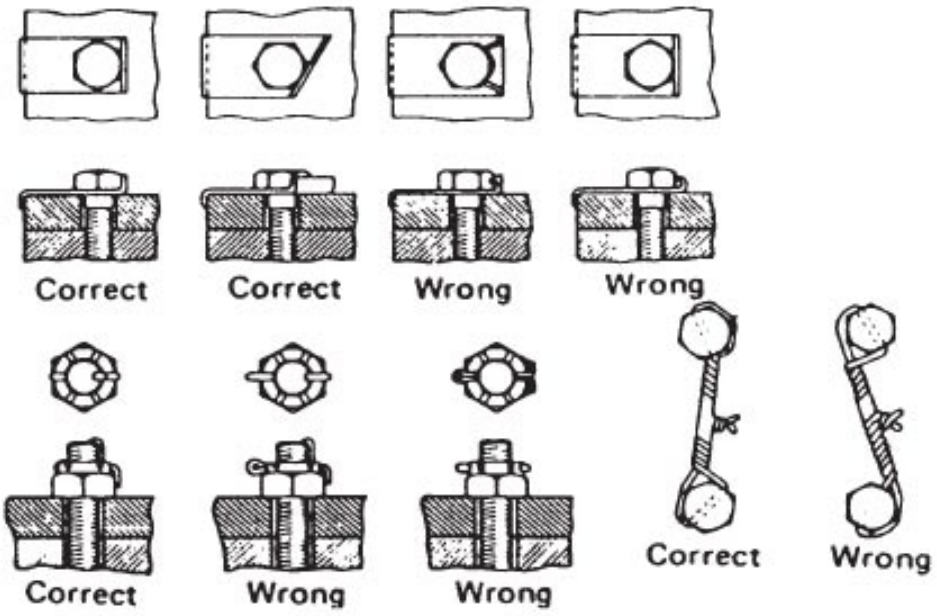
Be sure to tighten each bolt to the specified torque with a suitable torque wrench. Apply an even tightening force to the bolts by screwing them alternately or in a crisscross fashion.

Apply thread locking (see table for sealing/locking
compounds) to important bolts. Prior to coating with sealing or locking compound, wash the bolt with light oil/ trichlorethylene or other fluid recommended by the manufacturer.

Tighten bolts in the prescribed sequence figures evenly to the specified torque.

- **Be careful not to tighten bolts excessively.** *See next page for recommended values!*
- **Be sure to align match marks if provided.**
- **Keep the working area, tools, worker's hands, etc. clean during assembly operation.**
- Coat the surfaces of parts to be press-fitted wit Molykote grease.





0.2.19.1 Types of sealing-/locking Compounds and Lubricants used during Assembly

Loctite 242/243 ..... Middle strength (for locking of screws, bolts and nuts).

Loctite 270/2701 ..... High strength (for locking of screws, bolts and nuts).

Tree bond 1374.....High strength (for locking of screws, bolts and nuts).

Loctite 603 ..... High strength (for locking of bearings bushings, etc.).

Loctite 638 ..... Extra high strength (for locking of bearings, bushings, etc.).

Loctite 574 ..... Master gasket as liquid gasket.

Loctite 7063 ..... For cleaning of surfaces prior to lubrication or gluing.

Molycote 321R*:.....Anti-obstruction and running-in lubricant.

Würth 210/Loctite 8201 .....Anti-corrosion spray for electrical wires and components.

0.2.19.2 Torque limits for screws

TORQUE LIMITS FOR SCREWS (IN Nm) ACCORDING TO ZF - STANDARDS 148

Friction value: μ total= 0,12 for screws and nuts **without** after treatment as well as **phosphatized** nuts. **Tightening by hand!** Torque limits, if not especially indicated, can be taken from the following list:

Metric ISO Standard thread

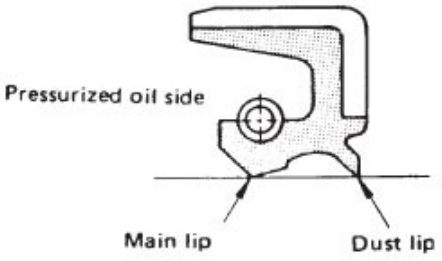
Size	8.8	10.9	12.9
M4	2,8	4,1	4,8
M5	5,5	8,1	9,5
M6	9,5	14	16,5
M7	15	23	28
M8	23	34	40
M10	46	68	79
M12	79	115	135
M14	125	185	215
M16	195	280	330
M18	280	390	460
M20	390	560	650
M22	530	750	880
M24	670	960	1100
M27	1000	1400	1650
M30	1350	1900	2250
M33	1850	2600	3000
M36	2350	3300	3900
M39	3000	4300	5100

Metric ISO Fine thread

Size	8.8	10.9	12.9
M 8 x 1	24	36	43
M 9 x 1	36	53	62
M 10 x 1	52	76	89
M 10 x 1,25	49	72	84
M 12 x 1,25	87	125	150
M 12 x 1,5	83	120	145
M 14 x 1,5	135	200	235
M 16 x 1,5	205	300	360
M 18 x 1,5	310	440	520
M 18 x 2	290	420	490
M 20 x 1,5	430	620	720
M 22 x 1,5	580	820	960
M 24 x 1,5	760	1100	1250
M 24 x 2	730	1050	1200
M 27 x 1,5	1100	1600	1850
M 27 x 2	1050	1500	1800
M 30 x 1,5	1550	2200	2550
M 30 x 2	1500	2100	2500
M33 x 1,5	2050	2900	3400
M 33 x 2	2000	2800	3300
M 36 x 1,5	2700	3800	4450
M 36 x 3	2500	3500	4100
M 39 x 1,5	3450	4900	5700
M 39 x 3	3200	4600	5300

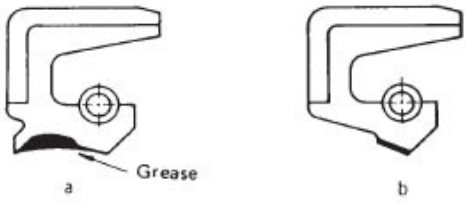
0.2.20 Handling of Oil Seals

Be careful to install an oil seal with its lips in the right direction as shown below.
Before installing an oil seal, coat it with grease to prevent dry-friction, which may occur during the break-in operation of the machine, according to the following procedure:



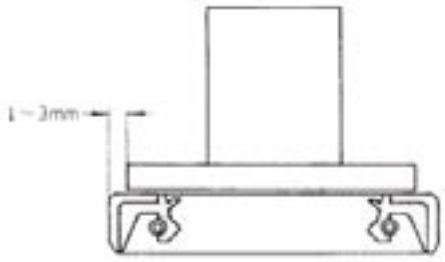
a) In case of a double-lip type, uniformly coat the surface of the groove around the lip with grease.

b) In case of a single-lip type, uniformly and evenly coat the surface surrounding the lip on the opposite side of the sealing surface of lip.

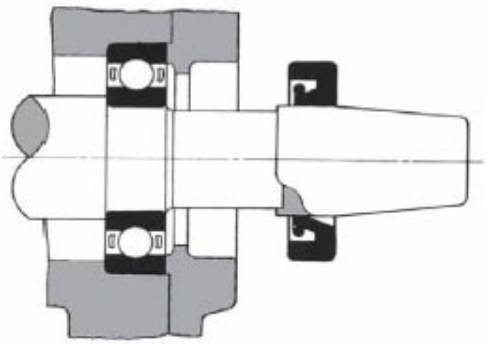


Apply the lube oil or grease to the surface an chamfered edge of the shaft on which the oil seal is to be installed, so that the shaft may b smoothly inserted into the oil seal without pinching the lip and that a proper lubrication of the shaft during the break-in period of the machine is accomplished.
Be sure to apply grease only by the fingers. Restrict the amount of grease to be applied in the range of 40 to 60 percent of the vacancy formed between the lips.

When fitting an oil seal, use of a guide shown below is recommended to prevent the lips of the oil seal from being scratched or soiled with dust.
Make sure that there are no scratches and dust on the contact surface (with the shaft) of an oil seal.
Do not use any hydraulic press to fit press-fit an oil seal.
Use only a hand press and a jig. The jig should be a snap cylinder of 1 to 3 mm smaller in the outer diameter than the oil seal, and the press-fit surface of the oil seal should be free from scratches and deformation.



When installed, the oil seal should not be inclined at an angle. Press-fitted angle of an oil seal should not exceed the permissable limit of 0.2 mm/100 mm diameter.



0.2.21 Handling of Gaskets

Discard copper gaskets whenever they are disassembled.

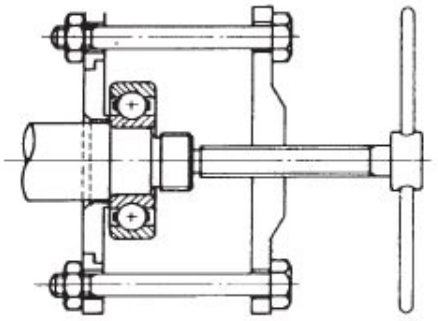
Immerse leather gaskets in oil before assembly.

Coat liquid gasket compound to the specially designated gaskets and o-rings (specified in each step). Make sure that the surface to be coated with liquid gasket is free from large scratches or any other damage. Wipe off dust, paint or oil, if any, from the surfaces to be coated with liquid gasket. Uniformly apply liquid gasket to the contact surface, and wait for a few minutes to allow drying of the gasket. When the liquid gasket becomes dry enough for the finger touch, put the gasket or o-ring in place.

0.2.22 Handling of O-ring Seals

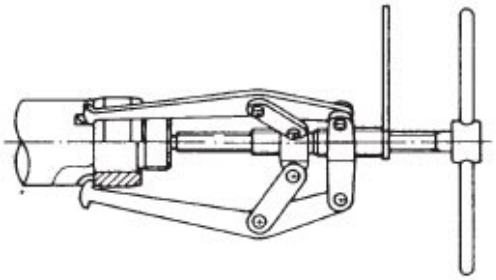
Replace a seal, if rust exists on the circumference of its contact surface.
Apply a thin coat of oil to the contact surfaces when installing a seal.
Insert the o-ring in the housing groove taking care not to twist the o-ring. An o-ring installed with a twisting condition will jump out of the groove when the seal is turned round under pressure.

0.2.23 Handling of Bearings



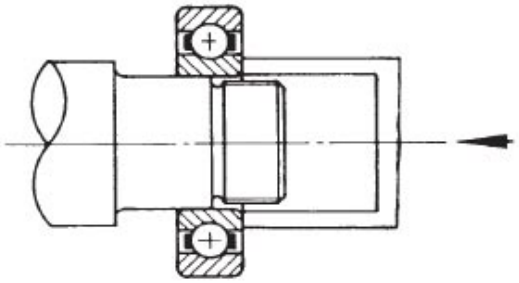
Keep the bearings and their surroundings clean. Every dust and dirt particle, even though they are invisibly small can affect bearings. Always take sufficient care to protect bearings against dust and dirt.

Handle bearings with the utmost care. Because of the high precision structure and the increased hardness which is provided by heat-treatment to improve wear resistance, bearings require special care to handle them.
Shock due to careless handling of bearings will cause dents to form on the inner and outer races or break the bearings.
Avoid excessive heating. The hardness of bearings will be lowered at temperatures higher than 120°C, this may cause considerably reduced life of the bearings.
Use the proper jigs for handling the bearings. Under no circumstances should any other jig be used as a substitute for the proper one.
Take necessary rust-preventive means.

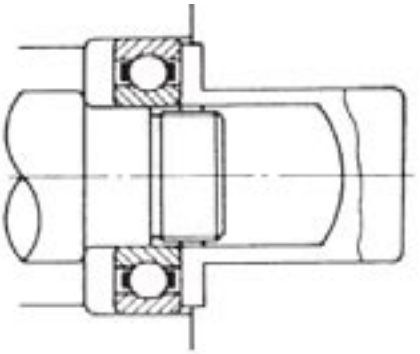


Keep the work where bearings are to be handled clean. Also, do not unpack a bearing package
until just before the installation of the bearing.

Be carefull not to drive an outer race onto an inner race by tapping the outer race, and vice versa. Such unreasonable handling will cause dents to form on the sliding surfaces between the races, and the bearing will be damaged early in its life.



Be careful not to force a bearing for removal. The use of a proper removing jig shown below is recommended.
To wash bearings, neutral and anhydride solvents such as light oil and kerosene may be used. Two vessels filled with washing oil should be provided; one for washing dirty bearings and the other for rinsing. Rapidly shake a soiled bearing in the washing oil to remove dirt. Rotating bearing
races, instead of shaking the bearing in the washing oil, should be avoided because bearing races may be damaged by foreign particles such between the races. It is also necessary to keep washing oil clean by filtering it from time to time.



0.3 Precaution before any Maintenance Operation

Study and carry out *Maintenance Precautions* **according to** *Operation and Maintenance Manual, Chapter 7.*

Place dumper in the shop maintenance area, preferably on a clean, level concrete floor and with the facilities to make the necessary heavy lifts involved during the maintenance operation.
Put dump truck in *Service Position* **according to** *Operation and Maintenance Manual, Chapter 2.22.*

Before any work is started, study the *Shop Manual* **and the Operation and** *Maintenance Manual, Safety Instructions* **and make sure everyone involved understand safety rules and the tasks to be completed.**

Check the all necessary tools and consumables are available.

For Lubrication Schedule, Recommended Lubricants and Tecnical Data, se *Operation and Maintenance Manual, Chapter 7 and 8.*

0.4 Location of Main Components

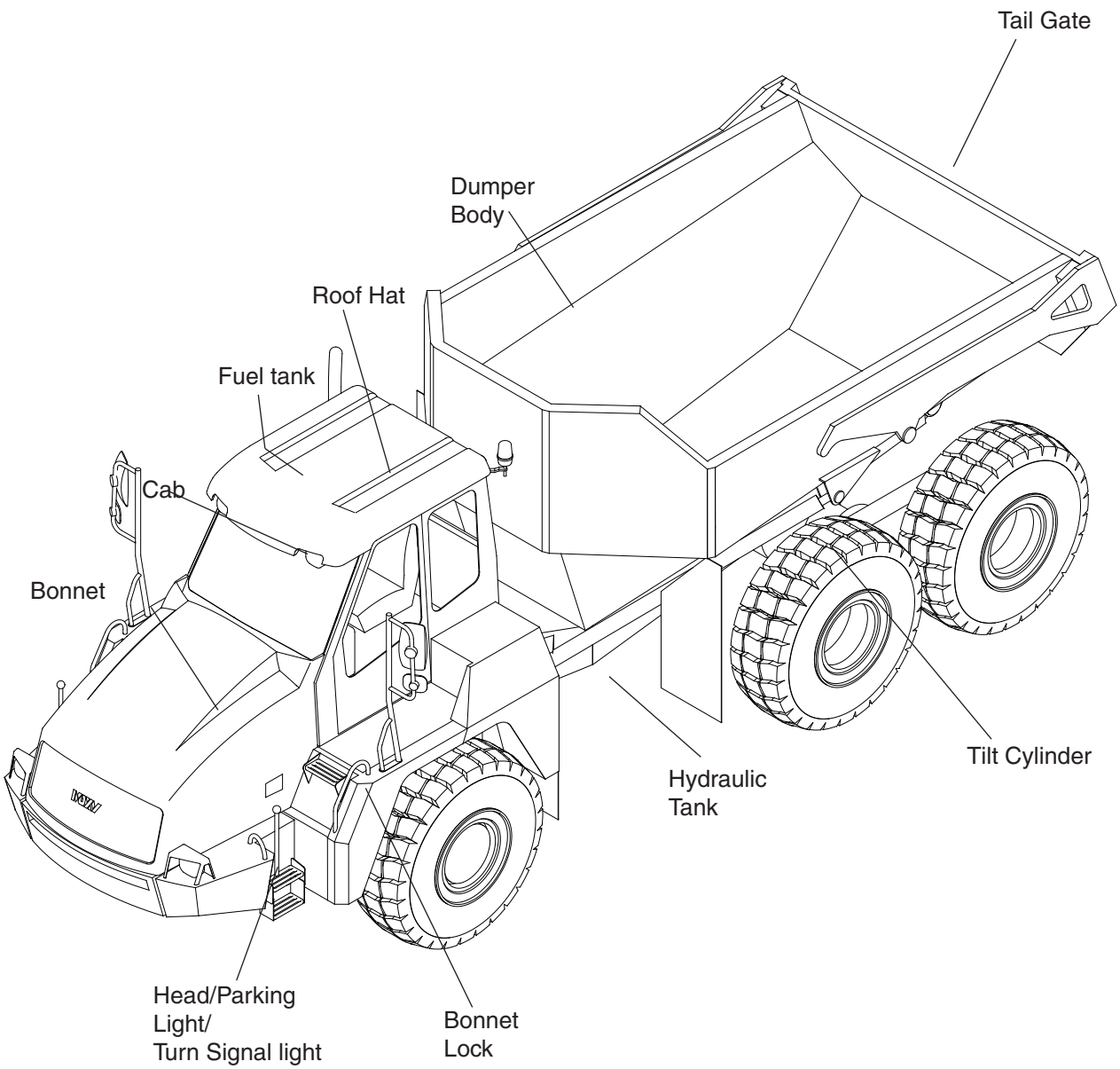


Fig 8.1 Location of Main Comoponents

0.5 Location of Drive Line Main Components

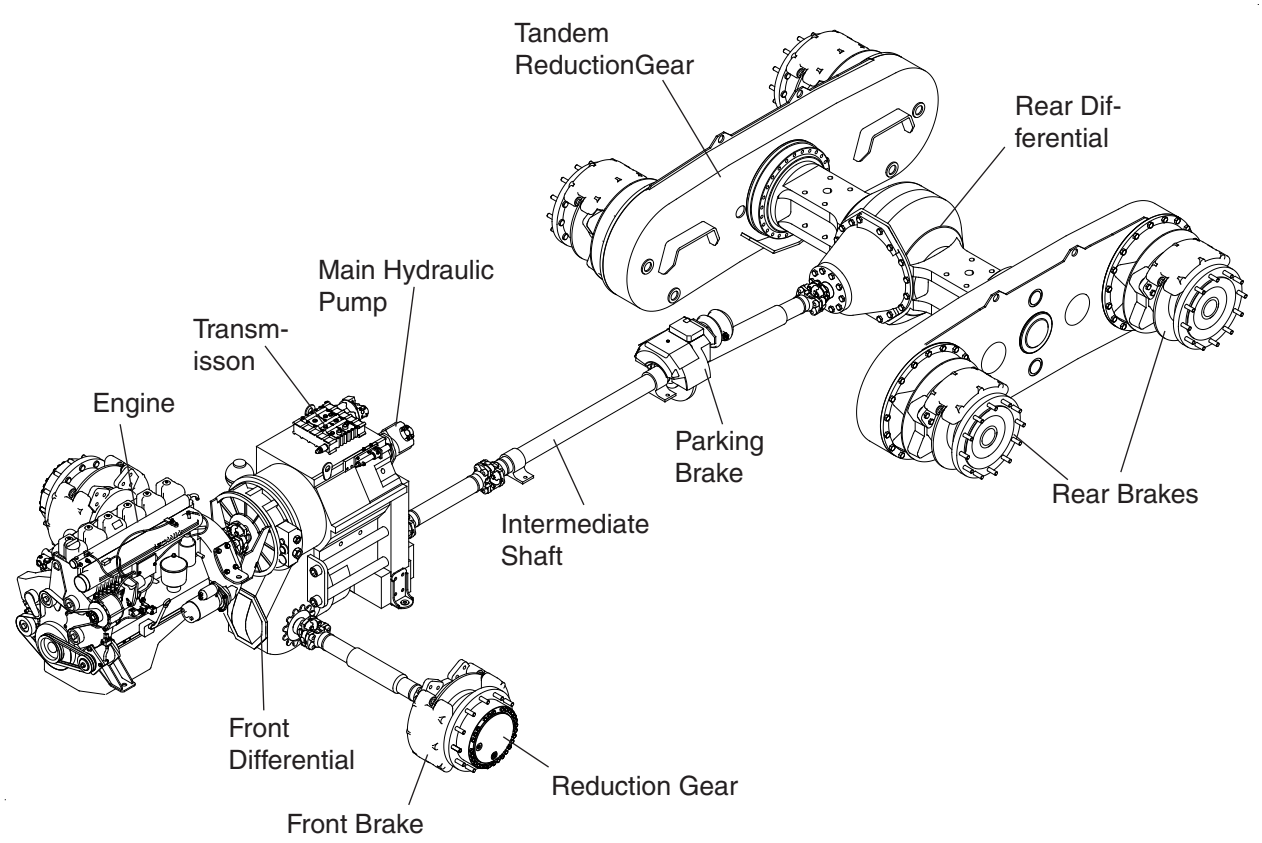
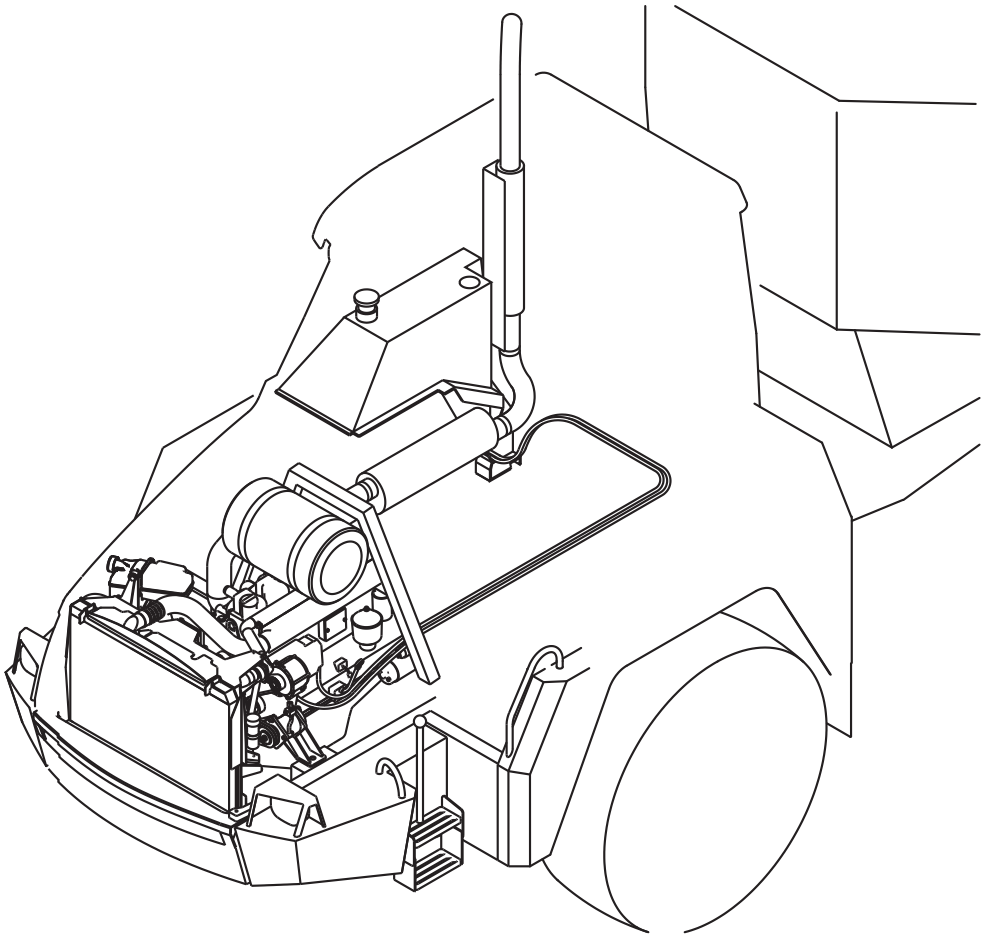


Fig 8.1 Drive Line Overview

Chapter 1

Engine



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Engine
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Removal of engine assembly

NOTE!
Place the dump truck on level ground and apply parking brake

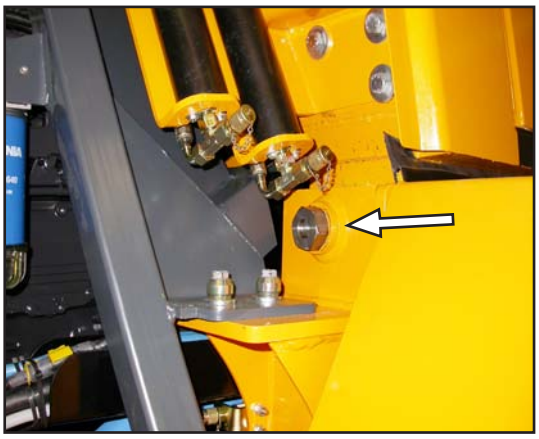
Apply articulation lock.
Turn off main switch in battery case.
Raise the dump body and lock it with the safety support.
Raise the tiltable cab and lock it with the safety support
Drain engine coolant

Look in OPERATION & MAINTENANCE MANUAL chapter 2 for instructions.

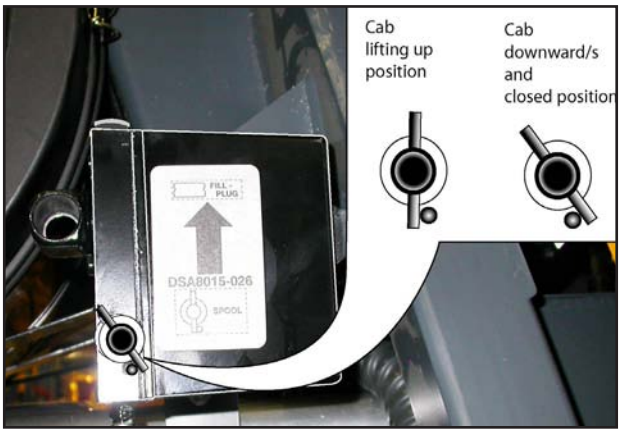
Place wheel chocks to the front wheel

Take away the cab bolt, left and right hand side.

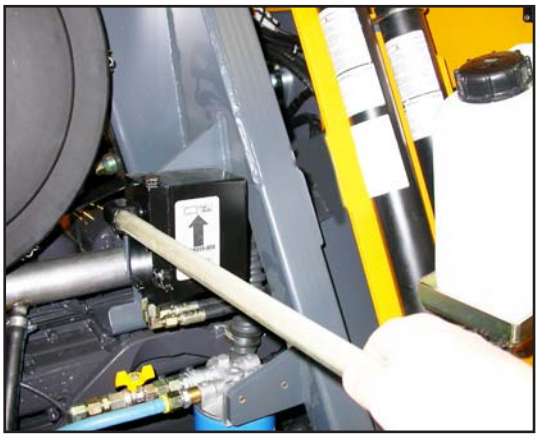
Nv 46 mm



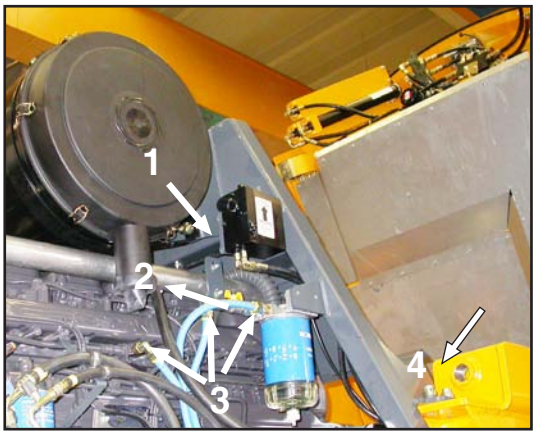
Turn the direction valve on the pump in lifting up position.



With the handle, pump and raise the cab.

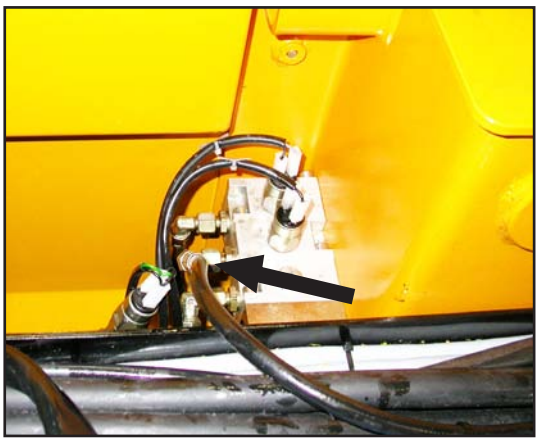


Left side:
1
Disassemble the cab pump unit from the air filter stand.
2
Remove the water hose from the pipe socket.
3
Remove the fuel hoses (3 pcs) and
4
Disassemble screws from filter stand bracket

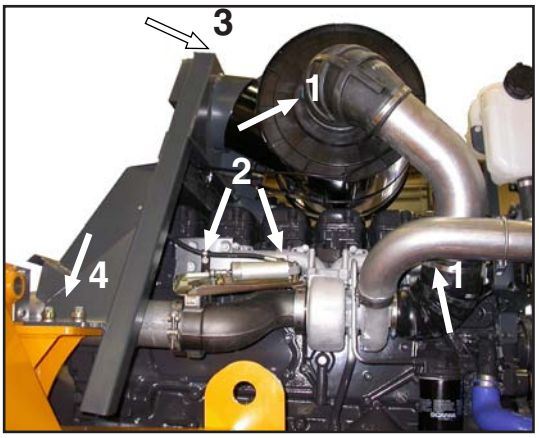


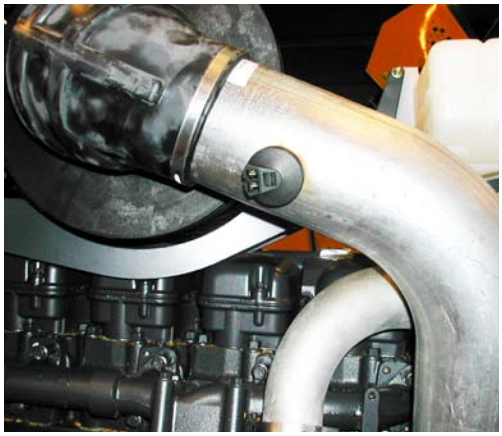
Disconnect the brake hose from the magnetic valve.

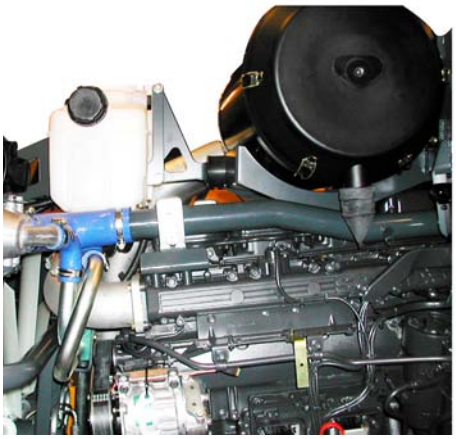
(Left side behind the cab bracket)



Right side:
1
Unscrew the hose clamps and remove the pipe bend,
filter - turbo
2
Disconnect the oil hose from engine brake cylinder and bracket
disassemble the other end at left side on the magnetic valve
3
Hook up the filter stand in lifting device.
4
Screw off the fastening bolt for filter stand,
left and right hand side



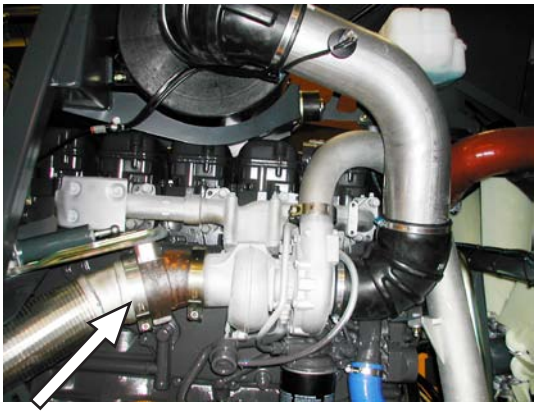




Disasssemble the cable to the Air filter sensor.

Disassemble the clamps for the wiring on the filter stand

Disconnect the exhaust pipe from the turbo pipe bend.



Slack the transmission belt.

Disassemble the ground wiring.

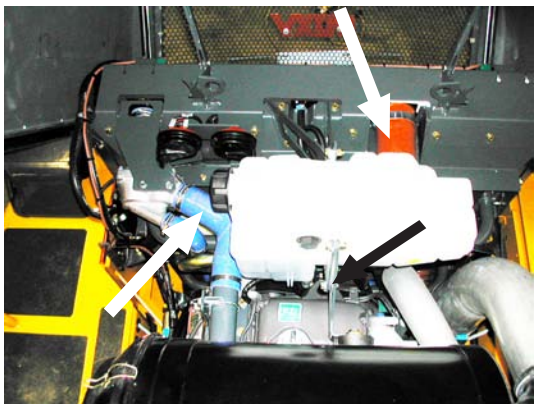
Detach the Air Cond. compressor with the hoses on, from the engine. Check that all of the clamps are undone.

Place the Air condition compressor on the left while the engine is dismount.

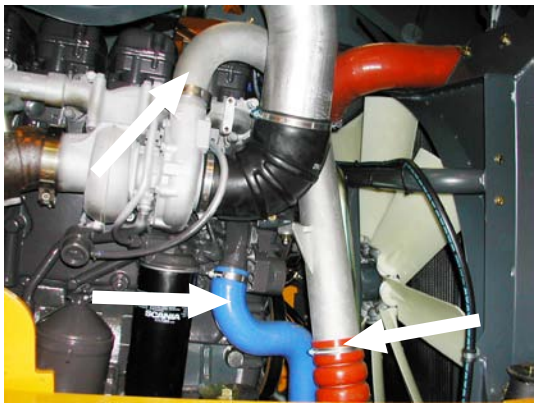


Disconnect the hose from the termostathousing,
the pipe between the air cooler and the engine air inlet.

Disconnect bracket for the air pipe and bracket between engine and fan rack



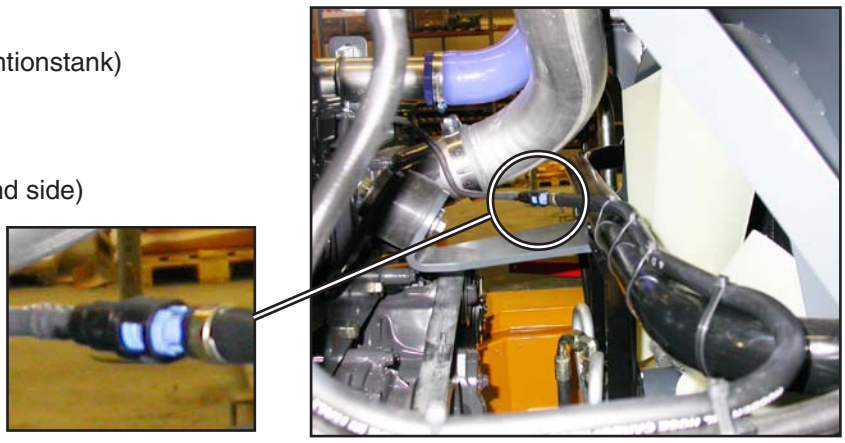
Disconnect the outlet pipe bend from turbo, and the inlet water hose from the transmission cooler.



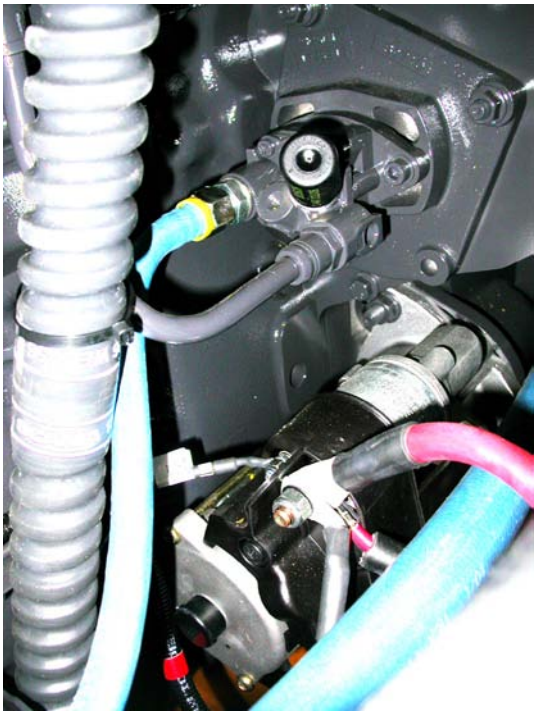
Disconnect the retur hose. (Engine - ekspantionstank)

(Quick release coupling)

(Front of the engine, view from the right hand side)



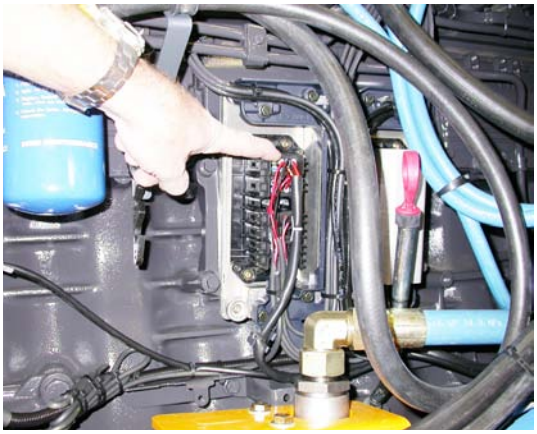
Disconnect the cables between starter motor and the frame



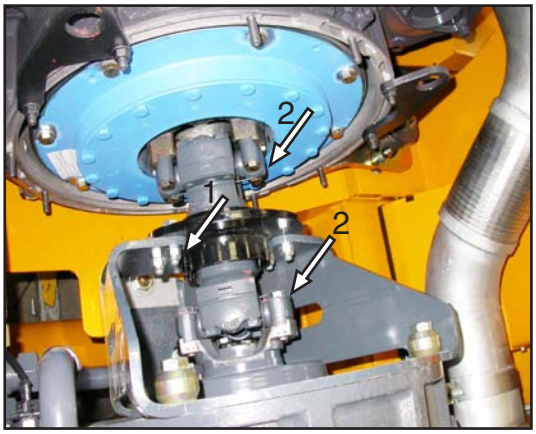
Disconnect the contact on the dynamo.



Remove the cover and disconnect the electrical contact from the engine ECU -S6 control unit

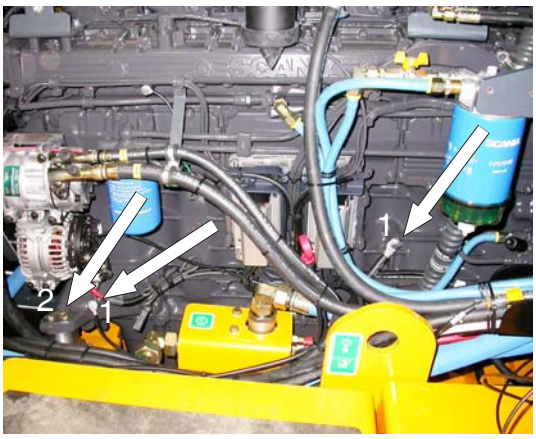


Drive shaft
Remove safety atcher.
Remove driveshaft between transmission and engine coupling,



1
Disassemble screw for the ground cable (2 pcs)

2
Left and right hand side, disassemble 3 screws on the engine mounting bracket.



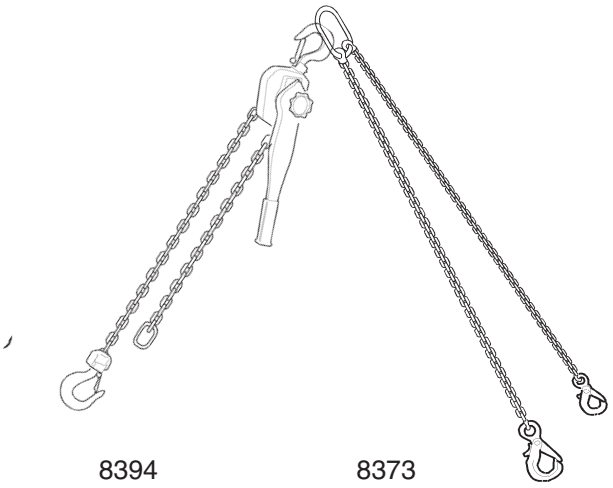
1
Disassemble the hose clamp bracket.

2
Unscrew the engine bracket bolt left and right hand side.



Lifting the engine

Note:
The engine lifting eyes are designed for lifting the engine only, not the engine together with its ancillary equipment (alternator, gearbox etc.) or fram

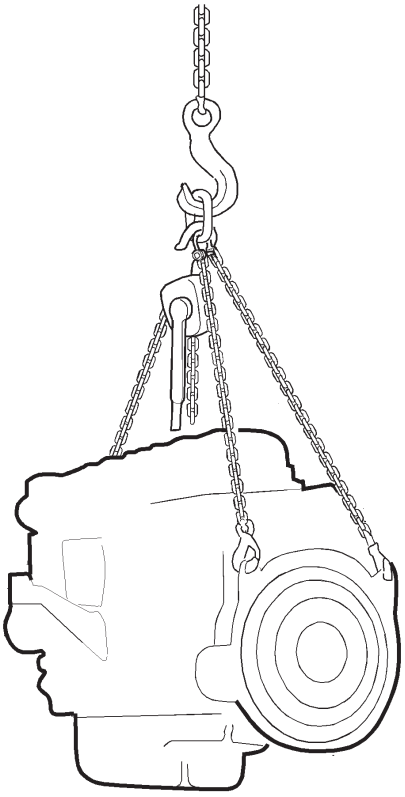


8394
Lever block

8373
Lifting chain

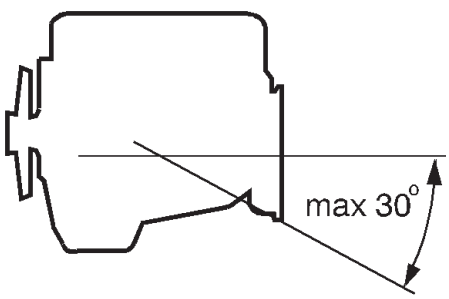
- Fasten the lifting chain 8373 to the rear lifting eyes.

- Fasten the lever block 8394 to the front lifting eye.



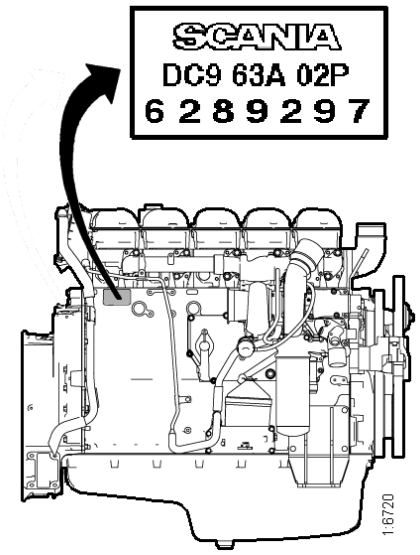
With attention, lift the engine out from the frame

Note:
The lifting eyes are sized to cope with a maximum angle of 30°.



Engine identification

The engine designation indicates, in the form of a code, the type of engine, its size and applications, etc.
The type designation and engine serial number are indicated on a type plate affixed to the right-hand side of the engine.
The engine number is also stamped on the engine block immediately above the type plate.
Refer to the illustration.



DC 9 63 A 02 P

Type

DC Supercharged diesel engine with air-cooled charge air cooler.

Displacement in whole dm^3

Performance and certification code

Indicates, together with the application code, the normal gross engine output.
The actual output setting of the engine is indicated on the engine card.

Application

A For general industrial use

Variant 01-99

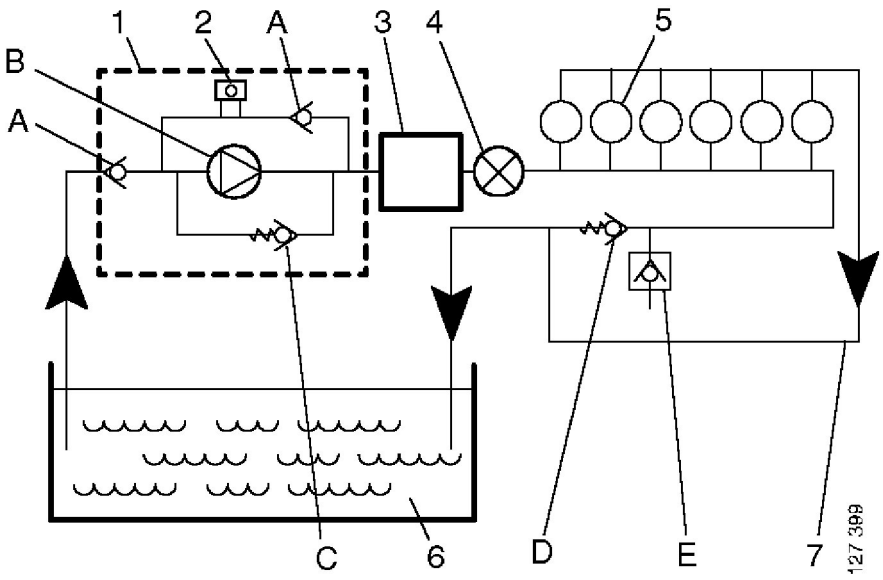
Type of regulator

P EMS engine management system with PDE and S6

Fuel system

Schematic diagram of the fuel system

1 Feed pump
2 Hand pump
3 EMS control unit
4 Fuel filter
5 Cylinders
6 Fuel tank
7 Return line for excess fuel
A Check valve
B Gear pump (feed pump)
C Safety valve
D Pressure relief valve
E Drain nipple

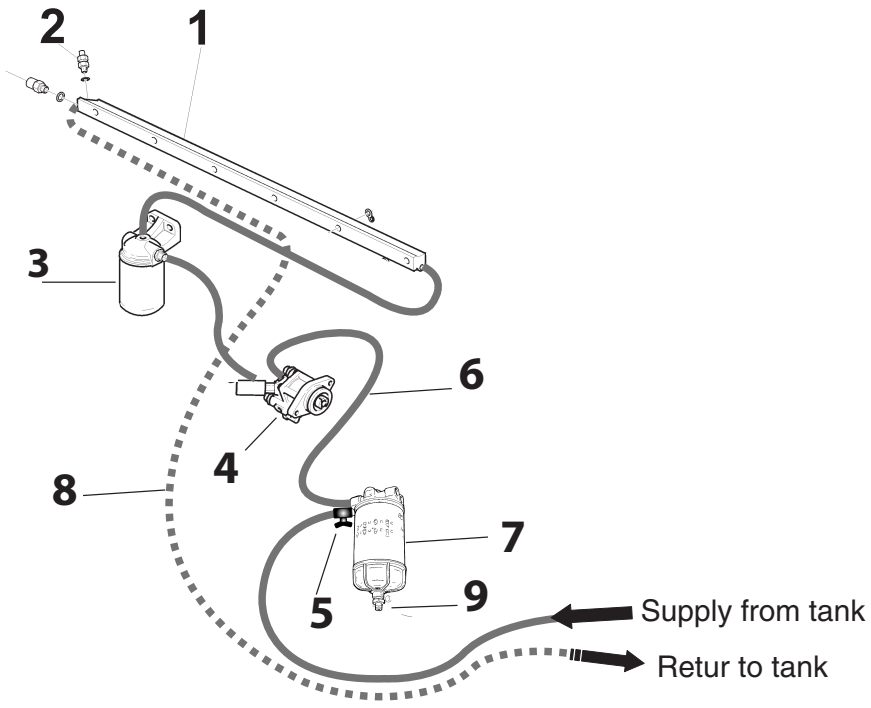


Overflow valve

The purpose of the overflow valve is to limit the pressure in the fuel system and continuously vent it. The overflow valve ensures that the fuel circulates round the system and that there is always fuel in the injection pump for cooling, lubrication and injection.

Opening pressure is **0.6 - 0.8 bar**.
Working pressure is approx. **1 bar**.

1 Fuel rail
2 Pressure relief valv
3 Fuel filter
4 Feed pump / hand pump
5 Shut-off cock
6 Oil hose water filter - feedpump
7 Water separating prefilter
8 Retur line
9 Drain valve

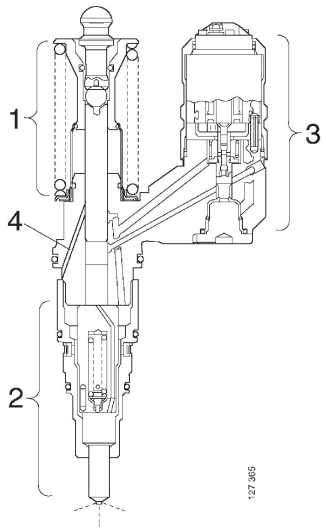


General

Apart from fuel lines and a fuel tank, a PDE (Pumpe-Düse-Einheit) fuel system with unit injectors consists of the following items:
- a feed pump
- a hand pump
- a fuel filter
- one fuel rail.
- a pressure relief valve
- One PDE type unit injector per cylinder.

The fuel system also includes an electronic control system. The control system includes an electronic control unit, the unit injector solenoid valves and sensors.

PDE



FUEL

Diesel fuel oil

The composition of the diesel fuel oil has a great influence on the functioning and the service life of the engine and the injection system.
The engine output and exhaust emissions are also dependent on the fuel quality.
The diesel fuel must meet European standard EN 590.
The table below shows the requirements for some of the most important properties:

Property	Requirement
Viscosity at 40°C	2.0 - 4.5 mm^2/s (cSt)
Density at 15°C	0.82 - 0.86 kg/dm^3
Sulphur (concentration by mass)	max. 0.3%
Ignitability (CET rating)	min. 49
Flashpoint	56°C

Environmentally favourable fuels (low sulphur fuels)

There are three classes of so called environmentally favourable fuels (SS15 54 35).

Class 1 is sulphur-free and class 2 is low in sulphur. Compared with class 3 (normal fuel), these fuels are less dense and this reduces engine power output.

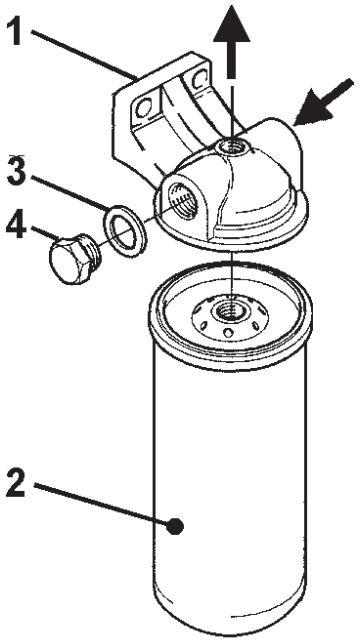
Fuel filter

Design
Fuel filter are of single-mounted type. The filter screw on to a retainer which is bolted to the engine.

The filter consists of a metal container with a folded paper element. The filter cannot be dismantled but must be changed as a complete unit.

The fuel filter has no bleed screw and is bled by undoing plug **4** in the free inlet passage.

Function
Fuel is pumped into the inlet by the fuel pump. It then continues through passages in the filter retainer to the upper part of the filter, down through the filter or filters and on to the outlet passage. From there, the fuel is piped to the injection pump.



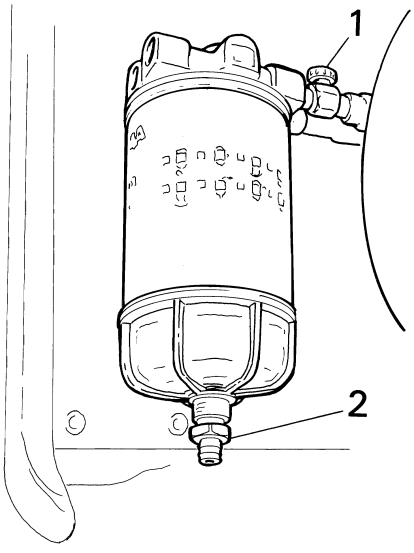
1. Filter retainer
2. Filter
3. Gasket
4. Plug

Fuel filter, constituent parts

Water separating prefilter

Note:
Close the shut-off cock when renewing the filter.

The same intervals between changes apply as for those for an ordinary fuel filter.



1 Shut-off cock
2 Drain valve

Temperature dependence of diesel fuel

At temperatures lower than those specified for the diesel fuel, paraffin wax may precipitate from the fuel and block filters and pipes. The engine can then loose power or stop. The diesel fuel is adapted for use in the specific climate of each country. If a vehicle or an engine is to be operated in a temperature zone with lower temperature than normal, first identify the temperature properties of the fuel concerned.

The properties of the fuel when cold can be improved by adopting one of the following measures before the temperature drops:

- If the fuel concerned cannot cope with the expected temperatures, and diesel fuel is not available with the correct temperature properties, we recommend that an electric fuel heater is installed **as a preventative measure.**

- The low temperature properties of diesel fuel may be improved by adding kerosene **as a preventative measure.** A maximum of 20% may be added. When refuelling, the kerosene should be added first, so that it mixes thoroughly with the diesel fuel.

Note:
It is prohibited to use kerosene in engine fuel in some countries.

- To prevent water in the fuel from freezing and forming ice, a maximum of 0.5-2% alcohol (isopropanol) may be added.

Drain fuel tanks and drain or change fuel filters regularly.

Warning

It is not permitted to mix kerosene with diesel fuel that is already adapted for the climate concerned. This can damage the
PDE injectors. All use of paraffin other than kerosene is forbidden, as it causes engine damage.

! Important

It is not permissible to mix petrol with diesel fuel. In the long term, petrol may cause wear to the PDE injectors and it may also cause damage to the **engine.**

Feed pump

The feed pump 1 draws fuel from the fuel tank and forces it through the fuel filter 3 and into the fuel rail 4.

On the feed pump there is a hand pump 2.
The hand pump is used to vent air from the fuel system.

On the fuel rail there is a pressure relief valve 5.
The pressure relief valve constantly regulates the fuel pressure. When the pressure is too high, the pressure relief valve opens, so that the excess fuel is returned to the fuel tank.

The fuel rail distributes the fuel to the unit injectors in each cylinder head.

The ECU control unit determines when the unit injectors must inject fuel into the cylinders.

Feed pump renewal

1
Clean the outside of the feed pump.
Remove the suction and pressure lines from the feed pump.
Fit protective plugs.

2
Unscrew the bolts and remove the feed pump.

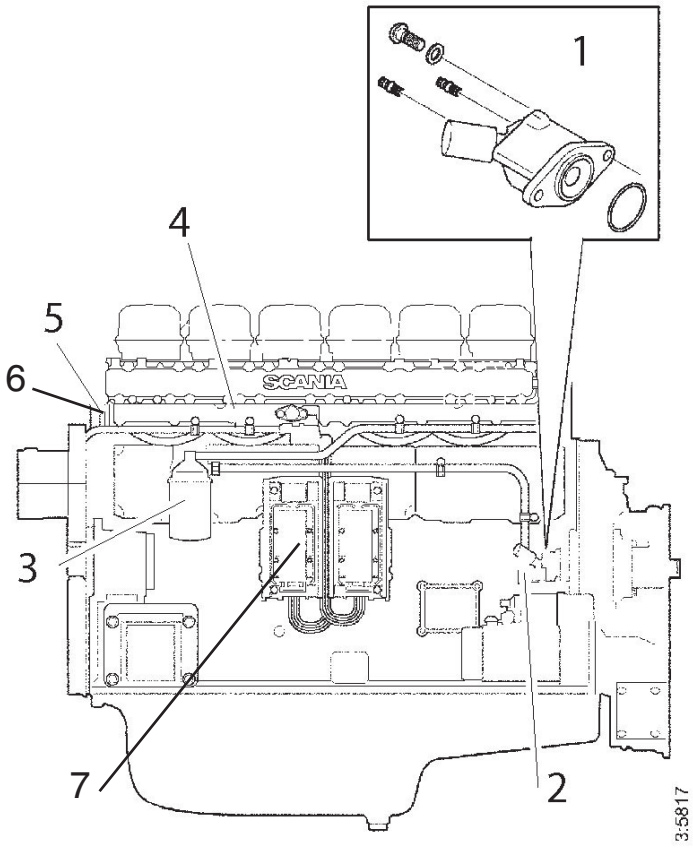
3
Place a new O-ring onto the feed pump and lubricate with O-ring grease.

4
Fit the feed pump.

5
Connect the suction and pressure pipes.

6
Bleed the fuel system; refer to *Bleeding the fuel system*.

7
Start the engine and check for leaks.



1 Feed pump
2 Hand pump
3 Fuel filter
4 Fuel rail
5 Pressure relief valve
6 Bleeder nipple
7 ECU control unit

Diagnostic prosedure

Use of diagnostic kit, machine

Install the VCI (ECOM programming unit)
Moxy No.513376

1. Switch on the laptop.

2. Connect the cabel end (1) to the CT1 unit

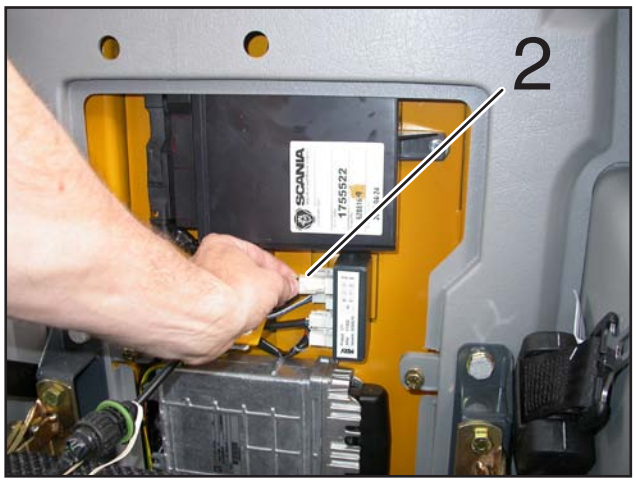
3. Connect the USB plug (2) to the Laptop

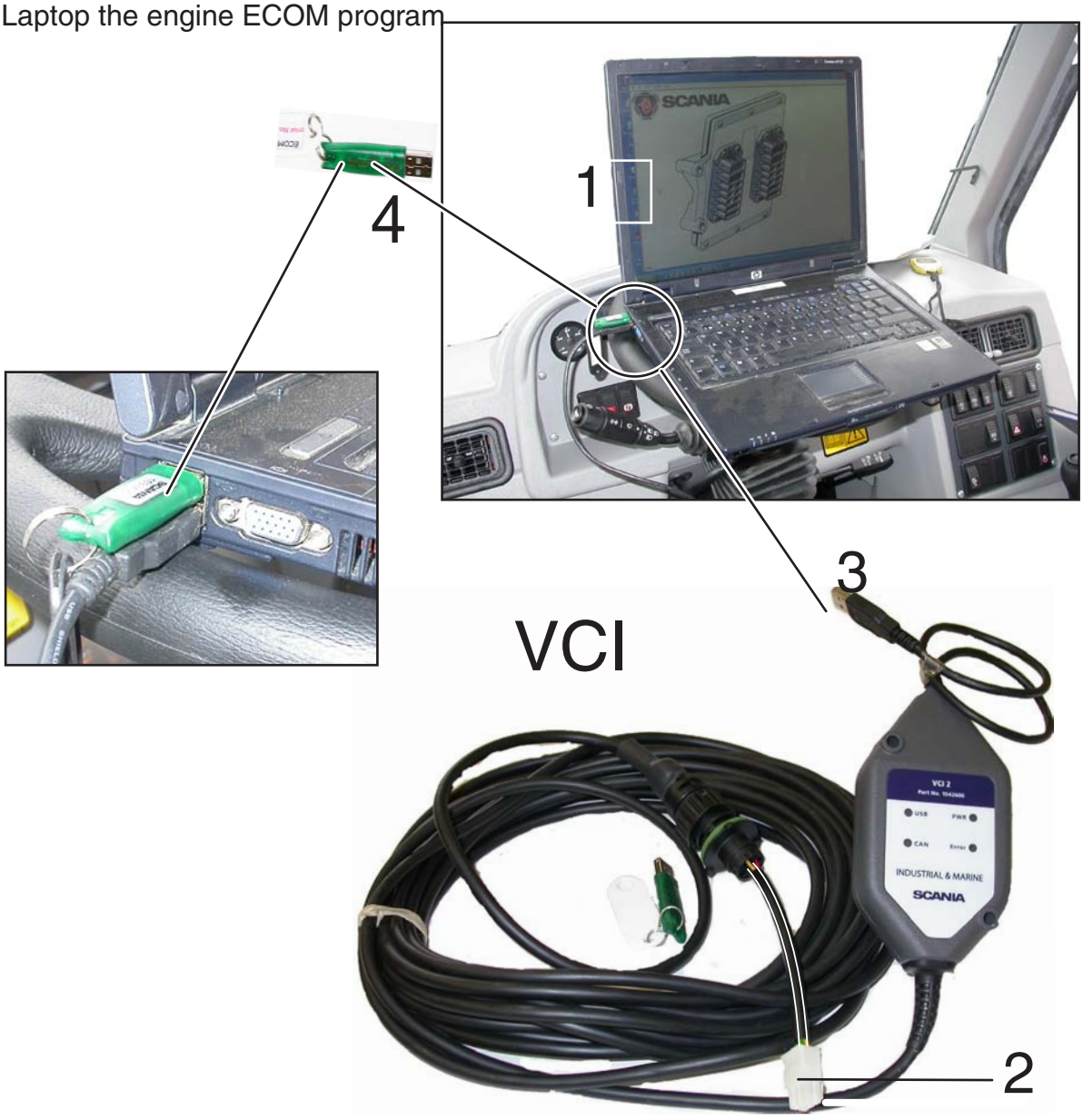
4. Put in the USB key

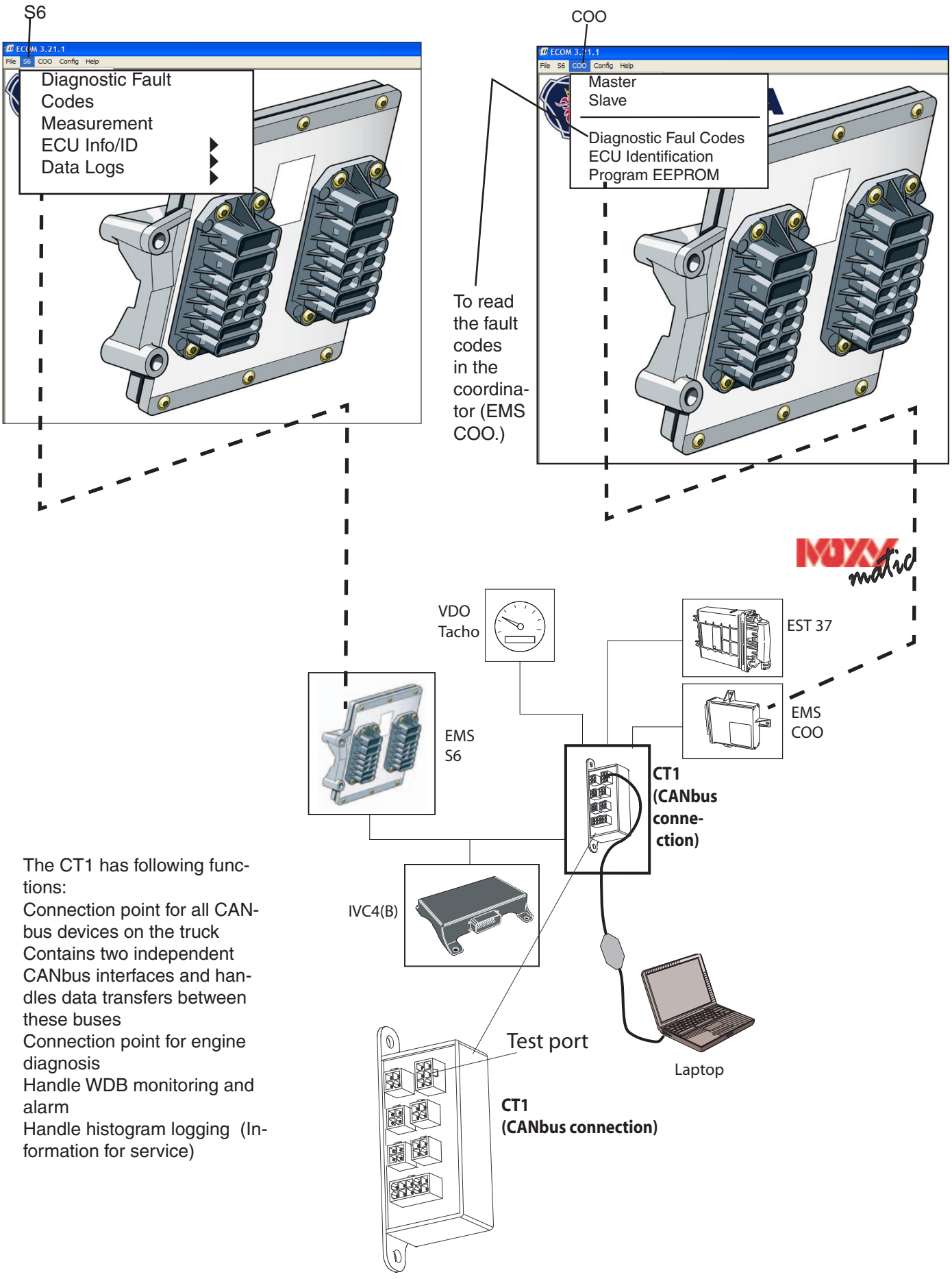
5. Switch on the ignition key (If read the setting parameters)

6. Start the engine. (If controlling of the parameters)

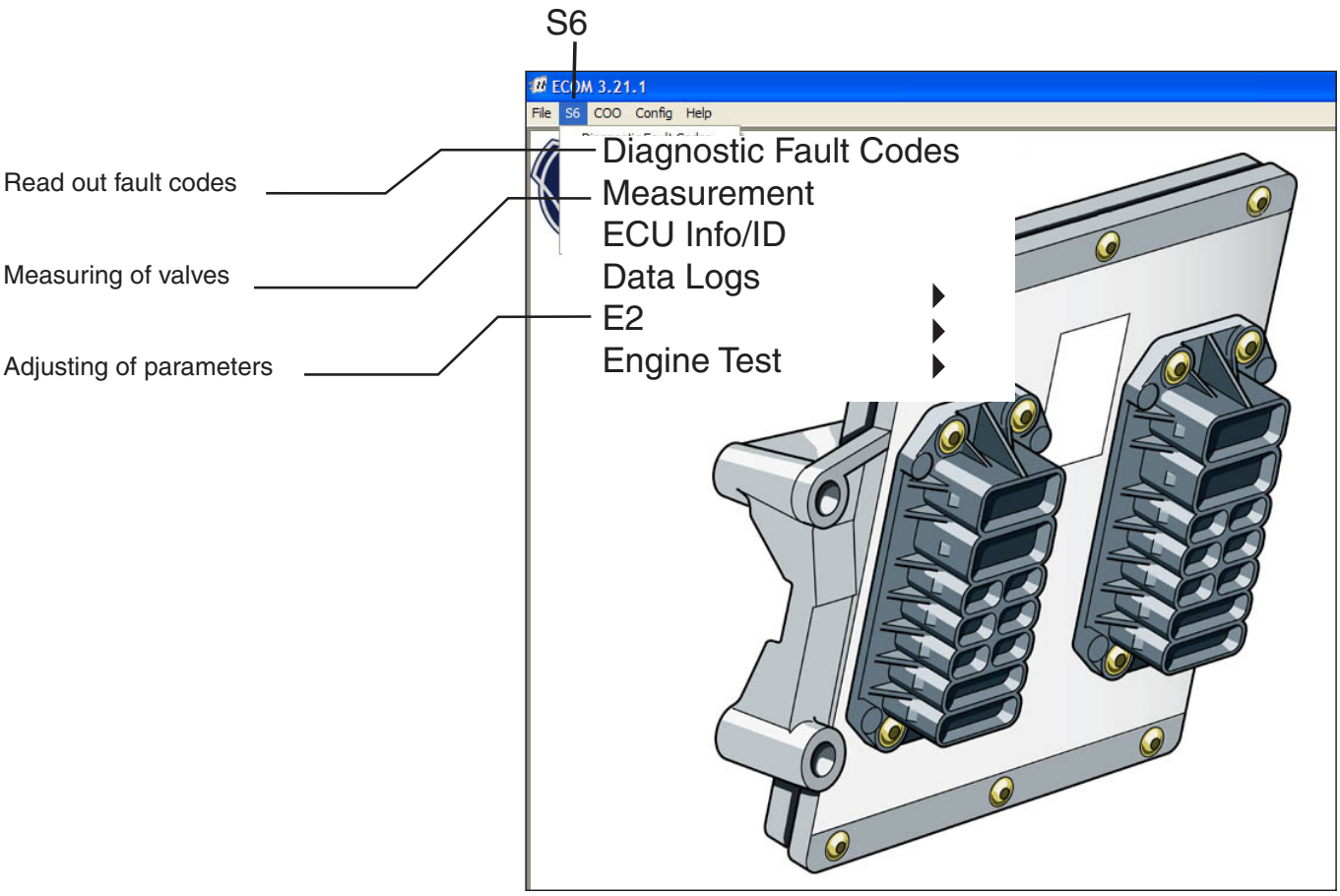
7. Start on Laptop the engine ECOM program



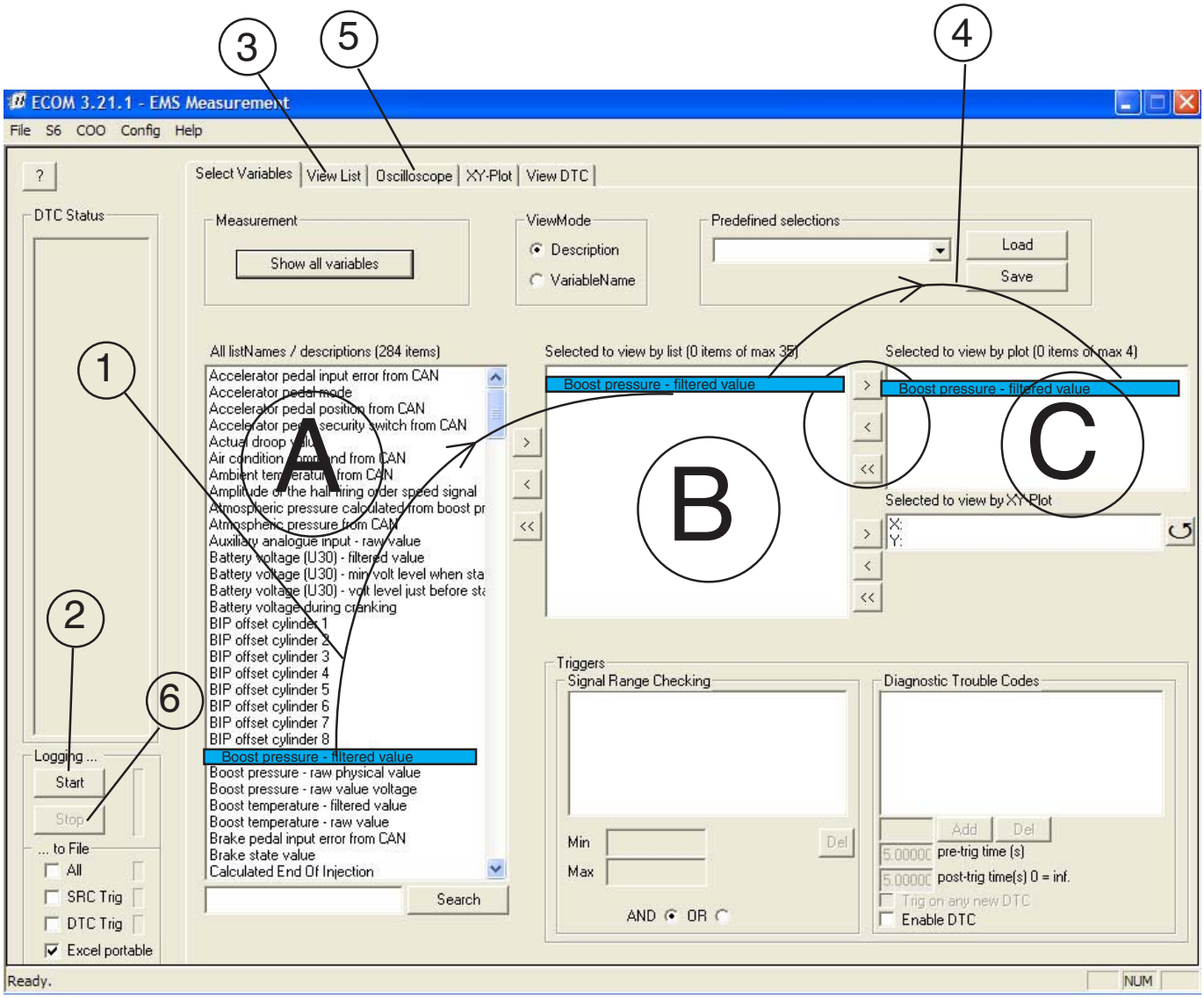




The CT1 has following functions:
Connection point for all CAN-bus devices on the truck
Contains two independent CANbus interfaces and handles data transfers between these buses
Connection point for engine diagnosis
Handle WDB monitoring and alarm
Handle histogram logging (Information for service)


S6
ECOM 3.21.1
File
S6
COO
Config
Help
Diagnostic Fault Codes
Measurement
ECU Info/ID
Data Logs
E2
Engine Test
Read out fault codes
Measuring of valves
Adjusting of parameters

Measurement



1. Move text line from the A section to B

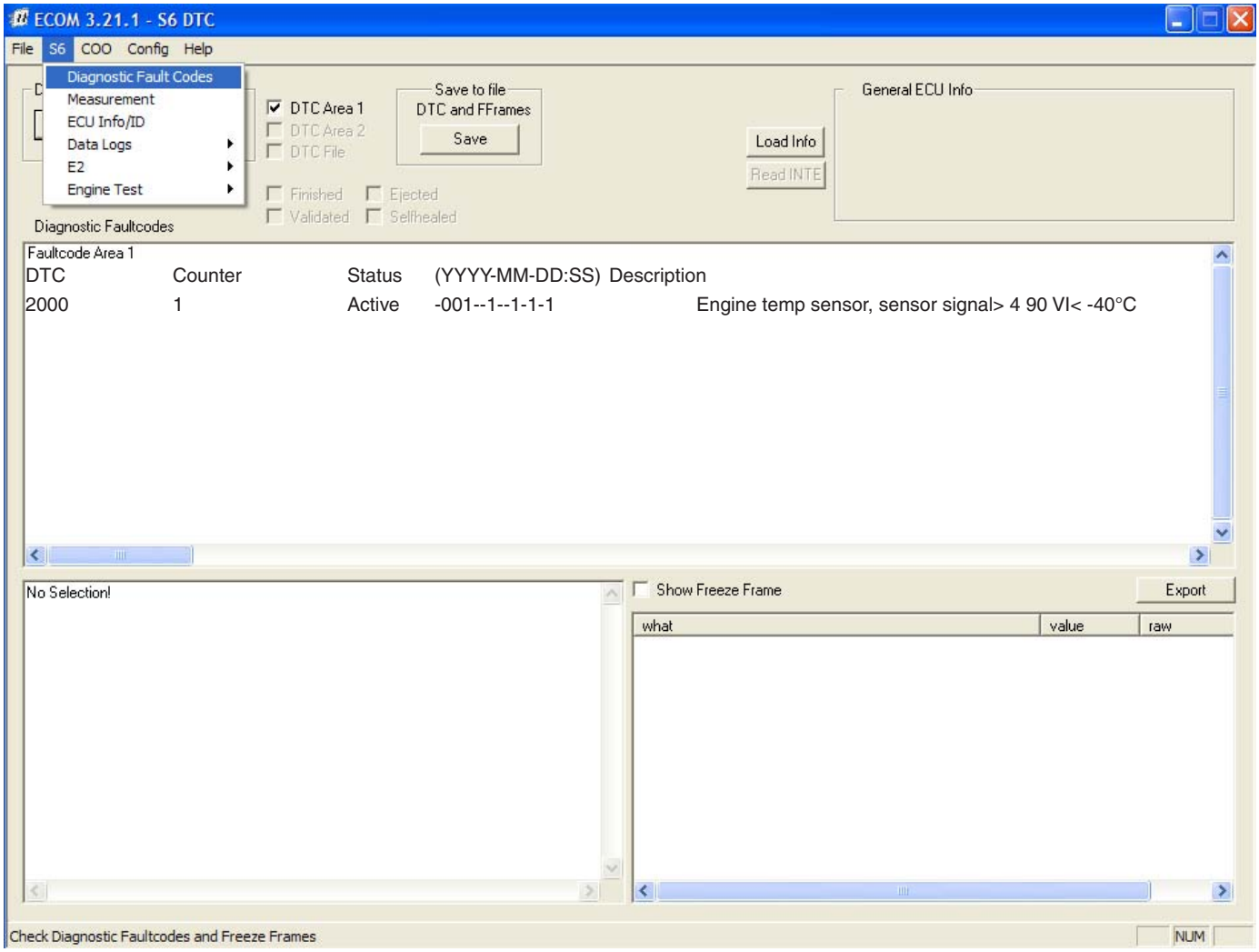
2. Start the logging by the start button

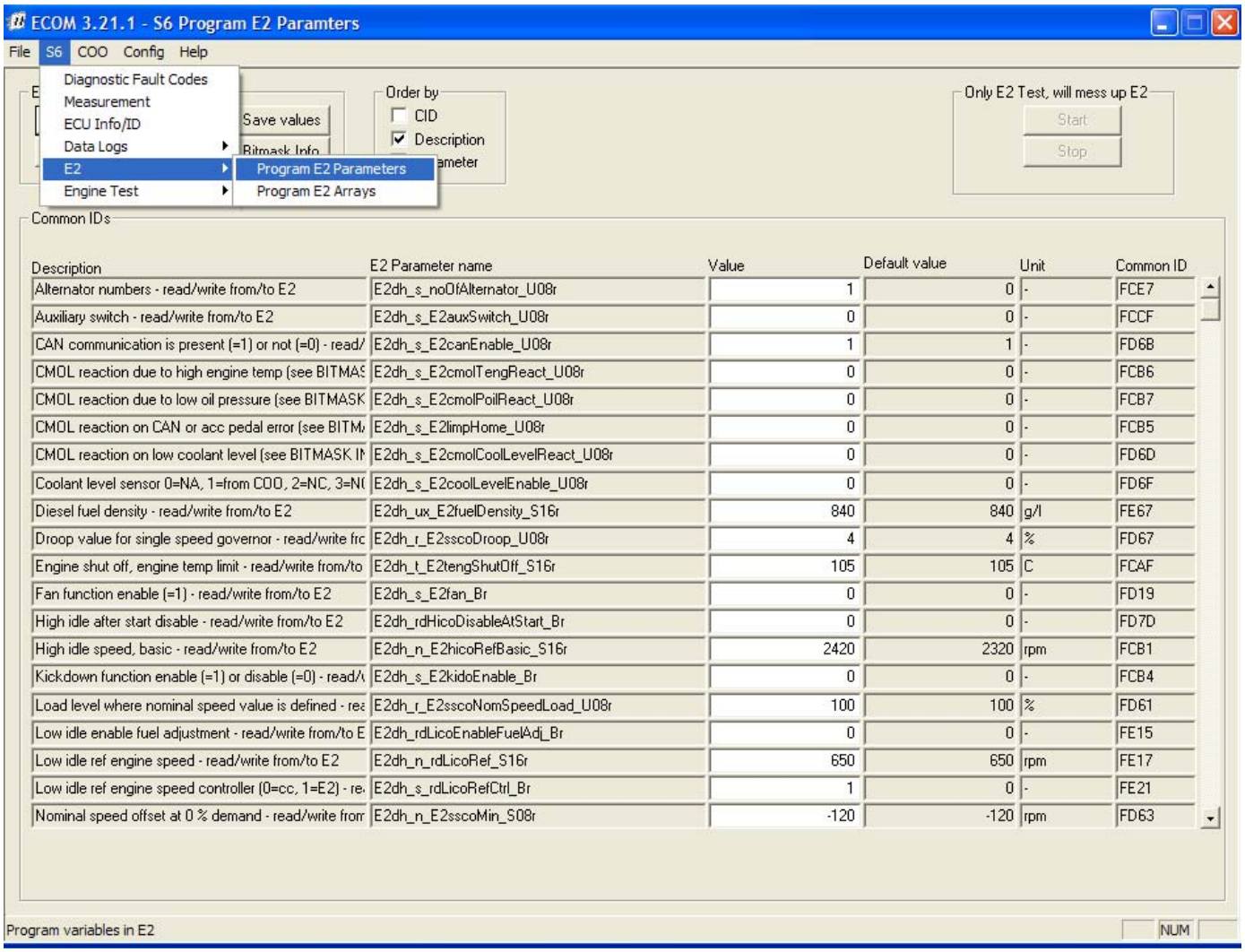
3. Select "Viev the list" to watch the values or -

4. Move text linr to section C

5. select the "Osciloscope" to view the graphical diagram

6. Stop logging to select new variable


ECOM 3.21.1 - S6 DTC
File
S6
COO
Config
Help
Diagnostic Fault Codes
Measurement
ECU Info/ID
Data Logs
E2
Engine Test
DTC Area 1
DTC Area 2
DTC File
Save to file
DTC and FFrames
Save
Load Info
Read INTE
General ECU Info
Finished
Ejected
Validated
Selfhealed
Diagnostic Faultcodes
Faultcode Area 1
DTC
Counter
Status
(YYYY-MM-DD:SS)
Description
2000
1
Active
-001--1--1-1-1
Engine temp sensor, sensor signal> 4 90 VI< -40°C
No Selection!
Show Freeze Frame
Export
what
value
raw
Check Diagnostic Faultcodes and Freeze Frames
NUM



Example to change temp alarm and warning:

Go to S6 ---> E2 ---> Program E2 parameter.

Read values.

Go to the column for values,
find the line for engine temp and change the value.

Then go to the "button" ; write values and click on it,
the value will now be change.
Confirm your choise

Ecom standard settings code

From Main Menu, Select:
S6
Program E2 parameters
Read values
Make changes
Write values

CID	Description	Limits	Typical Value	Unit	MT Value
FE17	Low idle, ref engine speed	0 - 3200	650	rpm	650
FE21	Low idle, ref engine speed controller.	0 - 1			1
	0 = use basic low idle, adjustable with CC-buttons				
	1 = Use FE17, not adjustable with CC-buttons				
FE65	Oil temperature sensor on EMS available	0 - 1	0/1		
	0 = Not available				
	1 = Available				
FE63	Use safety switch on accelrator pedal	0 -1	1		1
	0 = Not available				
	1 = Available				
FE67	Diesel fuel density, used only for fuel rate calculation	0 - 2000	840	g/litre	840
FD7D	Reduced high idle after start	0 - 1			
	0 = Enable				
	1 = Disable				
FC8D	Type of governor	0 - 1	1		1
	0 = RQ				
	1 = RQV				
FCB1	High idle, ref engine speed	0 - 3200	23 - 2400	rpm	2420
FD6F	Coolant level sensor	0 - 1	0/1		
	0 = Not present				
	1 = From coordinator				
FD6D	Reaction to low coolant level	0, 1, 2, 6			
	0 = Alarm only				
	1 = Torque limitation				
	2 = Stop engine				
	6 = Stop engine with override option				

CID	Description	Limits	Typical Value	Unit	MT Value
FCB7	Reaction due to low oil pressure	0, 1, 2, 6			
	0 = Alarm only				
	1 = Torque limitation				
	2 = Stop engine				
	6 = Stop engine with override option				
FCB6	Reaction due to high coolant temperature	0, 1, 2, 3,	0/1/6		
	0 = Alarm only				
	1 = Torque limitation on low limit				
	2 = Stop engine on high limit				
	3 = Torque limitation and stop engine				
	6 = Stop engine with override option				
	7 = Torque limitation and stop engine with override option				
FCAF	Engine coolant temperature shut-off limit	0 - 150	105	°C	105
FCF3	Engine coolant temperature torque limitation limit	0 - 150	95	°C	102
FCB5	Reaction on CAN or accelrator pedal error	0, 1, 2, 3, 4, 8	0/1		
	0 = No action, low level				
	1 = Increased low idle				
	2 = CAN shut-off				
	3 = CAN shut-off and increased low idle				
	4 = AUX_AN as redundant accelrator pedal				
	8 = Always use AUX_AN accelrator pedal				
FC81	PTO mode 0, max engine speed	0 - 3200	3000	rpm	3000
FC82	PTO mode 1, max engine speed	0 - 3200	3000	rpm	3000
FC83	PTO mode 3, max engine speed	0 - 3200	3000	rpm	3000
FC80	PTO mode 3, fixed engine speed	0 - 3200	1500	rpm	1100
FD09	PTO mode 0, max torque	0 - 5100	5100	rpm	5100
FD0B	PTO mode 1, max torque	0 - 5100	5100	rpm	5100
FD0D	PTO mode 2, max torque	0 - 5100	5100	rpm	5100
FD0F	PTO mode 3, max torque	0 - 5100	5100	rpm	5100

CID	Description	Limits	Typical Value	Unit	MT Value
FCA1	PTO mode 1, accelrator pedal effective	0 - 1			1
	0 = Active				
	1 = Not active				
FD11	PTO mode 4, max torque	0 - 5100	5100	rpm	5100
FE15	Low idle to adjust fuel adjustment. Droop function on low idle	0 - 1			
FCE3	Accelrator pedal value converted to reference engine speed	0 - 3200	array x 4	rpm	480/2500/ 2500/2500
FCF9	Accelrator break point for FCE3	0 - 100	array x 4	%	0/100/ 100/100
FCE5	Droop values for different accelrator pedal values	0 - 8	array x 4	rpm/ mg/st	4,5/4,5/ 4,0/0,5
FCFB	Accelrator pedal breakpoint for FCE5	0 - 100	array x 4	%	0/20/80/ 100
FD77	Voltage breakpoints for 0% and 100% for redundant Accelrator pedal connected to input AUX_AN on EMS	100 - 4900	Array x 2		
			485/2693	mV	485/2693
FD73	Engine speed dependent friction torque. Breakpoints in flash, 500, 1000, 1500, 2200 rpm	0 - 5100	array x 4	Nm	0/0/0/0
FD75	Engine speed and temperature dependant friction torque. Breakpoints in flash, 500, 1000, 1500, 2200 rpm	0 - 5100	array x 4	Nm	0/0/0/0
FD71	Temp. breakpoints for 0% and 100% of fan friction torque of FD75	0 - 150	array x 2	°C	80/100
FD13	Torque limit 2, extra torque curves for customer use. Breakpoints for software version 2253: 1000, 1100, 1200, 1400, 1600, 1800, 1900, 2000, 2100, 2200, 2300, 2400	0 - 5100	array x 12	Nm	12 x 5100
FD15	Torque limit 3, extra torque curve for customer use. Breakpoints for software version 2253: 1000, 1100, 1200, 1400, 1600, 1800, 1900, 2000, 2100, 2200, 2300, 2400 rpm	0 - 5100	array x 12	Nm	12 x 5100

Engine control unit, ECU

This engine has an electronic management system, ECU Engine Control Unit
(also called EMS, Electronic Management System) with unit injectors (PDE) which provide each cylinder with the right amount of fuel at the right time in all operating situations.

The ECU system consists of a control unit (S6) and sensors for speed, charge air temperature and pressure, coolant temperature, oil pressure, accelerator pedal/throttle actuation which constantly emit signals to the control unit.

With the aid of this input data and the programmed control software, the correct fuel amount and correct injection time are calculated for each unit injector (PDE) under the specific operating conditions.

The ECU system sensors can also be used to emit signals to the instruments in the instrument panel.
The control unit constantly checks the sensors to make sure they are operational.

The control unit contains monitoring functions to protect the engine in the event of a fault which would otherwise damage it. In the event of a fault, e.g. alarm level for low oil pressure or high coolant temperature, the S6 control unit sends a CAN message to a coordinator.

The main task of the coordinator is to pass on data by means of CAN communication from the engine control unit to other control units and signals to gauges and lamps in the instrument panel.
The coordinator also has monitoring functions.

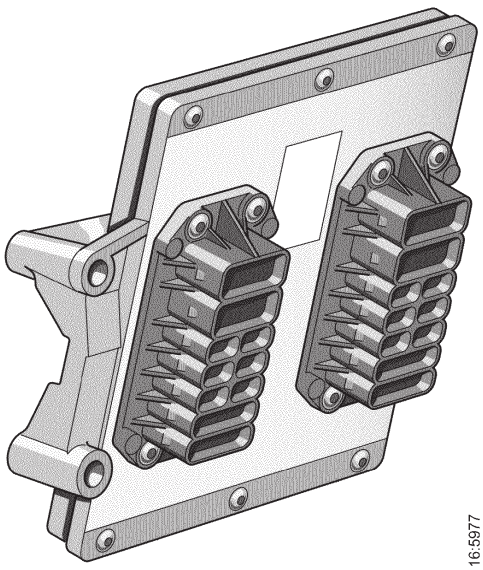
When the ECU control unit detects a fault, the control unit diagnostics lamp comes on (left-hand lamp on the instrument panel) and it stays on as long as the fault is active. At the same time, a fault code is generated which can be read off via the coordinator on the diagnostics lamp in the form of a flashing code when a separate diagnostic switch is actuated. A flashing code may consist of a number of different fault codes.
When the coordinator detects a fault, a fault code is generated which can be read off on the coordinator diagnostics lamp (the left-hand lamp on the instrument panel) in the form of a flashing code when a separate diagnostic switch is actuated.
If the torque reducing function is activated, the fuel amount is reduced to 70%, and if the engine shutoff function is actuated, the engine is shut off at programmed alarm levels.

A separate PC-based diagnostics program is used to read off the contents of the flashing codes.
Reading off the fault codes, and descriptions of these, are also covered with writing in the section
Flash codes tables

Only authorised personnel are allowed to carry out diagnostic procedures and program changes.
The positions of the sensors which emit signals to the control unit are shown in the illustrations on next page.

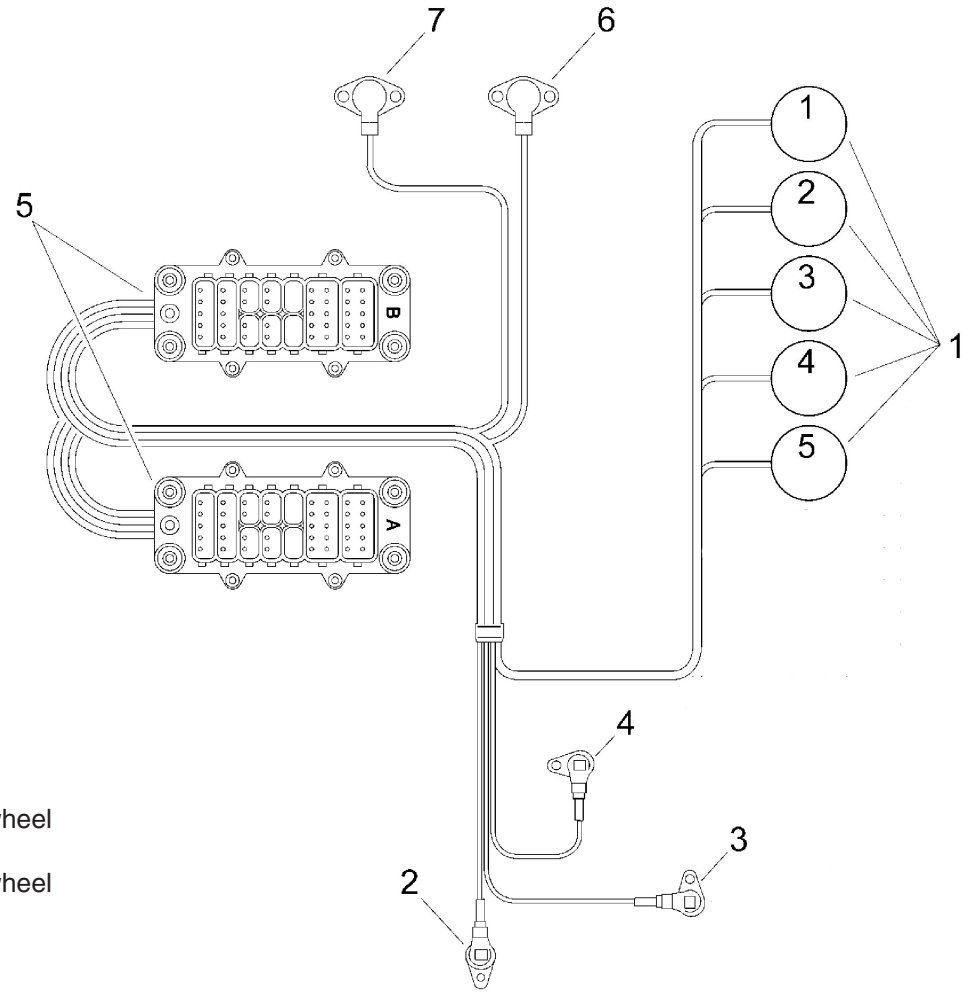
See the section
How to read fault codes from the ECU control unit,
for a description of how to read off flashing codes.

See the section
Flash codes tables
for a list of flashing codes for the control unit and



ECU Control unit

Wiring and cable duct



1 Cylinder 1–6

2 Coolant temperature sensor

3 Engine speed sensor 1 on flywheel

4 Engine speed sensor 2 on flywheel

5 Connector to control unit

6 Charge air pressure and temperature sensor

7 Oil pressure sensor

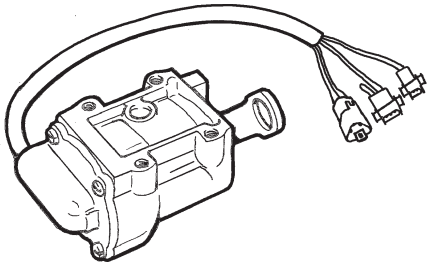
Throttle position sensor

A throttle position sensor need to be added to the system.

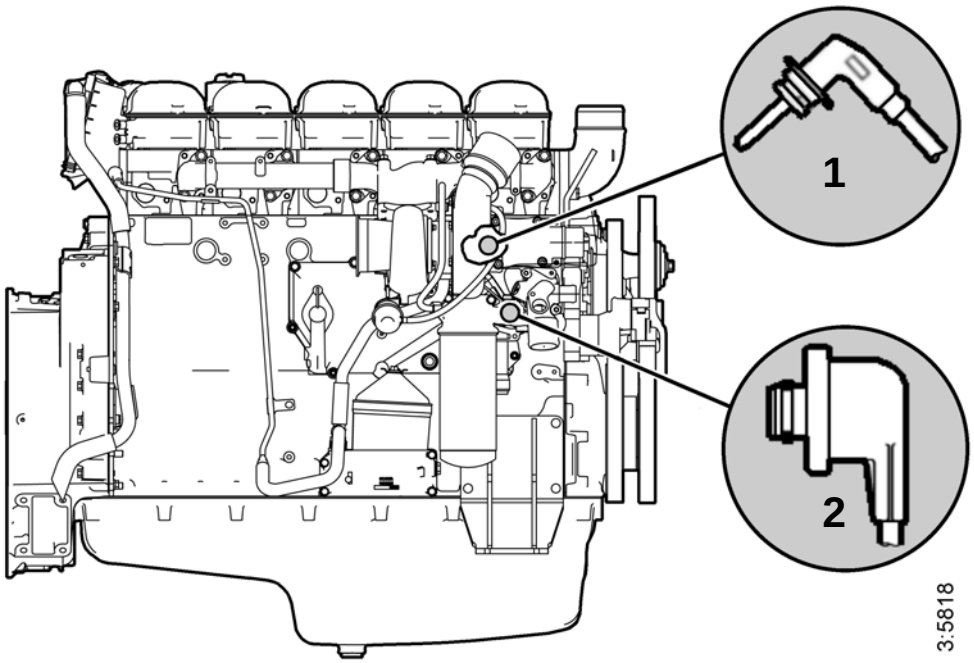
The potentiometer provides the control unit with information about accelerator position.

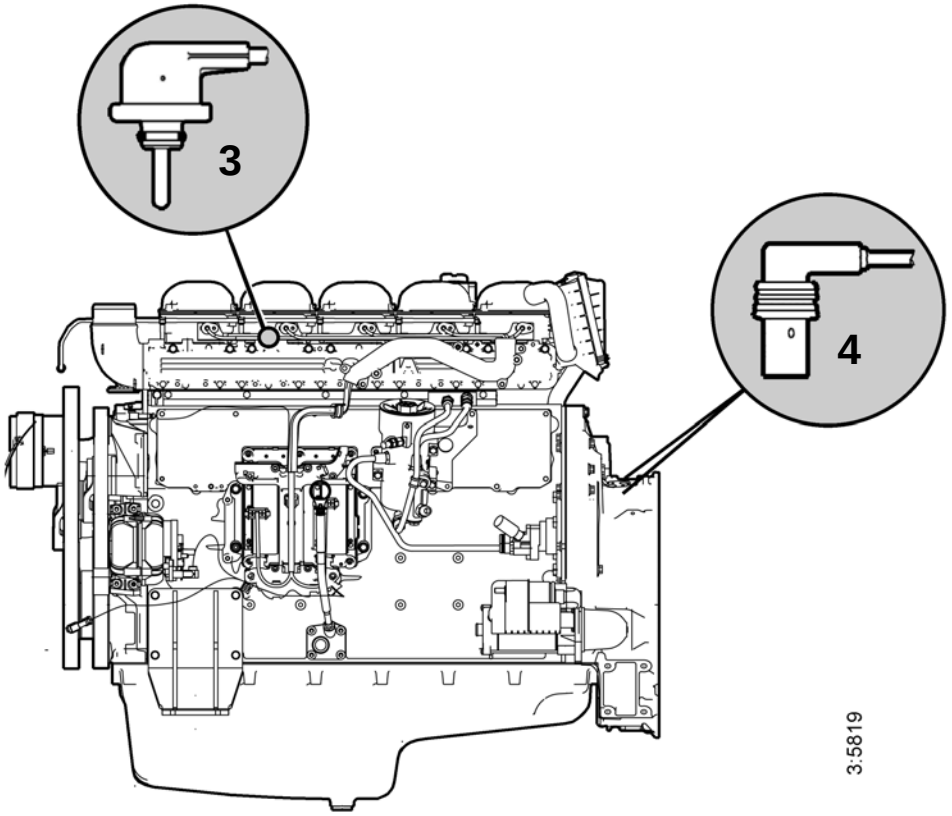
The accelerator position sensor (APS) has an integrated potentiometer and two microswitches for throttle activation (idle safety switch) and full throttle (kick down switch).

The idle safety switch tells the control unit whether the accelerator is released or activated. This is primarily a safety feature to check that the potentiometer is working as it should.



Positions of sensors for ECU



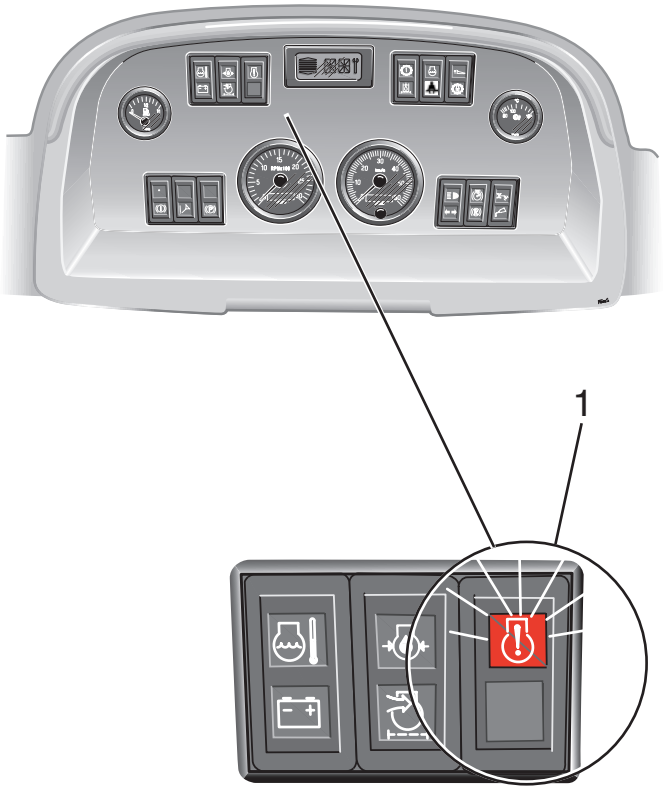


1. Oil pressure sensor
2. Sensor for charge air temperature and pressure
3. Coolant temperature sensor
4. Engine speed sensor (2)

Diagnostic lamp and switch

The diagnostics lamp comes on for one (1) second when the system is started.
The diagnostics lamp will be lit continuously while a fault code is active.

With the aid of the diagnostics switch, the diagnostics lamps flash out any fault codes.
The diagnostics lamp remains lit continuously while disconnecting, i.e. until voltage to the control unit is switched off, provided that the coordinator does not disconnect before this point.



NEW !
1
ECU diagnostics lamp (Engine Controller Unit) and Coo diagnostics lamp (Coordinator)
(The same lamp for both of the functions)

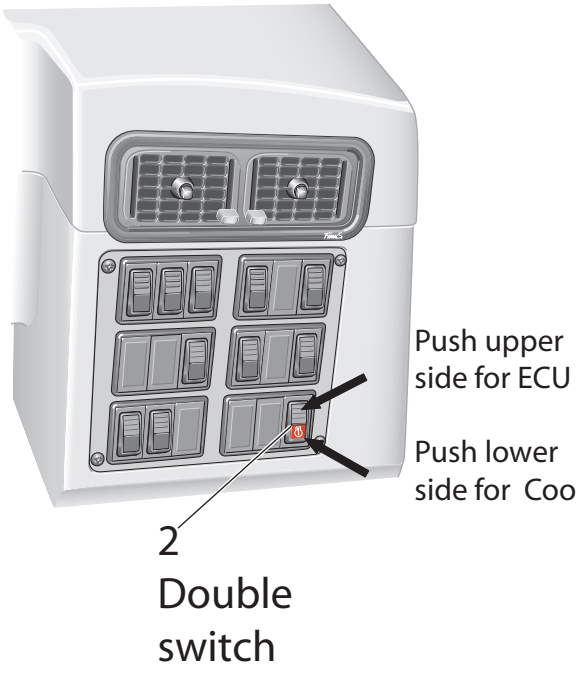
2
Double Diagnostics switch

Diagnostic switch (From machine 810036)
The diagnostics switch for the ECU or the Coordinator is located to the switch panel right hs

The diagnostics switch consists of a double switch for to select and read either the ECU or the Coordinator.

Push the upper side and read the blink code for the ECU.

Push the lower side and read the blink code for the Coo.



Fault codes

Troubleshooting using flash codes for the ECU control unit

• The diagnostics lamp for the control unit always comes on for a second when the system is powered up.

• As soon as a fault is detected by the control unit, a fault code is stored in the EEPROM and the diagnostics lamp for the control unit (the left-hand lamp on the instrument panel) lights up.

• The diagnostics lamp will remain permanently lit for as long as a fault is active. Even if the lamp has gone off and the fault is no longer active, the code can generally be read off in accordance with the instruction below.

• The diagnostics lamp for the control unit stays on during engine shutdown for as long as the control unit and coordinator are powered up.

Checking:

• Fault symptoms

• Conditions in which the fault occurs

• How often the fault occurs

• If the diagnostics lamp lit up when the fault occurred

• If the diagnostics lamp went out by itself when the fault ceased

• If the fault codes have been erased

How to read fault codes from the ECU control unit

Reading fault codes for the ECU control unit:

The instructions below explain how to read fault codes in the form of flashes from the diagnostics switch.
You can see how to interpret the flash codes on the next page.
How to read fault codes from the diagnostics lamp

1 Switch on the ignition.

2 Press the diagnostics switch for at least one second. Diagnostic lamp will light up.

3 A fault code will be flashed out on the diagnostics upper lamp for the control unit.

This flash code consists of
long flashes (about 1 second long)
and
short flashes (0.3 seconds long).

Long flashes are equivalent to tens and short flashes to units.

Example: long - long - short - short - short - short - short = fault code 25.

See the example on the right.

= 25

Repeat this procedure until the first flash code is repeated.
This means that the entire fault code memory has been flashed up.
If the fault code memory is empty, only one long flash about four (4) seconds long is given.

See the example on the right.

= 4 s

4 See the **flash code table** for a description and localisation of the fault.

5 The PC-based diagnostics tool must to be used to gain further information on the fault code.

6 A single, very long flash (4 s) means that there are no fault codes stored in the memory.

= 4 s

How to erase fault codes from the ECU control unit

The control unit memory has sufficient space to store 40 fault codes.
The fault codes are stored in two different places in the control unit.
Erasing with the diagnostic switch erases the fault codes that are flashed on the diagnostic lamp.
However, the fault codes will remain in another memory which can only be accessed using a ECOM.

Both fault code memories are erased at the same time with ECOM.
How to erase fault codes during pre-delivery inspection
Fault codes are to be erased with ECOM during pre-delivery inspection so that both memories are empty when the engine is delivered to the customer.

How to erase fault codes using the diagnostics switch

How to erase fault codes that are flashed on the diagnostic lamp is described below.
The fault codes are still stored elsewhere in the control unit.
These fault codes are erased with ECOM.

1 Start and switch off the engine once so that a shutdown test is carried out.
Wait until the ECU warning lamp has gone out.

2 First press and hold the diagnostics switch, then turn the starter key to the drive position.
Keep pressing the diagnostics switch for between 3 and 10 seconds.
The passive fault codes will then have been cleared.
When the engine is started again, the fault codes that are active will be shown again.

3 Start the engine and check that the diagnostics lamp goes out.

4 Press the diagnostics switch.
The fault code memory should be empty; only one long flash should be seen.

Flash codes tables

This is a list of the flash codes which can be read and the fault codes to which they correspond.
One flash code in ECU S6 corresponds to several different fault codes.

Flashing code list for the EMS control unit

Code	Description	Code	Description
0	No fault detected.	53	PDE in cylinder 3: The solenoid valve does not work correctly.
11	Overspeed. One or both engine speed sensors are displaying speeds in excess of 3000 r/min.	54	PDE in cylinder 4: The solenoid valve does not work correctly.
12	Engine speed sensor 1 faulty, or incorrect signal.	55	PDE in cylinder 5: The solenoid valve does not work correctly.
13	Engine speed sensor 2 faulty, or incorrect signal.	56	PDE in cylinder 6: The solenoid valve does not work correctly.
14	Coolant temperature sensor faulty, or incorrect signal.	57	PDE in cylinder 7: The solenoid valve does not work correctly.
15	Charge air temperature sensor faulty, or incorrect signal.	58	PDE in cylinder 8: The solenoid valve does not work correctly.
16	Charge air pressure sensor faulty, or incorrect signal.	59	Incorrect signal in extra analog input.
17	Oil temperature sensor faulty, or incorrect signal.	61	Incorrect control unit shutdown.
18	Oil pressure sensor faulty, or incorrect signal.	66	Shutdown due to coolant level
21	Coolant level sensor faulty.	68	Alternator charging incorrectly.
23	Fault code internally in the coordinator.	69	Starter motor function interrupted or not activated.
24	Accelerator/brake. If the accelerator and brake have been operated simultaneously.	82	Engine speed above ref. speed at start
25	Accelerator sensor/idling switch Accelerator sensor/kick-down switch	83	Fault in memory circuit (EEPROM) in control unit.
27	Engine shutdown bypassed.	84	Data transfer to the control unit memory (EEPROM) has been interrupted.
28	Shutdown due to oil pressure	85	Incorrect temperature internally in the control unit.
31	Torque limitation due to oil pressure	86	Internal fault in the control unit: Fault in hardware control.
32	Incorrect parameters for limp home function.	87	Fault in control unit RAM.
33	Battery voltage incorrect or no signal.	88	Internal control unit fault: Memory fault
37	Emergency shutdown switch activated in accordance with CAN message from coordinator.	89	Incorrect seal: Illegal editing of software.
43	CAN circuit faulty in the control unit.	93	Engine speed sensors faulty or not connected.
47	Immobiliser function. Ignition key code incorrect.	94	Shutdown due to high coolant temperature.
48	There is an incorrect CAN message or no CAN message from the coordinator.	96	Torque limitation due to high coolant temperature.
49	Incorrect CAN version in control unit or coordinator.	98	Incorrect voltage supply to one of the sensors.
51	PDE in cylinder 1: The solenoid valve does not work correctly.	99	Internal hardware fault in the processor (TPU).
52	PDE in cylinder 2: The solenoid valve does not work correctly.		

Troubleshooting using flash codes for the coordinator

• As soon as a fault is detected by the coordinator, it is stored in the EEPROM fault code memory.
The diagnostics lamp for the coordinator (the right-hand lamp on Scania's instrument panel) comes on when the diagnostic switch is actuated.

• The EMS lamp also lights up to indicate that there is an internal fault in the coordinator (fault code 23)

• Even if the lamp has gone off and the fault is no longer active, the code can generally be read off in accordance with the instruction below.

How to read fault codes for the coordinator

1 Switch on the ignition.
2 Depress the diagnostic switch for at least 1 second.
3 A fault code will then flash on the diagnostics lamp for the coordinator (the right-hand lamp on Scania's instrument panel).
This flash code consists of long flashes (about 1 second long) and short flashes (0.3 seconds long).
Long flashes are equivalent to tens and short flashes to units.

Example: long - long - short - short - short - short - short = fault code 25. Refer to the illustration.



4 Repeat this procedure until the first flash code is repeated. This means that the entire fault code memory has been flashed up. If the fault code memory is empty, only one long flash approximately 4 seconds long will be given.

5 See the flash code list on page 14 for a description and localisation of the fault.

How to erase fault codes

1 Turn the ignition off.

2 Depress the diagnostic switch while turning on the ignition.

3 Hold the diagnostic switch down for between 3 and 10 seconds.

4 This erases the passive fault codes.
The active codes must be rectified to make them passive. They can then be erased.

Overview of flash codes for coordinator

Code	Description of fault	Cause	Action	Note
11	Incorrect signals from the accelerator pedal sensor.	The flash code is registered when the voltage from the accelerator pedal sensor is outside the setting range.	Check the accelerator pedal sensor, connectors and cables.	See also fault codes for the ECU control unit.
12	Incorrect signals from the cruise control switches.	The flash code is registered when the voltage from the cruise control switches is not within the correct range.	Check the cruise control switches, connectors and cables.	When there are fault codes, the cruise control will perate.
13	No communication with the engine.	The flash code is registered when communication from ECU (S6) is cut off.	Check CAN connectors and cables.	When this fault occurs, the diagnostics lamp for ECU (S6) also comes on.
14	Short-circuit in the tachometer signal circuit.	The flash code is registered when there is a short circuit between the output signal and earth or supply. The flash code is registered after 10 seconds.	Check the instrument panel, connectors and cables.	
15	Faulty atmospheric pressure sensor.	The signal from the integrated sensor is outside the range.	Renew the coordinator.	See also fault codes for the ECU control unit. The signal is not always required. Check with Moxy service.
16	The signals from the brake pedal switches do not agree.	The flash code is registered after 5 minutes.	Check the brake pedal switches, connectors and cables.	See also fault codes for the ECU control unit.
17	Short circuit in the engine temperature gauge signal circuit.	The flash code is registered when there is a short circuit between the output signal and supply. The flash code is registered after 10 seconds.	Check the instrument panel, connectors and cables.	If there is a fault the gauge will display a low temperature.
18	Short-circuit in the oil pressure gauge signal circuit.	The flash code is registered when there is a short-circuit between the output signal and supply. The flash code is registered after 10 seconds.	Check the instrument panel, connectors and cables.	If there is a fault the gauge will display a high pressure.
19	Short-circuit in the oil pressure lamp signal circuit.	The flash code is registered when there is a short-circuit between the output signal and supply. The flash code is registered after 10 seconds.	Check the instrument panel, connectors and cables.	If there is a fault the lamp will not come on
21	Different versions of the communications protocol between the coordinator and EMS.	ECU does not have the same version of the communication protocol as the coordinator.	Replace the coordinator with a matching unit.	

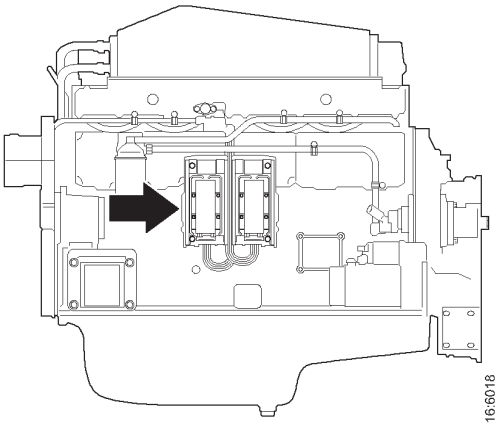
Continued next page

Code	Description of fault	Cause	Action	Note
22	The supply voltage is too high.	The supply voltage exceeds 35 volts for more than 2 seconds.	Check the alternator.	Certain inputs and outputs become inactive. The coordinator may suffer damage.
23	The supply voltage is too low.	The supply voltage is less than 18 volts for more than 2 seconds.	Check the battery and alternator.	Certain inputs and outputs become inactive.
24	The supply voltage is too low.	The supply voltage is less than 18 volts for more than 2 seconds.	Check the battery and alternator.	Certain inputs and outputs become inactive.
25	Check value from End of line (EOL) is incorrect			
26	Road speed sensor signal missing or faulty.			
27	The signal from the RCB (remote Control Box) switches are implausible.			
28	Incorrect signals from the droop-settings switches			
29	Faulty remote start switch or short circuit			
31	No communication from the slave-coordinator or the master coordinator.			
32	Short circuit in the signal cable to the coolant temperature warrning lamp			
33	Short circuit in the signal cable to the charge indicator lamp			
34	Incorrect signal from the Fixed speed switches			
35	Fault in CAN communication			

Renewing the control unit

Tightening torques

Control unit, screws	22 Nm



Work description

IMPORTANT!

The control unit may suffer damage if it is powered when you unplug it.
Before removing the control unit you must switch off the power with the starter key and wait for the EMS warning lamp to go out.

1
Remove the covers over the connectors on the control unit and then unplug the connectors.

2
Remove the control unit fixing screws and lift off the control unit.

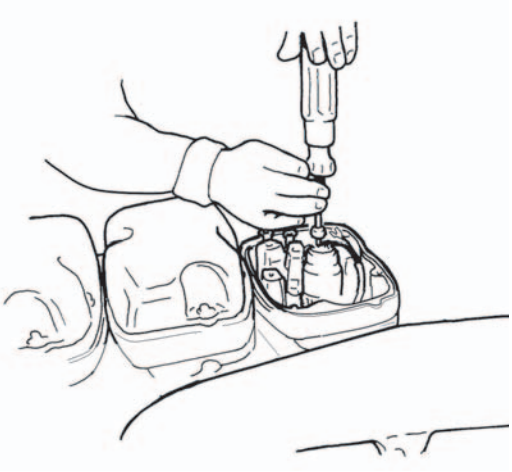
3
Fit the new control unit and tighten the screws to 22 Nm.

4
Plug in the connectors on the control unit.

5
Do the necessary programming with ECOM. Start the engine. Check the fault codes and then delete them in accordance with the routine in troubleshooting booklet or with the PC-tool ECOM if it is available.

Removing the ECU wiring

Drain the coolant from the engine as described in the work descriptions for the cooling system.

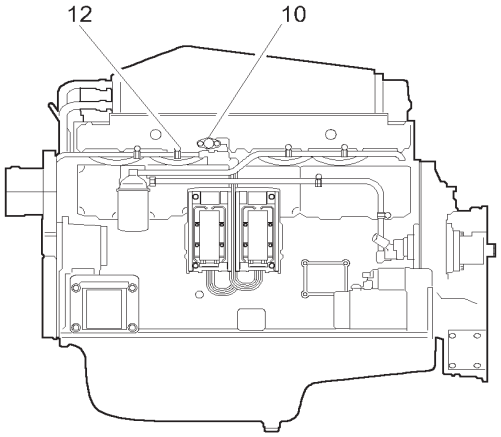


2
Wash clean the rocker covers and the area around them.

3
Remove the inlet pipe between the turbocharger and the air cleaner.

4
Remove the air line to the compressor. The air line is located on the left-hand cable duct.

5
Unplug the connectors from the control unit.

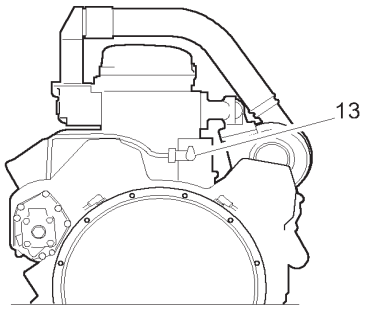


6
Remove the rocker covers.
On the 12-litre engine the crankcase ventilation must be removed before the rocker cover on cylinder 1 can be removed.

7
Disconnect the cables from the unit injectors.
The screws cannot be removed, but they should be unscrewed as far as possible.

8
Mark the cables with the respective cylinder numbers.

9
Remove the cable duct to which the cables are attached.
The unscrew the cable bushings in the lower rocker covers and remove the cables.

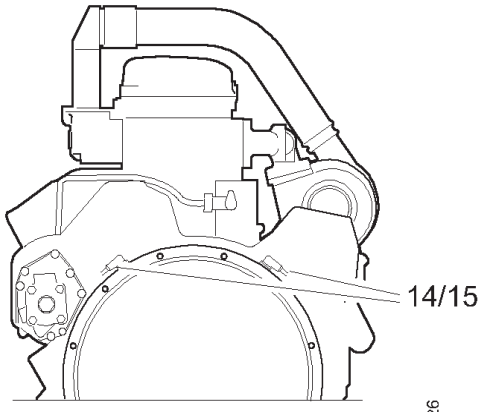


16:6027

10
Remove the charge air sensor and its clamps.

11
On engines fitted with an electricallycontrolled fan, separate the connector on the fan ring, which is connected to the solenoid valve. Remove the cable clamps as well.

Note:
Handle the engine speed sensors with care. They are magnetic and are sensitive to impacts.



16:6026

14
Remove engine speed sensor 1 and its clamps.

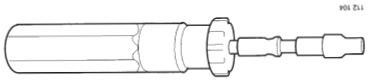
15
Remove engine speed sensor 2 and its clamps.

Fitting the wiring

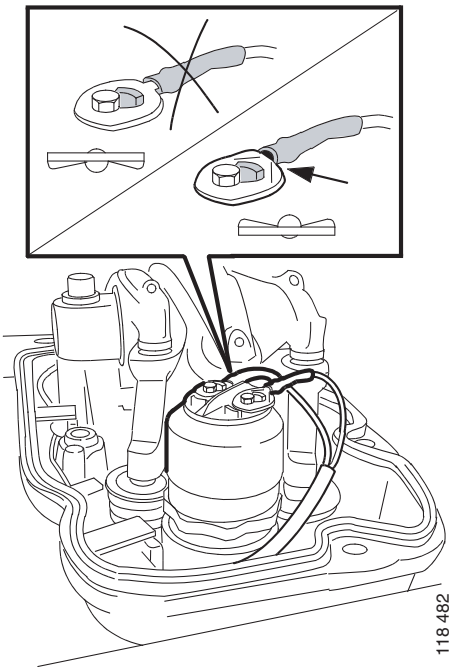
Tightening torques:

Unit injector solenoid valves, screws: 2,0 +/-0,2 Nm

512562 Torque screwdriver



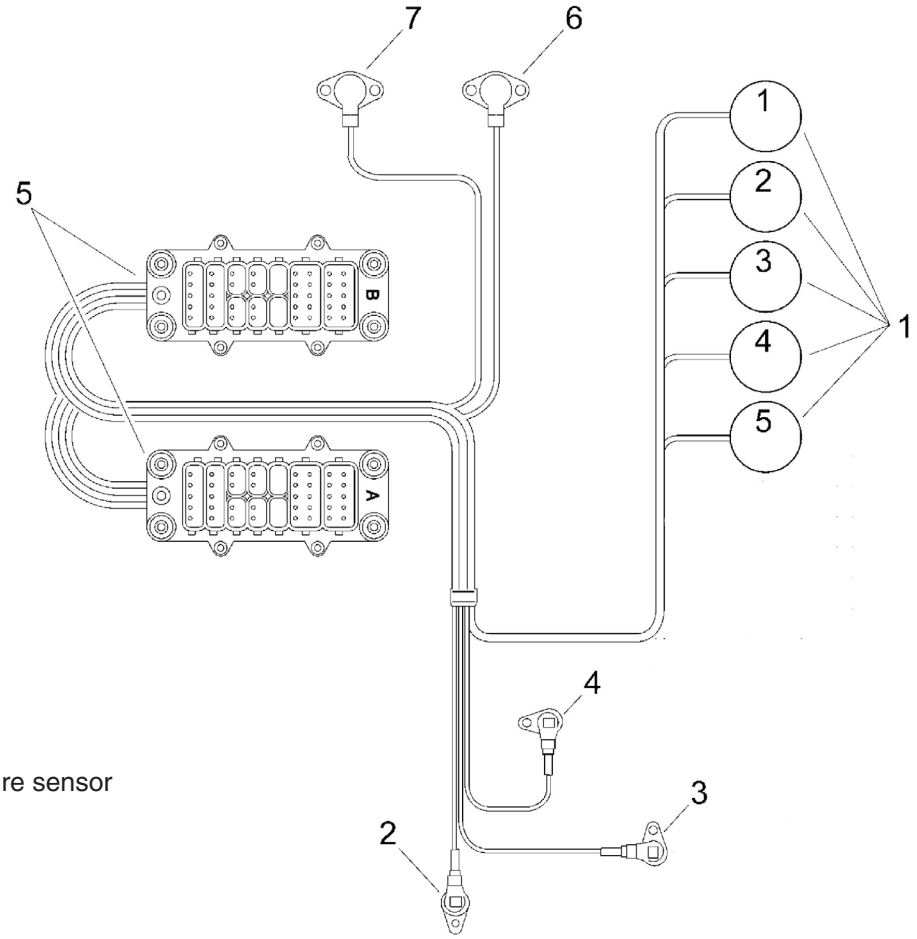
IMPORTANT!
If the screws are tightened too tight, there is a risk that they may break. If this happens, the entire unit injector must be replaced.



Work description:

1
Make sure that the inlet pipe between the turbocharger and the air cleaner has been removed.

2
Fit the cable ducts. Schematic illustrations of the location of the cable ducts and their components are shown below



1 Cylinder 1–6

2 Coolant temperature sensor

3 Engine speed sensor 1 on flywheel

4 Engine speed sensor 2 on flywheel

5 Connector to control unit

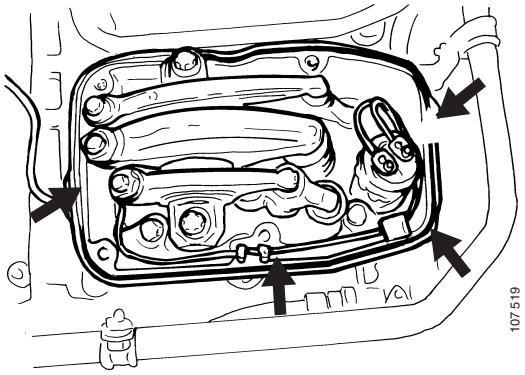
6 Charge air pressure and temperature sensor

7 Oil pressure sensor

3
Run the cables to the unit injectors.
Check that you have run the right cable to each unit injector by testing the cables with a multimeter as shown in the tables.

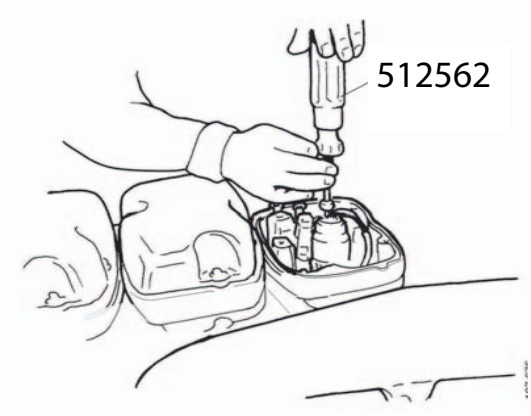
Cylinder	Connector	Pin
1	B2	1 and 6
2	B2	2 and 7
3	B2	4 and 9
4	A1	1 and 6
5	A1	2 and 7
6	A1	4 and 9

4
Press the cables into the groove in the lower rocker cover.
See the illustration about **Fitting the wiring.**



Note:
Take care when tightening the cable connection screws on the unit injector. If a screw breaks, the unit injector must be replaced.

5
Secure the cables to the unit injectors by tightening the screws. Use torque screwdriver 512562 and tighten the screws to 2.0 +/- 0.2 Nm.



(6- 7- 8- Other type of Scania engine)

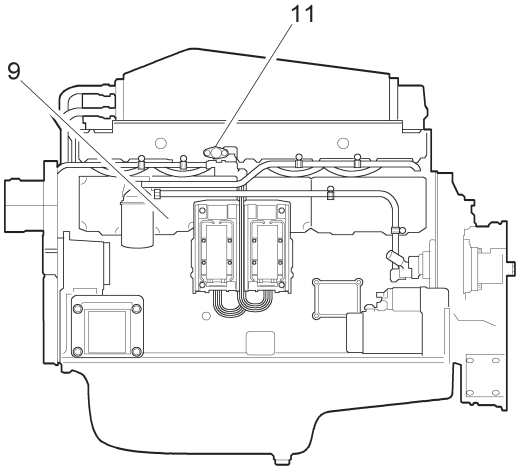
9
Fit the oil pressure sensor and its clamps.

10
Fit the coolant temperature sensor and its clamps.

11
Fit the charge air sensor and its clamps.
Note: Handle the engine speed sensors with care. They are magnetic and are sensitive to impacts.

12
Fit the auxiliary engine speed sensor and its clamps.

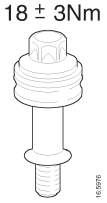
13
Fit the main engine speed sensor and its clamps.

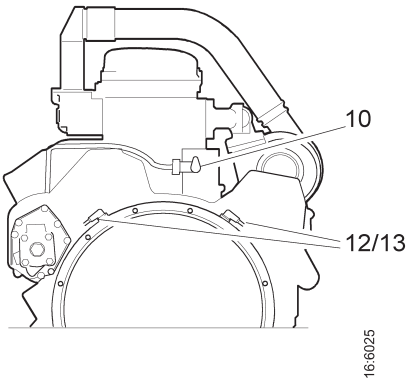


14
Connect ECOM to the engine and check the unit injectors by activating them. Check also that the values from the sensors are correct.

15
Plug the connectors into the control unit.

16
Fit the upper rocker covers and tighten the screws to 18 ± 3 Nm.





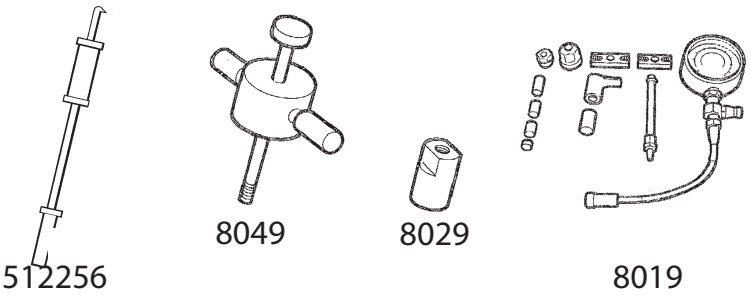
17
Fit the inlet pipe between the turbocharger and the air cleaner.

18
Top up with coolant in accordance with the

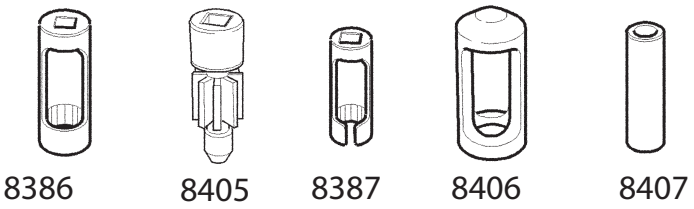
Cylinder head

Special tools

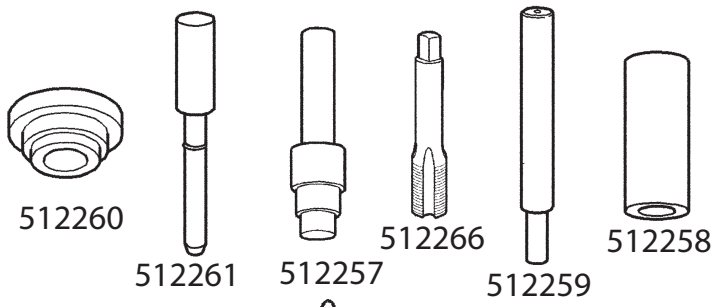
512256 Slide hammer
8049 Impact drift
8029 Extractor for injectors
8019 Compression tester



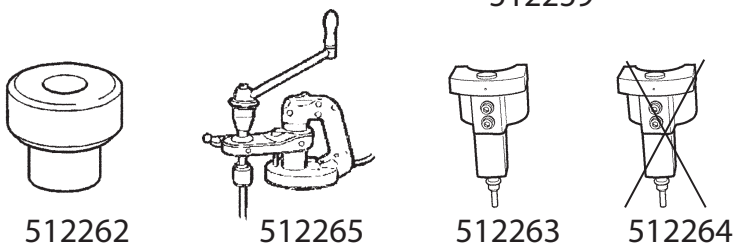
8386 Sleeve for injectors
8405 Tool for turning flywheel
8387 Socket
8406 Press drift
8407 Assembly drift



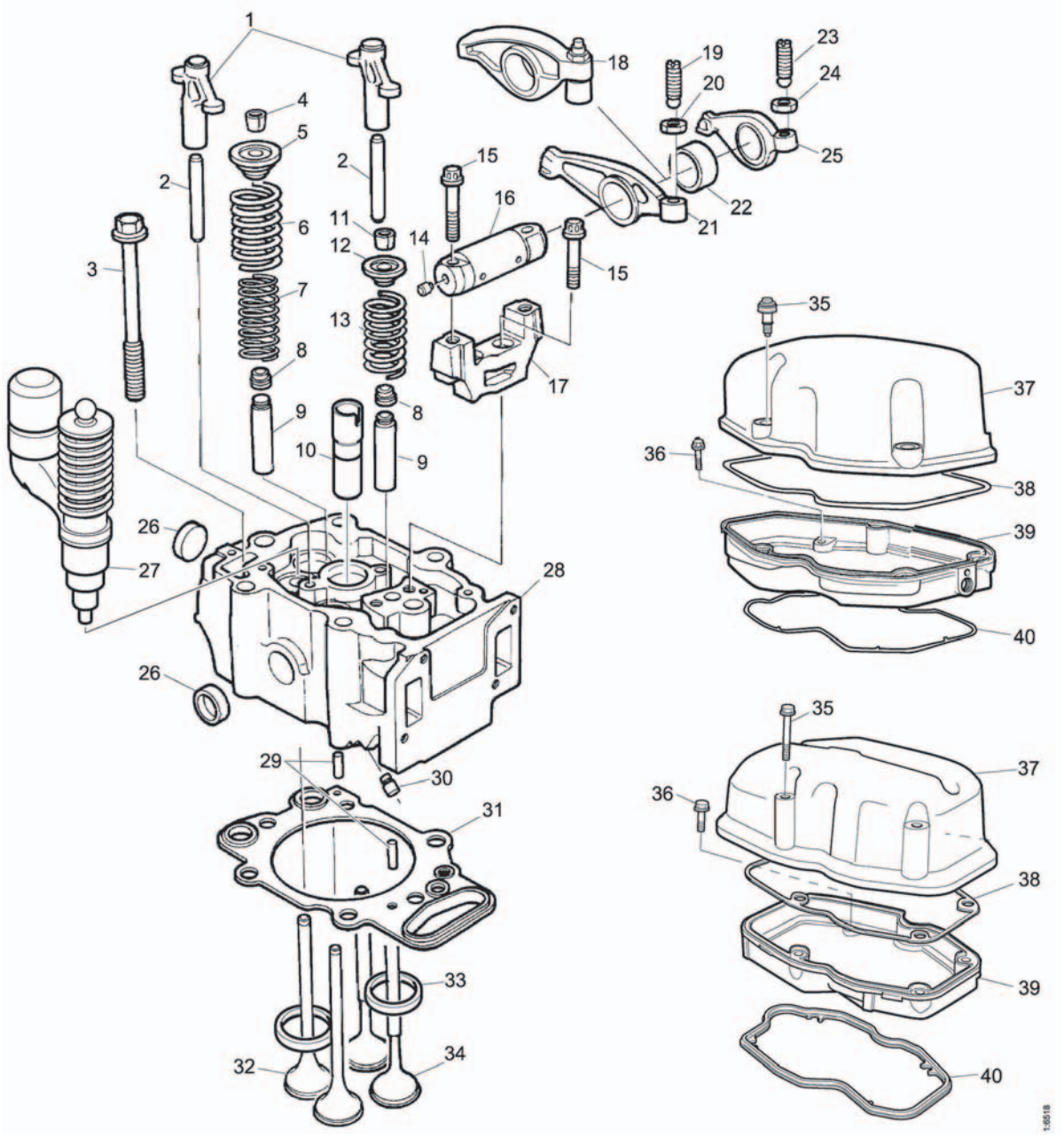
512260 Drift
512261 Handle
512257 Drift
512266 Pilot tap
512259 Drift
512258 Drift



512262 Guide
512265 Valve seat cutter
512263 Setting tool
512264 Setting tool



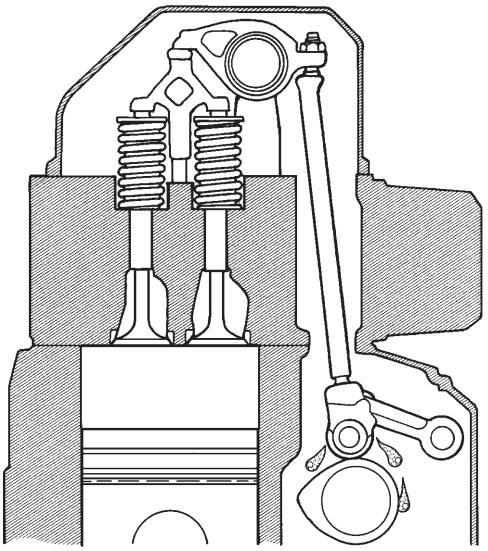
Cylinder head, parts view.



1. Valve bridge
2. Pin
3. Bolt
4. Collet
5. Valve spring collar
6. Valve spring
7. Valve spring
8. Valve stem seal
9. Valve guide
10. Socket
11. Collet
12. Valve spring collar
13. Valve spring
14. Rivet plug
15. Tight-fit screw
16. Shaft
17. Bearing bracket
18. Rocker arm for unit injector
19. Adjusting screw
20. Hexagon nut
21. Rocker arm
22. Spacing sleeve (injection pump)
23. Adjusting screw
24. Hexagon nut
25. Rocker arm
26. Core plug
27. Unit injector
28. Cylinder head
29. Pin
30. Rivet plug
31. Gasket
32. Exhaust valve
33. Valve seat insert
34. Intake valve
35. Flange bolt
36. Flange bolt
37. Rocker cover, upper section
38. Rocker cover gasket
39. Rocker cover, lower section
40. Rocker cover gasket

Valve mechanism

The purpose of the valve mechanism is to actuate the valves, causing them to open and close at the right times in relation to the position of the crankshaft and piston.



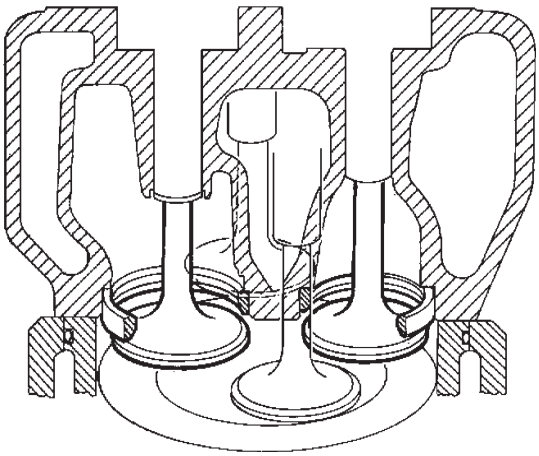
The camshaft is located high up and driven by the timing gears at the rear end of the engine so that it rotates at half the speed of the crankshaft.

The camshaft cams (lobes), two for each cylinder, actuate the valve tappets.

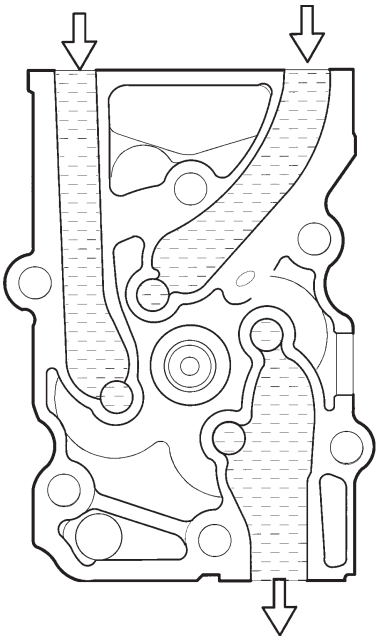
The pushrods have one end in the tappets and the other end, via the rocker arms, transfers the movement from the camshaft cam to the valves.

At one end of the rocker arm is an adjusting screw, the spherical lower end of which rests in the pushrod so that the tappet follows the camshaft at all times.

The correct clearance can be set with the adjusting screw to ensure that the valve will close properly during combustion.

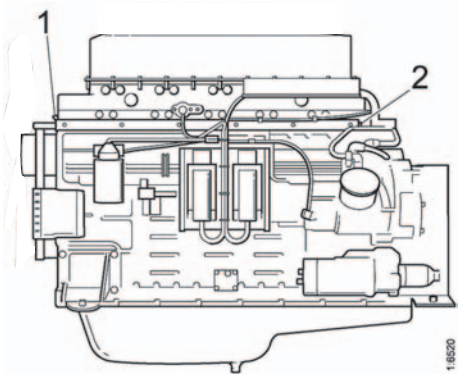


The valves seal against valve seat rings which are pressed into the cylinder head to make a tight fit.
The valve seat rings are made of extremely durable material to give them a long service life.
Should it be necessary, they are replaceable.



With four valves per cylinder, the total valve area becomes greater, making it easier to fill the cylinder with air. At the same time, less energy is consumed in forcing out the exhaust fumes.
The effort required for gas flow is reduced and engine efficiency is improved. This in turn leads to a reduction in fuel consumption.
The injector can be located centrally, which improves combustion and results in reduced emissions and lower fuel consumption.

1.
Open the bleeder nipple and drain the fuel system by undoing the banjo screw on the back of the fuel manifold.

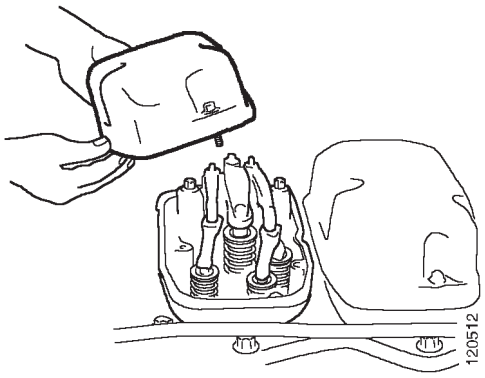


1. Bleeder nipple
2. Banjo screw

WARNING!

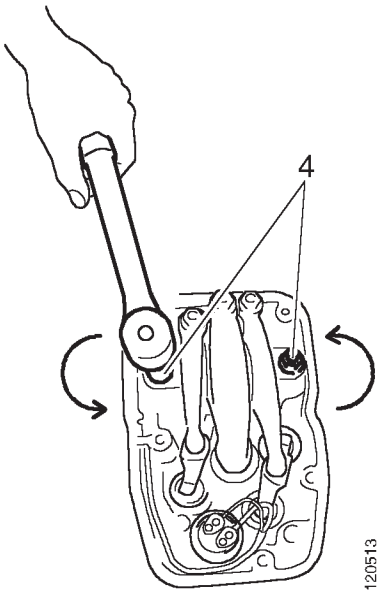
The fuel system must be empty or fuel may run down into the cylinders, which will result in a great risk of liquid hammering. If fuel runs into the combustion chamber, it must be removed immediately using a pump.

2.
Clean the rocker cover and the surrounding area.



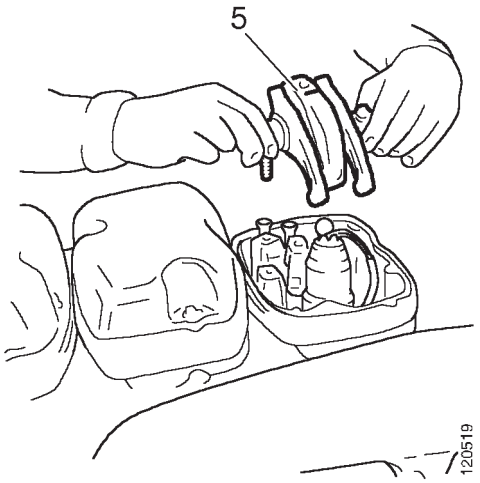
3.
Remove the top part of the rocker cover.

4.
Relieve the pressure on the valves by undoing the bolts on the rocker arm shaft alternately.



WARNING!

Do not lean over the engine when removing the rocker arm shaft. The unit injector spring is pre-tensioned and can come loose, causing personal injury.



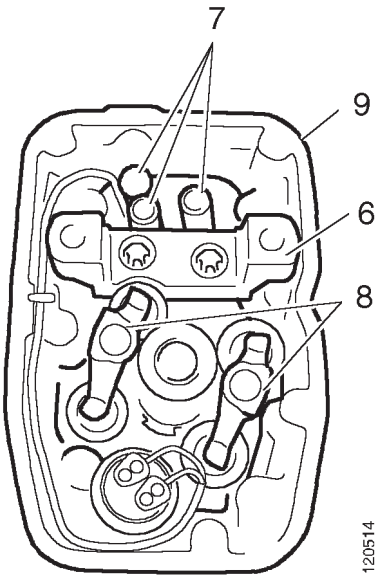
Note:

If the spring comes loose from the unit injector, the unit injector must be renewed.

5.
Remove the rocker arm shaft.

6.
Remove the bearing bracket.

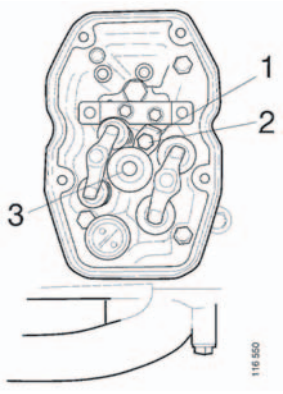
7.
Remove the pushrods.
Note: The pushrod for the unit injector is secured with a retaining ring. Jiggle and pull carefully on the pushrod to loosen it.



8.
Remove the valve bridges.

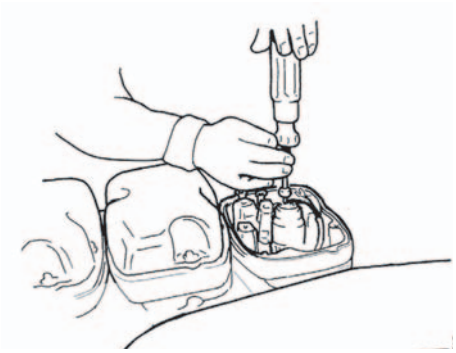
9.
Remove the lower rocker cover.

10.
Remove the fork clamp bolt holding the unit injector in place.



1. Fork clamp
2. Fork clamp bolt
3. Unit injector

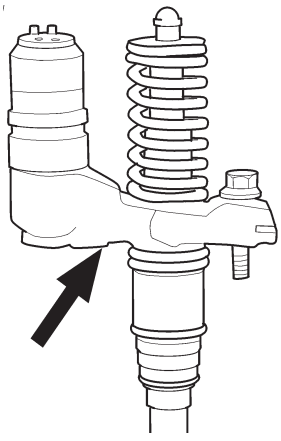
11.
Detach the cables on the unit injector. The screws cannot be removed but undo them as far as possible.



Note:
Do not lift the unit injector by the spring. The spring can come loose.

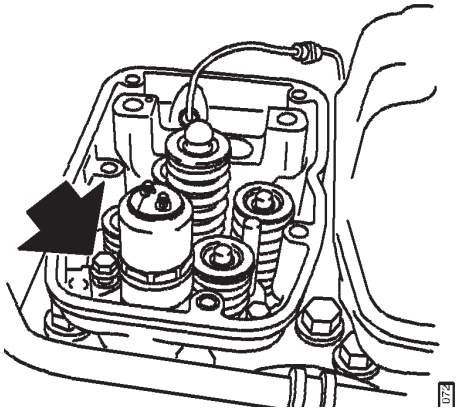
12.
Turn the unit injector anti-clockwise until it stops. Place the slide hammer 87 596 between the solenoid valve and the edge of the lower rocker cover as illustrated.

Note:
If the slide hammer is placed directly under the solenoid valve, there is a risk of breaking the solenoid valve.



Place the slide hammer as indicated by the arrow.

13.
It is easier to position the slide hammer if one of the lower rocker cover bolts is removed.

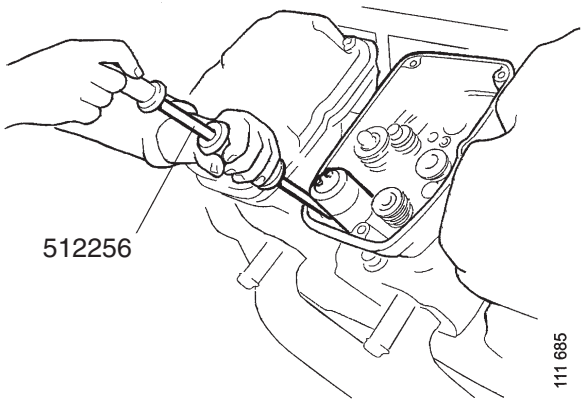


14.
Withdraw the unit injector. If the unit injector is stuck, tap carefully with a rubber mallet on the solenoid valve housing.

Important!

The unit injector is not to be dismantled.

Renew the entire unit.



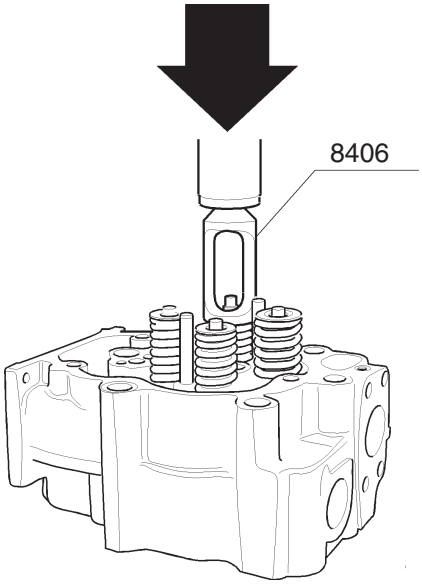
15.
Remove the sealing washer from the bottom of the injector seat, (if it was left behind when the unit injector was removed).

16.
Detach the intake manifold, fuel manifold, ventilation pipe for the cooling system and the exhaust manifold.

17.
Remove the cylinder head. Mark the cylinder heads if more than one is being removed at the same time.

Dismantling

1.
Remove collets, valve spring collars, springs and valves. Press the spring down using tool 8406 in a press so that the collets can be removed.

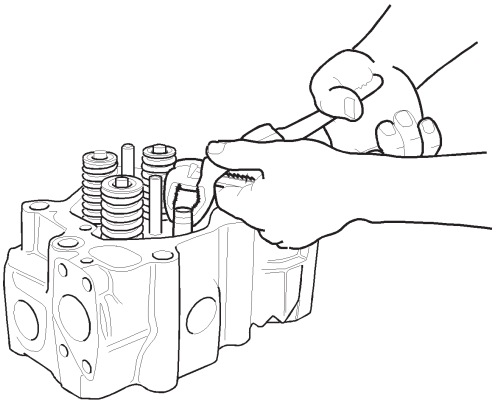


2.
Mark and place the valves in a rack so that they can be refitted in the same position in the cylinder head.

3.
Mark the cylinder heads if more than one is removed at the same time.

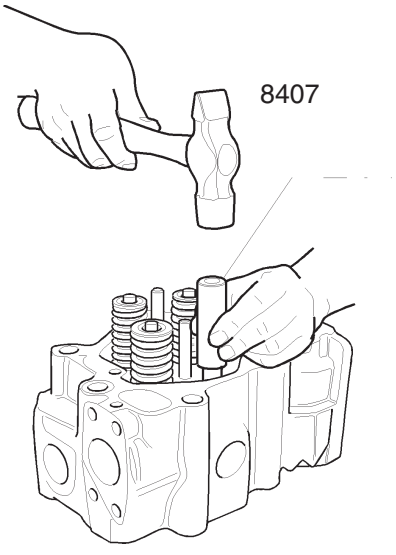
Renewing the valve stem seal

1.
Remove the valve.



2.
Remove the valve stem seal with a pair of pliers.

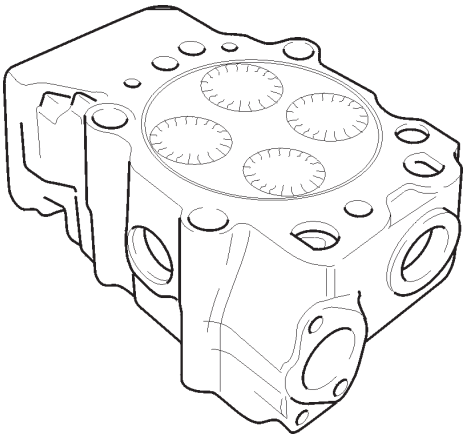
3.
Fit the valve.



4. Tap in a new valve stem seal carefully using tool 8407 and a hammer.

Replacement of valve seats

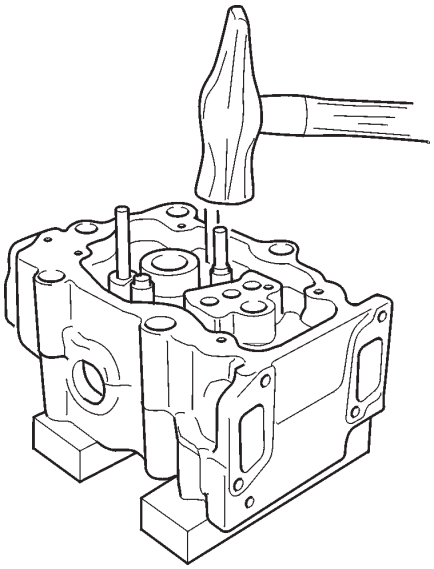
1.
Remove the valve seat inserts. Use a discarded valve that has been ground so that the diameter of the disc is slightly smaller than the inside diameter of the seat.



2.
Fit the valve and weld around it with an electric welder. Cool with water. Turn over the cylinder head and knock the valve stem so that the valve and seat insert fall out.

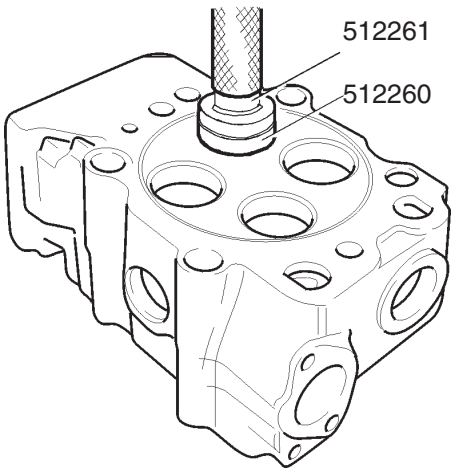
WARNING!

Use protective goggles. Always turn the cylinder head around with the underside downwards when tapping out the valve seat ring. Otherwise there is a risk of loose splinters causing personal injury.



3.
Press in new valve seat inserts. Use drift 512260 and handle 512261.
Cool the drift and valve seat to approximately 80°C in dry ice or using liquid air.
Pressing must be carried out rapidly.

WARNING!

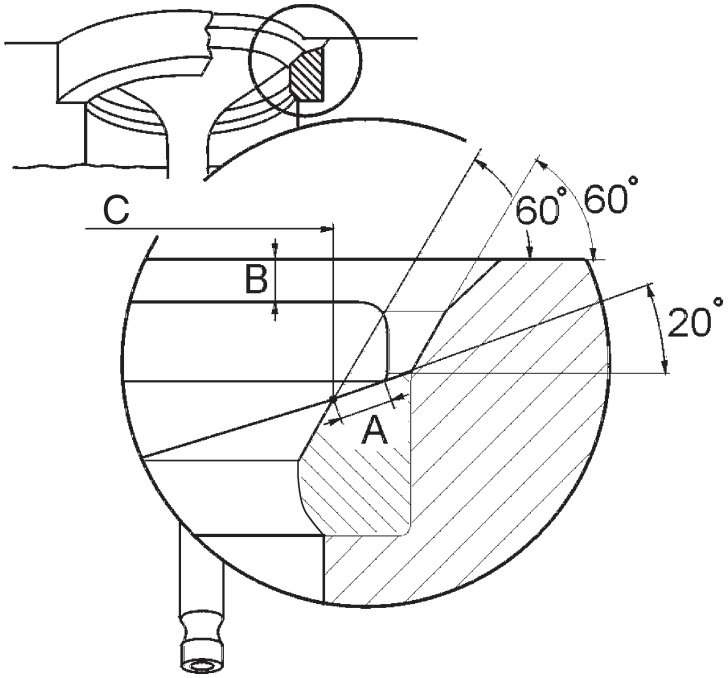


Be careful with the above-mentioned coolants and cooled components. There is a risk of frost injuries.

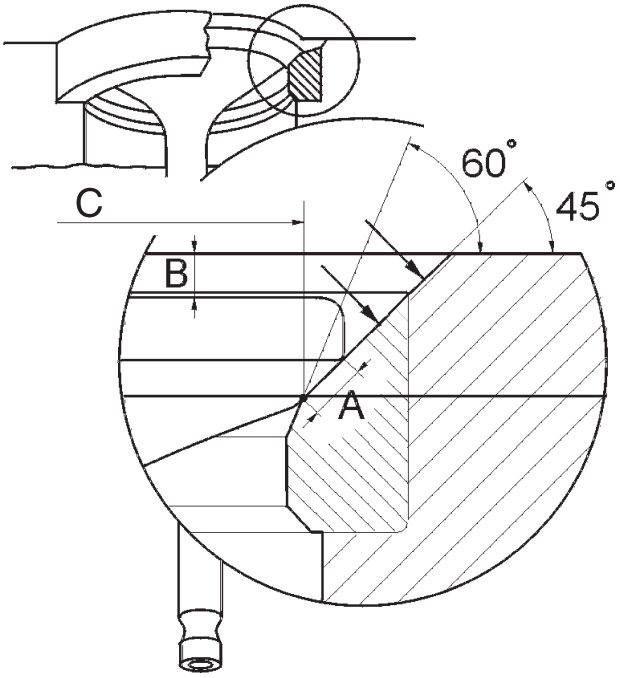
Oversize valve seat inserts can be fitted if the valve seat insert position has been damaged. If this is the case, the seat must be machined using valve seat cutter 512265.

Machining the valve seats insert

Machining values



Inlet valve
A = 1,9 - 2,6 mm
B = 0,75 - 1,8 mm
C = diameter 39,8 +/- 0,5 mm
(setting value for machining tool)



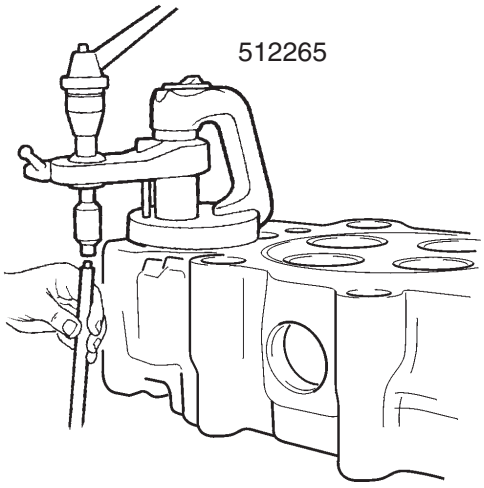
Exhaust valve
A = 1,8 - 2,6 mm
B = 0,66 - 1,8 mm
C = diameter 37,9 +/- 0,5 mm
(setting value for machining tool)

Work description

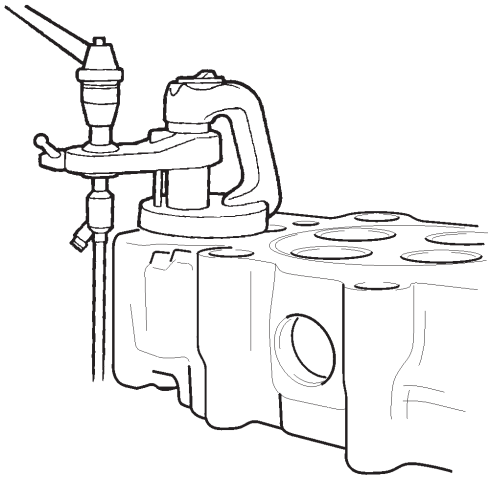
The following description applies to valve seat cutter 512265.
Machining values and over-sized valve seat inserts, see Specifications and above.

1.
Check that the contact surface and the magnetic base are smooth and clean. Clean the valve bushings.

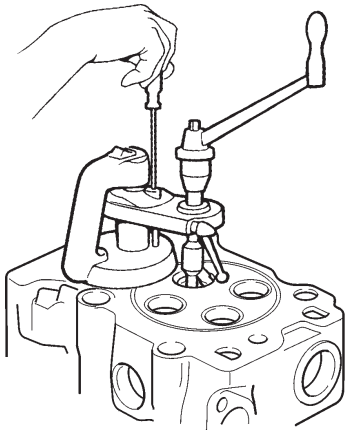
2.
Select the largest spindle which slides easily into the valve guide.Insert the guide spindle and turn the feed screw to its uppermost position.



3.
Select and fit the cutter.

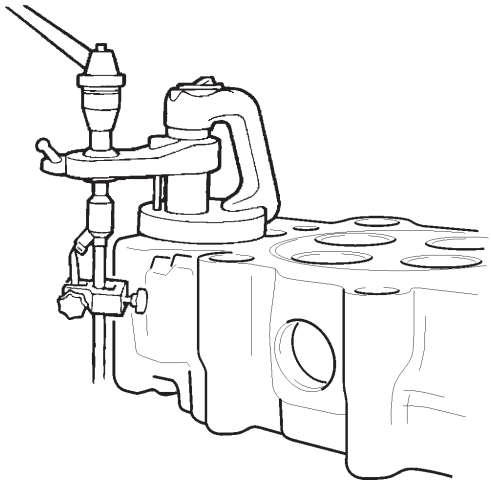


4.
Release the quick-action lock and move the pivot plate to the upper position with the adjusting screw.



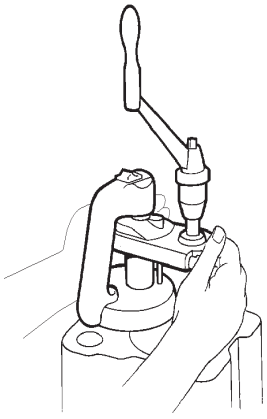
5.
Set up the dial on the cutter adjuster using a valve.

6.
Adjust the cutter. Diameter 37.9 mm or 39.8 mm, see Machining values.



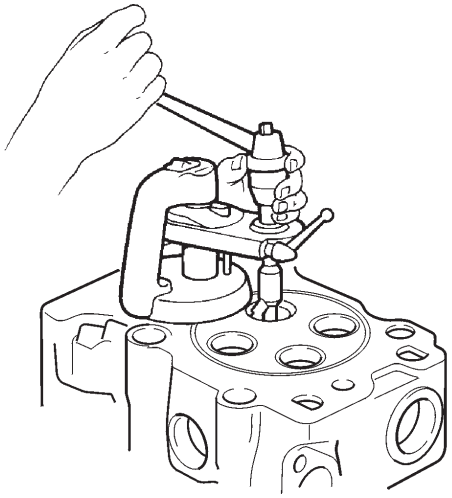
7.
Disconnect the magnetic base (position 2). Insert the guide spindle into the valve bushing. Adjust the pivot plate so that the distance between the cutter and the valve seat is approximately 1 mm.
Centre the tool precisely.

8.
Connect the magnetic base (position 1).



9.
Apply the quick-action lock. Make sure the crank can be turned easily. If not, redo the centering.

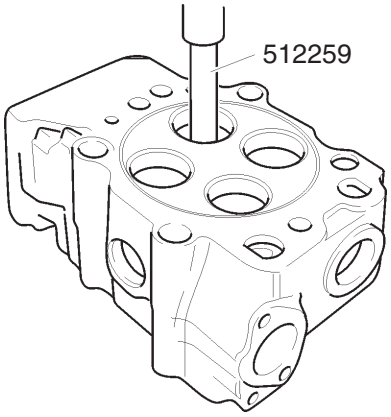
10.
Machine the valve seat by cranking clockwise while turning the feed screw.
Never crank counterclockwise, as this could damage the cutter.
Lubricate with cutting oil during the procedure.



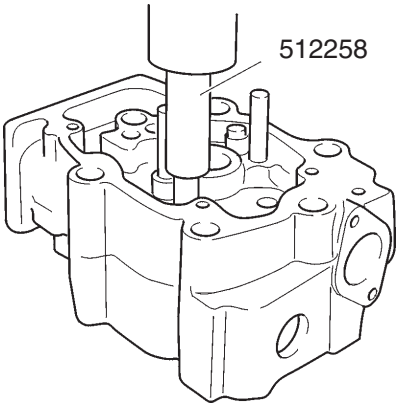
11.
When the machining of the valve seat is completed, reduce the cutting pressure by turning the crank 23
turns without feeding.
Then continue to turn the crank while turning the feed screw anti-clockwise. The valve seat cutter is now ready for the next valve seat.

Renewing the valve guides

1.
Press out the valve guides using drift 512259.

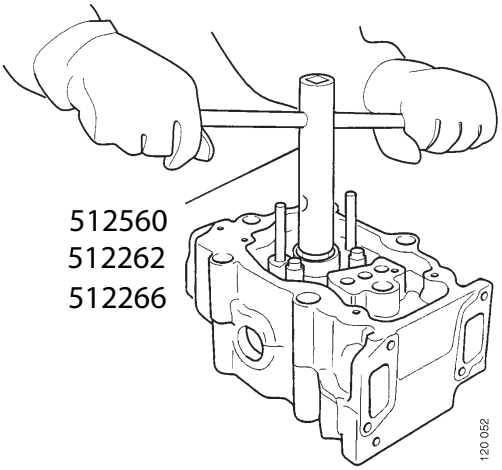


2.
Press in the new valve guides using drift 512258
Press the guide down as far as the drift allows, i.e. until it makes contact with the spring seat in the cylinder head.



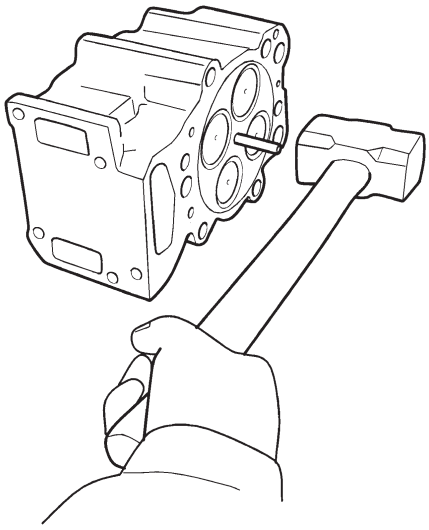
Renewing PDE unit injector sleeves

- The cylinder head must be removed when renewing the injector sleeve.
- The valves do not need to be removed.
- The illustration shows the cylinder head with valves removed to demonstrate clearly the work described.



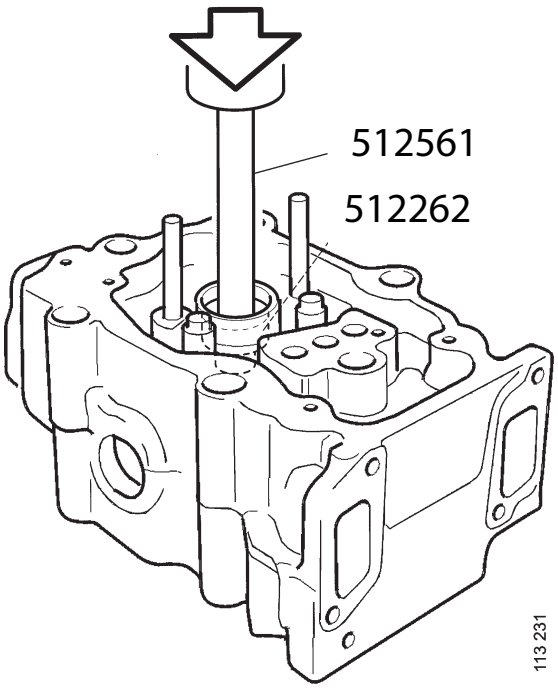
1.
Thread the bottom part of the sleeve with pilot tap 512266 and guide 512262 512560

2.
Knock out the pilot tap and sleeve from underneath. Use a 100 mm metal rod with a 9 mm diameter.



3.
Degrease and check the contact surfaces of the sleeve and cylinder head. Smooth off any burrs and irregularities that may score the sleeve.

4.
Degrease the new injector sleeve and apply a thin film of sealing agent 351161-- on the sleeve and cylinder head contact surfaces.



5.
Press in the sleeve with drift 512561 and guide 512262

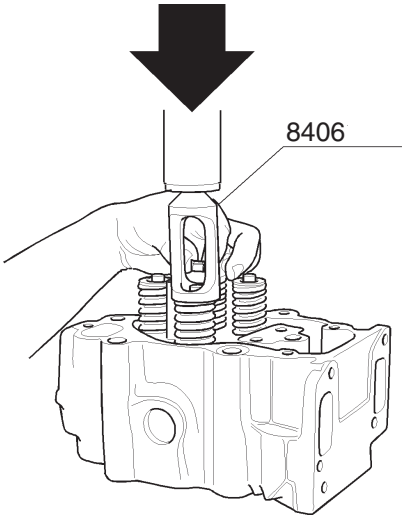
Assembly

1.
Lubricate all parts well with engine oil before assembly.

2.
Fit the valves in the their guides and position the cylinder head in a press.

3.
Fit the valve springs and the valve spring collars.

4.
Compress the springs using tool 8406 and fit the collets, making sure that they go into their correct positions.



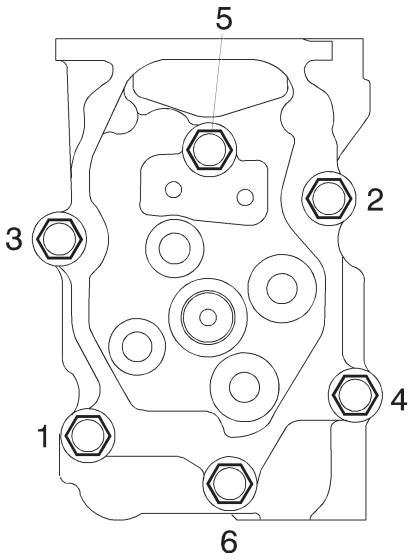
Fitting

1.
Check liner height, refer to Measuring the cylinder liner height.

2.
Fit a new cylinder head gasket.

3.
Fit the cylinder head and ensure that the guide pins fit into the holes.

4.
The cylinder head bolts can be reused up to 3 times. Therefore, make sure the bolts have no more than 2 punch marks on top of the bolt head. If any of the bolts has 3 marks, it must be replaced with a new one.



5.
Lubricate the threads on the cylinder head bolts and the surface under the head.

6.
Tighten the bolts in the order given in the figure and in three stages + 90° as follows:

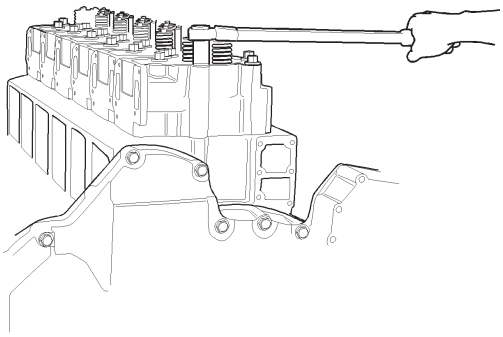
• Tighten all bolts to 60 Nm

• Tighten all bolts to 150 Nm

• Tighten all bolts to 250 Nm

• Finally, tighten all bolts a further 90°

• Make a mark with a centre punch on the head of the bolt.



7.
Fit the lower part of the rocker cover and tighten the bolts to 26 Nm.

PDE Injectors

Each unit injector consists of a pump element, a solenoid valve and a nozzle. In this way, it is possible to control the fuel injection for each individual cylinder.

EMS (Engine Management System) is the electronic system that controls both how much fuel each unit injector should inject into the cylinder and also when the unit injector should inject the fuel.

This control of the injection means that we can optimise the combustion, which in turn leads to cleaner exhaust gases.

The control unit is the brain of the EMS system. The control unit processes the information both from the sensors and the components that are part of the EMS system and also from the control units in other systems.
When the control unit has processed the information, it then transmits signals to the unit injectors.
The signals control the injection of the fuel.

The EMS system makes possible such functions as for example a special cold start programme.

Fitting the PDE injector

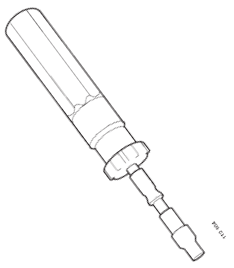
Specifications

Tightening torques:

Lock nut on rocker arm	39 Nm
Bolt for fork on unit injector.	20 Nm + 75°
Bearing bracket and rocker arm shaft	105 Nm
Screws for cable connections on unit injector	2 +/- 0.2 Nm

Special tools

Number	Description	Illustration
512562	Torque screwdriver	



IMPORTANT!
Check the unit injector spring diameter before adjusting and ensure that the correct tool is used when adjusting the unit injector.

Note:
All work that involves opening the fuel system must be completed in the following way:

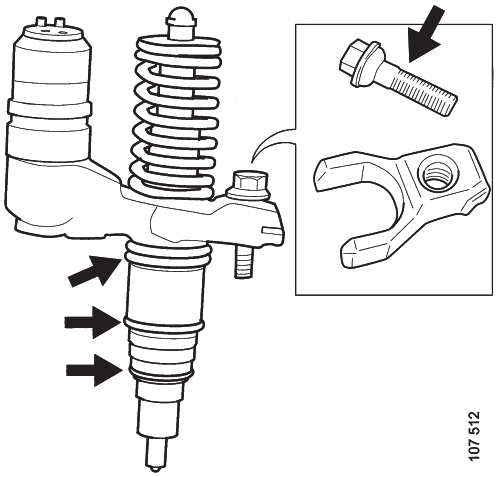
Start the engine and check for leaks. Allow the engine to run until it is running smoothly.

Check and delete any fault codes that are registered in the control unit after the work has been completed.

1
Make sure that the old seal is not at the bottom of the injector seat. Clean the sealing surfaces in the injector seat.

IMPORTANT!
Always renew the flange screw, O-rings and seal on unit injectors that have been removed. Make sure all sealing surfaces are clean.

2
Lubricate the unit injector O-rings with O-ring grease, part No. 512086
3
Fit a new sealing washer on the unit injector. A rubber insert will keep the seal in place on the unit injector.

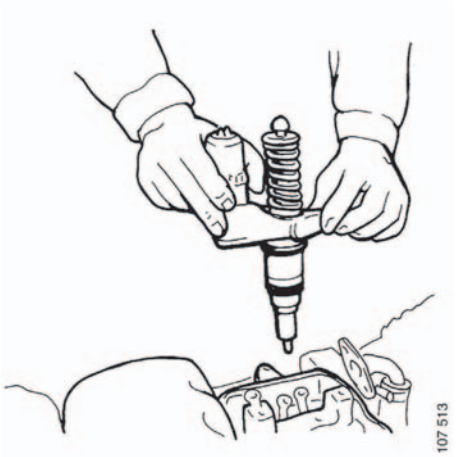


WARNING!

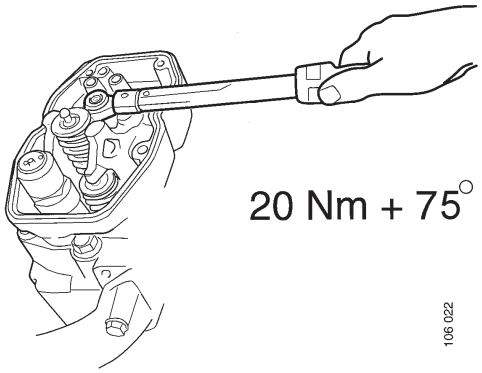
Check that there is no fuel left in the cylinder.

If fuel runs into the combustion chamber, it must be removed immediately using a pump.

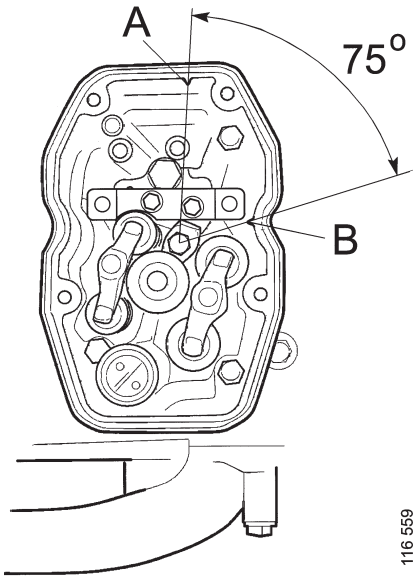
Note:
Make sure that the fork clamp and bolt are dry and free of oil.



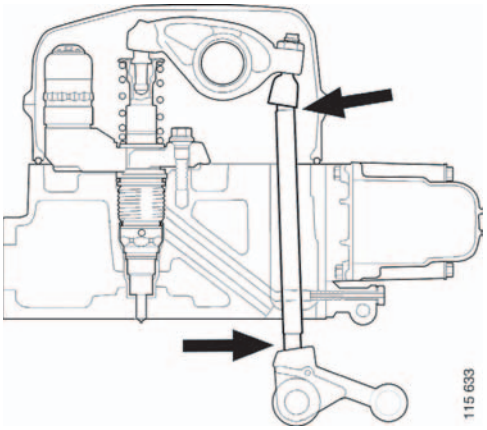
4
Place the fork clamp with screw in position on the unit injector and insert it into the cylinder head. Press down the unit injector by hand as far as possible.



5
Torque tighten the bolt to 20 Nm and then a further 75°. There are two marks on the rocker cover with a 75° angle between them.

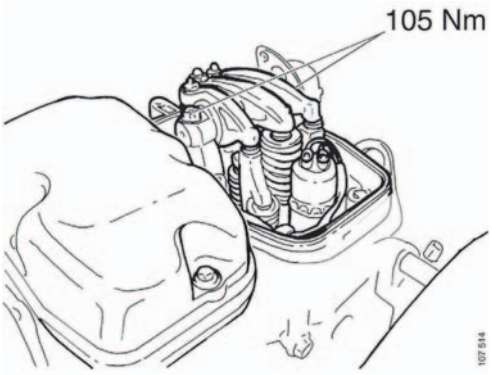


IMPORTANT!
Make sure the pushrods are placed in their correct positions. Make sure the pushrod to the unit injector is firmly secured in its lower position by the retaining ring.



IMPORTANT!
If the rocker arms have been removed on more than one cylinder, the rocker arm lock bolts must be completely unscrewed before adjustment commences.

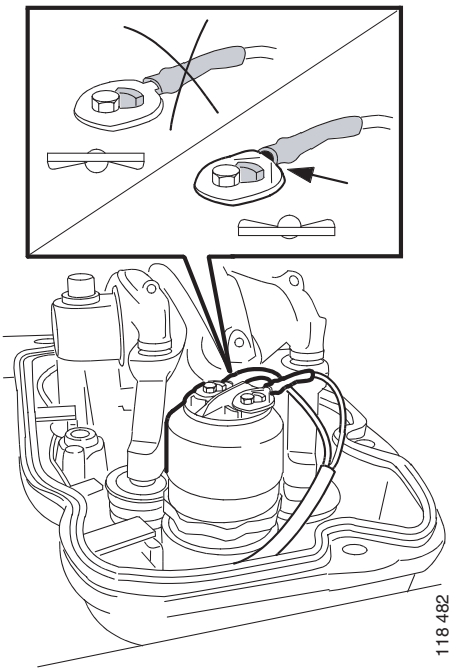
6
Refit the rocker arm shaft. Screw in the bolts alternately so that they are tightened in parallel or one of the bolts may bend.
Tighten the bolts to 105 Nm.



7
Check and adjust the unit injector as described in the section:
Testing & Adjusting / Checking/adjusting the injector rockers.

IMPORTANT!
Make sure that the cable terminals are the right way round when fitting the cables to the unit injector.

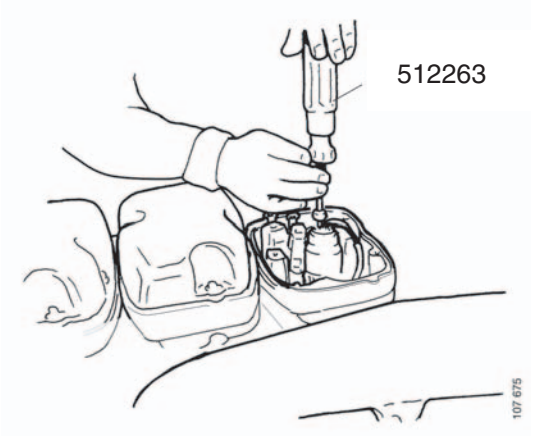
8
Reconnect the cables on the unit injectors. Their relative position is not important. Use torque screwdriver 588 179 to tighten the screws to 2 Nm.



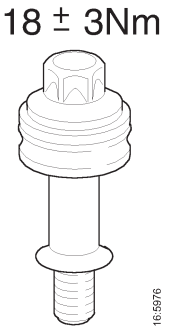
IMPORTANT!

Use torque screwdriver 512562 to avoid the risk of shearing off the screws.

The entire unit injector must be renewed if the screws shear off.



9
Refit the upper rocker cover and torque tighten the bolts to 18 Nm.



10
Close the bleed nipple and tighten the banjo screw.

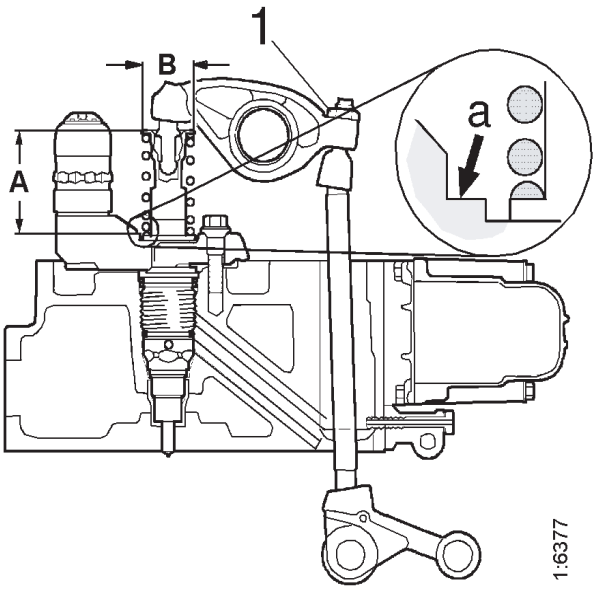
11
Fill and bleed the fuel system. Refer to Bleeding the fuel system.

Adjusting unit injectors

Important! The PDE31 unit injector is adjusted using setting tool 512264 or a digital sliding caliper.

This adjustment is important because an incorrectly positioned unit injector may result in poor performance and possible breakdown.

Screw on the rocker arm adjusting screw 1 while measuring the distance between plane a and the top of the valve spring collar using a digital sliding caliper.



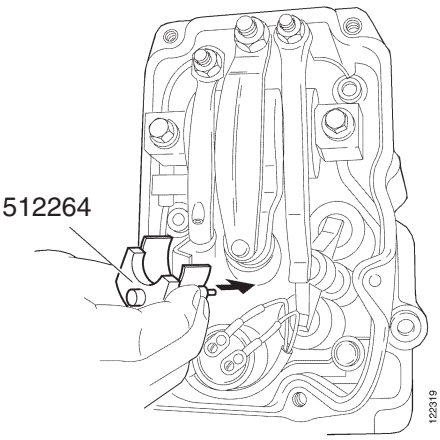
NOTE !
Machine 710656 (Tier 3) - :

Dimension A = PDE32: 69.9 +/- 0.1 mm
Dimension B = PDE32: 38,5 mm

Tightening torques
Lock nut on rocker arm: 39 Nm

WARNING!

Take care when carrying out the adjustment if the dimension is well outside the adjustment dimension.
The spring is pre-tensioned and can cause personal injury if it is released.



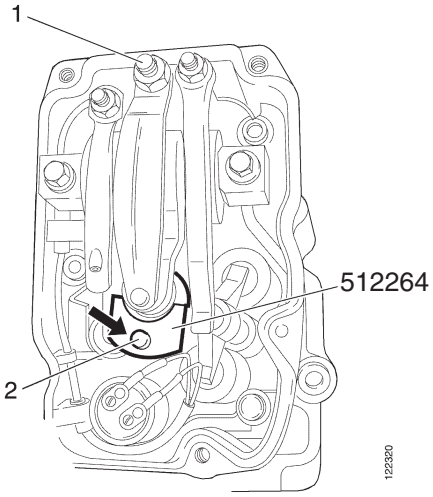
PDE32

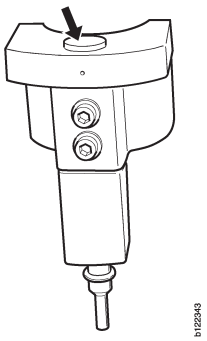
1.
Position setting tool 512264 with the metal plate around the injector spring.

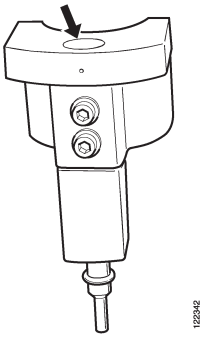
2.
Finely adjust dimension A by simultaneously using a finger to sense that the small piston 2 is level with the flat upper surface of the tool.
It is possible to sense differences of less than a tenth of a millimetre.

3.
If tool 512264 is not available:
Measure the distance between plane a and the top of the valve spring collar using a digital sliding caliper. Adjust the rocker position by means of the adjusting screw until the dimension is 69.9 +/- 0.1 mm.

4.
Tighten the lock nut to 39 Nm.







Adjusting the valve clearance and unit injectors

1.
Fit the unit injector according to the section
Fitting the PDE injector, steps 1-11.

2.
Fit the pushrods.

3.
Fit the bearing bracket and torque tighten the bolts to 115 Nm.

4.
Fit the valve bridges.

Important!
Lubricate the valve bridges with engine oil.

5.
Continue according to the section:
Fitting the PDE unit injector steps 6 - 11

Note:

Check and adjust the valve clearance and unit injectors at the same time and with the engine cold.

Checking and adjusting the valve clearance:

1.
Turn the flywheel with tool 8405 so that the piston in cylinder No. 1 is at TDC after compression.

2.
Check the valve clearance using a feeler gauge and, if necessary, use the adjusting screw on the rocker arm to set the correct clearance.

The clearance for intake valves should be 0.45 mm
and the
clearance for exhaust valves should be 0.70 mm
when the engine is cold.

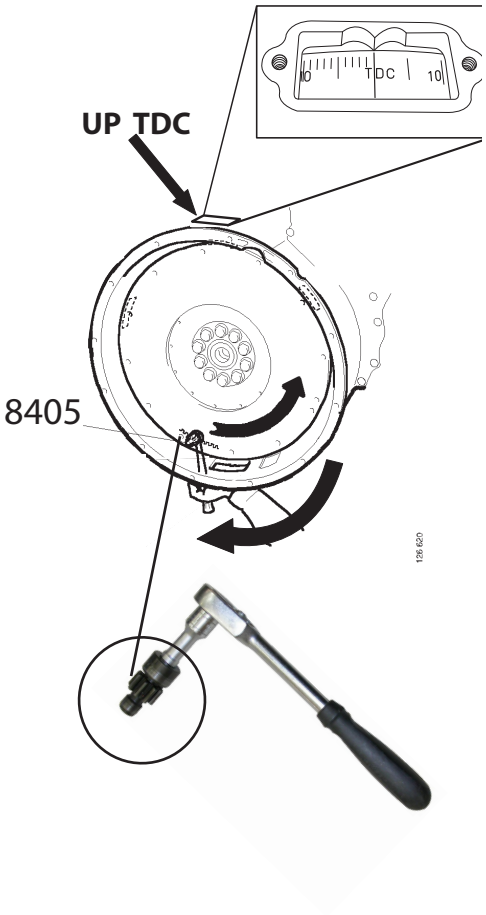
The intake valves are actuated by the short rocker arms and the exhaust valves by the long rocker arms. Make sure the valve bridge is resting correctly against the valves.

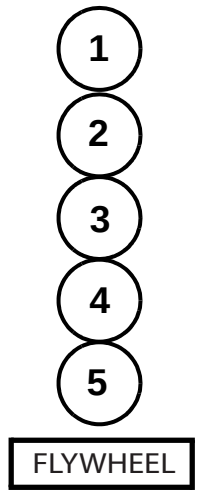
See the table next page.

Checking, adjusting the PDE32 injector rocker arms (I)

- Turn the flywheel with tool 8405 to valve overlap on cylinder 1 (which corresponds to TDC Up (0°) in the opening).
Then turn the flywheel anti-clockwise 144° at a time and observe the valve overlap. Adjust the valves according to the table below.

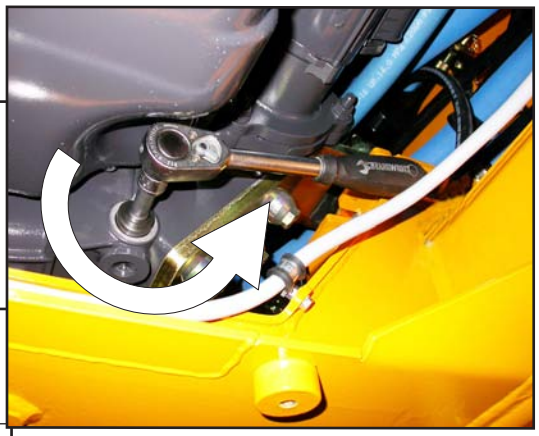
Firing order: 1-2-4-5-3



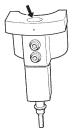


Cylinder numbering

NOTE !
The adjustable value for the injectors are aprox ±0,2 mm.
If the value is e.g. 0,8-1,0 mm, then check the position of engine.
Start the adjusting prosedure again and follow the table below.

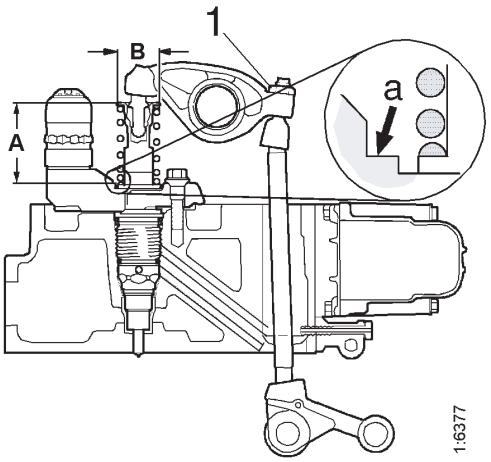


Valve overlap on cylinder		Adjust the valves on cylinder	Adjust unit injector rocker arm on cylinder
TDC Up (0°)	1	5	5
	2	3	3
	4	1	1
	5	2	2
	3	4	4

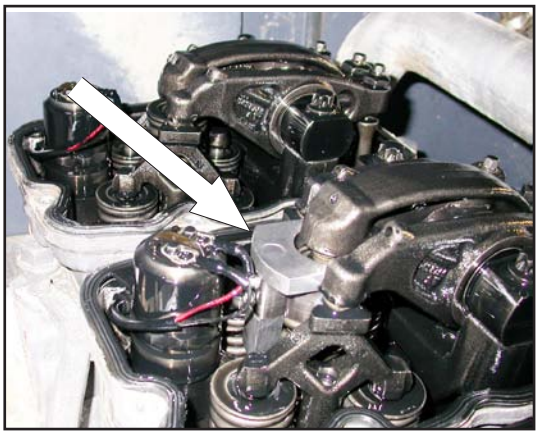


Dimension A= PDE32: 69.9±0.1 mm

Dimension B= PDE32: 38.5 mm



Placing of the tool 512264

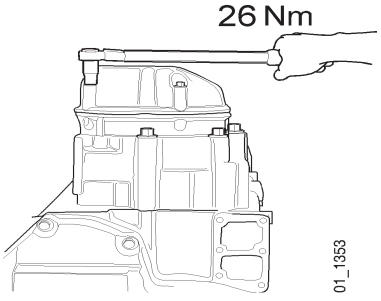


Check the clearanse, using a finger to sense that the small piston is level with the flat upper surface of the tool.

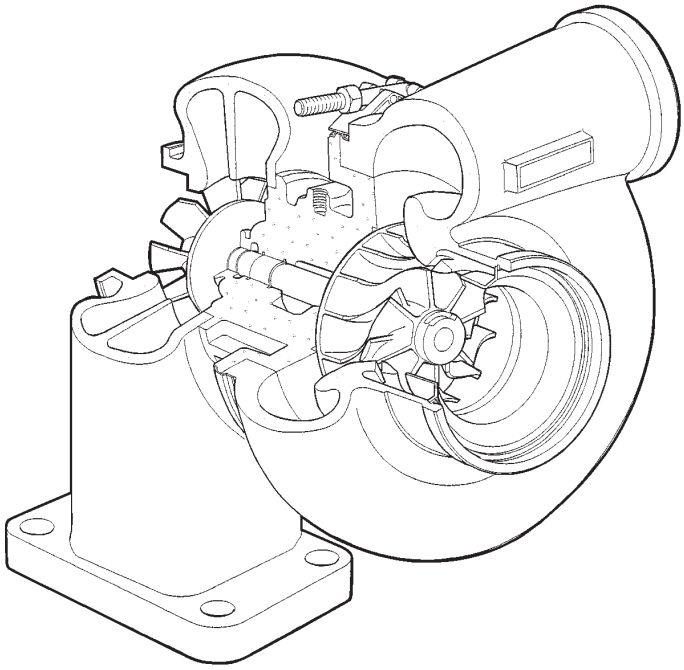


It is a good idea to mark the rocker arm with a pen after adjustment to keep track of what has already been adjusted.

Torque tighten the lock nut to 39 Nm after adjusting.



Turbocharger



The purpose of the turbocharger is to increase the volume of air entering the engine's cylinders. With more air the engine can burn more fuel and so develop more power and achieve cleaner combustion than a corresponding engine without supercharging.

The turbocharger is driven by the engine's exhaust gases and consists of a turbine part and a compressor part. The compressor part compresses the engine's intake air.

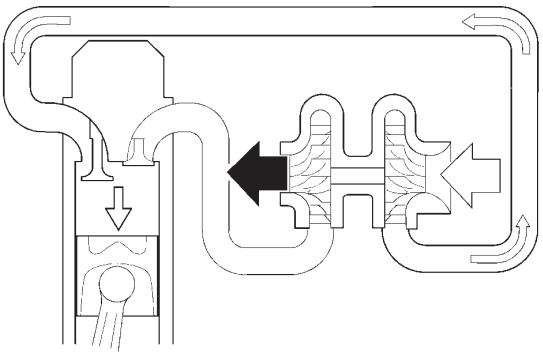
The compressor wheel is mounted on the same shaft as the turbine wheel. This shaft runs in a bearing housing between the compressor and turbine.

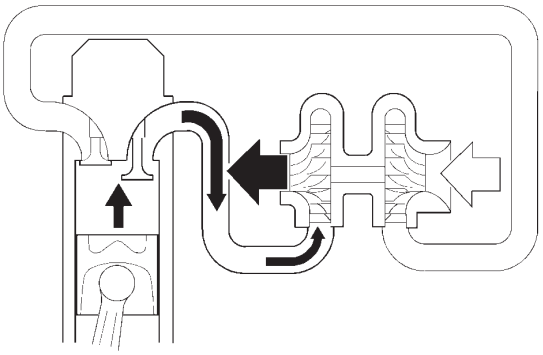
Higher power output from the engine gives more exhaust fumes and the increased exhaust means that the turbine wheel and therefore the compressor wheel rotate faster. In this way, the quantity of air is adapted to engine requirements without any special control devices.

The turbocharger wheel rotates extremely fast. At full power, speed is about 100,000 rpm. At the same time, the temperature on the exhaust side of the turbine wheel is above 600°C.

This makes big demands on the rotating parts in regard to balance, cooling and lubrication.

The shaft is mounted in two bushings which rotate freely in the bearing housing. The bearing housing seals for the turbine and compressor consist of seals which are similar to piston rings.





General

NOTE!
Whenever working on the turbocharger, observe utmost cleanliness. The oil intake and outlet connections must never be left open. A foreign body in the bearing housing can quickly cause total breakdown.

Oil leakage
With a clogged air cleaner, the vacuum in the intake pipe will be excessive. There is then a risk that oil mist will be sucked out of the turbocharger's bearing housing.

If the seal on the turbine side is worn, exhaust gas is blue when idling.

If the oil outlet pipe from the turbocharger is damaged, there is a risk of oil leaking out through the seals due to lubrication oil pressure.

Oil filter
The turbocharger rotates at high speed, sometimes above 100.000 rpm.

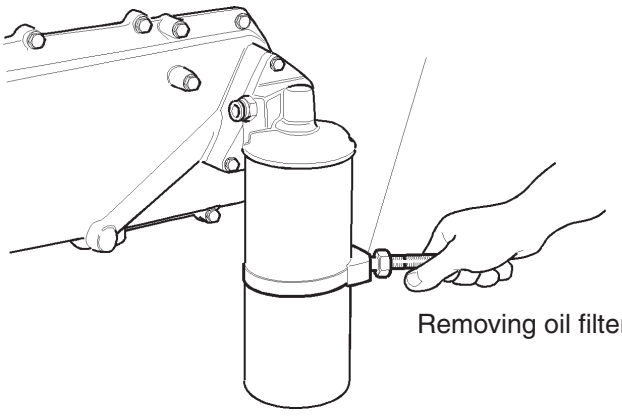
The oil lubricates and cools the turbocharger. Efficient lubrication is extremely important. There is no separate turbo filter and the oil passes through the engine oil filter. For this reason, change the oil filter and clean the oil filter assembly in accordance with our instructions.

Use filter wrench **8388** when removing the oil filter.

If the oil filter assembly is not cleaned, the oil filter will soon become clogged and its resistance to the flow of oil will increase.

A valve in the filter holder then opens and allows the oil to pass through the filter without being cleaned (filtered). Unfiltered oil is consequently supplied to the turbocharger with heavy bearing wear as a result.

The valve is designed for genuine Moxy filters and only these should be used.



Removing oil filter

Foreign bodies
Foreign bodies, such as grains of sand or metal filings, in the turbine or compressor will damage their blades.

This leads to imbalance and bearing wear. Engine output falls off and continued operation could give rise to overheating damage on account of a decrease in the supply of air.

This type of overheating cannot be observed on the coolant temperature gauge.

NOTE!
Never attempt to straighten a damaged impeller. It will usually break in operation causing the turbocharger to break down and may also cause enginedamage.
Change the entire turbocharger.

Air and exhaust leakage
Even small leaks in the line between the air cleaner and turbocharger cause dirt deposits on the compressor wheel.

Charge pressure decreases with increased exhaust temperature, causing smoke. In addition, the engine is worn unnecessarily.

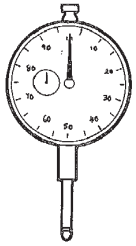
Exhaust leakage between cylinder head and turbocharger also results in lower charge pressure.

Cleaning the compressor wheel
Low charge pressure can be caused by a dirty compressor wheel, for example.

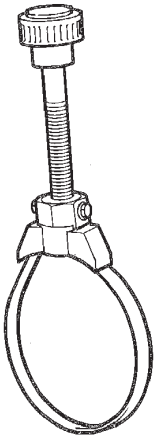
- Remove the compressor housing.
- Wash the compressor wheel using white spirit and a brush.
- Fit the compressor housing and measure charge pressure again.

NOTE!
The compressor wheel must not be removed from the shaft. Imbalance may occur when it is refitted.

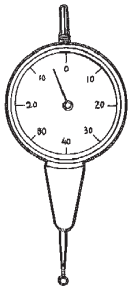
Special tools



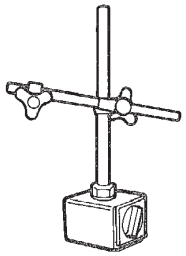
8014



8388

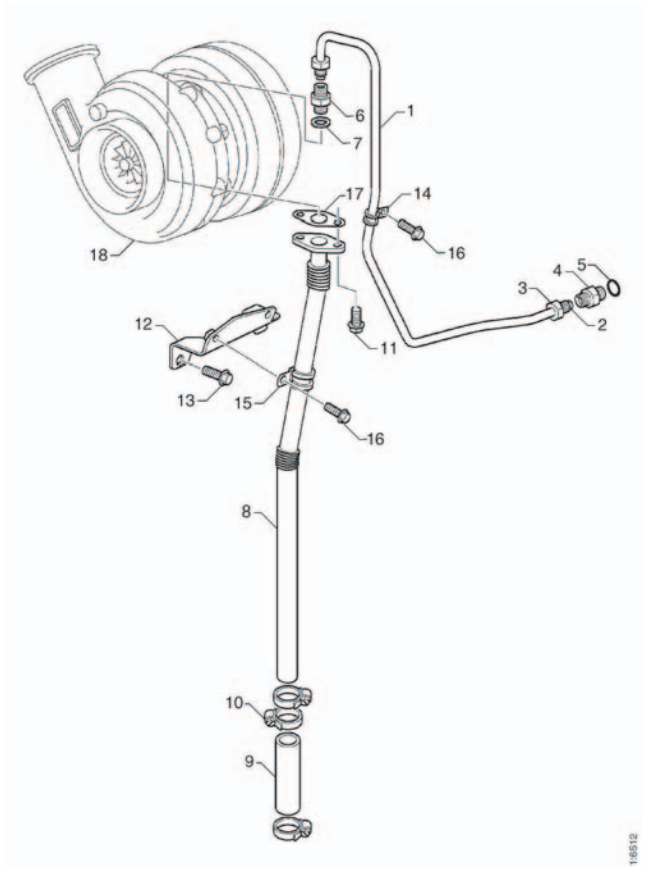


8389



8391

8014	Dial gauge
8388	Filter wrench
8389	Deflection gauge
8391	Stand



1. Lubrication oil pipe
2. Ferrule
3. Union nut
4. Straight union
5. Seal
6. Straight union
7. Gasket
8. Lubrication oil return pipe
9. Hose
10. Hose clamp
11. Bolt
12. Bracket
13. Bolt
14. Clamp
15. Clamp
16. Bolt
17. Gasket
18. Turbocharger

Measuring radial clearance and axial clearance

Measuring radial clearance and axial clearance does no usually give any indication of the remaining service life of the turbocharger.

When the turbocharger is not working correctly or sounds abnormal, measuring charge pressure or measuring radial clearance or axial clearance can show that the turbocharger is defective.

To measure axial and radial clearances it is advisable to remove the turbocharger and bolt it to a steel plate, which will also serve as a base for the magnetic stand holding the dial gauge.

Radial clearance
Take readings on both turbine wheel and compressor wheel.

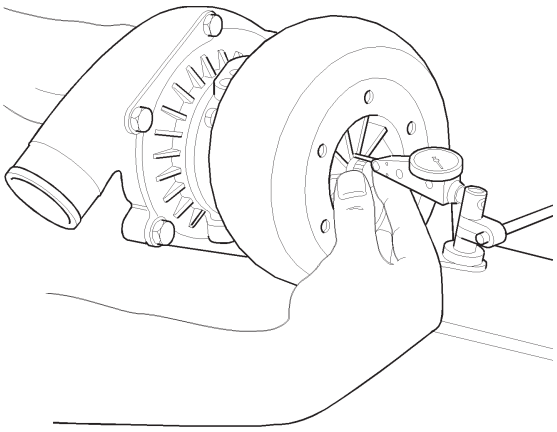
1.
Place the tip of the deflektion gauge against the turbine wheel and compressor wheel.

2.
Pull both ends of the shaft up. Take a reading.

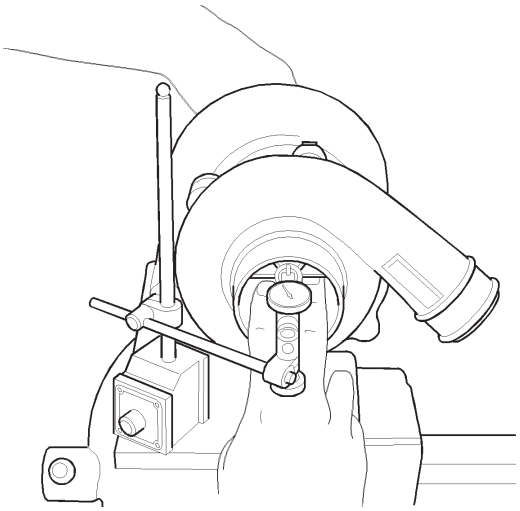
3.
Press both ends of the shaft down. Take a reading. The difference between readings is radial clearance.

4.
Repeat measurements three times on each side.

5.
If any wheel rubs against the housing, despite radial clearance being within tolerance, the turbocharger should be changed.



Measuring turbine wheel radial clearance with deflection gauge 8222 and measuring stand 8209



Measuring compressor wheel radial clearanse with deflection gauge 8222 and measuring stand 8209

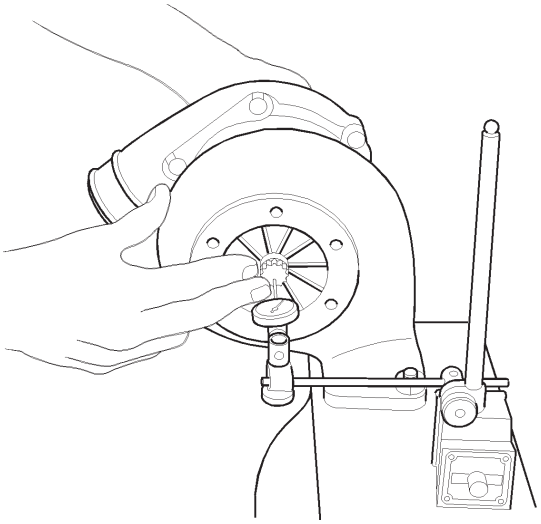
Axial clearance
1.
Place the tip of the dial gauge **8014** against the end of the shaft.

2.
Press the shaft forwards and backwards and read the dial at the end positions. The difference between readings is axial clearance.

3.
Repeat measurements three times.

Wear limits for Holset:

Radial clearance	**0.198-0.564 mm**
Axial clearance (after running in)	**0.025-0.106 mm**



Measuring axial clearance with dial gauge 8014 and measuring stand 8391

If the turbocharger does not work:

1.
Check that there is no leakage or loose objects in the line between the air cleaner and turbocharger.

2.
Check that there are no loose particles in the exhaust manifold or intake manifold.

3.
Check that all valves are intact.

4.
Check the lubrication oil return pipe from the turbocharger for blockage or deformation.

5.
Check the oil delivery pipe to the turbocharger for any blockage, deformation and leakage under pressure.

6.
Check the condition and part number of the oil filter.

7.
Check that the air filter is not blocked and that there are no other reasons for the abnormal increase of vacuum in the intake system.

8.
Check that engine output is correct. Excessively high output reduces the life of the turbo.

Renewing the turbocharger

Note:
When renewing the turbocharger, all gaskets and the oil filter must be changed and the centrifugal cleaner must be cleaned.

Removal

1.
Detach the delivery and return oil lines from the turbocharger.

2.
Detach the exhaust pipe, induction pipe and charge air cooler pipe from the turbocharger.

3.
Undo the bolts in the turbocharger base and remove the turbocharger.

Fitting
1.
Check the connecting flange on the exhaust manifold to ensure that there are no remnants of the old gasket.

2.
Fit a new gasket and bolt on a new turbocharger. Lubricate the exhaust manifold bolts with high-temperature resistant lubricant, part No. 561 205.
Tighten the turbocharger to 50 Nm and the exhaust manifold to 59 Nm.

3.
Connect the oil supply and return lines.

4.
Connect the charge air pipe, induction pipe and exhaust pipe.

5.
Disconnect the fuel valve's power supply (fuel shut-off) and turn the engine over with the starter motor for at least 30 seconds so that the lubricating oil will reach the turbocharger.

6.
Start the engine and check that there is no leakage.

Pistons and cylinder liners

1. O-ring

3. Cylinder liner for steel piston

5. O-ring

6. Compression ring

7. Compression ring

8. Oil scraper ring

9. Circlip

10. Steel piston

12. Gudgeon pin

13. Circlip

14. Bearing bushing

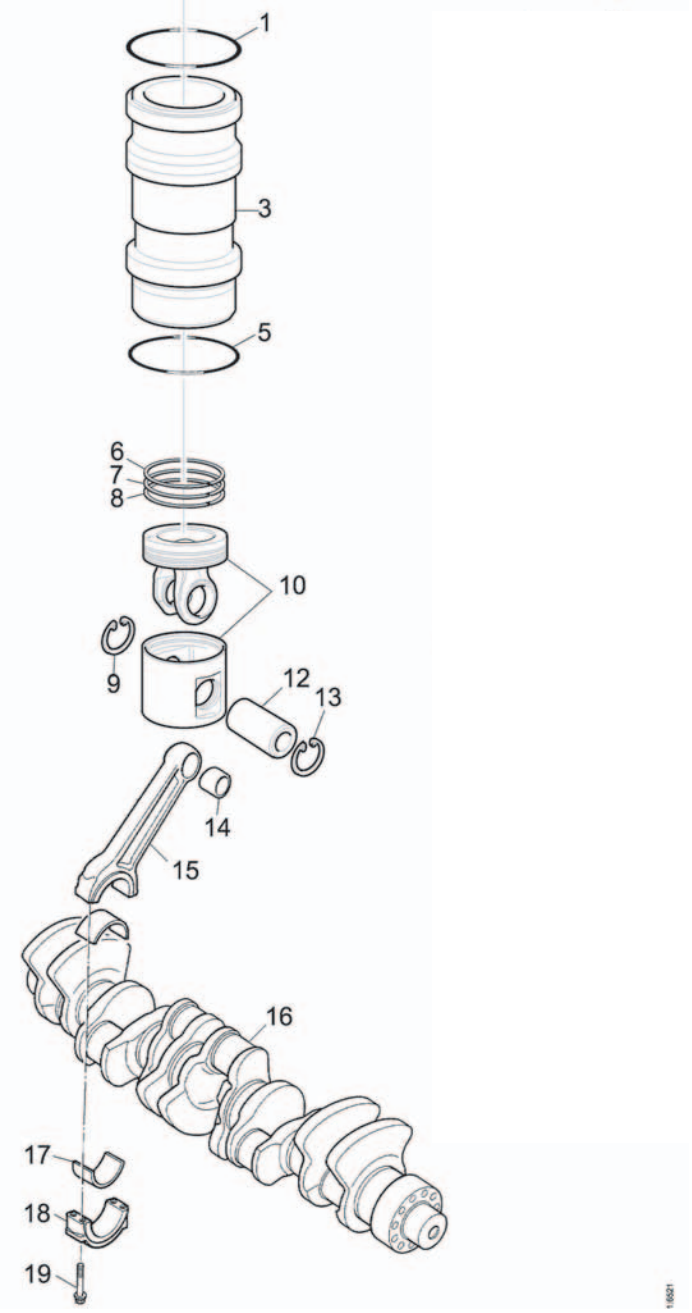
15. Connecting rod

16. Crankshaft

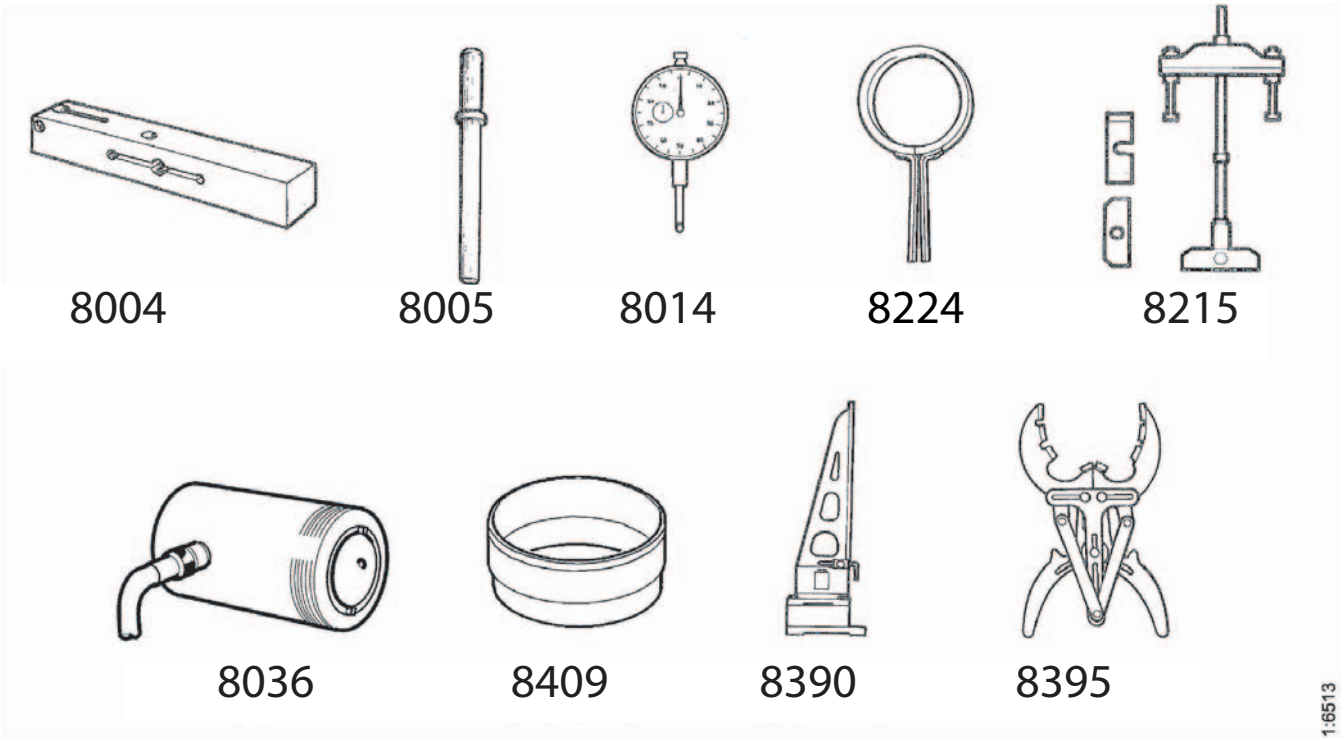
17. Bearing shell

18. Bearing cap

19. Flange bolt



Special tools



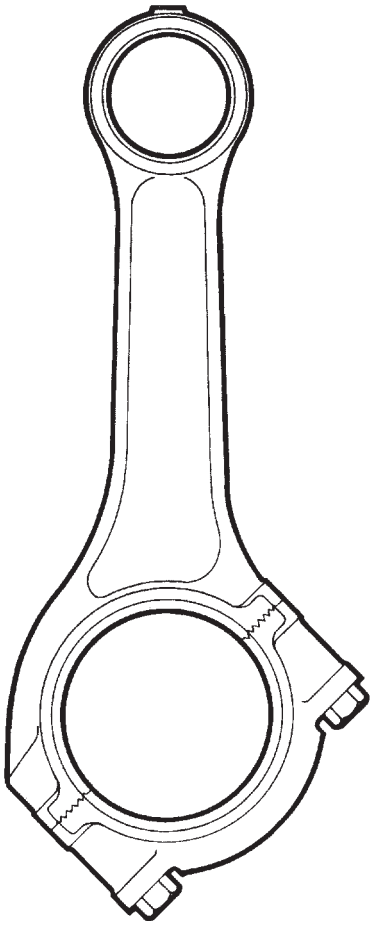
8004	Rule for dial gauge
8005	Drift
8014	Dial gauge
8224	Piston ring compressor
8028	Pressing tool
8036	Hydraulic cylinder
8215	Puller for cylinder liner
8049	Impact drift
8401	Dismantling tool
8409	Assembly tool
8390	Test apparatus for connecting rods
8395	Piston ring expander

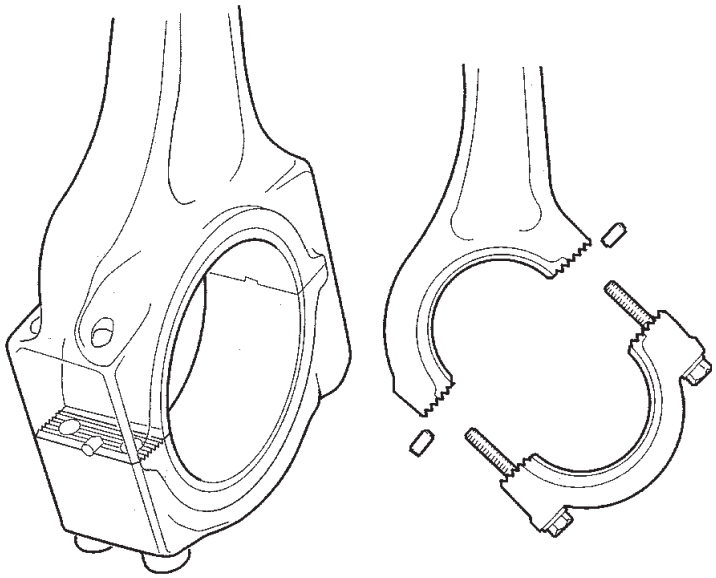
Connecting rods

The connecting rod and big-end cap consist of a single casting which is split during the machining operation.

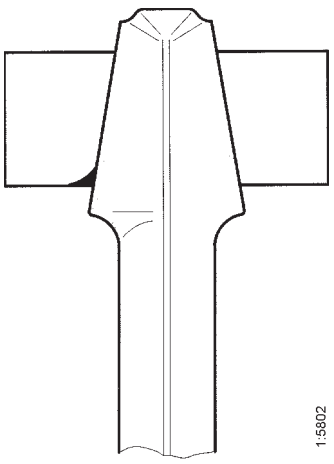
To prevent the big-end cap from being displaced in relation to the connecting rod, the contact surfaces are provided with grooves and guide pins. The surfaces are machined together to ensure a precise and accurate fit. The parts are also marked so that they can always be fitted in the same position.

The connecting rod and big-end cap are split obliquely, partly so that the con rod bolts will not be subjected to excessive loads and partly to enable the piston and con rod to be withdrawn through the cylinder.





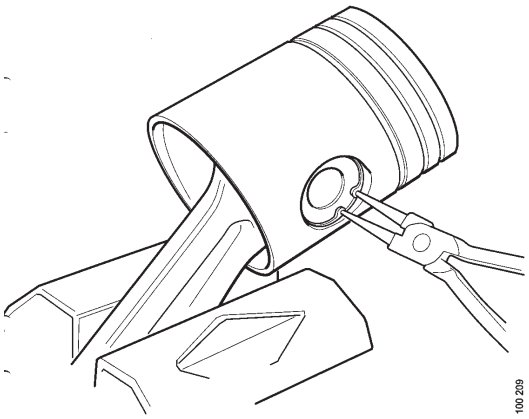
The upper part of the connecting rod is wedge shaped. This allows a larger journal surface on the underside of the gudgeon pin where load is greatest during combustion.



Removing and dismantling connecting rods and pistons

1.
Remove the cylinder head and oil sump.

2.
Remove the piston cooling nozzle in the cylinder block.

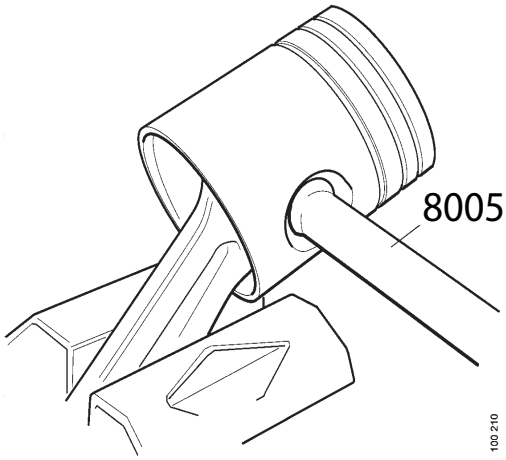


Note:
The piston cooling nozzle must not be damaged. The oil jet must hit the piston precisely. If it does not, the piston will become too warm resulting in engine breakdown.
Damaged nozzles must not be straightened.
They must be renewed

3.
Remove the bearing cap and bearing shells.
Protect the oil way in the crankcase using, e.g. adhesive tape, applied with the sticky side out.

4.
Mark the piston and connecting rod before removing them. They must be refitted in the same place and in the same way.

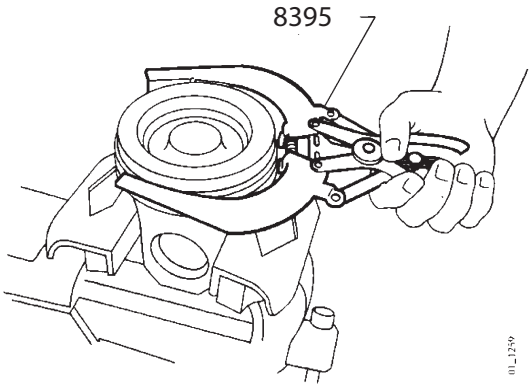
5.
Lift out the piston and connecting rod.



6.
Place the connecting rod in a vice with soft jaws. Remove the retaining rings for the gudgeon pin.

7.
Push out the gudgeon pin using drift 8005.

8.
Remove the piston rings using tool 8395, taking care to avoid scratching the surface of the piston skirt with the piston rings.



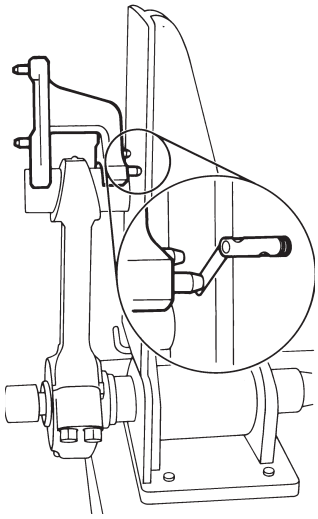
9.
When cleaning graphited pistons in a machine, the graphiting may disappear.
This does not matter after they have been in use for a while.
However, new pistons should be washed carefully using white spirit or the like.

Note:
Always inspect the connecting rod in cylinders which have seized, been filled with water or where the valve has broken. Bent connecting rods must not be straightened.

Checking connecting rods
Check the connecting rods using tool 587 110.
Proceed as follows:

1.
When the gudgeon pin bushing has been checked, insert the bearing cap as marked and tighten the bolts to full torque.

2.
Mount the connecting rod in the tool using the expander and place the gudgeon pin in its bushing. Then place indicator studs on the gudgeon pin.



Checking if connecting rod is twisted

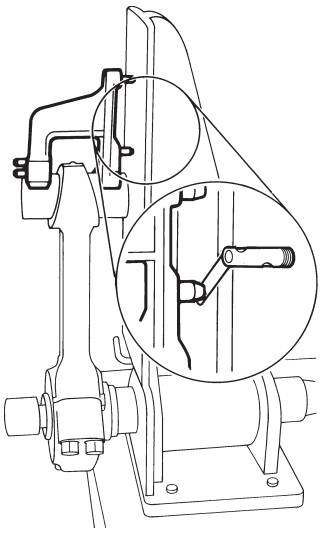
- Check whether the connecting rod is twisted with the indicator studs horizontal.

- Check whether the connecting rod is bent with the indicator studs vertical.

- The distance between the indicator studs on the tool illustrated here is 75 mm.

- The distance between one of the indicator studs and the measuring surface must be max. 0.1 mm when measured using this tool.

- Check with a feeler gauge.

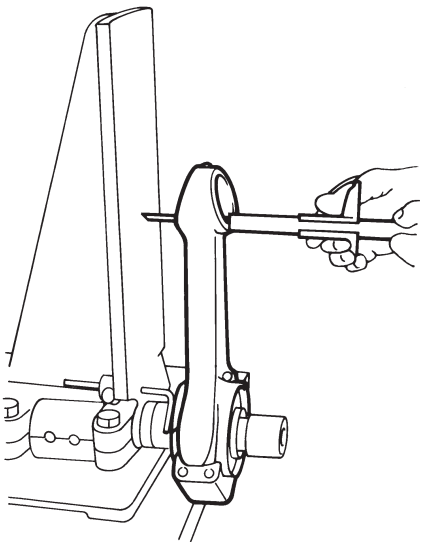


Checking if connecting rod is bent

- Also check whether the connecting rod is bent into an Sshape.
  This is done by measuring the distance between the outside of the connecting rod bushing and the level surface of the tool.

- Turn the connecting rod around and measure the corresponding distance.

Important!
The difference must not exceed 0.6 mm.



Checking whether the connecting rod is bent into an S shape

Renewal of bearing bushing in connecting rod

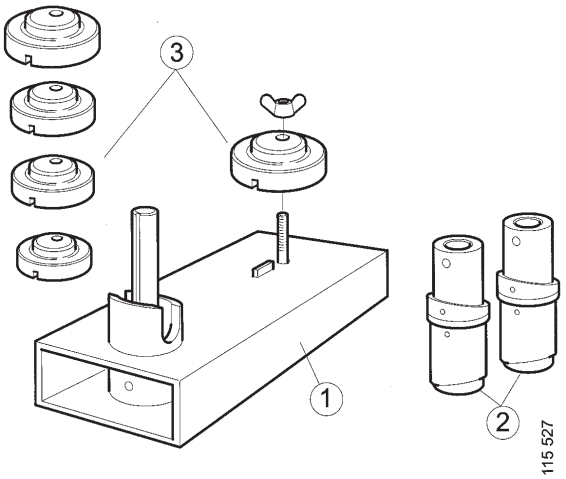
Use tool 512564 when renewing the bearing bushing.

The tool comprises three parts:

1. Pressplate with guide pin
2. Press drift
3. Supports

There are different supports, depending on the engine type.

The support marked with a D should be used for the 12engine.

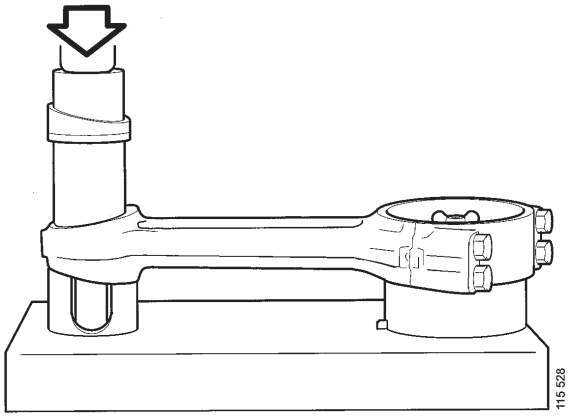


Important!

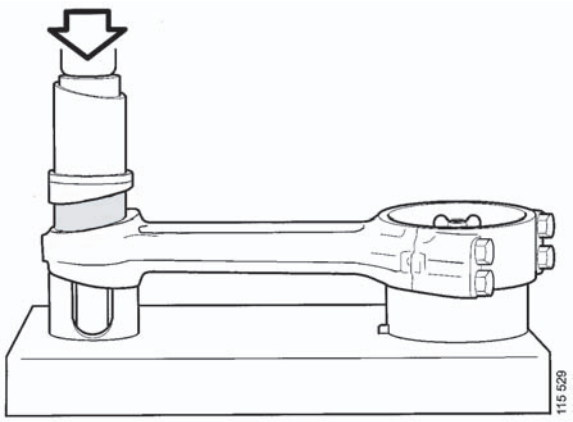
Before carrying out this procedure, the connecting rod should be checked for straightness in accordance with Checking connecting rods

Work description

1.
Fit the correct support on the pressplate and place the connecting rod so that the wide end of the connecting rod is resting against the support. Turn the press drift with the smaller diameter against the bearing bushing and press it out.

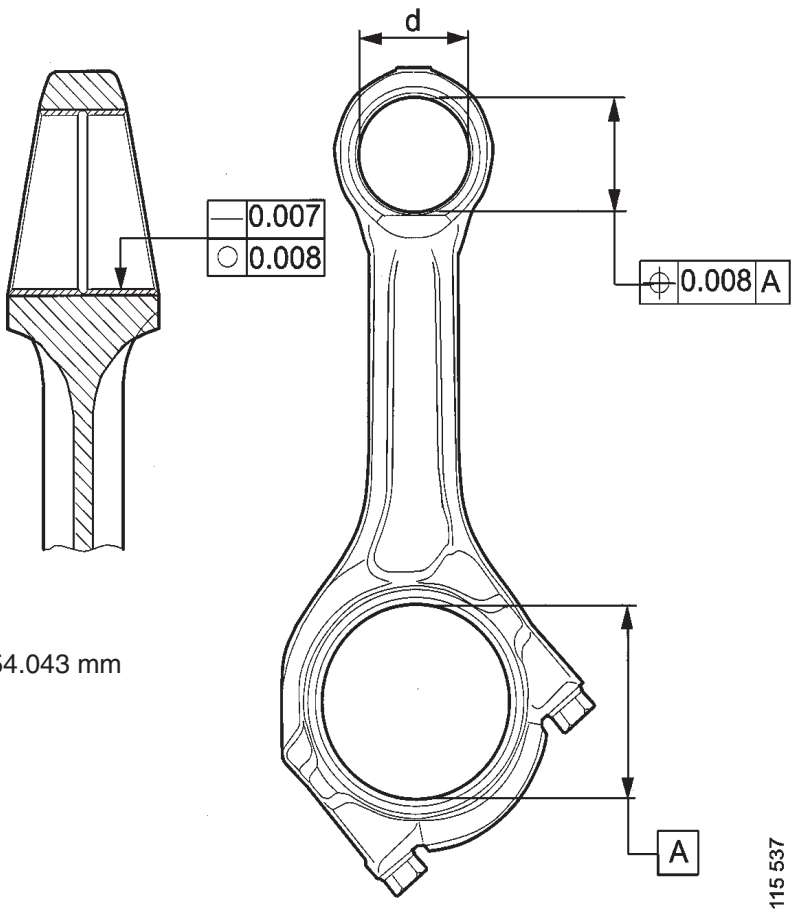


2.
Turn over the press drift and mount a new bearing bushing onto it. Press in the bearing bushing.



3.
After pressing in a new bearing bushing, it must be finish-turned. This requires special equipment.

Refer to illustration for the dimensions required.



Diameter, d = 54.030 - 54.043 mm
Surface quality = 0.6 Ra

Pistons

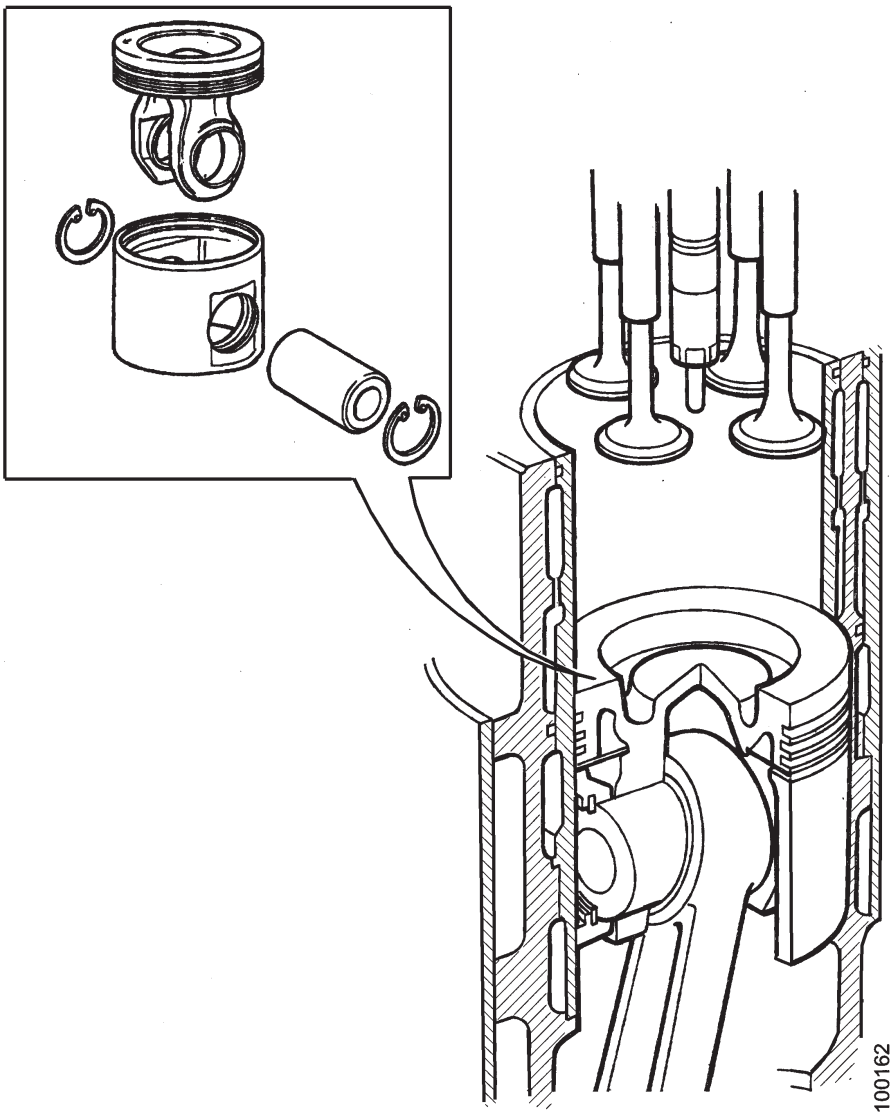
The pistons which are used in Moxy MT41 engine is of type; articulated pistons.
Articulated pistons are split and have an aluminium skirt and a steel crown.

(For the aluminium piston to resist the high pressure and high temperature prevailing in the combustion chamber, the material is thicker at the piston crown and piston ring grooves than in the remainder of the piston.)

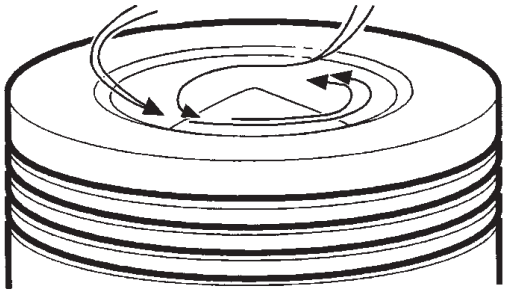
One of the advantages of articulated pistons is that they can tolerate higher loads than conventional pistons completely made of aluminium.

As the piston crown is made of steel it can withstand higher temperatures and pressure in the combustion chamber.

This enables more power to be extracted from engines with articulated pistons.



The bowl-shaped combustion chamber in the piston crown has a protuberance in the centre. The design of this protuberance ensures that the fuel injected at the end of the compression stroke is quickly mixed with the air in the combustion chamber.

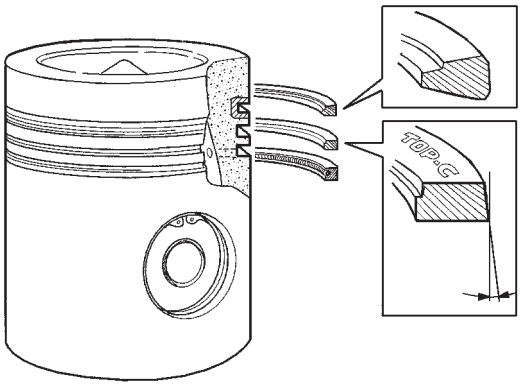


Piston rings
For the piston to travel freely, a gap is required between the piston and cylinder liner.

The piston therefore has two compression rings which seal this gap and conduct the heat from the piston.

The upper of these rings is exposed to higher pressure than the intermediate ring and is therefore wedge-shaped, a “keystone” ring, which increases the force pressing it against the cylinder wall.

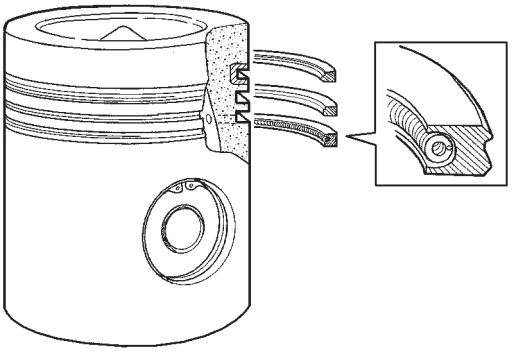
Since the greatest stress is on the upper piston ring groove, and also to reduce wear, a reinforcement of cast iron is incorporated in the piston.



The bottom piston ring, the oil scraper ring, prevents oil from the crankcase from finding its way up to the combustion chamber.

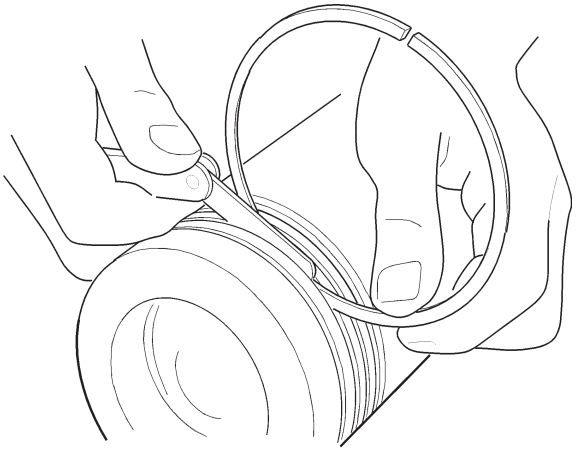
In the oil scraper ring is a coil spring which presses it against the cylinder wall.

The design and quality of the pistons and piston rings are extremely important for the reliability and lubrication of the engine as well as oil and fuel consumption.



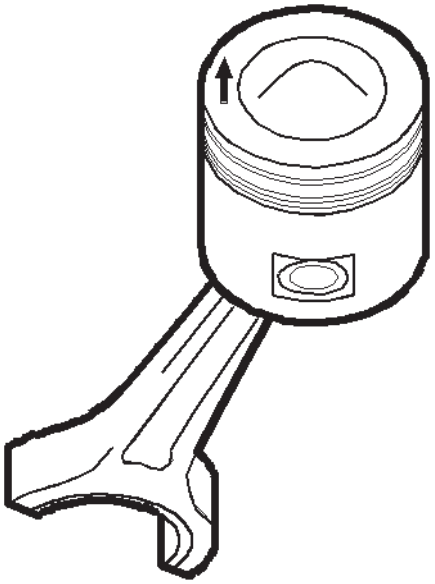
Assembling piston and connecting rod

1.
Clean the piston and its rings thoroughly without scratching the sides of the ring grooves. The oil holes in the piston should be cleaned using a suitable drill.



2.
Make sure the piston ring gaps do not exceed the permitted limit.
Place the piston rings in the cylinder liner and measure the gap using a feeler gauge. For permitted gap, see section entitled Specifications, piston rings.

3.
Fit the piston rings using tool 8395. The oil scraper ring has an expander. Pistons rings marked with TOP must be turned with TOP face up.

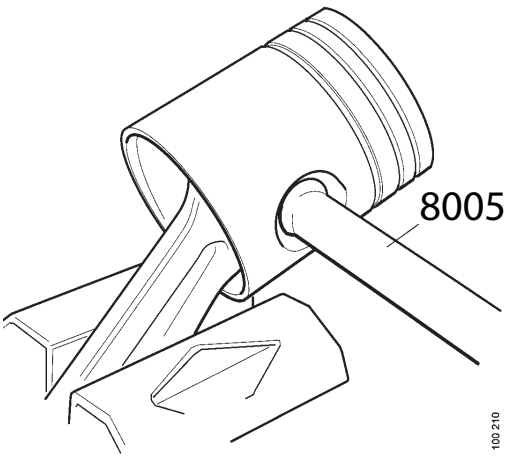


4.
Oil all the bushings, the gudgeon pin hole and the gudgeon pin before assembling.

5.
Place one of the retaining rings in the piston.

6.
Turn the piston and connecting rod as illustrated. The arrow mark should point forward on the engine.

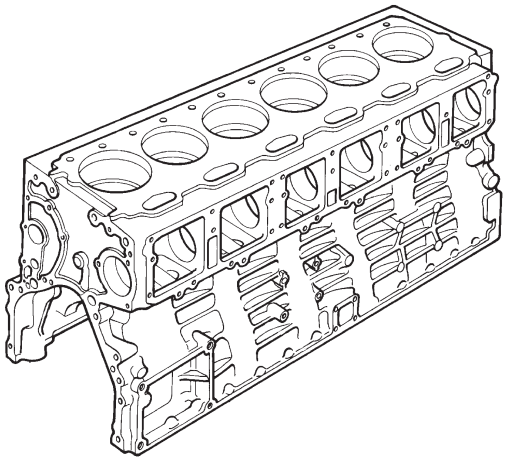
7.
Insert the gudgeon pin using tool 8005 and fit the second retaining ring for the gudgeon pin.



Cylinderblock

The cylinder block is a one-piece casting. It has 5 cylinder bores. There is a separate cylinder head for each cylinder.

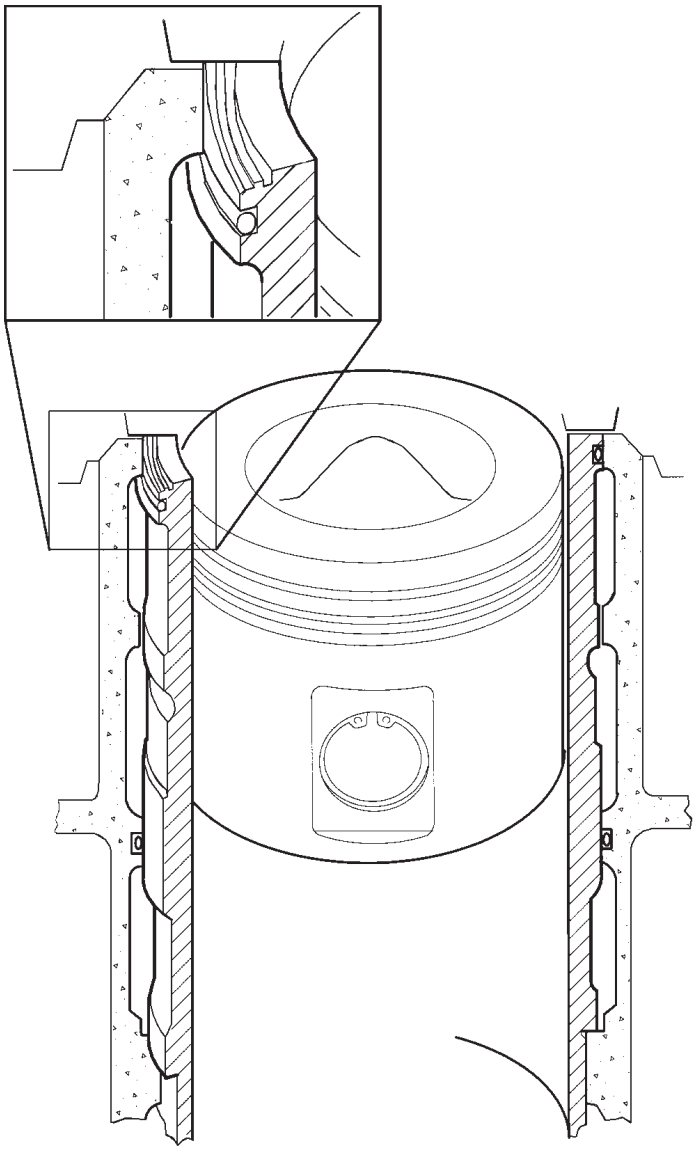
The seal between cylinder block and cylinder head consists of a steel/elastomer gasket. Seals are bonded in place at the oil and coolant passages.



Cylinder liner

The cylinder liners are of the “wet” type, i.e. they are surrounded by coolant.

To ensure a good seal, the edge of the cylinder liner protrudes slightly above the surface of the cylinder block.
This ensures that the cylinder head gasket is pressed against the cylinder head.

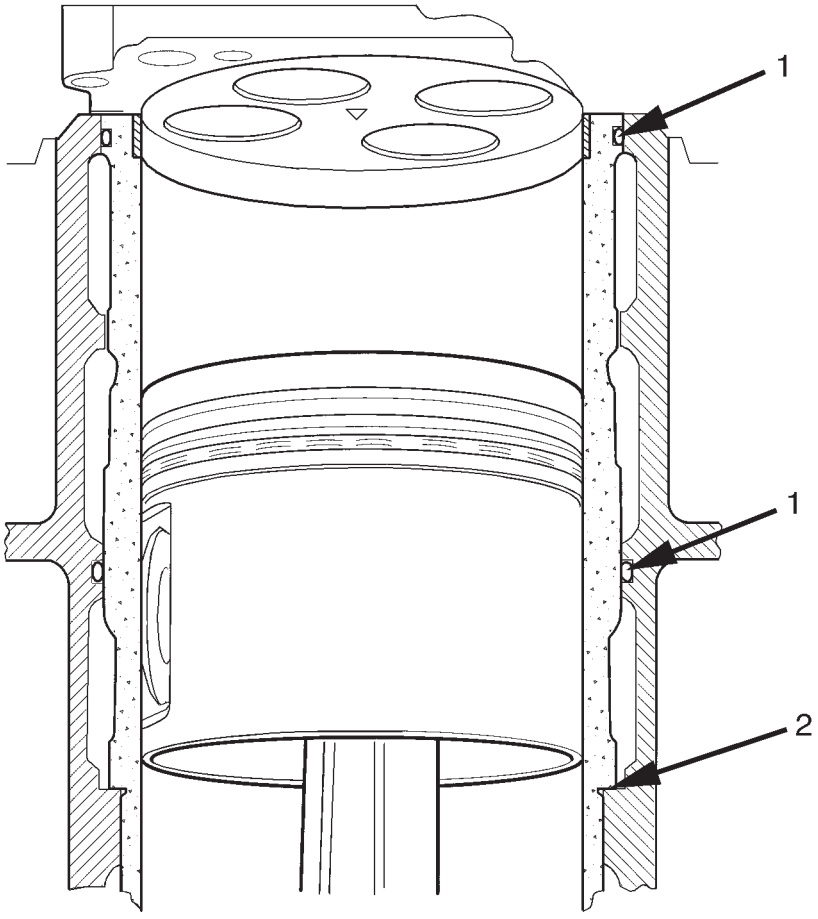


The inside of the cylinder liner is machined by what is known as plateau honing. This type of machining leaves a fine pattern of grooves which ensures that the oil needed for lubrication between piston rings and liner remains on the wall of the liner.

The design of the pattern is of major importance for ensuring low oil consumption in the engine.
Two sealing rings, one in the block and one in the liner, seal off the coolant jacket. The surface of the liner in contact with the liner shelf seals off the lubricating oil.

In the space between liner shelf and sealing ring in the block is an overflow hole which discharges in the side of the cylinder block under the side covers.

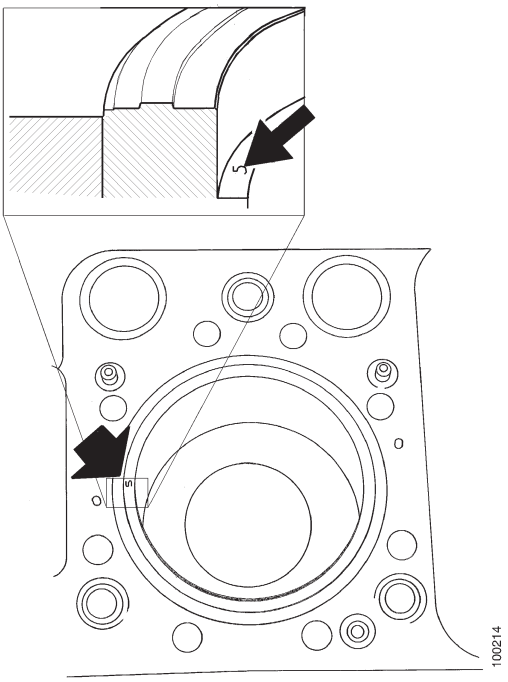
Leakage at any of the sealing surfaces will result in oil or coolant coming out of the overflow hole.



1. Seal for coolant
2. Support point for liner

Removing the cylinder liners

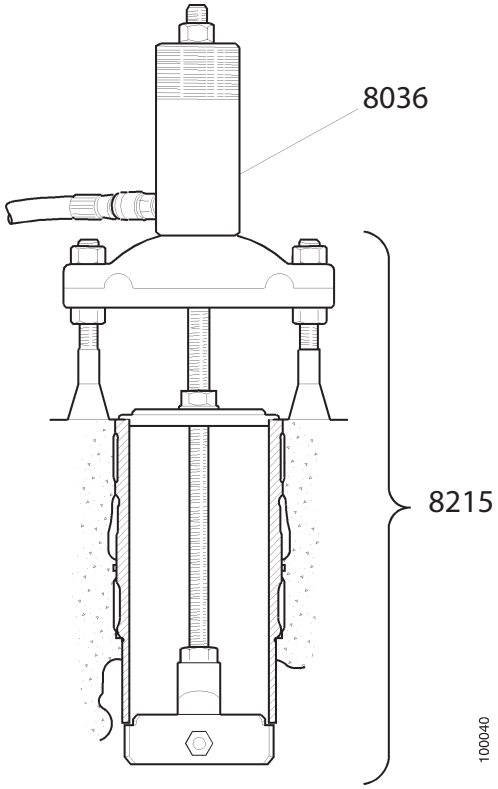
1.
Mark the liners with the numbers 1-6. The mark is necessary so that the liners can be refitted in the same place and position as previously.



Note:
The mark must be made only on the surface indicated in the illustration. Other surfaces are for sealing.

2.
Withdraw the cylinder liner using puller 99 066 and hydraulic cylinder 8036. Fit spacers under the support lugs to avoid damaging the surface of the block.

3.
Remove the sealing ring in the cylinder block.



Cylinder liner extractor with hydraulic cylinder

Measuring the cylinder liner height

1.
Thoroughly clean the cylinder block liner shelf, the face around the cylinder, the cylinder liner shelf and the upper face of the cylinder liner.

2.
Fit the cylinder liner without O-rings and twist down by hand into position.

3.
Lift out the liner and wipe the liner shelf in the cylinder block and the cylinder liner shelf.

4.
Insert the cylinder liner without O-rings and twist it down into position again by hand.

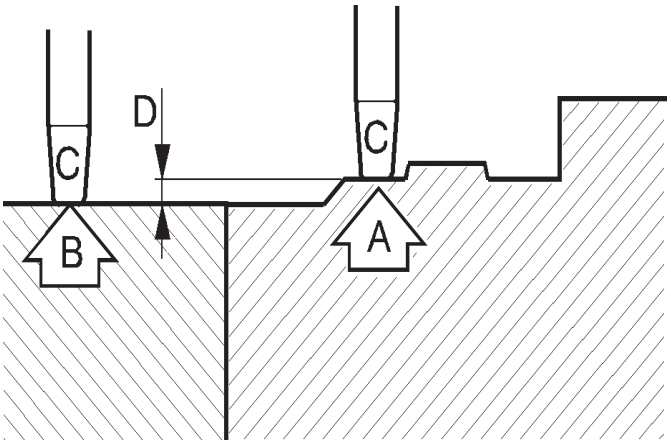
5.
Place straight edge 87 198 with dial gauge 98 075 on the liner and zero the dial gauge to the liner (A). Slide the tip of the dial gauge over to the cylinder block (B) and measure the height of the liner (A-B) as illustrated.

6.
Measure each liner at two diametrically opposite points transversely across the engine.

- The cylinder liner must be slightly above the face of the cylinder block.

- The difference between the two measurements on the same liner must not exceed 0.02 mm.

- The height of the cylinder liner D (=A-B) above the block should be 0.20 – 0.30 mm.



A = Measuring surface on cylinder liner
B = Measuring surface on cylinder block
C = Tip of dial gauge
D = Cylinder liner height D = A-B

Measuring cylinder liner height

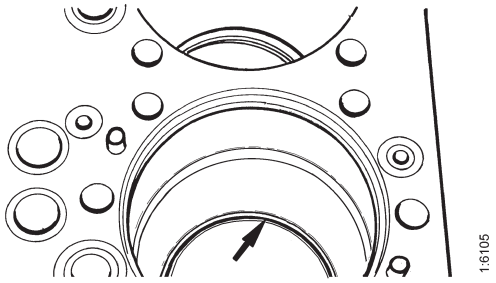
Fitting the cylinder liners

1.
Check cylinder liner height as described in the section entitled Measuring the cylinder liner height.

2.
Make sure the interior of the cylinder block is clean. Clean the O-ring surfaces.

3.
Check that the holes for coolant going to the cylinder head and cylinder liner are not clogged.

4.
Carefully check the cylinder liners, both new and old, for cracks which might have arisen during transport or careless handling.

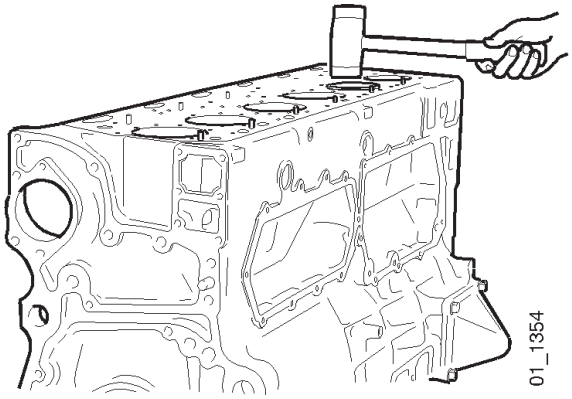


5.
Tap the liner carefully with a metal object. It should give a clear metallic ring if it is intact. If it sounds cracked, renew it.

6.
Lubricate the sealing ring to be fitted in the cylinder block with engine oil and fit it in place.

7.
Lubricate the sealing ring to be fitted in the cylinder liner with engine oil and fit it in place.

8.
Turn the liner with the stamped cylinder number facing forward and carefully tap it down with a rubber mallet.



9.
Fit the scraper ring in place after the piston has been fitted.

Fitting the piston and connecting rod

1.
Lubricate the piston, piston rings, cylinder liner and piston ring compressor with engine oil.

2. Remove the protection on the connecting rod journal and lubricate the journal.

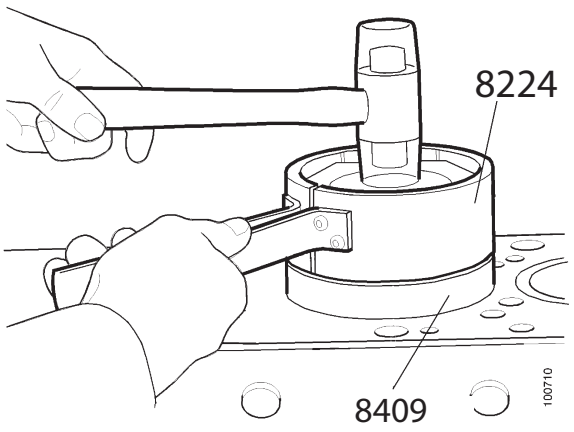
3.
Turn the piston rings so that the ring gaps are evenly distributed round the piston.

4.
Fit the upper connecting rod bearing shell to the connecting rod and lubricate the bearing surface.

5.
For engines with a scraper ring in the liner: Fit assembly tool 8409 instead of the scraper ring in the liner.

6.
Carefully insert the connecting rod and piston so that the arrow mark on the piston points forward.

7.
Clamp piston ring compressor 8224 round the piston and push the piston down into the cylinder past the assembly tool.

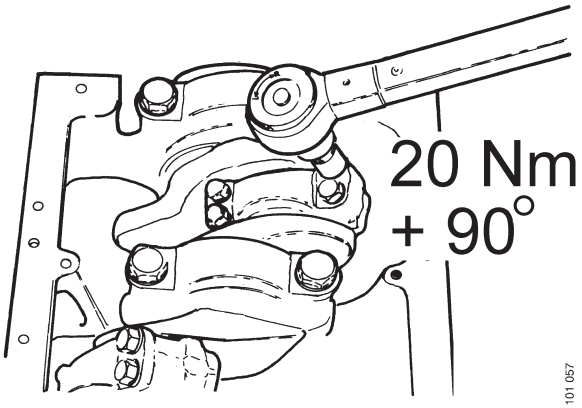


8.
Remove the assembly tool and press in the scraper ring. Be careful to press it in straight so that it does not tilt.

9.
For engines without a scraper ring in the liner: Insert the connecting rod and piston. On aluminium pistons the arrow mark on the piston should point forward.

10.
Clamp piston ring compressor 98 212 round the piston and push the piston down into the cylinder.

11.
Fit the lower connecting rod bearing shell into the cap and lubricate the bearing surface. Fit the cap. Check that the connecting rod and cap have the same marking and that they are opposite each other.



12.
Lubricate the bolts, fit them and tighten to 20 Nm + 90°. Check that the pistons nozzles are in perfect condition and fully open. If necessary, blow clean with compressed air.

13.
Fit the piston cooling nozzle and tighten the banjo bolts to 23 Nm.

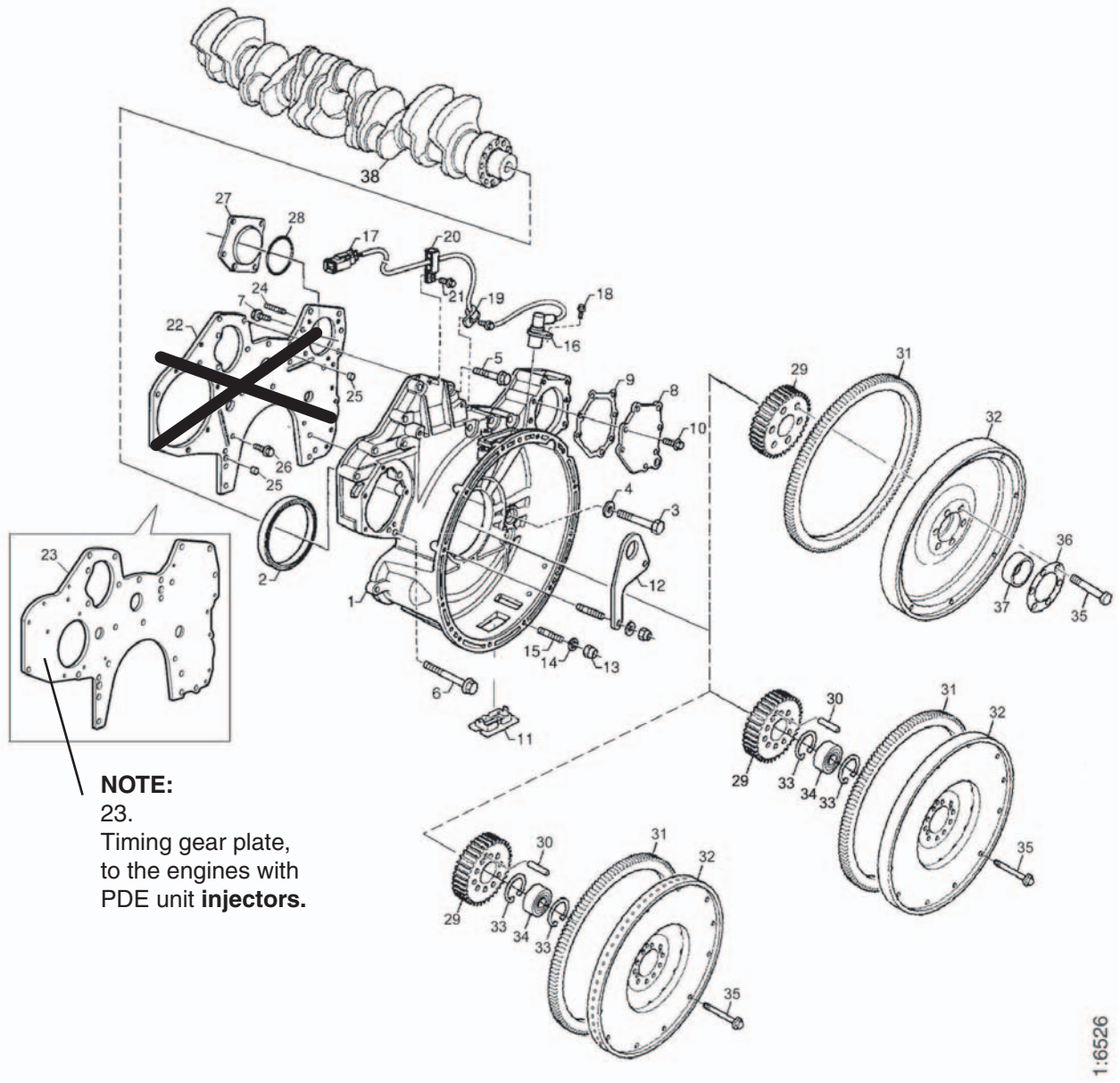
Note:

The piston cooling nozzle must not be damaged. The oil jet must hit the piston precisely. If it does not, the piston will become too warm resulting in engine breakdown. Damaged nozzles must not be re-aligned, renew them instead.

14.
Fit the oil sump and tighten the bolts to 30 Nm.

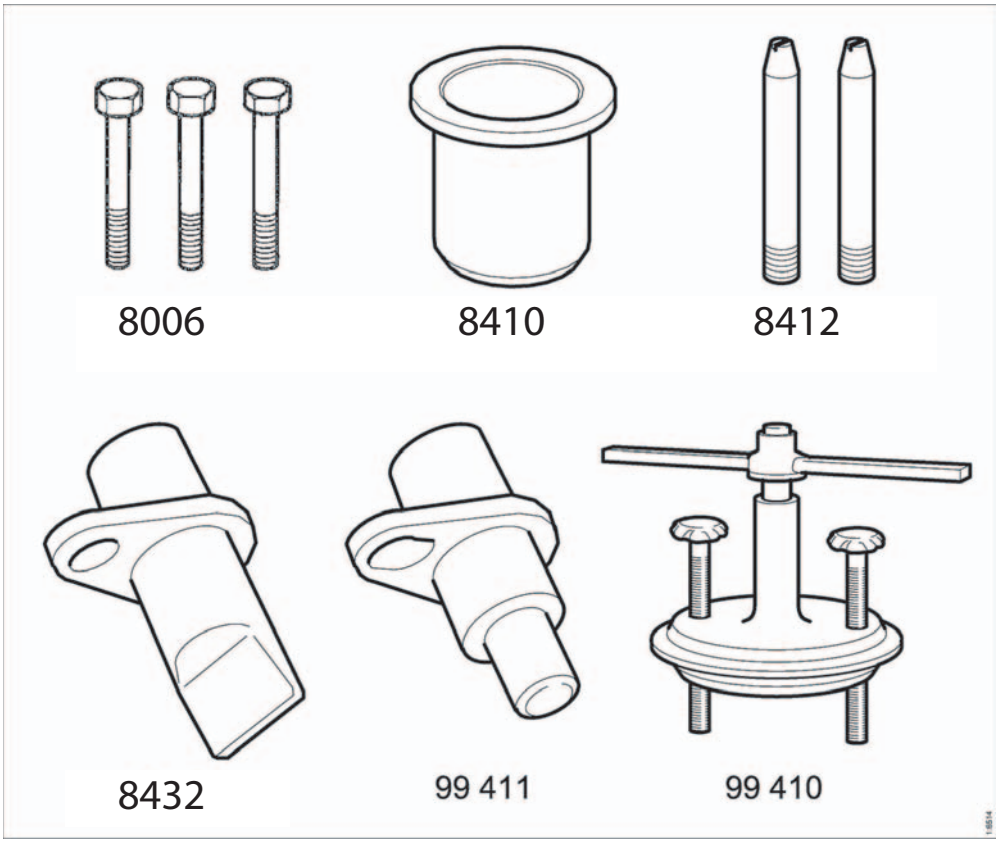
15.
Fit the cylinder head. Tighten the cylinder head bolts as described in the section Cylinder head.

Flywheel and flywheel housing



1. Flywheel housing
2. Seal
3. Bolt
4. Washer
5. Flange bolt
6. Flange bolt
7. Flange bolt
8. Cover
9. Gasket
10. Flange bolt
11. Cover
12. Lifting eye
13. Hexagon nut
14. Washer
15. Stud
16. Rotation speed sensor
17. Contact housing
18. Flange bolt
19. Clamp
20. Clamp
21. Bolt
22. Timing gear plate,
    engines with injection pump
23. **Timing gear plate,**
    engines with PDE unit injectors
24. Stud
25. Pin
26. Flange bolt
27. Cover
28. O-ring
29. Crankshaft gear PF
30. Pin
31. Ring gear
32. Flywheel
33. Circlip
34. Ball bearing
35. Bolt
36. Washer
37. Guide sleeve
38. Crankshaft

Special tools



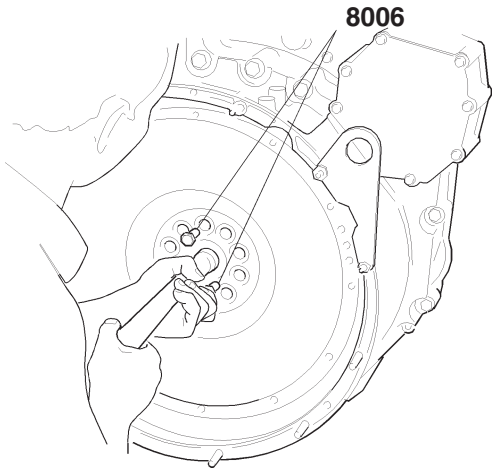
8006	Puller bolts	8432	Assembly tool	Not illustrated:	
8410	Drift	512556	Assembly tool		
8412	Guide pins	512555	Assembly tool	512559	Air powered sprayer
				512557	Cartridge adapter
				512558	Nozzle

Removing the flywheel

1.
Remove the engine speed sensor(s) in the flywheel housing.

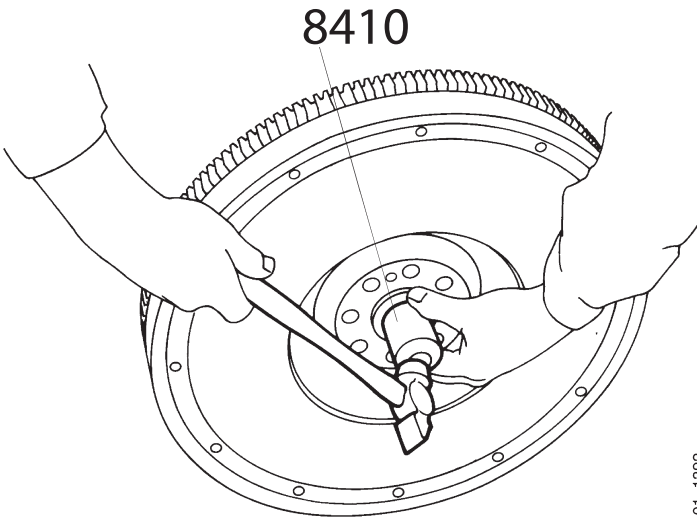
2.
Remove the bolts for the flywheel.
14” flywheel: Also remove the washer.

3.
Pull off the flywheel from the crankshaft using puller bolts 8006



Renewing support bearing

1.
Remove the retaining rings on both sides of the support bearing.



2.
Knock out the support bearing from the flywheel using drift 8410.

3.
Fit the inner retaining ring and fit the new support bearing with drift 8410.

4.
Fit the outer retaining ring.

Renewing ring gear

Renew the flywheel ring gear if the gear teeth have become so worn that the starter motor pinion will not engage.

1.
Grind a groove as deep as possible in the ring gear and crack it open with a chisel. Remove the ring gear from the flywheel.

WARNING!

Use protective goggles due to the risk of metal shivers.

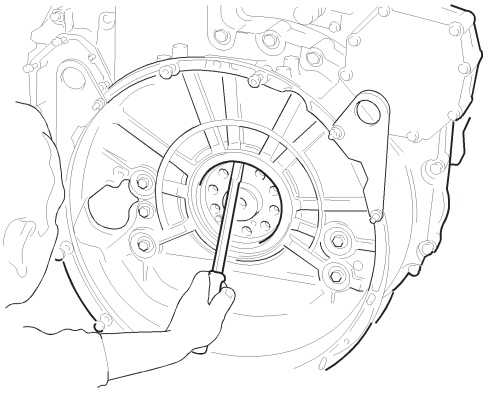
2.
Clean the contact surfaces on the flywheel with a wire brush.

3.
Heat the new ring gear evenly around its circumference to 100 -150°C.

4.
Place the heated ring gear on the flywheel so that the marking with the part number is facing the engine when fitting the flywheel. Make sure the ring gear is securely against the flywheel. If necessary, knock down the ring gear with a plastic hammer.

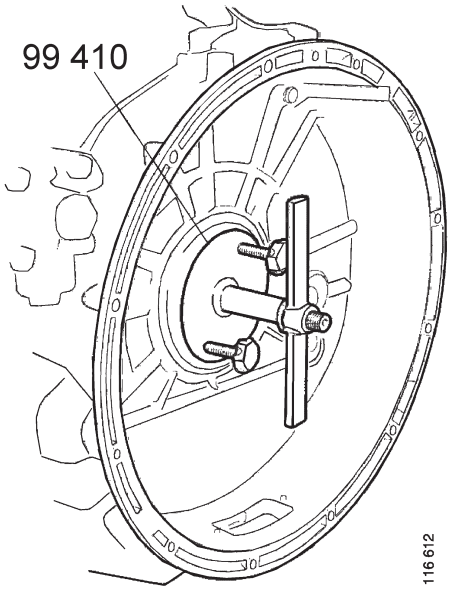
5.
The ring gear must not be cooled rapidly but be left to cool in the open air.

Renewing the rear crankshaft seal



1.
Remove the crankshaft seal using a screwdriver. Take care not to scratch the sealing surfaces on the crankshaft and the flywheel housing.

Note:
The crankshaft seal must be fitted dry and must not be lubricated. The sleeve in the seal should be left in place until the seal is fitted.
The crankshaft should be degreased before the new seal is fitted.

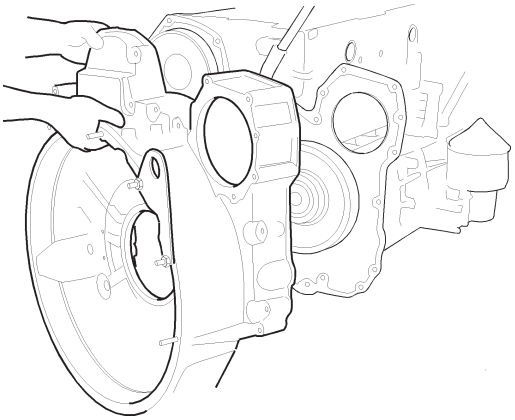


2.
Fit the new crankshaft seal using tool 512555. Place the crankshaft seal on the tool and fasten the tool with the bolts.

3.
Turn the tool clockwise until is stops in order to attain the correct crankshaft seal position.

Removing the flywheel housing

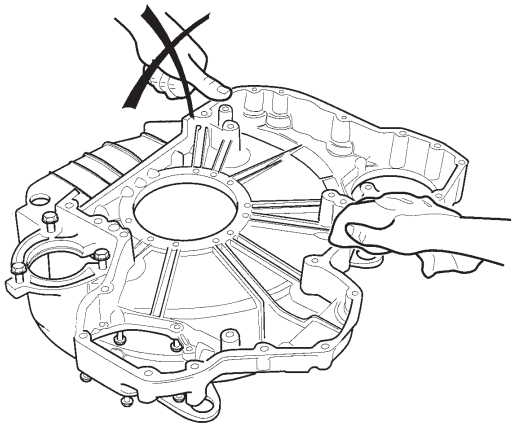
1.
Remove the starter motor.



3.
Remove flywheel housing.

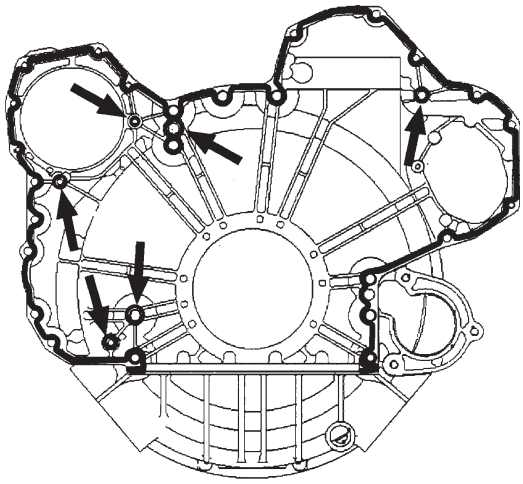
Fitting flywheel housing

1.
Remove all old sealing compound on the sealing surfaces of the timing gear casing and timing gear plate.
Clean off any oil and grease using an alcohol based cleaning agent.



Note:
The sealing surfaces must be absolutely clean and free from grease. Do not touch the surfaces after degreasing.

2.
Apply the sealing agent (512565) on the timing gear housing with the air powered sprayer (512559), cartridge adapter (512565) and nozzle (512558).
The width of the bead should be between 0.8 and 1.2 mm.
Follow the pattern as illustrated.



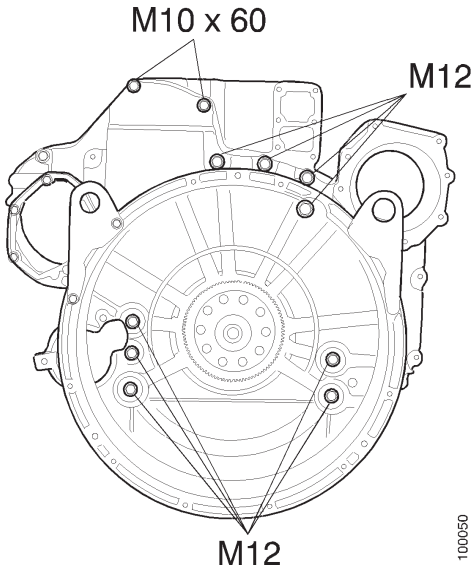
Important!
Ensure that you apply sealing agent inside the screwholes, but without allowing sealing agent into the crankcase.
The sealing agent may block channels and nozzles.
This is particularly important to bear in mind around oil ways, where the flow of oil to the air compressor or injection pump can be blocked.

Important!
Assembly must be completed within 25 minutes of starting to apply the sealing agent.

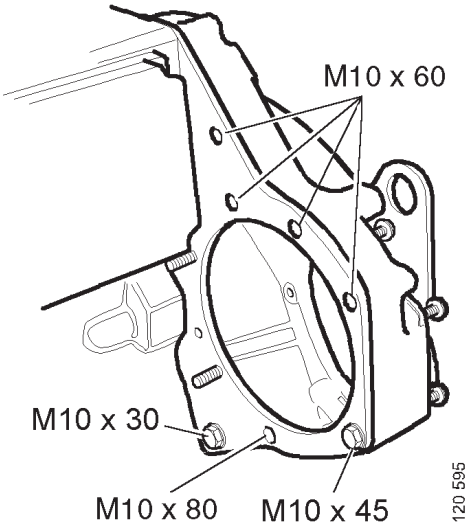
Note:
The bolts are of various sizes and lengths. Ensure that they are fitted in the correct places. See also the illustrations on the next page.

3.
Torque tighten the M12 bolts to 90 Nm and the M10 bolts to 50 Nm.

4.
Fit the starter motor

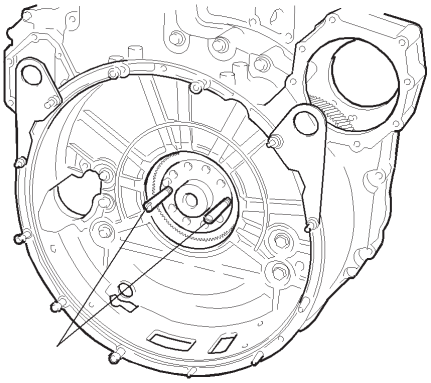


Apply the sealing agent on the timing gear housing side against the transmission plate. Apply the sealing agent around the screw holes marked with arrows.


M10 x 60
M10 x 30
M10 x 80
M10 x 45
120 595

Fitting the flywheel

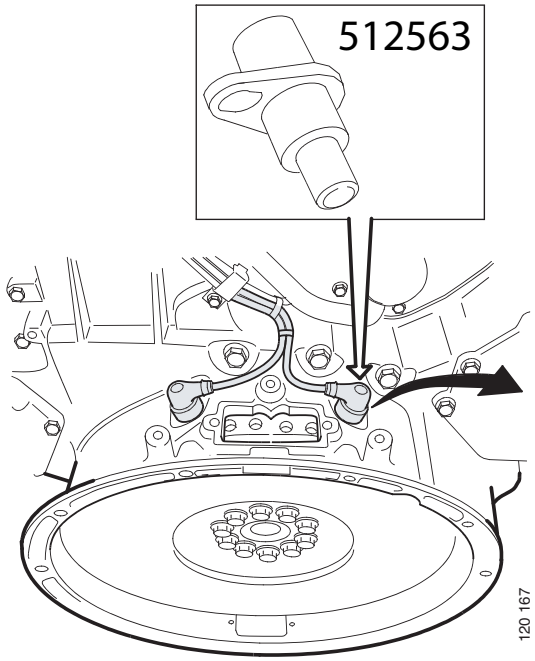
1.
Fit two guide pins **8412** in the crankshaft flange.



2.
Fit the flywheel on the crankshaft.

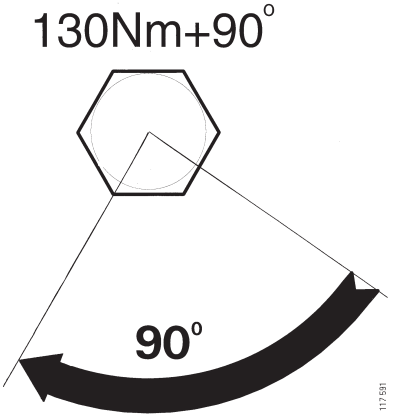
NOTE!
Always use new bolts and washer .

3.
Lock the flywheel using tool:
- 512563 for engines with unit injector.



4.
Torque tighten the bolts alternately to
130 Nm and then a further 90°.

5.
Fit the engine speed sensors).



Timing gears

Gear drive

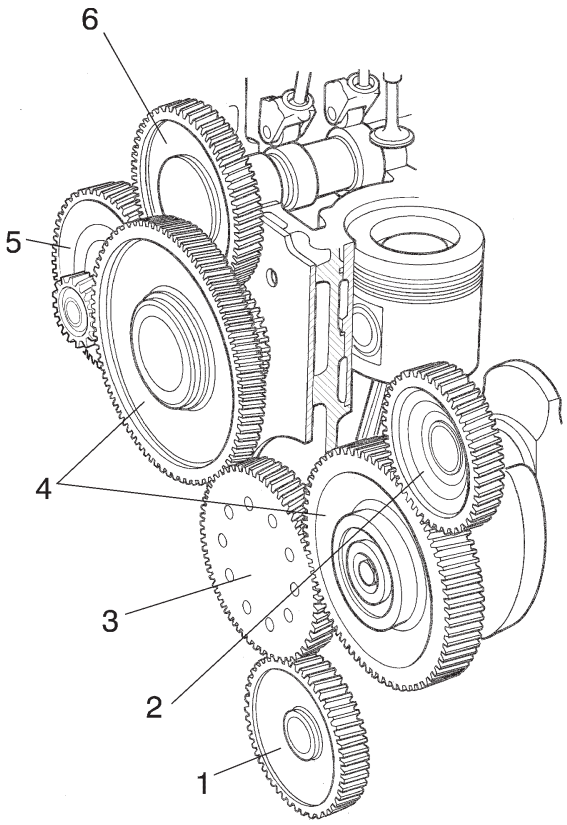
On the engine, the gear drive is located at the rear end of the engine.

Important components like the injection pump and valve mechanism require precise operation and are therefore attached to the rear end of the crankshaft, close to the flywheel, where crankshaft rotation is smoothest.

The gear on the crankshaft drives two intermediate gears and the oil pump gear.

One of the intermediate gears drives the camshaft. The camshaft gear in its turn drives the injection pump gear.

The other intermediate gear meshes with the gear for the air compressor

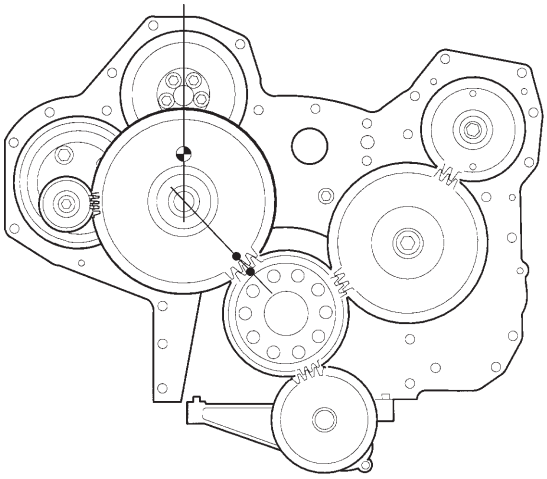


1. Oil pump gear
2. Air compressor gear
3. Crankshaft gear
4. Intermediate gear
5. Injection pump gear
6. Camshaft gear

The camshaft and injection pump rotate at half the speed of the crankshaft.

To facilitate correct assembly of the timing gears, the gears are marked on a tooth or in the space between two teeth.

The injection pump gear has an oval hole for setting the injection timing (the a angle).



Belt drive collant pump, generator and AC compressor

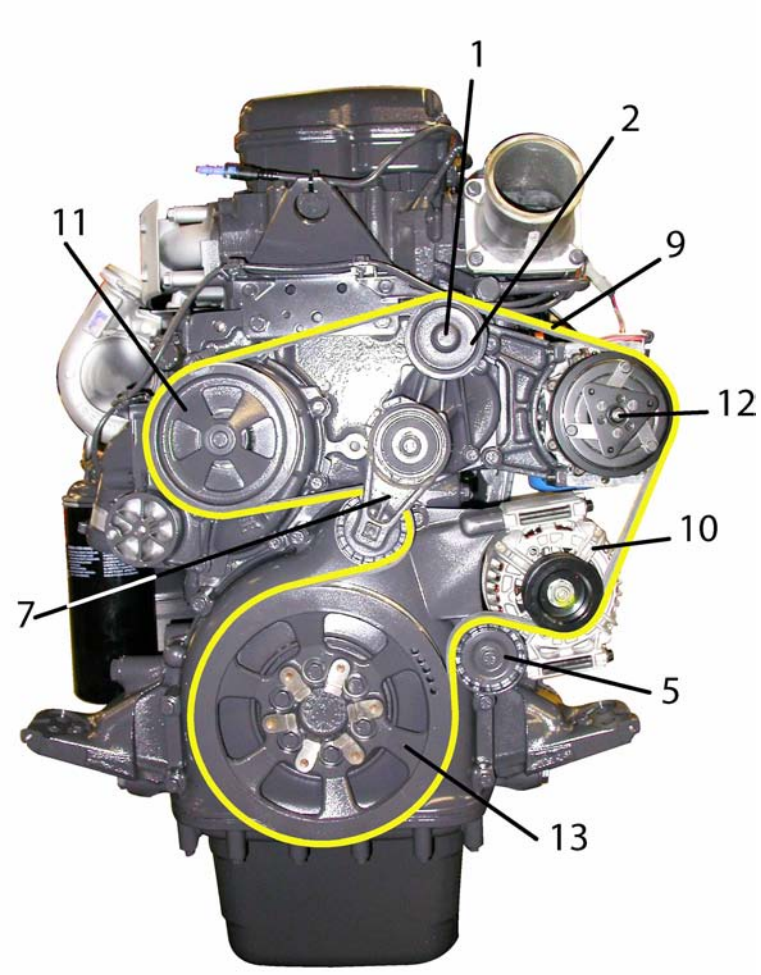
The coolant pump and alternator are driven by the belt drive, as also is the A/C compressor.

(The fan is mounted on a special bracket and is driven by the hydraulic system. See in chapter 5 Hydraulic system)

The drive belt is a “Multigroove V-belt”, i.e. the belt has numerous V-shaped grooves on the drive side. The pulleys are of corresponding design and the belt therefore has an extremely large contact surface for its width. A large contact surface reduces the risk of belt slippage.

Included in the belt circuit are also jockey pulleys, the purpose of which is to give the belt a good arc of contact round the pulleys.

An automatic belt tensioner is used to obtain the correct belt tension.



1 Spacing sleeve
2 Roller
5 Roller
7 Belt tensioner
9 Poly V belt
10 Alternator
11 Coolant pump
12 A/C compressor
13 Pulley

Renewing the seal in the front cover

1.
Remove the fan ring and the fan.
Thermostatic fan: Store it upright (vertical).

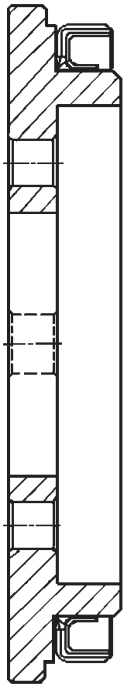
2.
Remove the belt(s), crankshaft damper and belt pulley.

3.
Remove the driver bolts and withdraw the driver. Mind the sealing surface.

4.
Pull or prise off the seal in the cover.
Take care to avoid damaging the sealing surface in the cover.

5.
Wipe the sealing surface in the cover clean.

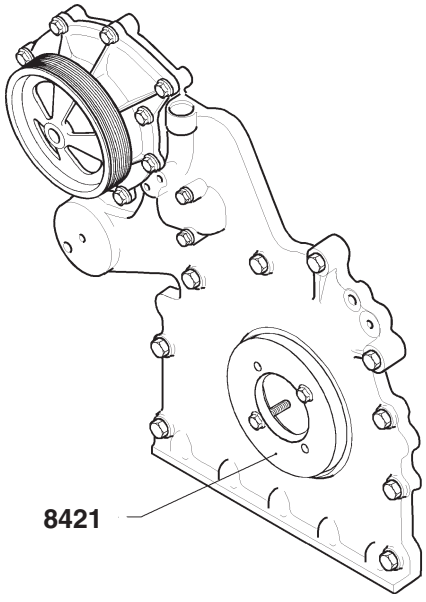
Note: The crankshaft seal must be fitted dry and must not be lubricated.
The sleeve in the seal should be left in place until the seal is fitted.



Tool 8421 with crankshaft seal

6.
Place the new seal on tool 8421 and press it in place by tightening the diametrically opposite bolts alternately.
The seal is correctly fitted when the tool comes up against the cover.

7.
Remove the tool by screwing the bolts into the threaded holes.



8.
Wipe the driver sealing surface clean. Fit a new seal on the end surface of the driver and push the driver onto the spacing sleeve on the end of the crankshaft.

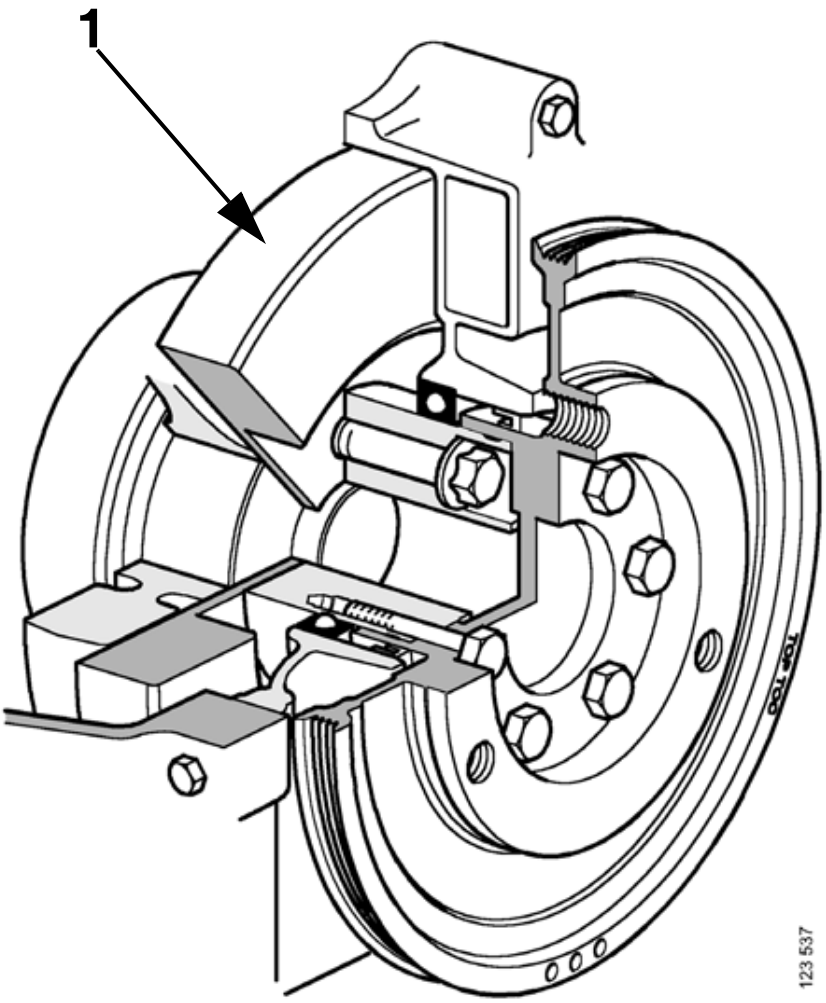
9.
Bolt the driver to the crankshaft flange and tighten the flange bolts to 135 Nm.

10.
Bolt the crankshaft damper and possibly the belt pulley to the hub and tighten to 110 Nm.

11.
Fit the belt(s), fan ring and fan.

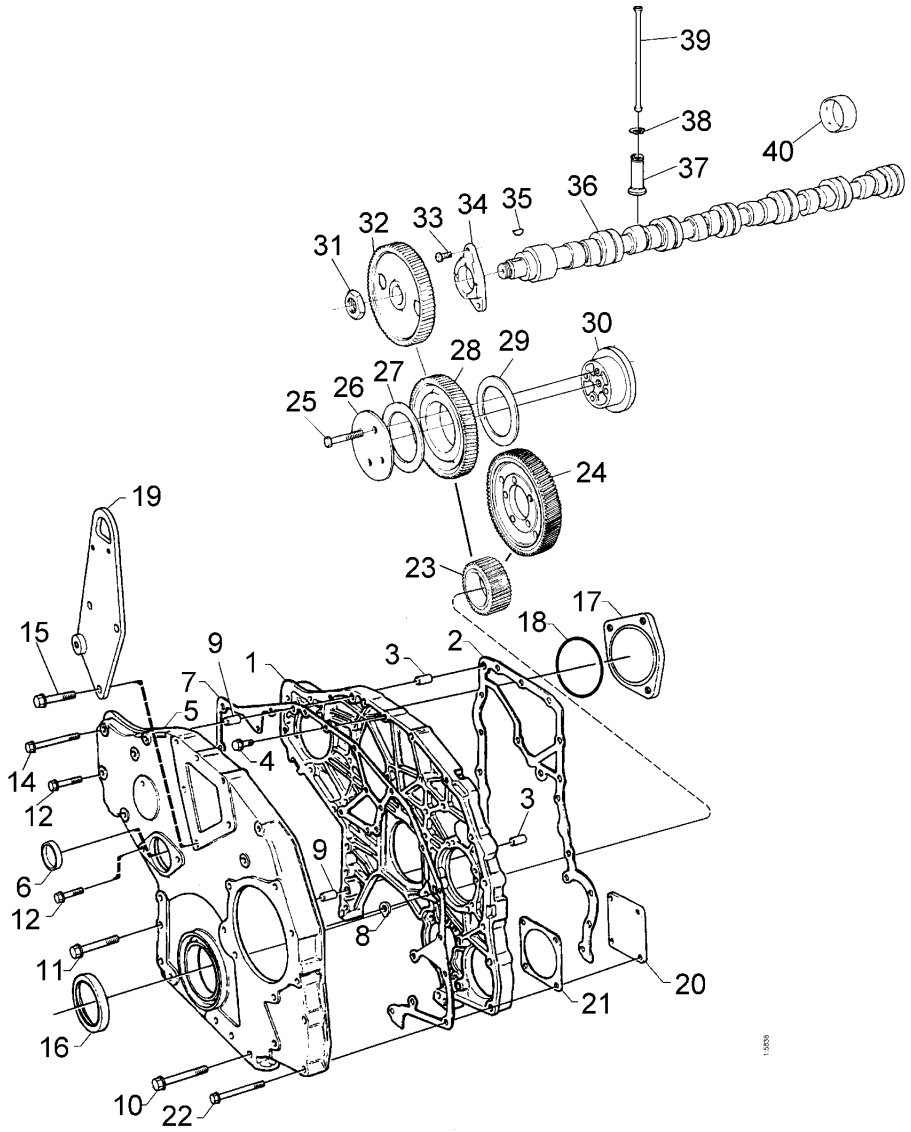
Crankshaft damper

1.Oscillation damper



Crankshaft damper
The power impulses from the connecting rause torsional oscillations in the crankshaft.
These oscillations are severest at certain engine speeds which vary with the design of the engine, how it is loaded, etc.
Torsional oscillation is characterised as follows:
The flywheel (at the “rear” end of the crankshaft)
rotates at an almost constant speed throughout each revolution of the crankshaft. In relation to the constant speed of the flywheel, the rotational speed of the front end of the crankshaft will increase and decrease several times during each rotation.
To reduce the amplitude of the oscillation, a crankshaft damper is attached to the front end of the crankshaft underneath a cover.
A ring of steel is incorporated in the circular and completely enclosed housing of the crankshaft damper. The housing is bolted onto the crankshaft.
There is a heavy oil between the housing and ring which damps the relative movement between the two. The oscillation at the front of the crankshaft is damped by the ring striving to rotate with even speed. 1

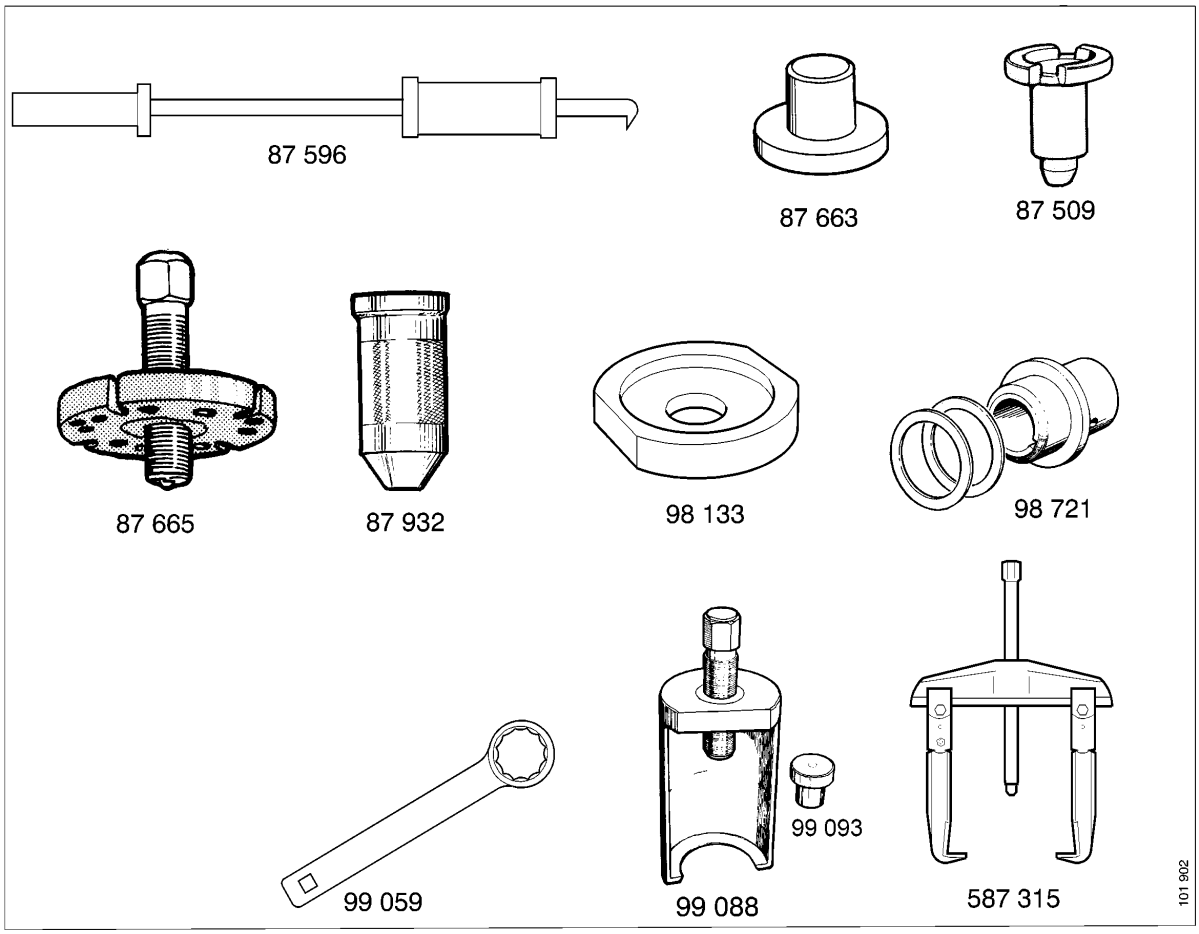
Timing gear, view exploded



1. *Timing gear housing*
2. *Gasket*
3. *Pin*
4. *Flange bolt*
5. *Timing gear cover*
6. *Core plug*
7. *Gasket*
8. *Gasket*
9. *Pin*
10. *Flange bolt*
11. *Flange bolt*
12. *Flange bolt*
13. *Flange bolt*
14. *Flange bolt*
15. *Flange bolt*
16. *Crankshaft seal*
17. *Cover*
18. *O-ring*
19. *Lifting eye*
20. *Cover*
21. *Gasket*
22. *Flange bolt*
23. *Crankshaft gear*
24. *Injection pump gear*
25. *Bolt*
26. *Washer*
27. *Thrust bearing*
28. *Intermediate gear*
29. *Thrust bearing*
30. *Shaft journal*
31. *Nut*
32. *Camshaft gear*
33. *Flange bolt*
34. *Guide flange*
35. *Key*
36. *Camshaft*
37. *Tappet*
38. *Retaining ring*
39. *Pushrod*
40. *Bushing*

Special tools

Special tools, gear

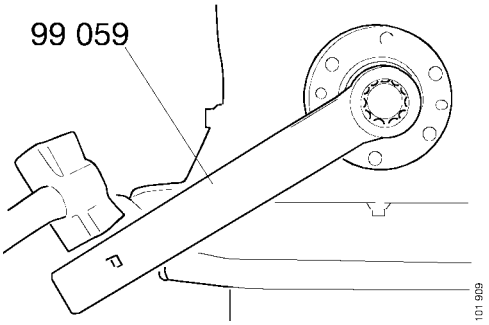


87 509	*Drift*
87 596	*Slide hammer*
87 663	*Support drift*
87 665	*Puller*
87 932	*Drift*
98 133	*Washer*
98 721	*Assembly tool*
99 059	*Slogging wrench*
99 088	*Puller*
99 093	*Support drift*
587 315	*Puller*

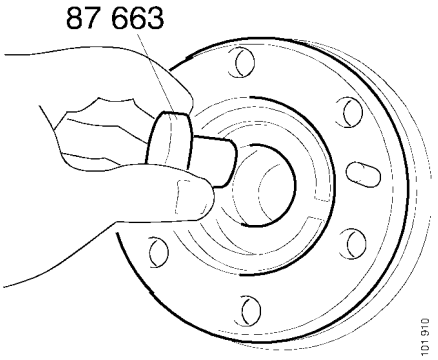
Crankshaft seal

Removing

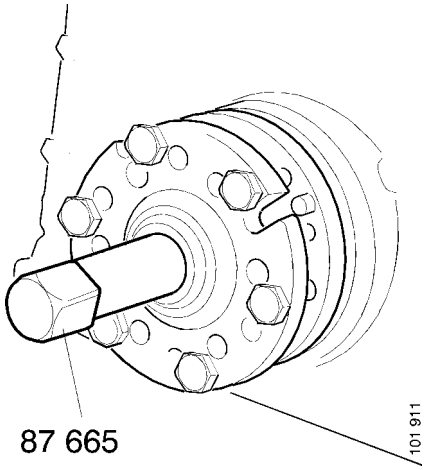
1. Remove components that are in the way: radiator, fan ring, fan or belt guard.
2. Undo the crankshaft damper bolts and those for the belt pulley, if fitted. Remove the crankshaft damper and belt pulley, if fitted. Take care to avoid damaging the crankshaft damper.
3. Remove the crankshaft bolt in front of the damper hub.
   Use slogging wrench 99 059.



4. Fit support drift 87 663 in the end of the crankshaft.



5. Screw on puller 87 665 with all six bolts. Pull the hub out 2-5 mm.
   Then unscrew the bolt a few turns and tap the hub in to loosen the cone.

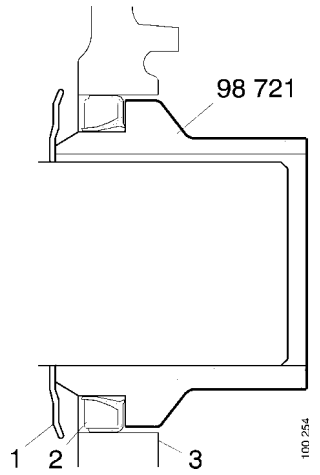


6. Pull the hub off altogether.
7. Remove the seal using slide hammer 87 596. Protect the end of the crankshaft against scratches.

Fitting

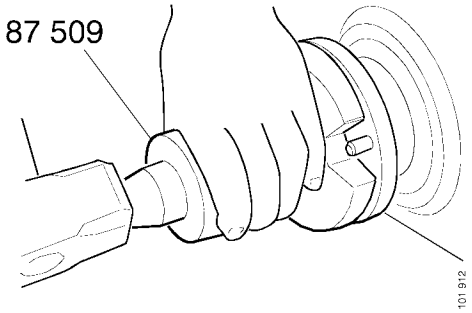
1. Wipe clean the seal seat in the housing.

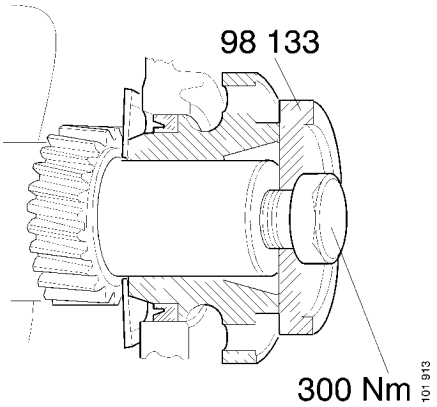
Note The crankshaft seal should be fitted dry and must not be lubricated. The sleeve inside the seal must not be removed until immediately before the seal is fitted in the engine.



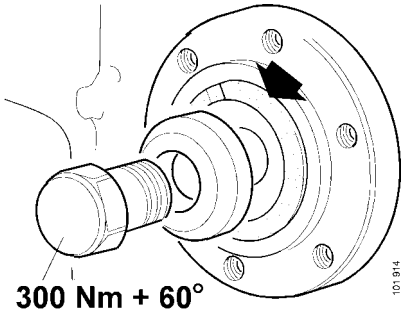
1. Oil deflector
2. Seal
3. Timing gear cover

2. Use assembly tool 98 721 to press in the seal. This tool is tapped in using a copper hammer.
3. Degrease the surface of the oscillation damper hub in contact with the seal and drive on the hub using drift 87 509.
4. Fit the crankshaft bolt with washer 98 133 but without the cone in the hub. Tighten the crankshaft bolt to 300 Nm.





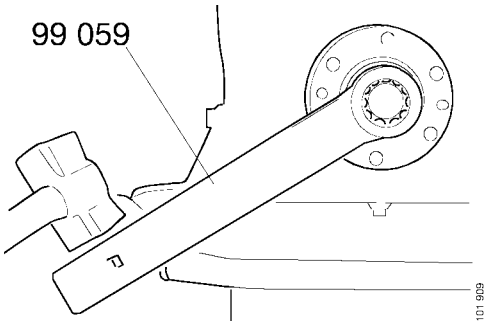
5. Remove the crankshaft bolt and washer 98 133 and fit the cone. Screw in the crankshaft bolt with attendant washer. Tighten first to 300 Nm and then a further sixth of a turn (60°) using slogging wrench 99 059.
6. Fit the oscillation damper and, if fitted, the belt pulley.
   Tighten the bolts to 110 Nm.
7. Refit the components that were removed earlier because they were in the way.



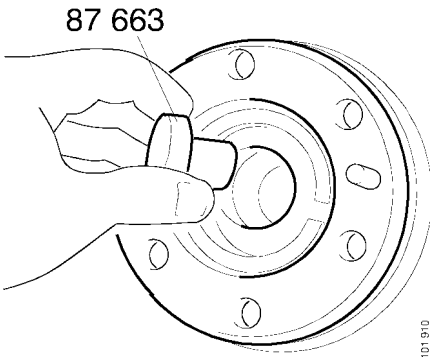
Timing gear cover

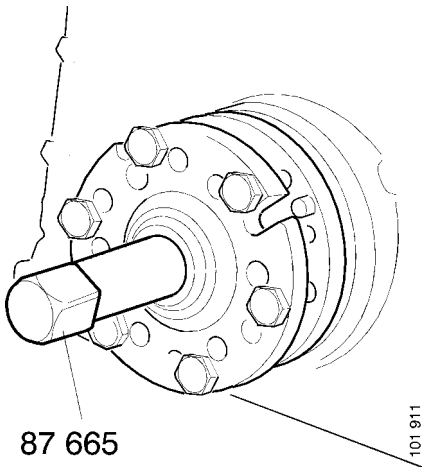
Removing

1. Remove components that are in the way: radiator, fan ring, fan, belt guard, alternator, V-belt, belt tensioner, tensioning rollers, fan drive, alternator bracket.
2. Turn the engine over to the ignition position.
3. Undo the crankshaft damper bolts and those for the belt pulley, if fitted. Remove the crankshaft damper and belt pulley, if fitted. Take care to avoid damaging the crankshaft damper.
4. Remove the crankshaft bolt in front of the damper hub.
   Use slogging wrench 99 059.



5. Fit support drift 87 663 in the end of the crankshaft.
6. Screw on puller 87 665 with all six bolts. Pull the hub out 2-5 mm. Then unscrew the bolt a few turns and tap the hub in to loosen the cone.
7. Pull the hub off altogether.
8. Remove the seal using slide hammer 87 596. Protect the end of the crankshaft against scratches.
9. Engine equipped with compressor:
   Remove the coolant manifold between the coolant pump and compressor.
10. Undo the three compressor retaining bolts in the timing gear housing. Extract the compressor and gear.

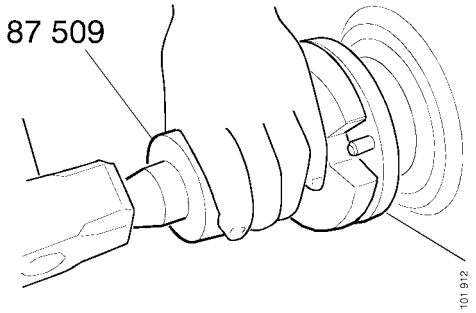


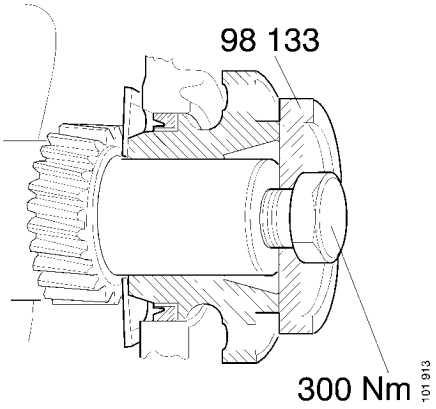


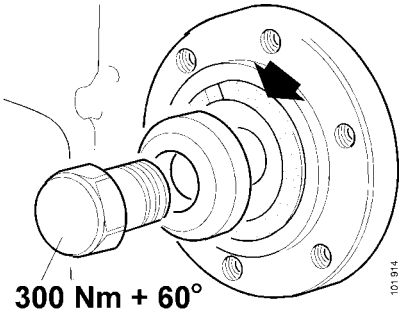
11. Check that the engine is in the ignition position.
12. Remove the oil sump.
13. Remove the timing gear housing.

Fitting

1. Clean the mating surfaces and fit a new gasket.
2. Fit the timing gear housing in place and tighten the bolts to a torque of 39 Nm.
3. Fit a new crankshaft seal.
   See Crankshaft seal: Fitting.
4. Drive on the oscillation damper hub using drift 87 509.
5. Fit the crankshaft bolt with washer 98 133 but without the cone in the hub. Tighten the crankshaft bolt to 300 Nm.
6. Remove the crankshaft bolt and washer 98 133 and fit the cone. Screw in the crankshaft bolt with attendant washer. Tighten first to 300 Nm and then a further sixth of a turn (60°) using slogging wrench 99 059.
7. Fit the oil sump with a new gasket.
8. Refit the components that were removed earlier because they were in the way.

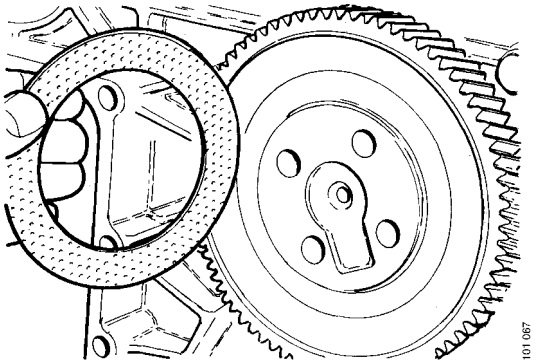






Intermediate gear

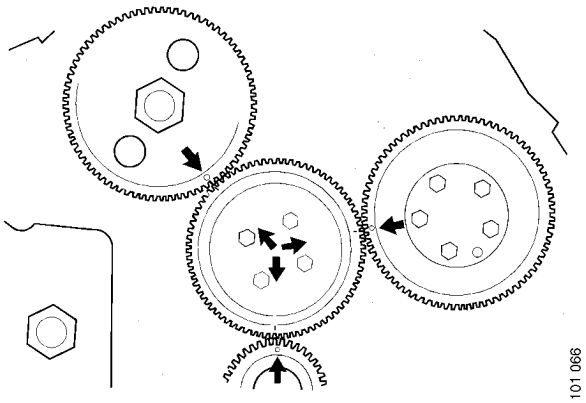
Removing



1. Remove the timing gear cover.
   See Timing gear cover: Removing.
2. Remove oil catcher from end of crankshaft.
3. Turn the crankshaft so that the marks on the camshaft gear and crankshaft gear point towards the centre of the intermediate gear.
4. Remove the intermediate gear.

Note After the intermediate gear has been removed, the camshaft and crankshaft must not be moved. Pistons and valves could then strike each other and sustain damage.

Fitting

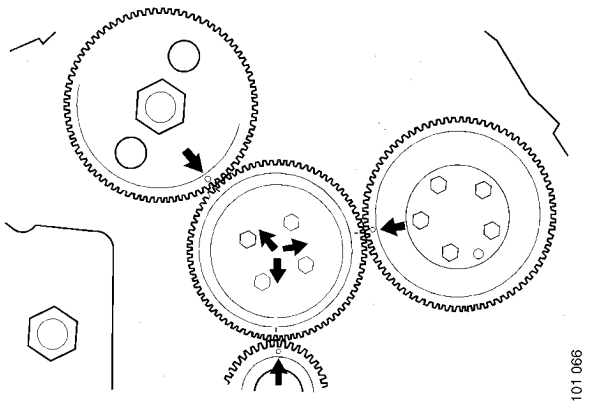


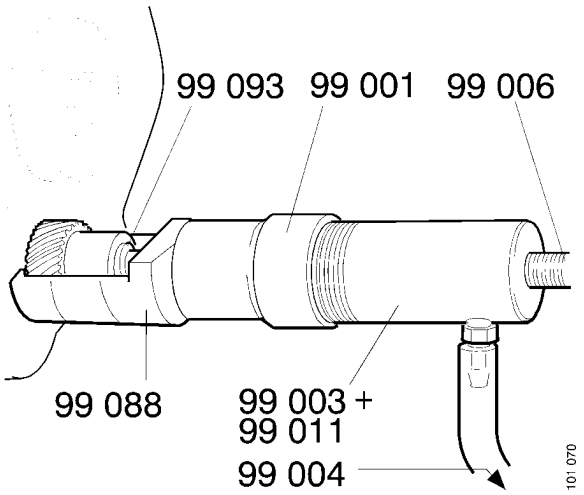
1. Lubricate the bearing surfaces and fit the intermediate gear and thrust bearings so that all marks are in the correct positions.
2. Fit the washer and tighten the bolts to a torque of 39 Nm.
3. Fit the oil catcher on the end of the crankshaft.
4. Fit the timing gear cover.
   See Timing gear cover: Fitting.

Crankshaft gear

Removing

1. Remove the timing gear cover.
   See Timing gear cover: Removing.
2. Remove oil catcher from the end of the crankshaft. Remove oil pump.
3. Turn the crankshaft so that the marks on the camshaft gear and crankshaft gear point towards the centre of the intermediate gear.
4. Remove the intermediate gear. If necessary, also remove the oil pump gear.
5. Pull off the crankshaft gear using puller 99 088 and support drift 99 093, with or without the aid of the hydraulic tool as shown in the figure.





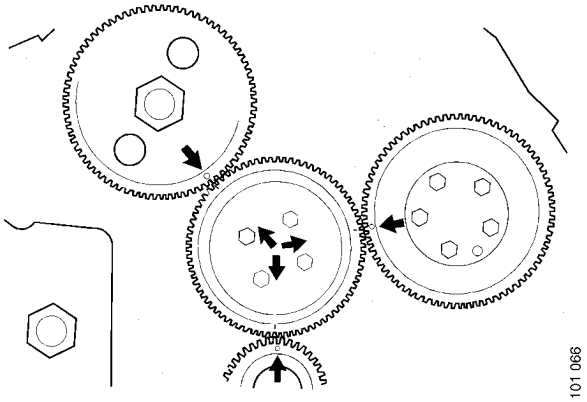
Note **After the intermediate gear has been removed, the camshaft and crankshaft must not be moved. Pistons and valves could then strike each other and sustain damage.**

Fitting

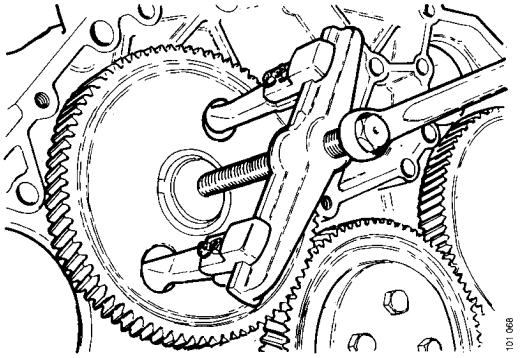
1. Lubricate the end of the crankshaft using engine oil.
2. Heat the gear to 130 °C and fit it onto the shaft with the marking facing outwards. Make sure that the key is fitted in place. Use drift 87 932 and tap the gear fully home.
3. Fit the intermediate gear.
   See Intermediate gear: Fitting, points 1-2.
4. Fit the oil pump.
5. Fit oil catcher on end of crankshaft.
6. Fit the timing gear cover.
   See Timing gear cover: Fitting.

Camshaft gear

Removing

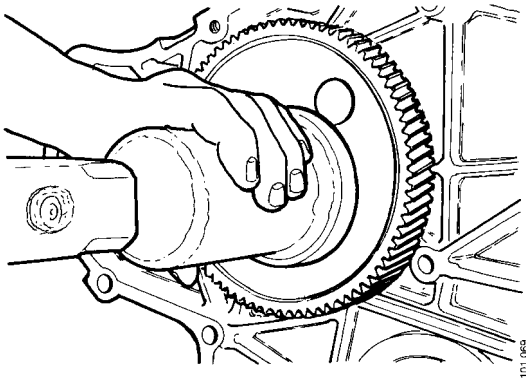


1. Remove the timing gear cover.
   See Timing gear cover: Removing.
2. Remove oil catcher from end of crankshaft.
3. Turn the crankshaft so that the marks on the camshaft gear and crankshaft gear point towards the centre of the intermediate gear.
4. Remove the intermediate gear.
5. Pull off the camshaft gear using puller 587 315.



Note After the intermediate gear has been removed, the camshaft and crankshaft must not be moved. Pistons and valves could then strike each other and sustain damage.

Fitting



1. Lubricate the end of the camshaft using engine oil.
2. Heat the gear to 100 °C and drive it onto the shaft with the marking facing outwards. Make sure that the key is fitted in place.
3. Fit the intermediate gear.
   See Intermediate gear: Fitting, points 1-2.
4. Check that the gear has cooled down. Secure the flywheel. Tighten the camshaft nut to a torque of 600 Nm.
5. Fit oil catcher on end of crankshaft.
6. Fit the timing gear cover.
   See Timing gear cover: Fitting.

Camshaft

Removing

- It is assumed that the timing gear housing has already been removed.

1. Remove rocker arms and pushrods.
2. Turn crankshaft around until the tooth marked "O" on the crankshaft gear and camshaft gear point towards the centre of the intermediate gear. In this position, the camshaft guide flange bolts can be accessed through the holes in the camshaft gear.
3. Remove the side covers with valve tappets.
4. Undo the camshaft gear retaining nut. The camshaft gear can now be pulled off the camshaft using puller 587 315 or can be left in place when the camshaft is extracted.
5. Remove the intermediate gear and the guide flange bolts.
6. Extract the camshaft from the front. Take care to avoid damaging cams and bearings.

Fitting

1. Lubricate and push in the camshaft. Be careful not to damage cams and bearings.
2. Fit the guide flange bolts.
3. Fit the intermediate gear,
see Intermediate gear: Fitting, points 1-2.
4. Fit the camshaft gear,
see Camshaft gear: Fitting, points 1-4.
5. Lubricate the camshaft cams. Fit the side covers with a new gasket.
6. Lubricate pushrods and rocker arms with motor oil and fit them in place.

Changing valve tappets

1. Clamp the side cover in a vice. Remove the retaining ring and valve tappet.
2. Fit a new valve tappet. Fit the retaining ring, using a screwdriver.

Camshaft bearings

- There is very little wear on the camshaft and camshaft bearings and these components rarely need any work to be done on them.
- However, when reconditioning the engine, check that the bearing surfaces and cams are not abnormally worn.
- Fit new bearings so that the lubricating holes are opposite the oilways in the block.

Checking camshaft setting

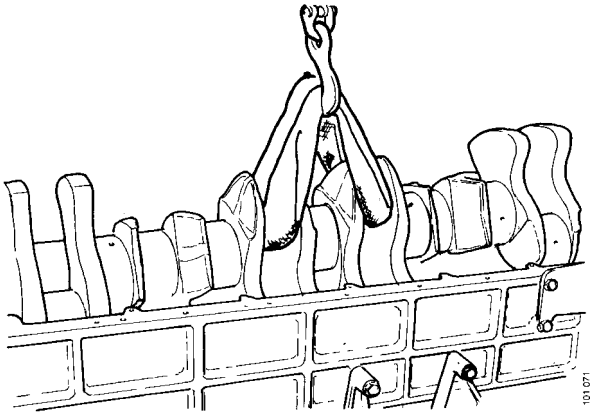
1. Set the crankshaft at TDC for No. 1 cylinder's compression stroke (valves closed).
2. Set up two dial gauges against the valve spring thrust washers.
3. Adjust the rocker arms so that there is no clearance and then an additional 0.1 mm (see that both valves are open 0.1 mm).
4. Zeroize both dial gauges.
5. Turn the crankshaft one revolution in its direction of rotation until the TDC position is reached again.
6. Read the two dial gauges and compare the results with the values given below:

Intake valve lifting height	0.55-1.65 mm
Exhaust valve lifting height	0.50-1.50 mm

Crankshaft

Removing

1. Remove the cylidner heads and pushrods.
2. Remove the flywheel and flywheel housing.
3. Remove the fan, fan bearing, oil sump, timing gear housing and intermediate gear.
4. Remove the oil pump and all pistons and connecting rods.
5. Remove all main bearing caps and carefully lift out the crankshaft using a lifting strap or the like which will not damage the shaft journals.
6. Remove all main bearing halves and thrust washers on the 7th main bearing.

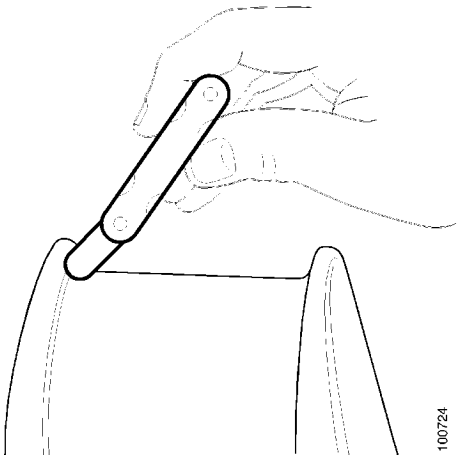


Checking and grinding

1. Measure the crankshaft pivot pins. Use a micrometer to take measurements at two points 90 degrees apart.

   If either of these diameters is below the specified lower limit, regrinding of the crankshaft or the fitting of a replacement crankshaft should be considered.

   The oil pressure should also be taken into account, which is in turn also affected by wear in the main and big-end bearings.



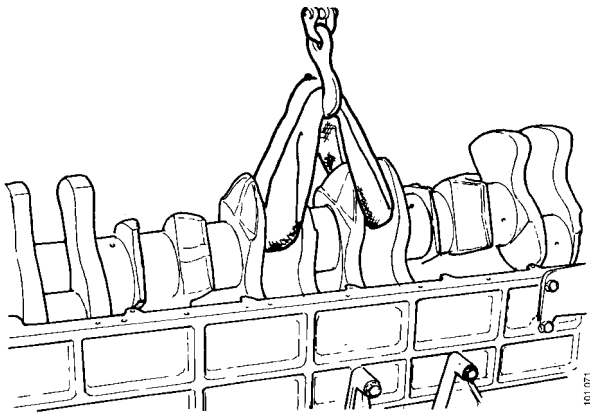
2. When regrinding, stated undersizes must be complied with. There are bearings adapted to these dimensions.

   It is important that the fillet radius of the pivot pins is correct.

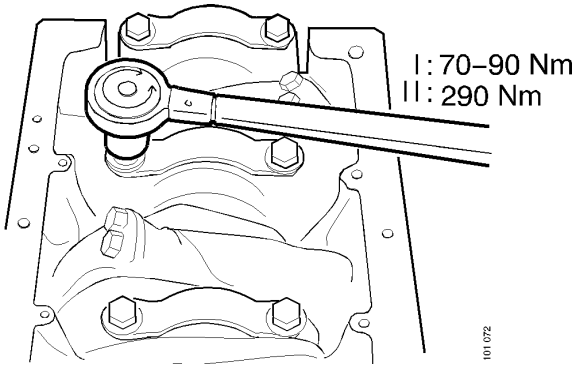
   After grinding the pivot pins, the oil hole orifices at the bearing surfaces should be rounded and polished.

Fitting

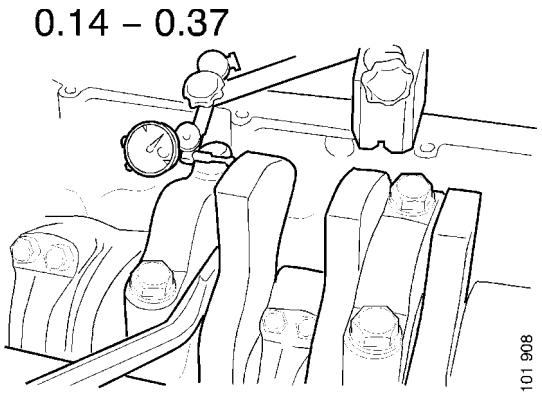
1. Be particularly careful to clean all oilways in the crankshaft, pivot pins and contact surfaces for bearings and caps.
2. Check that the dimensions of bearings and thrust washers are correct. Fit the bearing halves in block and cap. Generously lubricate bearings and pivot pins.
3. Carefully lift in the crankshaft. Fit the thrust washers and place the caps as marked.



4. Lubricate the bolt threads and start by tightening the cap bolts to 90 Nm. The tighten the bolts to 290 Nm.
   Check that the crankshaft rotates easily.



5. Check crankshaft axial clearance. It should be 0.14-0.37 mm. The clearance can be adjusted by changing the thrust bearing washers.
6. Fit pistons, connecting rods and oil pump.
7. Fit the fan bearing and fan, oil sump, timing gear housing and intermediate gear.
8. Fit the flywheel and flywheel housing.
9. Fit the cylinder heads and pushrods.



Lubrication system

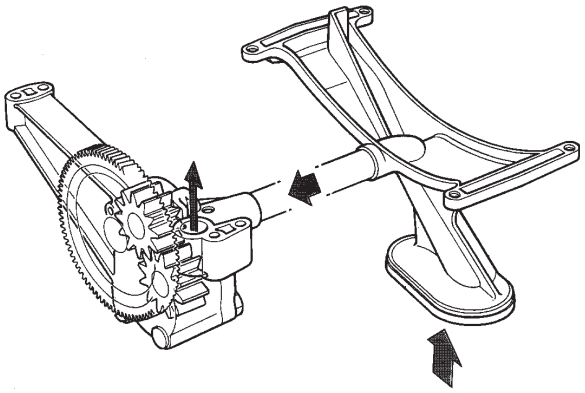
Oil pump

An oil pump, driven by the crankshaft gear, generates the circulation required to provide lubrication oil to all lubrication points so that it flows through the oil cleaner and oil cooler.

The lubricating oil is sucked from the sump through a strainer in the oil pump.

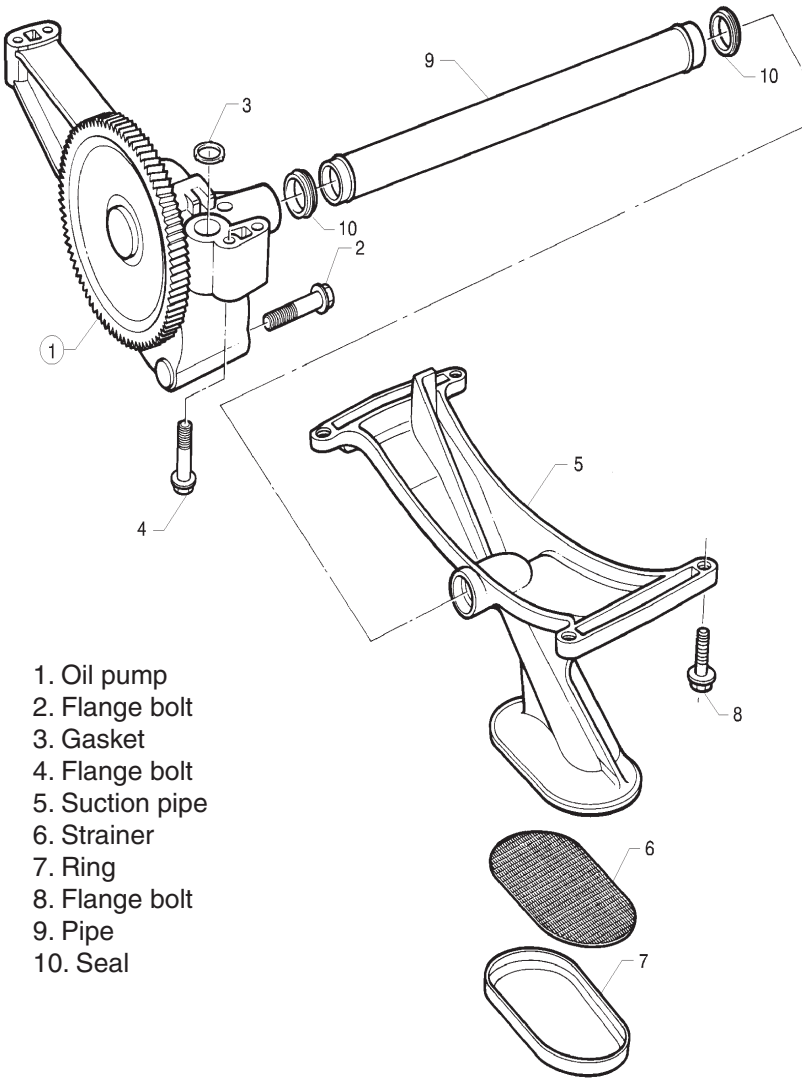
The oil pressure must be so high as to ensure that each lubrication point receives the amount of oil needed for its lubrication and cooling.

Too high oil pressure could cause excessive stress to components in the lubrication system.



1. Oil pump

Particularly when the oil is cold there is a risk that the pressure will be high and for this reason a safety valve is incorporated in the oil pump. If the pressure is too high the oil pressure valve will allow oil to escape (and run back to the sump) so that the pressure will not be so high as to cause any damage.



1. Oil pump
2. Flange bolt
3. Gasket
4. Flange bolt
5. Suction pipe
6. Strainer
7. Ring
8. Flange bolt
9. Pipe
10. Seal

NOTE!
In the case of leakage or fault in the oil pump, it should not be reconditioned but should be renewed as a unit.

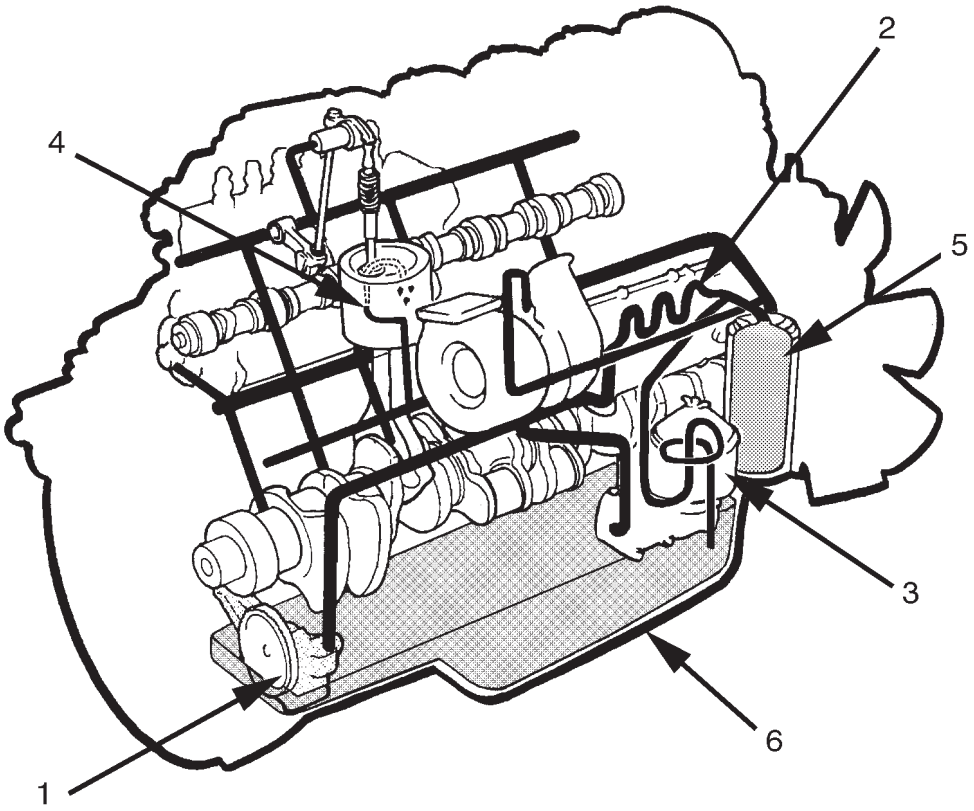
Lubrication oilways

The lubrication oil passes through channels in the cylinder block to reach the camshaft bearings and the crankshaft main bearing.

Channels in the crankshaft feed the oil on to the connecting rod bearings.

Lubrication oil for the rocker arms is led via a direct channel from the main oilway.

The channel is constantly pressurised.
The oil is led to the roller tappet shafts via grooves in the camshaft bearing.
The roller tappet shafts have drilled channels to lubricate the roller tappets.



1. Oil pump
2. Oil cooler
3. Oil cleaner centrifuge
4. Piston cooling nozzle
5. Oil filter
6. Oil sump

Oil pressure

High lubricating oil pressure (above 6 bar) is normal when starting a cold engine.

Max. oil pressure:
Warm engine running at a speed above 800 rpm 6 bar

Normal oil pressure:
Warm engine running at an operating speed of 3 - 6 bar

Min. oil pressure:
warm engine running at a speed of 1000 rpm 1.0 bar

The control system has the following alarm levels:
- at a speed of less than 1000 rpm and an oil pressure of less than 1.0 bar
- at a speed of more than 1000 rpm and an oil pressure of less than 2.3 bar for longer than 5 seconds.

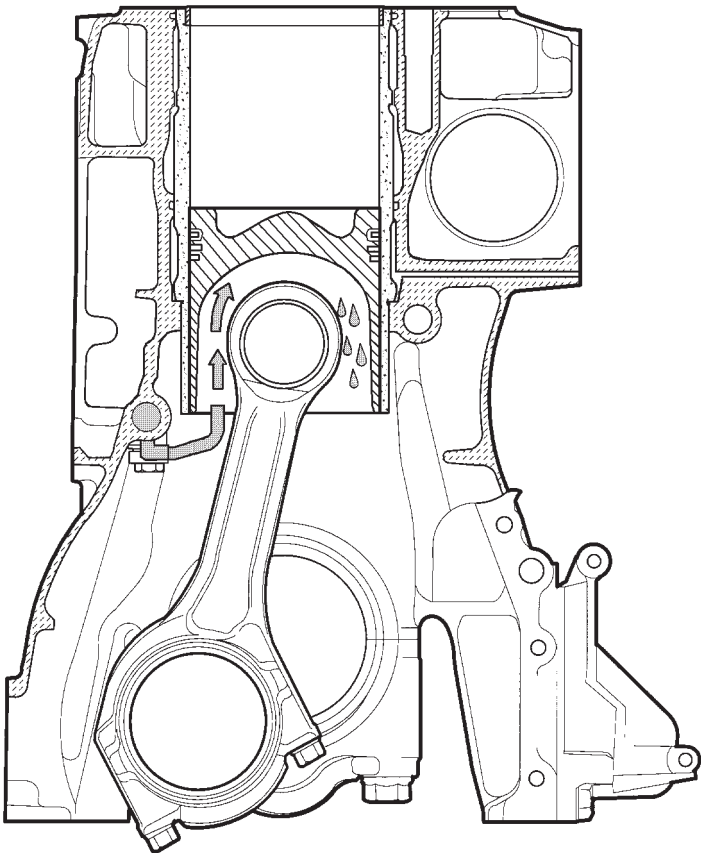
The following functions are available if there is an alarm:
- Alarm which only switches on the warning lamp and diagnostics lamp.

A fault code is generated in the control unit.

After an alarm, approved values should be registered for more than 1 second to reset the alarm.

The pistons are cooled by the lubrication oil.
Oil is sprayed up under the piston crown through special nozzles, one for each cylinder.
Since piston cooling is not needed at low engine rpm, an oil pressure valve in the oil cooler housing opens at 3 bar.

See the next page.



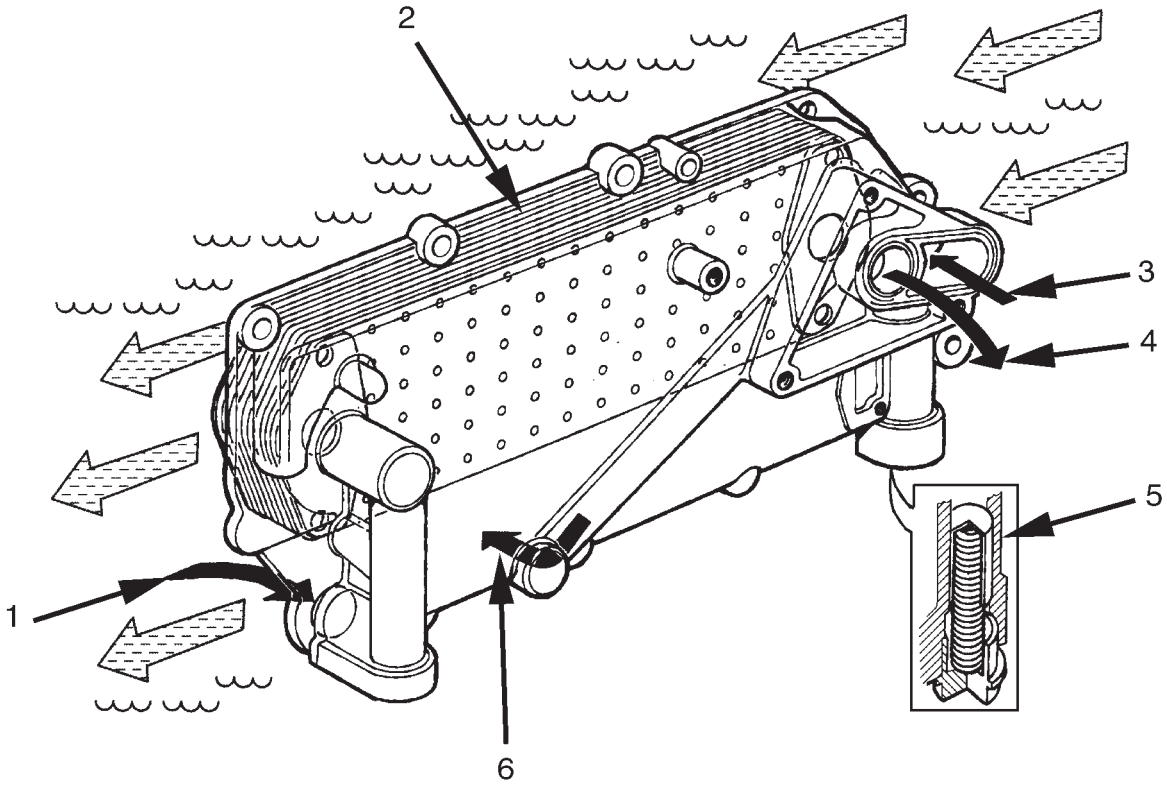
Oil cooler, engine

From the oil pump, the lubricating oil flows via passages in the block to the oil cooler located inside the front side cover on the right-hand side of the block.

The oil cooler is a plate heat exchanger.

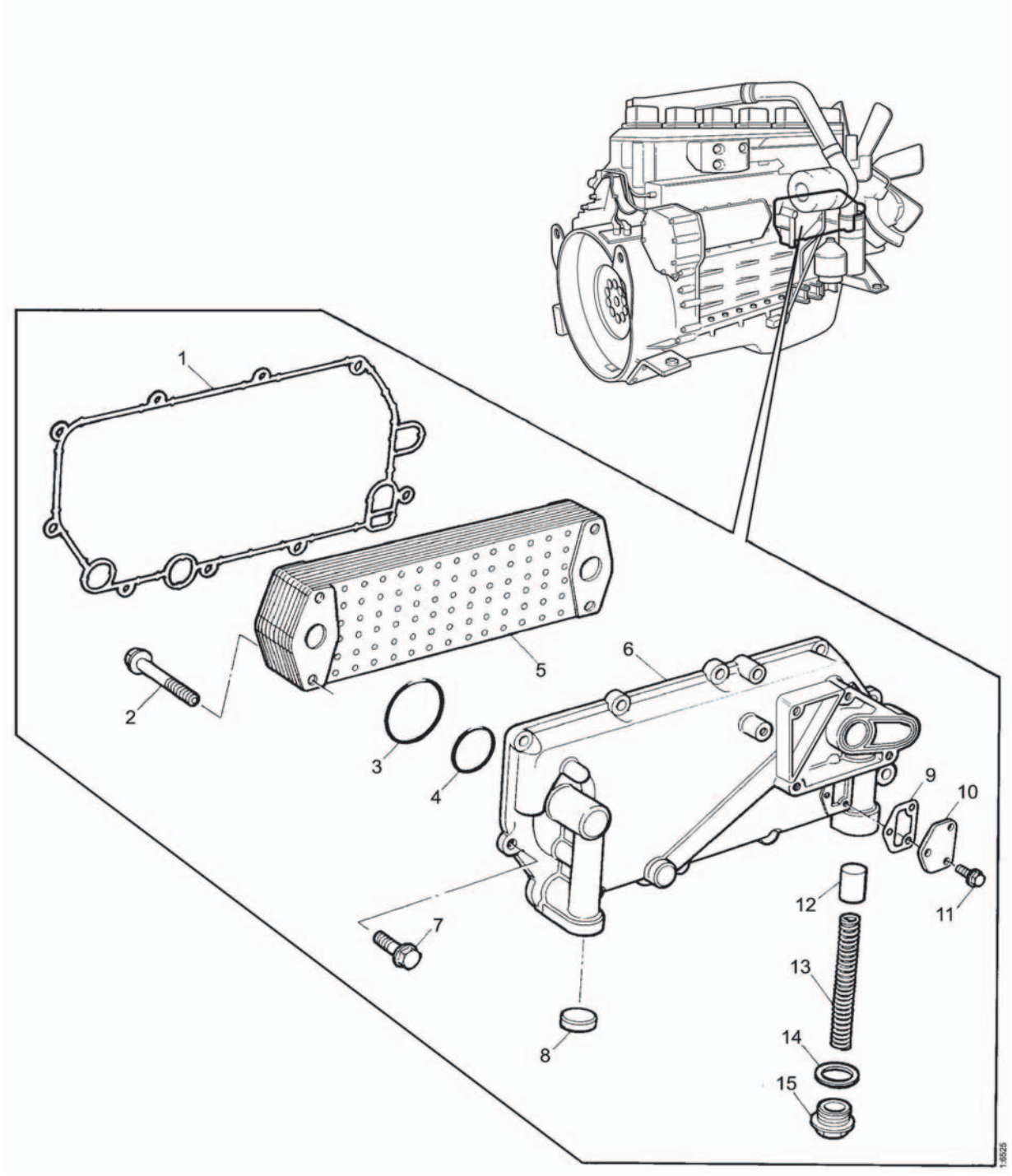
All the oil flows through the cooler where it is cooled by the coolant from the cooling system.

An oil pressure valve (5) is located in the coil cooler housing for cooling the pistons.
It has an opening pressure of 3 bar. No piston cooling therefore takes place at low engine speeds (idling).
See also under **Lubrication oilways**.



1. Oil from oil pump
2. Heat exchanger assembly
3. Oil from filter into engine
4. Cooled oil to paper filter
5. Delivery valve for piston cooling
6. Partial flow to centrifugal cleaner

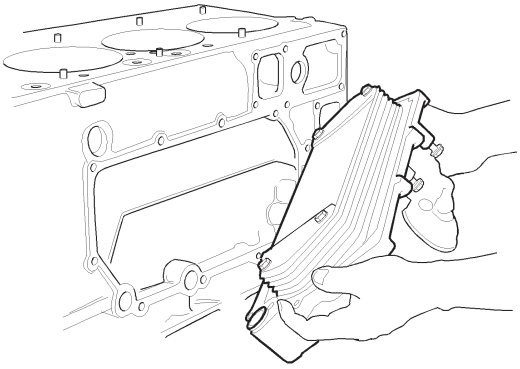
Oil cooler view



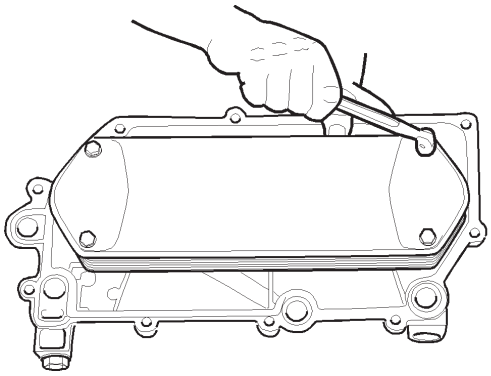
1. Gasket
2. Flange bolt
3. O-ring
4. O-ring
5. Oil cooler
6. Oil cooler cover
7. Flange bolt
8. Core plug
9. Gasket
10. Cover
11. Bolt
12. Piston
13. Spring
14. Gasket
15. Plug

Renewing seals

1.
Remove the side cover and oil cooler from the block.



2.
Remove the 4 bolts securing the oil cooler to the side cover.

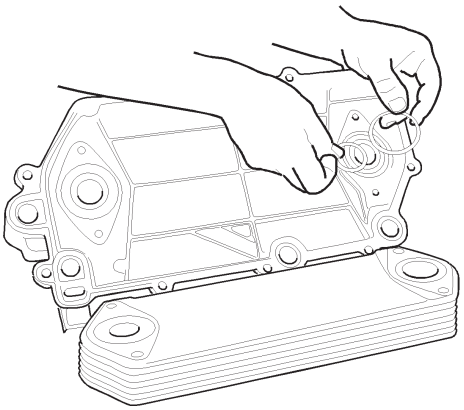


3.
Remove the oil cooler.

4.
Renew the 4 O-rings.

5.
Fit the oil cooler insert and bolt securely to the side cover using 26 Nm torque.

6.
Bolt the side cover to the block.



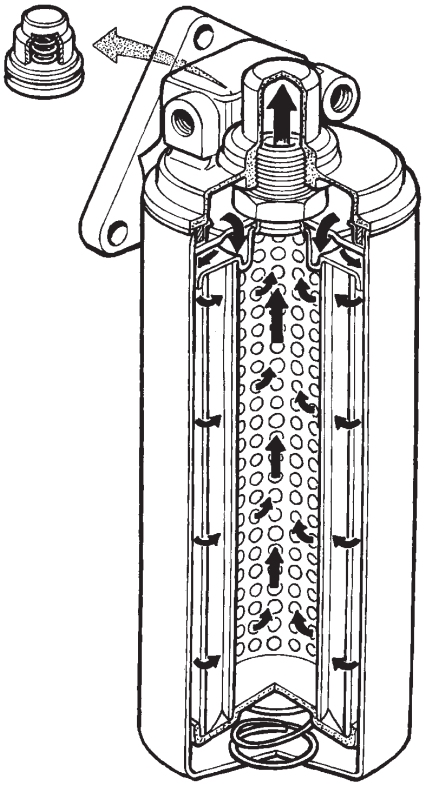
Oil filter

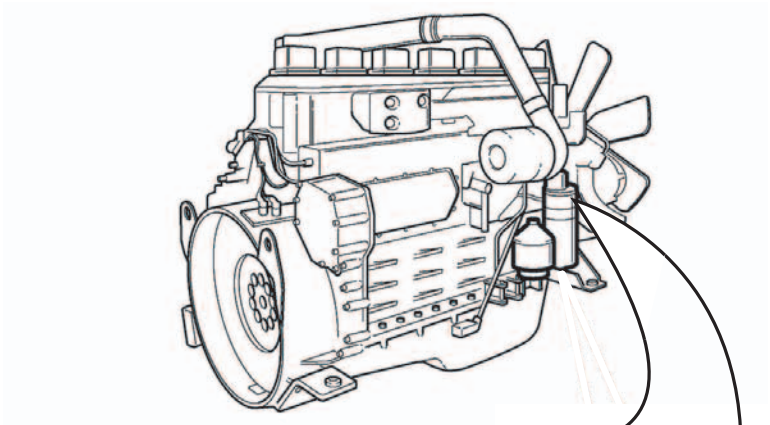
From the oil cooler, the oil passes through a large-capacity full-flow filter of paper.

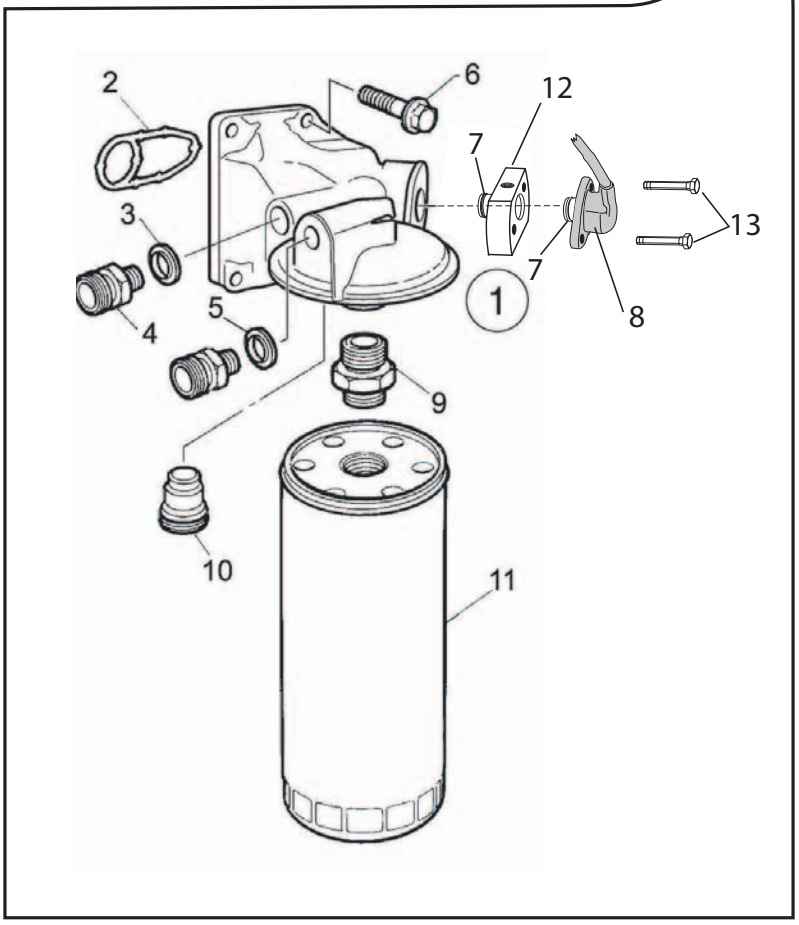
This filter also cleans the oil to the turbocharger.

The oil filter has an overflow valve which opens if the filter becomes clogged. Unfiltered oil than continues to the engine and only some of the oil is cleaned in the centrifugal cleaner.

It is therefore especially important to change the filter at the intervals recommended in the **Operating & Maintenance Manual**.







1. Filter head
2. Gasket
3. Seal
4. Straight union
5. Gasket
6. Flange bolt
7. O-ring
8. Pressure censor
9. Union
10. Overflow valve
11. Oil filter
12. Adapter
13. Screw

Centrifugal oil cleaner

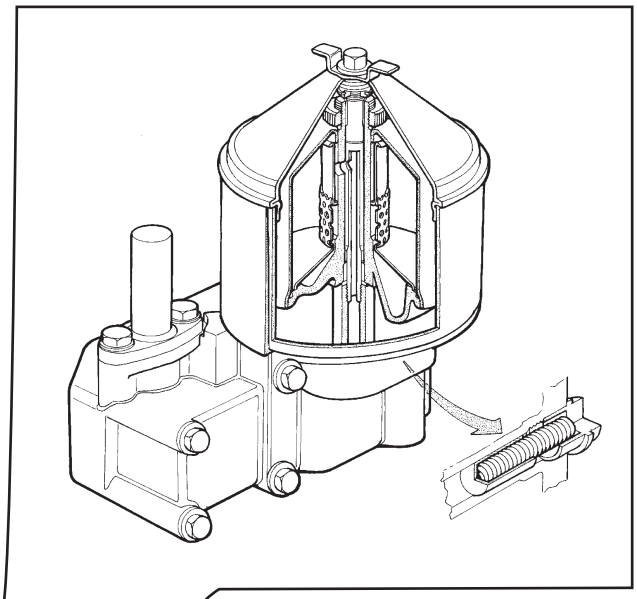
Some of the oil passes from the main passage in the oil cooler cover to the centrifugal cleaner and then, after cleaning, flows back to the sump.

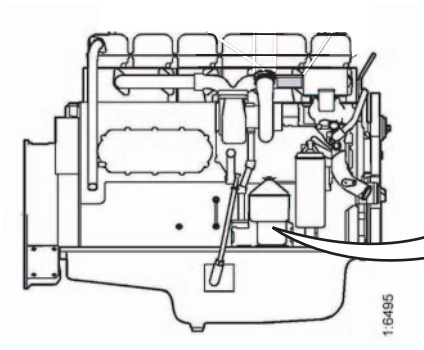
Surplus oil is drained back to the sump via an overflow valve. This ensures that the pressure in the oil system is not too high.

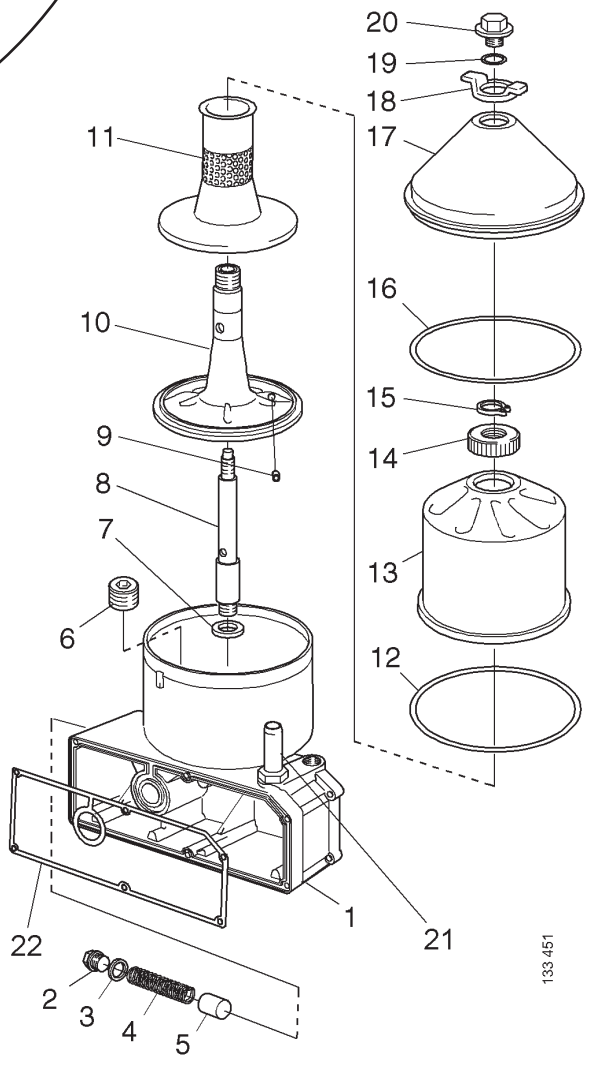
The centrifugal cleaner's rotor is caused to spin by the force of the oil which squirts out through two nozzles at the bottom of the rotor.

Dirt particles are slung against the wall of the rotor by centrifugal force and fasten there as a coating.

The rotor should be dismantled and cleaned at definite intervals according to the inspection programme included in the operator's manual.







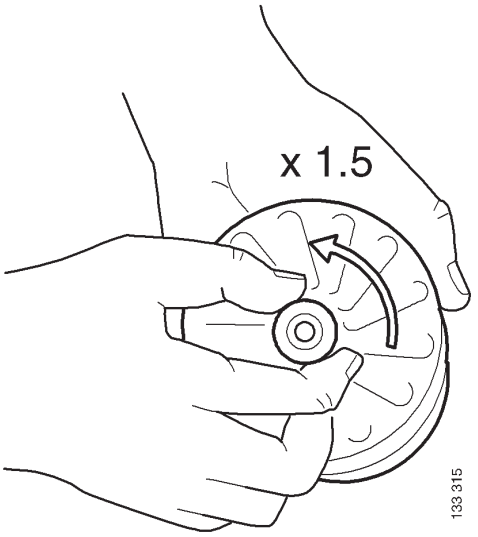
1. Housing
2. Plug
3. Gasket
4. Spring
5. Piston
6. Plug
7. Washer
8. Shaft
9. Nozzle
10. Rotor
11. Strainer
12. O-ring (change when cleaning)
13. Rotorbowl
14. Nut
15. Snap ring
16. O-ring (change when cleaning)
17. Cover
18. Lifting eye
19. O-ring
20. Lock nut
21. Nipple
22. Gasket

Dismantling and assembly

- During routine cleaning of the oil cleaner, there should be a certain amount of dirt deposits in the rotor bowl.

- If this is not the case, it indicates that the rotor is not spinning. The cause of this must be immediately investigated.

- If the dirt deposit exceeds 28 mm at the recommended intervals, the rotor bowl should be cleaned more often.



1.
Undo the nut holding the outer cover and remove the nut.

2.
Drain out the oil from the rotor

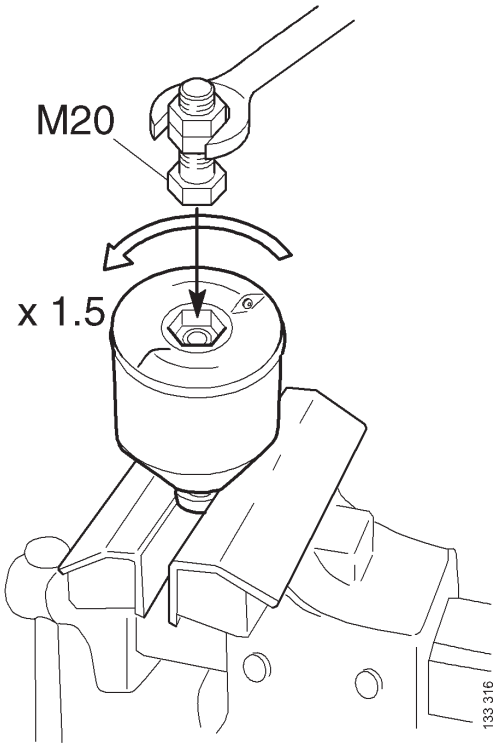
3.
Lift out the rotor. Wipe off the outside. Undo the rotor nut and unscrew it about three turns to protect the bearing.

Note:

The rotor must not be put in a vice. Never strike the rotor bowl. This may cause damage resulting in imbalance.

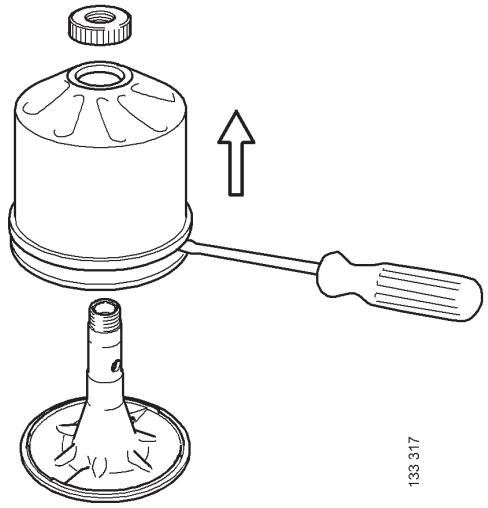
4.
If the rotor nut is difficult to get loose, turn the rotor upside down and fasten the rotor nut in a vice.

5.
Turn the rotor counterclockwise 1,5 turns by hand, or if this does not help, use M20 screw and nut as shovn at the figure



6.
Grasp the rotor bowl and tap lightly with your hand or carefully use a screwdriver between the rotor bowl and the strainer so that the rotor bowl comes loose from the rotor.

Note:
Never strike on the rotor directly as this may damage its bearings.

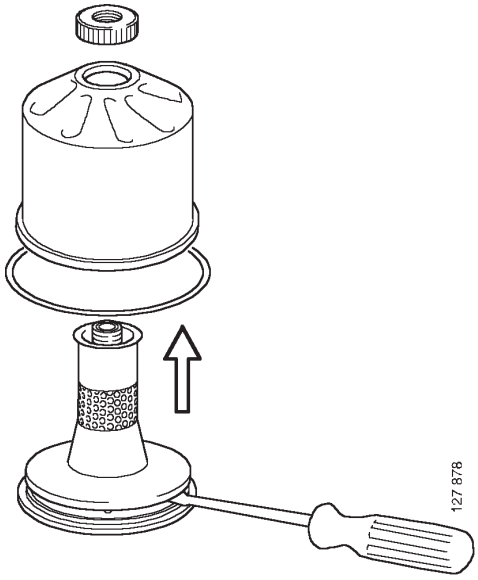


6.
Remove the rotor nut and bowl from the rotor.

7.
Remove the strainer located on the rotor. If the strainer has fastened, prise carefully with a knife or screwdriver at the bottom between the rotor and the strainer.

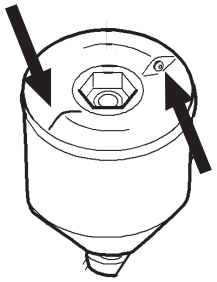
8.
Scrape away the deposits inside the bowl with a knife.

9.
Wash the parts.



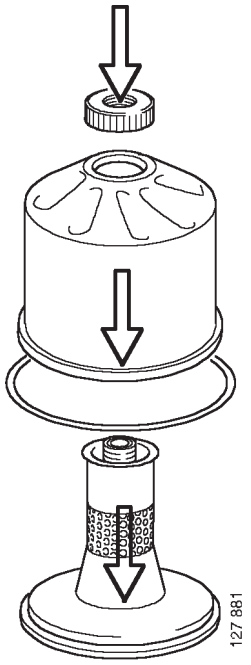
10.
Inspect the two nozzles on the rotor. Make sure they are not blocked or damaged.
Renew with new rotor if any damaged on the nozzles.

11.
Make sure the bearings are not damaged.
Renew with new rotor if any damaged on the bearing



12.
Position the O-ring in the lid. Renew the O-ring if it is at all damaged.

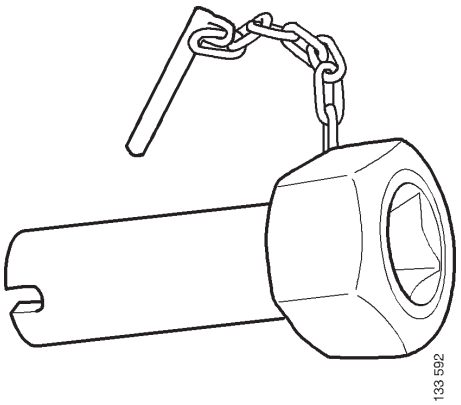
13.
Assemble the parts and tighten the rotor nut by hand.



14.
When tighten the rotor axle (point 15) its neccesarry to modified the Socket spanner 8023 with to weld nut M20 without threads, on the square end.
See the figure.

The socket spanner 8023 is still usable for the old type of the centrifugalfilter after this modification

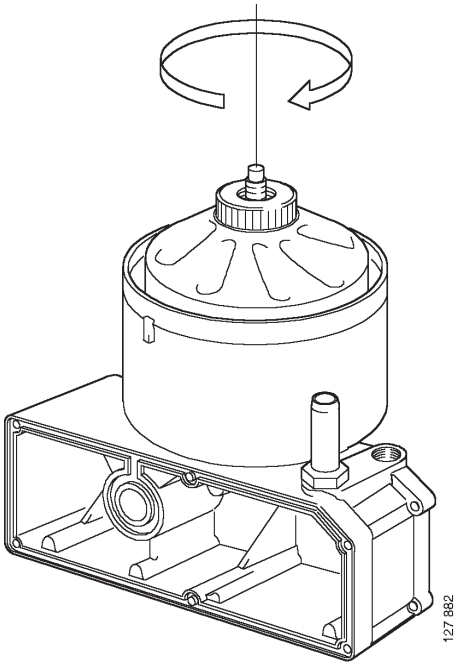
14. För att kunna dra fast rotoraxeln vid punkt 15 i detta Ti behöver hylsnyckeln 98 421 modifieras med en mutter:
-Borra ur gängorna i en M20-mutter så att den passar på hylsnyckelns fyrkantsfäste.
-Svetsa fast muttern.
Obs! Hylsnyckeln passar fortfarande för den gamla centrifugaloljerenaren efter ombearbetningen.



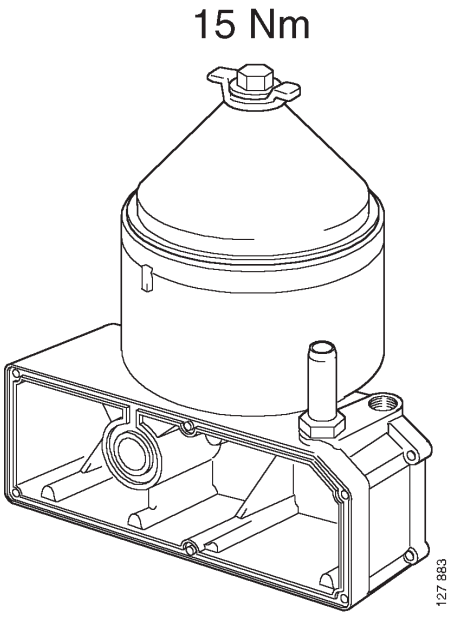
14.
Make sure the shaft is not loose. If it is, it can be locked using screw locking compound. First clean thoroughly using a suitable solvent.

15.
Tighten the rotor shaft using socket 8023.
Tightening torque 34 Nm.

16
Refit the rotor and spin it by hand to make sure it rotates easily.



17.
Inspect the O-ring on the cleaner housing cover and fit it with a lock nut.
Tighten the lock nut to 15 Nm.



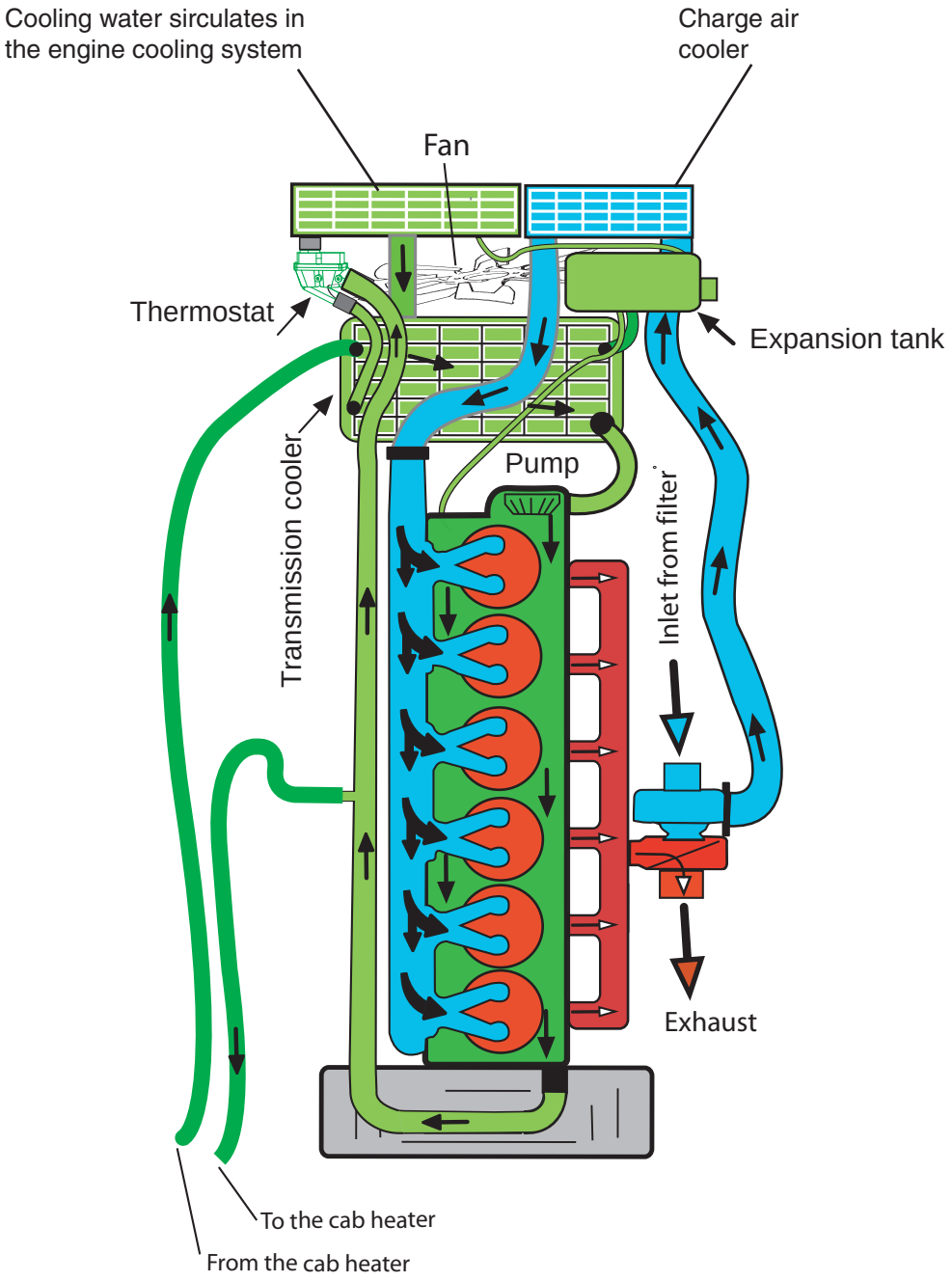
Cooling fan

The fan is driven by the hydraulic system and is moved to the hydraulic chapter.

Look in the chapter 5.

Cooling system

View of the cooling system



Circulation

From the pump, the coolant is carried into the cylinder block's longitudinal distribution ducting and then through holes in the cylinder block, washes round the cylinder liners and flows up to the cylinder heads.

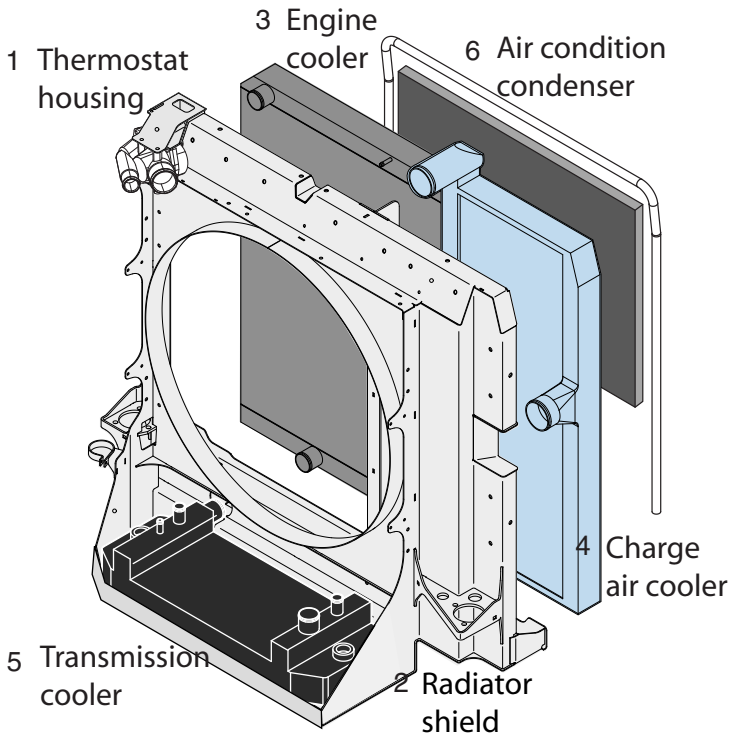
The coolant is also forced directly up into the cylinder heads from the distribution ducting via passages which leads to the injectors and exhaust valves.

From the engine's rear cylinder head the coolant flows forward through the pipe directly into the thermostat housing, which is located on the left-hand side of the radiator shield.
The by pass in the thermostat housing forwards the coolant which is under the temperature limit for the thermostat, back to the engine through the transmission cooler. The coolant which needs to be cooled, are going through the open thermostat and to the radiator cooler system, through the transmission cooler and back to the engine, where the coolant pump is circulating the coolant in the system.

The cab heater takes the heat coolant from the pipe line on the left-hand side of the engine, and after heating the cab, the returned coolant is going to the transmission cooler.

The inlet air to the engine, is by the turbo compressor forced through the charge air cooler. The hydraulic driven fan are also feeding the air through the air charge cooler and cools the air from the turbo compressor.
The pressure of the air, in the air charge system, to the cylinders is approx 1 - 2 bar, depend on the engine's rpm.

View of the radiator system



Disassemble the cooling unit



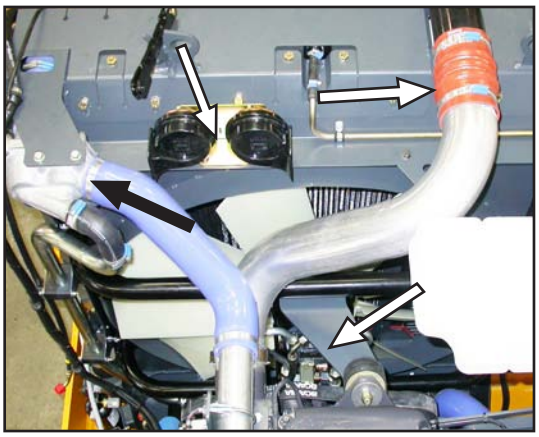
1
Drain the coolant and transmission oil.
First, remove both cover on the underside front frame left and right side.

On left side of the transmission cooler unscrew the plug (Nv 13 mm) and drain the coolant from the engine and radiator.

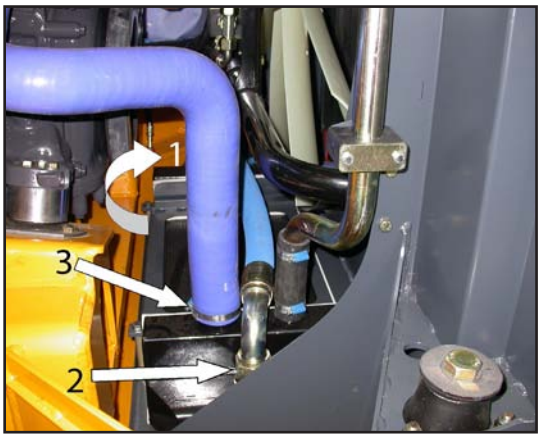
On the right side under the transmission cooler unscrew the plug (Nv 13mm) and drain the transmission oil from the system.

NOTE !

Use a clean drum or similar if the cooling water shall be reused.
Its recommend to supply with new oil when refilling oil to the transmission.



2
Disassemble the horn unit, remove the fastening wiring strips and clamps from the brackets.
3
Disconnect the cooling hoses from the thermostat housing and the outlet hose from the transmission oil cooler.
4
Disassemble the hose on the charge air cooler
5
Disconnect hoses between the expansion tank and the engine.

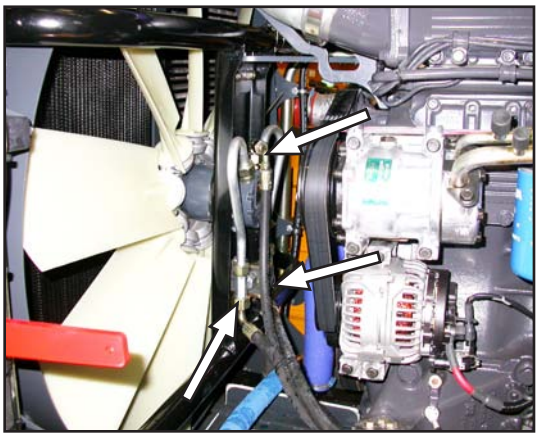


5
Disassemble oil hoses from the transmission oil cooler

and the fan motor.

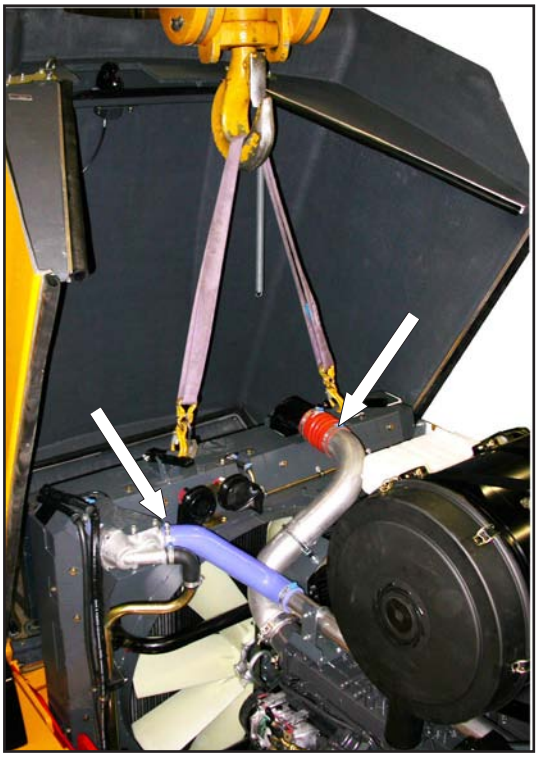
NOTE !
Oil under hydraulic pressure !

The oil system for the fan motor is in the same oil system as the brake, therefore it is recomended when disassemble hoses or units from this system, allways to eliminate pressure in the accumulator,
locate in front of the cab. (2 on left and side 2 on the right side). this can be doing with to operate the brake pedal several times. (Approx 15-20 times)



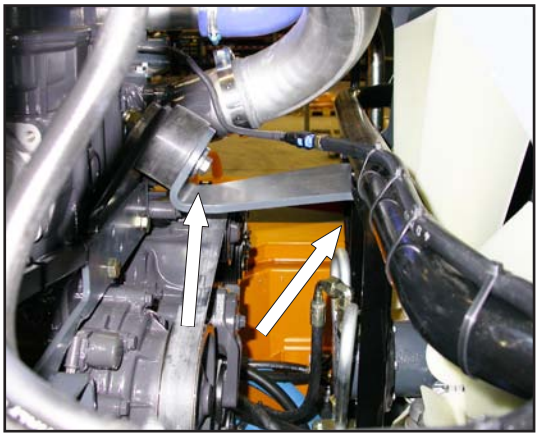
6
Disassemble the Air Condition condenser and the fastening clamps from the fastening brackets.
Place the condenser on the left side of the engine.

NOTE !
Do not disassemble the Air Condition hoses from the condenser filter or the compressor.



7
Fastening the lifting device to the radiator unit.

Check that all cooling pipes and hoses are disassembled



8
Disassemble the upper bracket between engine and fan bracket, (3 screws).



9
Disassemble lower fastening 2 screws
(left and right hand side)

10
Carefully lift the cooler unit out from the frame.

Thermostat and thermostat housing

The engine have a double thermostat.

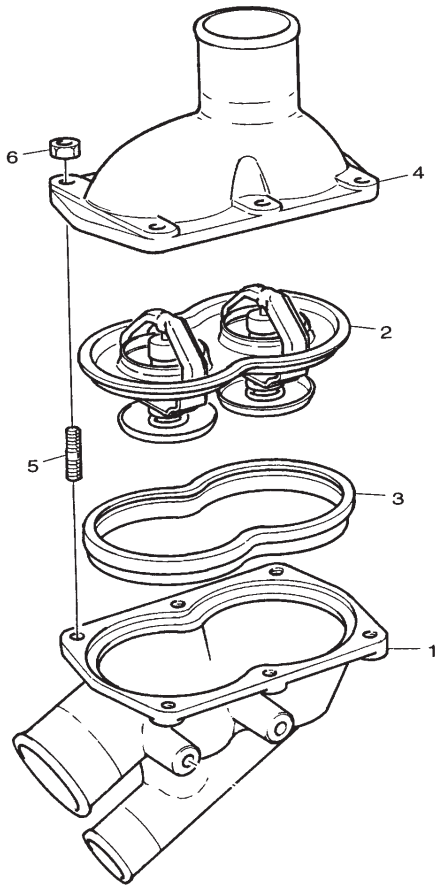
When a double thermostat are used they have the same opening temperature as standard.

The thermostats use wax as the temperature-sensitive medium.

At coolant temperatures below the opening temperature of the thermostats, nearly all the coolant circulates between the engine's coolant passages and the coolant pump without passing through the radiator.

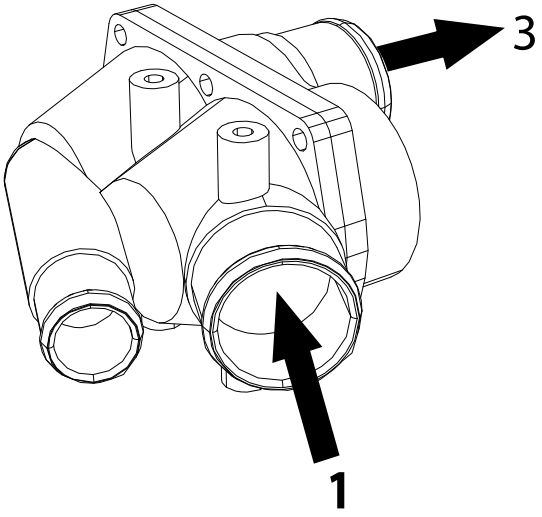
When the coolant temperature in the engine is higher than the temperature for fully open thermostat, the by-pass channel is closed and all coolant flows through the thermostats and on to the radiator.

If temperature equilibrium occurs within the operating range of the thermostats, i.e. between the temperature limits for fully closed and fully open thermostat, the thermostat valves will assume a corresponding intermediate position.
Some of the coolant will then be directed to the coolant pump without being cooled and the remainder directed to the radiator.

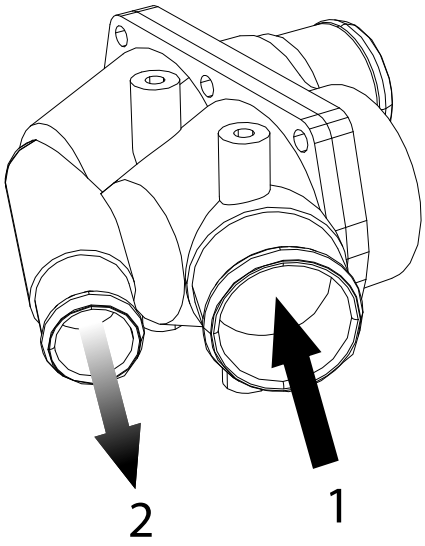


1. Termostat housing
2. Thermostat
3. Gasket
4. Cover
5. Stud
6. Flange nut

Open thermostat -
full flow to radiator



Closed thermostat -
return to coolant pump trough
by-pass channel



1. Coolant from the engine
2. By-pass channel (back to the coolant pump)
3. Outlet to the radiator

Thermostat

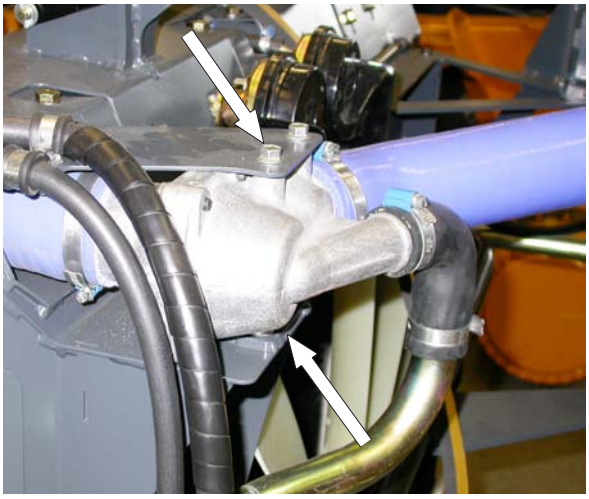
Removing

1.
Remove the expansion tank filler cap.

Drain a sufficient amount of coolant from the system.

2.
Remove the hose from the thermostat housing cover.

Detach the thermostat housing cover and remove the thermostat (double thermostat).



Fitting

1.
Clean the thermostat housing and check that nothing obstructs the function of the thermostat.

2.
Insert the thermostat in the housing. Fit new gaskets and screw the thermostat housing together.

3.
Fill the system with coolant.
See **OPERATING & MAINTENANCE MANUAL** chapter 7 for the composition of the coolant.

4.
Start the engine and check that there are no leaks.Check the coolant level and top up as necessary.

Apply Loctite No. 510
Part No. 516204

Assemble cover;
Screw No. 051735 M8 x 38 - 8.8
Nut No. 502975 M8

Torque with 24 Nm



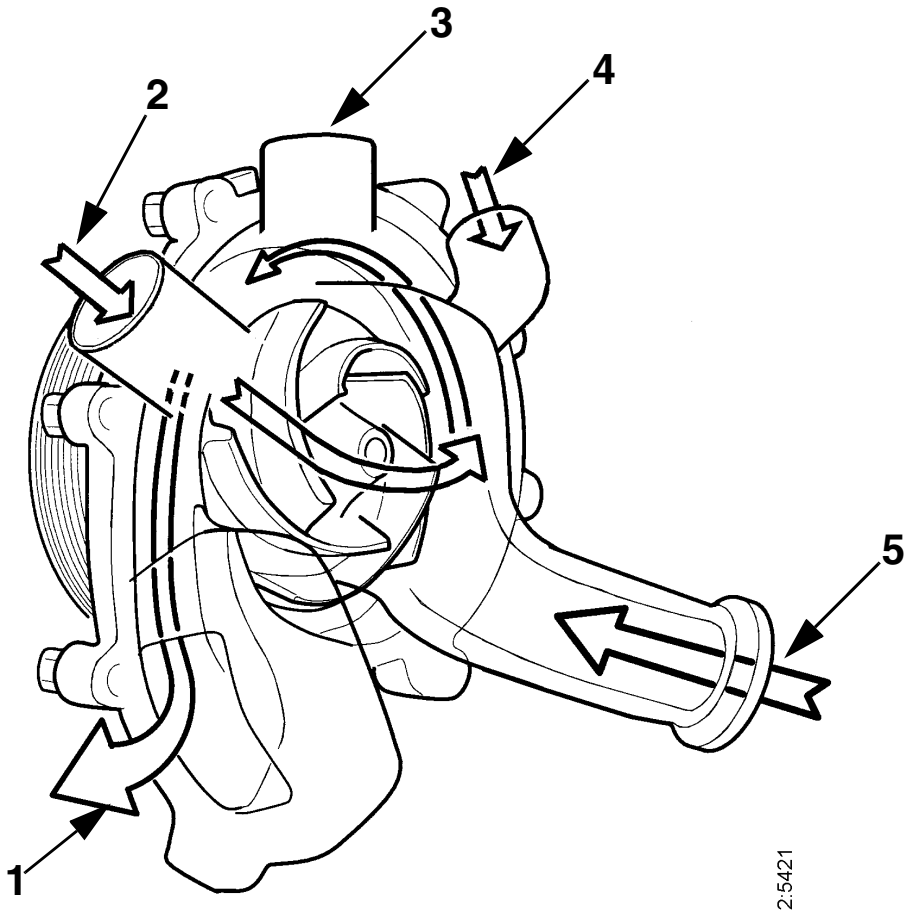
Coolant pump

The coolant pump is located at the front side of the front cover on the right-hand side of the engine.

The coolant pump is driven by a multigroove belt directly from the crankshaft damper.

The pump is of centrifugal type and consists of a spiral shaped pump housing with an impeller directly mounted on the driveshaft. The shaft is mounted in the housing and by means of two permanently lubricated ball bearings.

The pump shaft bearing is sealed against the ingress of coolant by an elastic axial seal.



Circulation through coolant pump

1. Outlet to engine
2. By-pass channel
3. Static line
4. Return from charge air cooler
5. Coolant from radiator

Removing

1.
Drain the cooling system through the drain taps in the block and in the pipe from the outlet on the radiator.

2.
Remove any protection meshes and fan ring with sealing ring to gain access to the fan.

3.
Remove the fan.

4.
Turn the automatic belt tensioner and prise the poly-V-belt off the coolant pump pulley.

5.
Remove the coolant pump assembly.
Fitting the pump

1.
Clean old gasket debris from the sealing surfaces.

2.
Fit the pump without damaging the seal(s).

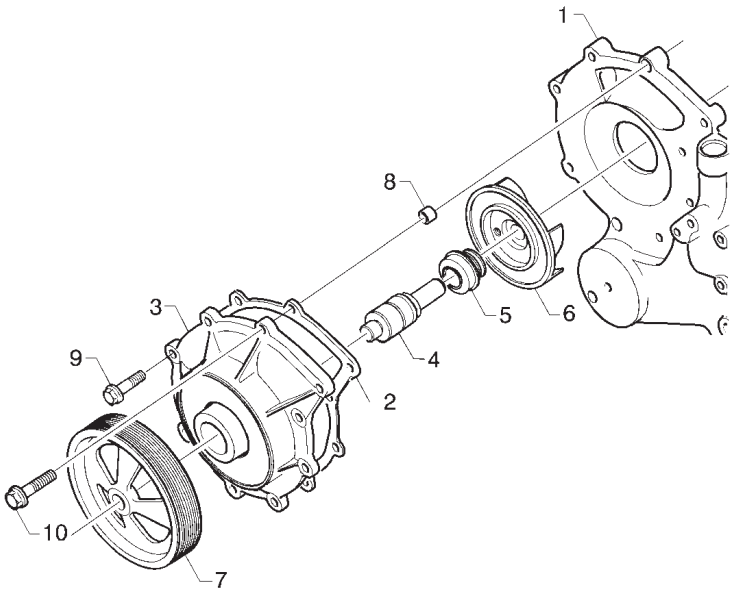
3.
Fit the automatic belt tensioner.

4.
Fit the (poly-V) drive belt and any protection mesh and fan ring with sealing ring.

5.
Fit the fan.

6.
Fill the cooling system. See booklet 00:03-01 for the composition of the coolant.

7.
Start the engine and check that no leakage occurs. Check the level of the coolant and top up as necessary.

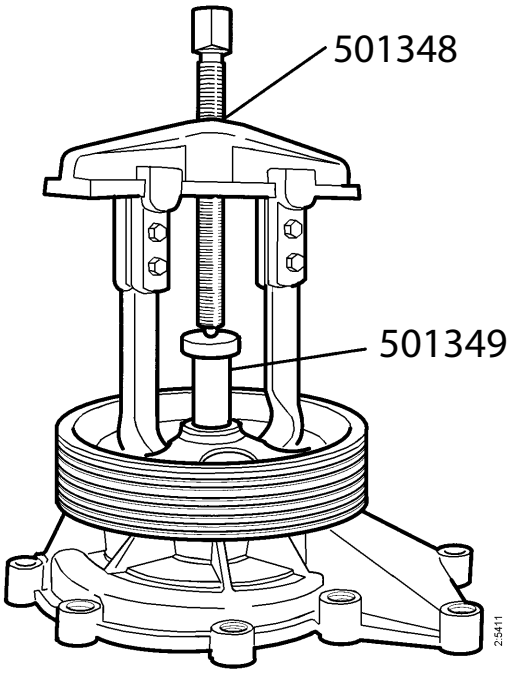


1. Front cover
2. Gasket
3. Pump cover
4. Shaft with bearing
5. Sealing ring
6. Impeller
7. Pulley
8. Guide sleeve
9. Flange screw
10. Flange screw

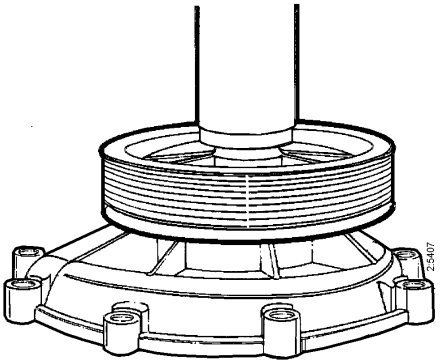
Changing the pulley

1.
Remove the pulley using puller 501348 and drift 501349.

2.
Press the pulley on until it is flush with the shaft end face.



The pulley is removed



The pulley is pressed on

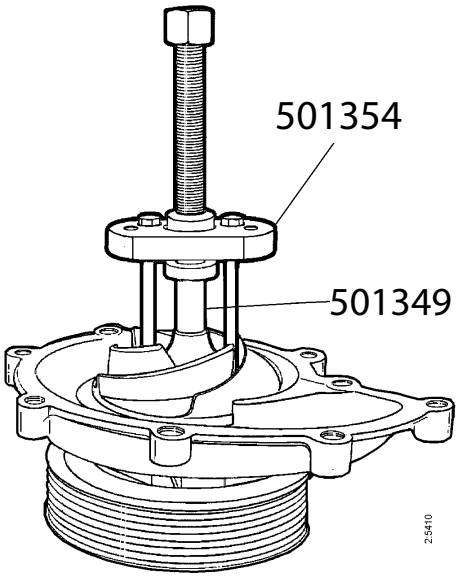
Changing the sealing ring

If coolant has leaked out inside the housing behind the pulley, the sealing ring can be changed.

1.
Place the pump with pulley on a flat and level surface.

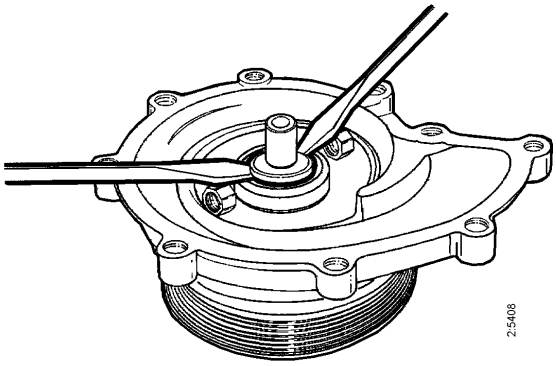
2.
Fit puller 501354 using two M 8 x 65 mm bolts and drift 501349. Pull off the impeller.

3.
Split the carbon ring on the seal and remove the debris.



The impeller is removed

4.
Prise off the seal using two screwdrivers and separator plates.



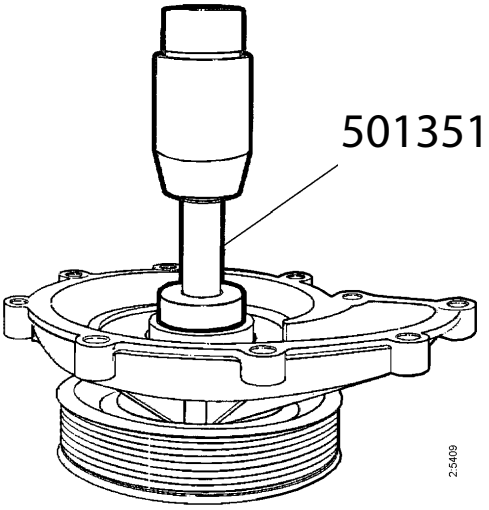
The seal ring is removed

Note:
Do not damage the pump housing gasket surface.

5. Apply sealing agent (501350) to the inside and outside (brass sleeve) of the sealing ring. Make sure that no sealing agent gets onto other sealing surfaces.

Important!
Sealing agent (501350) should be used sparingly. There is a risk of the sliding surfaces being glued together.

6.
Press in the new sealing ring with drift 501351 until the edge of the brass sleeve abuts against the pump housing. Keep it under pressure for about 10 seconds.

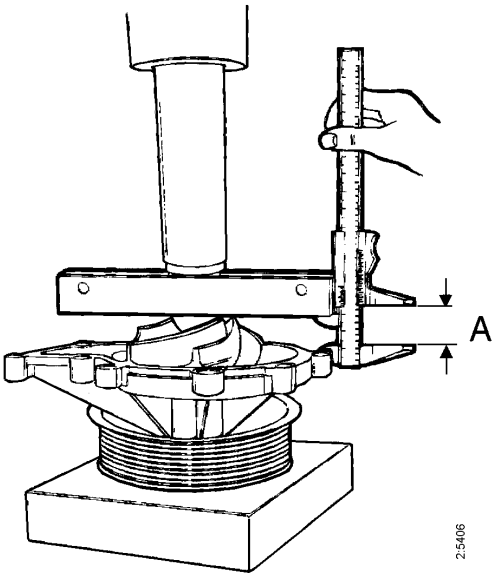


The new seal ring is pressed in

Note:
It is very important that tool 501351 is used. It is designed to correctly preload the spring which holds the seal.

7. Press on the impeller using drift 501351 until the clearance between the gasket surface of the pump housing and the end of the impeller shaft is 13.3 - 13.7 mm.

Important!
The shaft must not change position in the pump housing as there is a danger that the sealing ring would then also change its position.



A = 13,3 - 13,7 mm
The clearance is measured

Puller for pulley	501348
Drift for pulley	501349
Puller for impeller	501354
Drift for pressing in sealing ring and for impeller	501351

External cleaning

Radiator

- Check that the radiator is not clogged on the air side and that the cooling fins are not damaged.
- Carefully scrape the deposit off the radiator's cooling fins. If necessary, a paraffin-based engine cleaner can be used.
- Bent fins can be straightened using a wire brush, for example, and exercising care.

Internal cleaning

Removing oil and grease

- If possible, run the engine until it has reached the operating temperature and then drain the cooling system.
- Remove the thermostat.
- Fill the system with clean, hot water mixed with liquid dishwasher detergent intended for household use. Concentration 1% (0.1/10 l).
- Run the engine until warm for about 20-30 minutes. Do not forget the cab heating system (if fitted).
- Drain the cooling system.
- Fill the system again using clean, hot water and run the engine for approximately 20-30 minutes.
- Drain the water from the system.
- Refit the thermostat.
- Fill up with new coolant according to the specification on page 3**3.**

WARNING

Handling cleaning agents for the cooling system: Read the warning label on the container.

Removing deposits

- If possible, run the engine until it has reached operating temperature and then drain the cooling system.
- Remove the thermostat.
- Fill the system with clean, hot water mixed with a commercially available radiator cleaner based on sulphamic acid and containing dispersing agents. Follow the manufacturer's instructions for mixing proportions and cleaning times.
- Run the engine for the specified time and then drain the cooling system.
- Refill the system with hot water and run the engine for approximately 20-30 minutes.
- Drain the water from the system.
- Refit the thermostat.
- Fill up with new coolant according to the specification on page 33.

Mind the environment!

Always collect fluid in a suitable container to avoid spillage when draining coolant.
Dispose of used coolant through an authorized waste disposal contractor.

Specifications

General information

GENERAL		DC9 EMS
Number of cylinders		5 in line
Cylinder diameter	mm	127
Stroke	mm	140
Displacement	dm^3 (litres)	8.87
No. of main bearings		6
Firing order		1 - 2 - 4 - 5 - 3
Compression ratio		18:1
Engine direction of rotation viewed from rear		Anticlockwise
Fan direction of rotation viewed from front		Clockwise
Cooling		Liquid
Valve clearances, cold engine intake valve exhaust valve	 mm mm	 0.45 0.70
Weight, without coolant or oil *With charge air cooler, radiator, expansion tank and pipes	kg	887
LUBRICATION SYSTEM		
Max. oil pressure hot engine at engine speeds above 1000 r/min	bar (kp/cm^2)	6
Normal oil pressure: hot engine at operating speed	bar (kp/cm^2)	3 - 6
Min. oil pressure: hot engine under 1000 rpm hot engine above 1000 rpm	bar (kp/cm^2)	 0.7 2.3
Oil volume, see page 27		
Crankcase pressure with closed crankcase ventilation	mm VP	-55 - +20

FUEL SYSTEM		DC9 EMS
Low idle speed	rpm	700 (adjustable 500-800)
Maximum full load speed		See engine card
Fuel		Diesel fuel oil[1]
[1] see page 55		
COOLING SYSTEM		
Number of thermostats		1 (dual thermostat)
Thermostat, opening temperature	°C	8 3
Coolant temperature: system at atmospheric pressure system at overpressure	 °C °C	 83 - 95 83 - approx. 100
Volume, including radiator, engine and expansion tank with 1.0 m^2 radiator	dm^3 (litres)	57
ELECTRICAL SYSTEM		
System voltage	V	24
Alternator, current	A	80 or 100
Starter motor output	kW (hp)	5.5 (7.5)
Monitors, threshold values: oil pressure monitor temperature monitor	 bar (kp/cm^2) °C	 1,0 0,15 Programmed in S6

Cylinder head

Intake valve

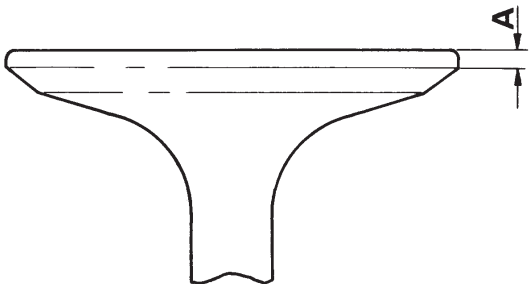
Valve head angle 19.5
Minimum dimension A for ground valve . . . . 2.6 mm
Distance between the surface of the cylinder head and the valve head . 0.75-1.8 mm

Exhaust valve

Valve head angle 44.5
Minimum dimension A for ground valve . . . . . 1.8 mm
Distance between the surface of the cylinder head and the valve head . 0.66-1.8 mm

- Check dimension A for each valve.

- Grind the valves in a valve grinding machine



Minimum dimension A for ground valve

Intake valve seat

Seat angle . . . . . 20.0°-20.5°
Width of contact surface A . . . . . 1.9 - 2.6 mm
Valve seat insert, outer diameter . . . . . 46.054 - 46.065 mm
Seat for valve seat insert, diameter . . . . . 46.000 - 46.016 mm
Seat for valve seat insert, depth . . . . . 11.25 - 11.35 mm

Oversized valve seat insert:

Outer diameter . . . . . 46.254 - 46.265 mm
Seat for valve seat insert, diameter . . . . . 46.200 - 46.216 mm
Cooling temperature when fitting valve seat insert . . . . . approx. -80°C

Exhaust valve seat

Seat angle . . . . . 45.0°-45.5°
Width of contact surface A . . . . . 1.8 - 2.6 mm
Valve seat insert, outer diameter . . . . . 44.081 - 44.092 mm
Seat for valve seat insert, diameter . . . . . 44.000 - 44.016 mm
Seat for valve seat insert, depth . . . . . 11.25 - 11.35 mm

Oversized valve seat insert:

Outer diameter . . . . . .44.281 - 44.292 mm
Seat for valve seat insert, diameter . . . . . 44.200 - 44.216 mm
Cooling temperature when fitting valve seat insert . . . . . approx. -80°C

Tightening torques

Cylinder head bolts:
First tightening . . . . . 60 Nm
Second tightening . . . . . 150 Nm
Third tightening . . . . . 250 Nm + 90°
Nut for injector . . . . . 70 Nm
Bolts for rocker arm bracket . . . .115 Nm
Nut for adjusting screw on rocker arm . . . . . .40 Nm
Bolt for rocker cover . . . . . 26 Nm
Bolts for exhaust manifold . . . . . 50 ± 5 Nm +60°
Bolts for turbocharger . . . .50 Nm

Valve clearances and unit injectors

Valve clearance, intake valve (cold engine) . . . . . 0.45 mm
Valve clearance, exhaust valve (cold engine). . . . . 0.70 mm
Dimension for PDE31 unit injector (cold engine) . . . . . 66.9 +/- 0.1 mm
Dimension for PDE32 unit injector (cold engine) . . . . . 69.9 +/- 0.1 mm

Tightening torques

Adjusting screw lock nut on rocker arm for unit injector . . . . . 39 Nm
Adjusting screw lock nut on rocker arm for valves . . . . . .35 Nm
Bolt for upper rocker cover. . . . . 18 Nm
Bolt for lower rocker cover. . . . . .26 Nm
Support bracket and rocker arm shaft . . . . . .105 Nm
Cable connection, unit injector . . . . . .2 +/- 0,2 Nm

Cooling system

Number of thermostat. . . . . 1 (dual thermostat)
Thermostat opening temperature . . . . . 80°C
By pass closed at. . . . . 87°C
Fully open at.. . . . . 95°C

Turbocharger

Wear limits

Shaft radial clearance. . . . . 0.198-0.564 mm
Shaft axial clearance (after running in) . . . . . 0.025-0.106 mm

Tightening torques

Bolts, turbocharger - exhaust manifold . . . . . .63 Nm
Bolts in turbine housing (exhaust pipe) . . . . . 24 Nm
V-clamps, exhaust and intake . . . . . 6-10 Nm

Pistons and cylinder liners

Cylinder liner

Shims for cylinder liner, thickness. 0.20, 0.25, 0.30,
. . . . . 0.40, 0.50, 0.75 mm
Height of cylinder liner above cylinder block . . . . . 0.20 - 0.30 mm
Maximum permitted height difference on one liner between
dimensions measured at two diametrically opposite points. . . . . 0.02 mm

Pistons

Fitted with arrow on piston crown facing forward.

Piston rings

Number of compression rings 2
Gap: 1st ring . . . . . 0.35 - 0.60 mm
2nd ring. . . . . 0.45 - 0.65 mm
Maximum clearance in groove, 2nd ring . . . . . 0.25 mm

Rings marked “TOP” should be turned with the marking up.

Number of oil scraper rings 1
Gap . . . . . 0.40 - 0.65 mm
Max. clearance in groove. . . . . 0.25 mm

Connecting rods

Connecting rod and bearing cap marked 1 to 6.
Fitted with marking in.

Tightening torques

Oil sump bolts. . . . . 30 Nm
Connecting rod bolts. . . . . 20 Nm + 90°

Flywheel and flywheel housing

Flywheel
Maximum machining allowance for disc pressure surface: 2.0 mm

Ring gear

Heated to 100 - 150°C before fitting.

Tightening torques

Flywheel bolts. . . . . 130 Nm + 90°
Bolts for flywheel housing . . . . . M10: 50 Nm
. . . . . M12 : 90 Nm

Timing gear

Camshaft gear

Backlash against intermediate gear . . . . . 0.03 - 0.15 mm

Injection pump gear

Backlash against intermediate gear . . . . . 0.03 - 0.15 mm

Intermediate gear

Max. axial clearance . . . . . 0.238 mm

Camshaft

Axial clearance. . . . . 0.10 - 0.25 mm

Tightening torques

Bolts for camshaft gear . . . . . 63 Nm
Bolts for intermediate gears . . . . . 50 Nm + 60°
Bolts for compressor gear . . . . . 105 Nm
Connecting rod bolts . . . . . 20 Nm + 90°
Main bearing bolts . . . . . 50 Nm + 90°
Bolts for driver . . . . . 135 Nm
Bolts for crankshaft damper and pulley . . . . . 110 Nm
Flange bolts and banjo bolts for valve tappets. . . . . 32 Nm
Bolts for timing gear plate . . . . . 63 Nm

Lubrication system

Oil cleaner

Permitted thickness of deposits on wall of cover . . . . . max. 20 mm

Oil pressure valve (Note: not safety valve)

Oil pressure:
Idle. . . . . 1.6 bar
With warm engine running at 1000 rpm . . . . . 2.5 bar
With warm engine running at 2,000 rpm . . . . . 4.5 - 6.0 bar
Free spring length . . . . . 61.4 mm

Oil filter

Only use original MOXY filters.

Tightening torques:

Oil pump:

Bolts for oil pump cover . . . . . 26 Nm
Bolts, oil pump - cylinder block . . . . . 26 Nm

Oil cleaner:

Lock nut for oil cleaner housing cover . . . . . 15 Nm
Nut for rotor bowl . . . . . Tightened by hand
Rotor shaft . . . . . 34 Nm

Oil nozzle for piston cooling:

Banjo bolt . . . . . 23 Nm

Oil cooler:

Bolts for oil cooler insert. . . . . 26 Nm

Troubleshooting tables

White smoke

Effect	Cause	Troubleshooting	Action
Incompletely burnt fuel	Cold engine	The white smoke starts to turn blue and disappears when the engine is warmed up	If possible: reduce engine speed or put the engine under load Install a white smoke limiting device (exhaust brake) Install flame heater Install an engine heater
Too much fuel in relation to air at low combustion temperatures.	Injection timing too late		
	Inlet valve does not open properly. Valve adjustment disturbed.		
	Broken delivery valve spring, uncontrolled injection	Disconnect one delivery pipe at a time and listen for changes in the engine sound. ***WARNING!*** ***Be careful when disconnecting the delivery pipes as the pressure is extremely high and could cause injury***	
	Leaky injector, dripping		

White smoke, water vapour

Effect	Cause	Troubleshooting	Action
Water in the combustion chamber	Leaky charge air cooler	Test pressure (air 0.5 bar, liquid 4 bar)	
	Leaky cylinder head gasket	The fault is also present when the engine is hot	
	Cracked cylinder head (not cracks between valve seats)	**If the fault is hard to trace:** Change all cylinder heads for exchange cylinder heads. (Or test pressurizing all cylinder heads. Heat the cylinder heads before pressurizing them.)	
	Crack in cylinder liner		

Black smoke when running/under load

Effect	Cause	Troubleshooting	Action
Too much fuel in relation to air at high combustion temperatures	"Adjusted" injection pump, attempt to boost	Check the lead seal	Test in test bench
	Injection timing too late		
	Inlet valve does not open properly. Valve adjustment disturbed		
	Broken delivery valve spring, uncontrolled injection	Disconnect one delivery pipe at a time and listen for changes in the engine sound. ***WARNING!*** ***Be careful when disconnecting the delivery pipes as the pressure is extremely high and could cause injury***	
	Leaky injector, dripping?		
	Nozzle tip jams		
	More than 1 washer under injector		
	Fault in turbo	Check charge air pressure	
	Clogged air filter		
	High exhaust counter-pressure	See page 48	
	Worn intake valves		
	Clogged intake port		

Black smoke on starting

Effect	Cause	Troubleshooting	Action
Engine difficult to start	Binding control rack	Open the cover on the actuator solenoid and check with a finger on the control rod that it goes to the maximum stop bracket.	Take the pump to a Bosch workshop for repair

Blue smoke

Effect	Cause	Troubleshooting	Action
	Oil coating past piston rings		
	Oil leakage in turbo-charger		
	Damaged piston cool-ing nozzles		Change damaged nozzles
	Petrol in diesel oil		

Fuel in the oil

Effect	Cause	Troubleshooting	Action
Dilution of oil in sump	Unburnt fuel passes the piston		Normally about 1% of fuel in the lubricating oil per 200 h
	Defective injector		
	Internal leakage in injection pump (worn pump element or crack in pump housing)		
	Worn/broken O-ring at feed pump pushrod	Check “blow-by” in crankcase Correct value for new engine: 0 - +10 mm wc (flow rate 60 - 100 l/min.) Closed crankcase ventilation: -50 - +20 mm wc	
	Frequent cold starts Worn engine		
	Intake valve not open-ing		

Oil in coolant

Effect	Cause	Troubleshooting	Action
	Oil cooler leaks when engine is running	Test pressurize the oil cooler Note: classed oil cooler, test pressurized: 10 bar oil on the oil side, 0.5 bar air on the water side, immersed in water 25 - 27 °C	
	Defective cylinder head gasket		
	Crack in cylinder head (not cracks between valve seats).	**If the fault is hard to trace:** Change all cylinder heads for exchange cylinder heads. (Or test pressurize all cylinder heads. Heat the cylinder heads before pressurizing them.)	

Coolant/water in oil

Effect	Cause	Troubleshooting	Action
Dilution of oil in sump	Oil cooler leaks when engine is not running	Test pressurize the oil cooler, see above	
	Leaky O-rings at cylinder liner	Leakage in telltale hole?	Change liner seals
Dilution of oil in sump	Water is condensed in crankcase ventilation and runs down into the sump	Run the engine until warm. Remove the oil sump and all side covers. Test pressurize the cooling system. If coolant seeps out behind side covers or at the camshaft bearing there is probably a crack in one of the cylinder heads. As a rule it is possible to see which cylinder head or heads are leaking.	Change the cylinder head for a exchange cylinder head. If no leakage can be found, change <u>all</u> cylinder heads for exchange cylinder heads.
	Crack in cylinder head		
	Crack in water jacket on cylinder block/cylinder head. (Coolant runs down through the pushrod hole.)		
	Crack in water jacket on cylinder head. (Coolant runs down via the oil duct for rocker arm lubrication.)		
	Leakage in charge air cooler core	Test pressure (air 0.5 bar, liquid 4 bar)	

Low oil pressure

Effect	Cause	Troubleshooting	Action
Gauge shows low pressure	Crankshaft bearing/ main bearing of wrong size has been fitted on reground crankshaft	Max. oil pressure 2 bar also when engine cold	Change to bearings of the correct size. Check the bearing seats before assembly
	Excessive play in big-end and main bearings		
	Seizing in camshaft bearings	If the bushing slides all the way out of the bearing seat, the oil pressure warning lamp will come on. The engine throws out oil through the crankcase ventilation	
	Piston cooling nozzle has come loose		
	Suction pipe to oil pump has come loose, the pump sucks air		
	Extremely low lubricating oil viscosity Worn bushings or loose shaft in oil cleaner		Choose a viscosity that is suitable for the ambient temperature Change rotor if bushing is worn oval Change worn/damaged shaft
	Broken O-ring on cyclone part of oil cleaner		
	Defective oil pump drive		
	Internal leakage in oil cleaner Defective sensor/instrument	Check that the oil cleaner is correctly assembled Take a reading of the oil pressure on warmed-up engine using a mechanical pressure gauge directly on the engine: Minimum 1 bar at 800 r/min. Maximum 6 bar > 800 r/min.	
	Incorrectly adjusted oil relief valve		1 shim = 0.2 bar
	Broken spring in oil relief valve	Max. oil pressure 2 bar at 2000 r/min	Check/remedy relief valve
	The piston in the oil relief valve has jammed in open position		

Continue next page

Effect	Cause	Troubleshooting	Action
Gauge shows low pressure	Loosened guide plates in the oil cooler prevent passage of the oil		
	Worn/damaged oil pump		
	Clogged oil cooler		
	Loose screws in timing gear's intermediate gear		
Gauge indicates low pressure at maximum speed but not at idling speed	The main oil duct (to piston cooling nozzles) plug in the rear of the engine has come loose	Oil pressure at idling/ low engine speed is not affected since the delivery valve closes at 3 bar	

High oil pressure (Engine warmed up)

Effect	Cause	Troubleshooting	Action
Gauge indicates high pressure	Defective sensor/ instrument	Take a reading of the oil pressure on the warmed-up engine using a mechanical pressure gauge directly on the engine: Minimum 1 bar at 800 r/min. Maximum 6 bar > 800 r/min.	
	Oil viscosity too high		Choose a viscosity that is suitable for the ambient temperature
Gauge indicates high pressure	Incorrectly adjusted oil relief valve		1 shim = 0.2 bar
	Piston in oil relief valve jammed in closed position		
	Valve in oil duct to piston cooling nozzles is binding		

Abnormal wear (liner, piston rings, etc.)

Effect	Cause	Troubleshooting	Action
Short service life	Unclean intake air due to leakage in intake piping		
	Wrong grade of oil, polishing damage		
	Changing of filters and oil has been neglected		
	Low coolant temperature (cold engine)		
	Excessive sulphur content in fuel		Change the fuel Change to oil with a higher base number. Shorter oil change intervals
	Defective injector (causes oil film to be washed off)		

Vibration, no driven components engaged

<table>
<tr><th>Effect</th><th>Cause</th><th>Troubleshooting</th><th>Action</th></tr>
<tr><td rowspan="8"></td><td>Wrong injection timing</td><td></td><td></td></tr>
<tr><td>Broken delivery valve spring</td><td colspan="2" rowspan="2">Disconnect one delivery pipe at a time and listen for changes in the engine sound.

WARNING!
Be careful when disconnecting the delivery pipes as the pressure is extremely high and could cause injury</td></tr>
<tr><td>Individual injectors not operating</td></tr>
<tr><td>Fan imbalance</td><td rowspan="6"></td><td rowspan="6"></td></tr>
<tr><td>Flywheel has come loose</td></tr>
<tr><td>Crankshaft hub loosened</td></tr>
<tr><td>Abnormally worn main bearings</td></tr>
<tr><td rowspan="2">Vibration or unusual noise at 1500 - 1700 r/min

Drive belts run off pulleys</td><td rowspan="2">Defective vibration damper</td></tr>
<tr><td>Only when compressed air compressor is charging, worst at about 1000 r/min, see also page xx</td><td>Compressor operates with excessive counter-pressure (e.g. clogged piping/air dryer) or excessively high safety valve opening pressure</td></tr>
<tr><td></td><td>Alignment fault</td><td>Check engine alignment</td><td></td></tr>
</table>

Delivery pipe fractures

Effect	Cause	Troubleshooting	Action
	No clamping		
	Carelessly handled delivery pipe		

External corrosion on cylinder liner

Effect	Cause	Troubleshooting	Action
	Unsuitable corrosion protection agent, glycol or water in coolant		Clean the cooling system and fill up with coolant as described in the maintenance instructions

Engine difficult to start

Effect	Cause	Troubleshooting	Action
Air in fuel system	Leakage in suction pipe		
	Leaky overflow valve		
	Low battery voltage		
	Ambient temperature too low		Starting aids are not normally needed at temperatures above -15 °C
	Oil viscosity too high		
	Paraffin precipitation in the fuel		
	Blocked intake or exhaust system		
	No fuel		
	Wrong injection timing		
	Faulty injector		

Fluid stroke

Effect	Cause	Troubleshooting	Action
Starter motor not powerful enough to pull the piston over the compression stroke (if the engine fires a connecting rod could be bent)	Leaky charge air cooler	Test pressure (air 0.5 bar, liquid 4 bar)	
	Leaky cylinder head gasket		
	Crack in cylinder head	**If the fault is hard to trace:** Change all cylinder heads for exchange cylinder heads. (Or test pressurize all cylinder heads. Heat the cylinder heads before pressurizing them.)	
	Crack in cylinder liner		
	Water has entered the engine via the exhaust/ intake system		
	Crack in water-cooled exhaust manifold		
	Injector open		

Knocking noise

Effect	Cause	Troubleshooting	Action
Exhaust valves close too late and strike the piston crowns	Timing gears incorrectly meshed	Check the valve timing.	
	The crankshaft gear has come loose		
	Valve mechanism not operating		
Rapidly increasing valve clearances	Disturbances in the supply of lubricant for the rocker arms		
The piston strikes the cylinder head	Loosened big end cap (wrong tightening torque after repair)		Tighten to the torque specified in the Shop manual
	Foreign objects in the piston crown		

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Effect	Cause	Troubleshooting	Action
	Piston seizure (may be caused by clogged piston cooling nozzles)		
	Wrong injection timing		
	Worn collets on exhaust valves		
Broken upper piston rings	Incorrectly adjusted injection pump	Disconnect one delivery pipe at a time and listen for changes in the engine sound. WARNING! Be careful when disconnecting the delivery pipes as the pressure is extremely high and could cause injury	
	Broken delivery valve spring (after-injection)		
	Connecting rod bearing seizure		
	Faulty injector (seized, worn, incorrect or cracked tip, fatigued spring)		
	Incorrectly adjusted injector		
	More than 1 washer under injector		
	Fuel leakage in flame start	Check whether it leaks. (Take out the flame start and run the engine with fuel pipe connected)	
	Loosened big end cap		
Melting damage on piston crown		Check the injection timing	
	Incorrectly adjusted injector		

High oil consumption

Effect	Cause	Troubleshooting	Action
Blue smoke under load	Piston ring seizure		
		Combustion temperature too high?	
	Cylinder seizure		
	Liner wear	Unclean intake air?	
	Carbon polishing (in patches)	Poor grade of oil?	
	Piston ring wear		
	Piston rings stuck		
	Tapered piston rings fitted wrong way		
	Broken piston rings	Individual piston rings broken = incorrectly fitted Several upper rings broken = start spray used wrongly, wrong injection timing (too early) Several intermediate rings broken = worn rings or grooves	
	Worn valve guides	Check the clearance between valve and guide. High exhaust temperature? Poor grade of oil?	
	Oil level too high?		
	Defective shaft seals in turbocharger	Check whether oil is present in the compressor or intake manifold	
	Clogged air filter		
	Excessive vacuum in the air intake before the turbocharger	Measure the vacuum (max. 500 mm wc) Check the air filter	
	Oil viscosity too low		
	Deformed/incorrectly directed piston cooling nozzles		

High fuel consumption

Effect	Cause	Troubleshooting	Action
	Faulty injector		
	Low charge air pressure		
	Adjusted injection pump	Check in a pump test bench that the amount (Q-mm^3/stroke) corresponds to specification	
	Manner of driving, operating/load conditions		

Low compression

Effect	Cause	Troubleshooting	Action
Effect		Troubleshooting	
	Worn engine	Check the compression	
	Broken piston rings		
	Incorrectly adjusted/ defective valves		
	Hydrostatic lock/bent connecting rod		
		Take compression readings on a hot engine, with all injectors removed, at starter motor speed Check cylinders 1 - 6, then cylinder 1 again Check that starter motor speed does not drop Correct reading: 20 - 30 bar Max. 3 bar difference between cylinders	

Low engine output

Effect	Cause	Troubleshooting	Action
	Low fuel supply pressure (below 0.3 bar)	Check the feed pump and overflow valve for leakage as described in the workshop manual Look for leakage in the suction pipe between tank and feed pump Clogged fuel filter/Paraffin precipitation in fuel	
	Faulty injector		

Continue next page

Effect	Cause	Troubleshooting	Action
	Fuel too hot		
	Incorrect fuel specification	Check density and viscosity	
	Low charge air pressure	Check charge air pressure	
	Abnormal pressure drop in intake piping	Check the vacuum before the turbocharger, max. 500 mm wc. Check the air filter	
	Worn engine	Check “blow-by” in crankcase Correct value for new engine: 0 - +10 mm wc (flow rate 60 - 100 l/min.) Worn crankcase ventilation: -50 - +20 mm wc	
	Leaky valves	Take compression readings and compare those of the different cylinders	
	Wrong injection timing		
	Intake air temperature too high	Check the temperature of the air before the engine. Above +25 °C reduces engine power	
	Exhaust counterpressure too high	Take a reading, recommended counterpressure: 500 mm wc, max. 1000 mm wc	
	Intake counterpressure too high	See “Low charge air pressure”, page 48	
	Incorrectly adjusted injection pump	Check in a pump test bench	
	Blocked fuel consumption gauge		
	Binding injector	Injector’s nozzle nut tightened too hard	
	Exhaust brake/white smoke limiter throttle in closed position		

Hot engine

Effect	Cause	Troubleshooting	Action
Instrument shows high temperature	Defective sensor/instrument	Check that sensor and instrument suit each other (120 and 150 °C) Check with a separate instrument	
	Low coolant level		
	Clogged cooling system		Clean the cooling system internally and externally
	Pressure cap not operating	Test pressurize	
	Impeller on coolant pump worn or damaged		
	Cooling capacity too low	Take a reading of the cooling capacity	
	Gas leakage (causes loss of coolant)		
	Defective thermostats	Check opening temperature of thermostats	
Reduced coolant flow	Drive belts slip or pump wheel loose on pump shaft		
	Air pockets in engine's outer cooling circuit		Vent at the cooling system's highest point Check that the ventilation piping to the expansion tank is not clogged
	Excessive pressure drop in the external cooling system	Check with forcibly opened thermostats	
	Clogged radiator		
	Circulation of cooling air	Check by taking temperature readings	
	Cavitation damaged impeller in coolant pump		
	Leakage in charge air cooler		

Cold engine

Effect	Cause	Troubleshooting	Action
Instrument indicates low temperature	Defective sensor/instrument	Check that sensor and instrument match each other (120 and 150 °C) Check with a separate instrument	
	Thermostat jammed in open position	Check operation of thermostat	

Coolant loss

Effect	Cause	Troubleshooting	Action
	Defective cylinder head gasket (external leakage)		
	External leakage		
Coolant pressed out of radiator on DSI engines	Turbocharging pressure enters cooling system via leaking charge air element	Test pressure (air 0.5 bar, liquid 4 bar)	
	Crack in cylinder head (not cracks between valve seats)	**If the fault is hard to trace:** Change all cylinder heads for exchange cylinder heads. (Or test pressurize all cylinder heads. Heat the cylinder heads before pressurizing them.)	
	Cracked cylinder liner	Grey oil = Coolant in oil Locate the leak by removing the oil sump and pressurizing the cooling system while turning the engine over by hand	

Polluted coolant

Effect	Cause	Troubleshooting	Action
	Faulty inhibitor		Clean the cooling system and fill it with coolant as described in the maintenance instructions
	Overdosed corrosion inhibitor		

Engine heater

Effect	Cause	Troubleshooting	Action
Boiler scale on engine heater	Incorrect mixture or type of glycol and/or corrosion inhibitor Anti-freeze with phosphate-based inhibitor must not be used		Clean the cooling system and fill it with coolant as described in the maintenance instructions
Short service life	The heater is not designed for continuous engagement. Suitable temperature for thermostat control = 40 - 60 °C		

High oil temperature

Effect	Cause	Troubleshooting	Action
Instrument indicates too high temperature	Defective sensor/instrument	Check with separate instrument	
	Poor water flow in oil cooler		

High exhaust temperature

Effect	Cause	Troubleshooting	Action
	Adjusted injection pump	Check the lead seal, check CRO if necessary	Test in test bench
	Wrong injection timing	Check the injection timing	
	Nozzle drips	Check type, opening pressure and general condition	
	High exhaust counter-pressure	Take a reading, recommended counterpressure: 500 mm wc, max. 1000 mm wc Check silencer, spark arrester, length and inside diameter of exhaust pipe	
	High inlet air temperature		
	Low charge air pressure		
	Clogged air filter		

Low charge air pressure

Effect	Cause	Troubleshooting	Action
	Dirty/damaged turbine/ compressor wheel in turbocharger		Check/clean
	Leakage between turbocharger and cylinder head		Check/change gaskets
	Bearing seizure in turbocharger	Check bearing play	Recondition/change turbocharger
	Clogged air filter	Check the vacuum before the turbocharger, max. 500 mm wc	
	High exhaust counter-pressure	Take a reading, recommended counterpressure: 500 mm wc, max. 1000 mm wc Check silencer, spark arrester, length and inside diameter of exhaust pipe	
	High fuel temperature		

Low fuel pressure

Effect	Cause	Troubleshooting	Action
	Clogged fuel filter		
	Defective overflow valve		
	Defective feed pump		
	Air leakage in suction pipe		
	High pressure drop in suction pipe		

Low system voltage

Effect	Cause	Troubleshooting	Action
Normal charging voltage: 27 - 28 V	Broken alternator drive belt		
	Slipping alternator drive belt		
	Batteries in poor condition		
	Alternator fault		
	Voltage regulator fault		
	Battery charger fault		

High system voltage

Effect	Cause	Troubleshooting	Action
Normal charging voltage: 27 - 28 V	Voltage regulator fault		
	Battery charger fault		

External oil leakage

Effect	Cause	Troubleshooting	Action
	Crankcase pressure too high	Check “blow-by” in crankcase Correct value for new engine: 0 - +10 mm wc (flow rate 60 - 100 l/min.) Closed crankcase ventilation: -50 - +20 mm wc	
	Leaky crankshaft seal		
	Leakage at liner seal via overflow hole in cylinder block		
	Defective cylinder head gasket		
Leakage in manifold joint	Low load		

External fuel leakage

Effect	Cause	Troubleshooting	Action
	Damaged injector and injection pump connections/gaskets		
	Defective pulsation damper		
	Blocked overflow valve	Leakage at high engine speed and low power output	

External coolant leakage

Effect	Cause	Troubleshooting	Action
	Leakage in cylinder liner seal		
	Cold leakage		Change to original hoses
	Defective cylinder head gasket		
	Water pump leakage	Check at the water pump housing's telltale hole	
	Leakage at charge air cooler connection		

Oil pressed out via crankcase ventilation

Effect	Cause	Troubleshooting	Action
	Hole in piston crown	Increases when white smoke limiting device is engaged or exhaust brake applied	
	Bearing seizure in turbocharger		
	Oil seepage via pistons - liner		
	Oil seepage in air compressor		

Turbocharger breakdown

Effect	Cause	Troubleshooting	Action
Loss of power	Excessive bearing play in turbocharger		
	Lubrication piping between turbocharger and filter incorrectly connected		Check the connections

Note

Note

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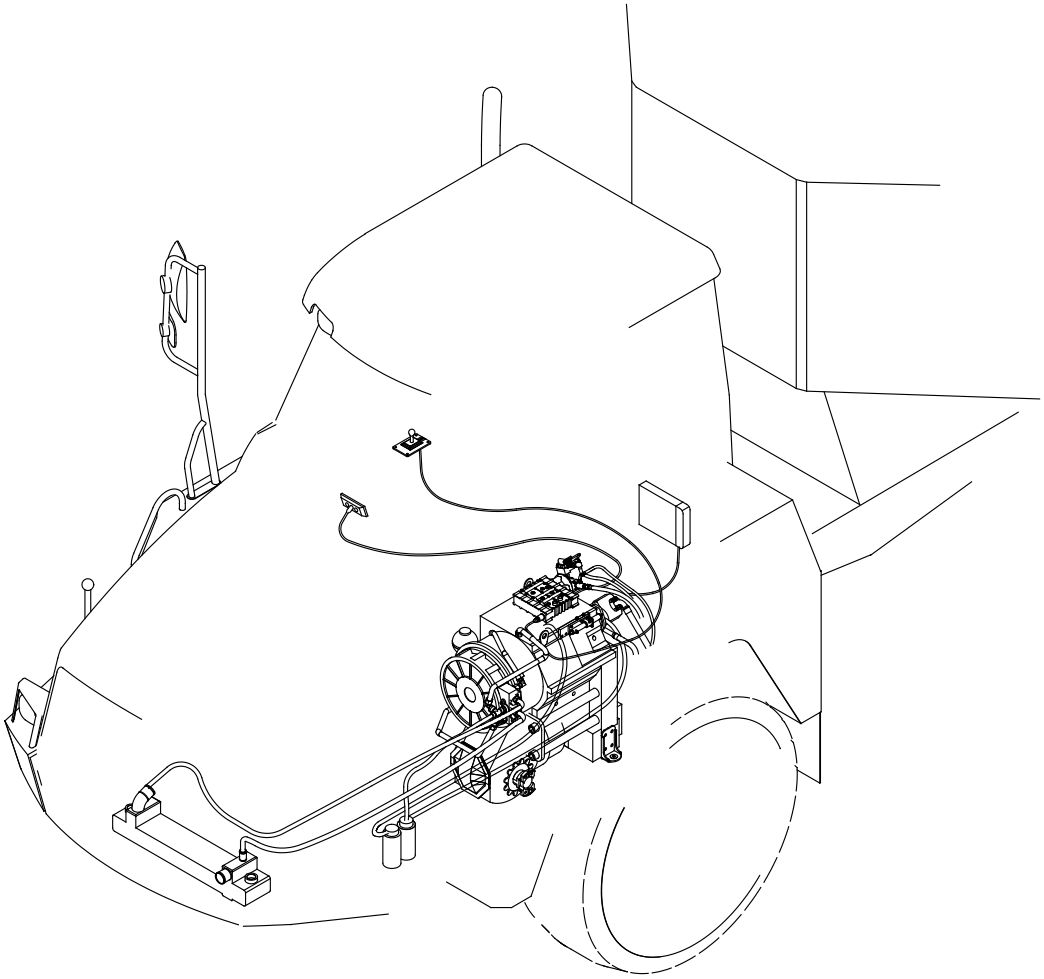
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GENERAL

The Service Manual covers all works required for dismantling and the pertaining installation.
When repairing the transmission, ensure utmost cleanliness and that the works are carried out in an expert-like manner.
The transmission should only be disassembled for renewing damaged parts. Covers and housing parts installed with seals must be loosened by slight blows with a plastic mallet after screws and nuts have been removed. For removing parts being in tight contact with the shaft such as antifriction bearings, bearing races, and similar, use suitable pulling devices.

Dismantling and mounting works must be carried out at a clean working place. Use the special tools developed for this purpose. Prior to the re-installation of the parts, clean the contact surfaces of housings and covers from the residues of old seals. Remove burrs, if any, or similar irregularities with an oil stone. Clean housings and locking covers with a suitable detergent, in particular corners and angles. Damaged parts or parts heavily worn down must be renewed. Here, the expert must assess, whether parts such as antifriction bearings, thrust washers etc. subjected to normal wear during operation, can be installed again.
Parts such as sealing rings, lock plates, split pins etc. must generally be renewed. Radial sealing rings with worn down or torn sealing lip must also be renewed. Particularly ensure that no chips or other foreign bodies remain in the housing. Lube oil bores and grooves must be checked for unhindered passage.
All bearings must be treated with operating oil prior to installing them:

REFERENCE: For heating up parts such as bearings, housings etc, only a heating furnace or an electric drier is permitted to be used!

CAUTION

When assembling the transmission, absolutely observe the indicated torque limits and adjustment data. Screws and nuts must be tightened according to the enclosed standard table, unless otherwise specified.
In view of the risk of functional failures in the control unit, the use of liquid sealing agents is not permitted.
By no means, Molykote is permitted to be used.
Lined plates must not be washed. They must be cleaned with a leather cloth.



DANGER

When using detergents, observe the instructions given by the manufacturer regarding handling of the respective detergent.

Structure of the Repair Manual

The structure of this Repair Manual reflects the sequence of the working steps for completely disassembling the dismantled transmission. Dismantling and installing as well as the disassembly and assembly of a main group are always summarized in one chapter.

Special tools required for performing the respective repair works are listed under **„Special tools“** See this chapter, 2.0

Important information on industrial safety

Generally, the persons repairing MOXY product-sets are responsible on their own for the industrial safety.

The observation of all valid safety regulations and legal impositions is the pre-condition for avoiding damage to persons and to the product during maintenance and repair works.
Persons performing repair works must familiarize themselves with these regulations.

The proper repair of these MOXY-products requires the employment of suitably trained and skilled staff.
The repairer is obliged to perform the training.

The following safety references are used in the present Repair Manual:



Serves as **reference** to special working procedures, methods, information, the use of auxiliaries etc..

CAUTION Is used, if a deviating and improper working procedure can **damage the product.**



DANGER: Is used, if lacking care can lead to **personal injury or danger to life.**

REFERENCE: Prior to starting the checks and repair works, thoroughly study the present instructions.

CAUTION: Illustrations, drawings and parts do not always represent the original; the working procedure is shown. The illustrations, drawings, and parts are not drawn to scale; conclusions regarding size and weight must not be drawn (not even within one representation).
The works must be performed according to the description.

REFERENCE: After the repair works and the checks, the expert staff must convince itself that the product is properly functioning again.

Denomination of standard dimensions

Note: linear density in kg/m; areal density in t/m2

Unit		New	Old	Conversion	Note
Mass	m	kg (Kilogramm)	kg		
Force	F	N (Newton)	kp	1 kp = 9,81 N	
Work	A	J (Joule)	kpm	0,102 kpm = 1J = 1 Nm	
Power	P	KW (Kilowatt)	PS (DIN)	1 PS = 0,7355 KW 1 KW = 1,36 PS	
Torque	T	Nm (Newtonmeter)	kpm	1 kpm = 9,81 Nm	T (Nm) = F (N) . r (m)
Moment(Force)	M	Nm (Newtonmeter)	kpm	1 kpm = 9,81 Nm	M (Nm) = F (N) . r (m)
Pressure (Overpress)	pü	bar	atü	1,02 atü = 1,02 kp/cm2 = 1 bar = 750 torr	
Speed	n	min -1			

Conversion table

25,40 mm	=	1 in (inch)
1 kg (Kilogramm)	=	2,205 lb (pounds)
9,81 Nm (1 kpm)	=	7,233 lbf x ft (pound force foot)
1,356 Nm (0,138 kpm)	=	1 lbf x ft (pound force foot)
1 kg / cm	=	5,560 lb / in (pound per inch)
1 bar (1,02 kp/cm ^{2})	=	14,233 psi (pound force per squar inch lbf/in^2)
0,070 bar (0,071 kp/cm^2)	=	1 psi (lbf/in^2)
1 Liter	=	0,264 Gallon (Imp.)
4,456 Liter	=	1 Gallon (Imp.)
1 Liter	=	0,220 Gallon (US)
3,785 Liter	=	1 Gallon (US)
1609,344 m	=	1 Mile (Landmeile)
0° C (Celsius)	=	+ 32° F (Fahrenheit)
0 ° C (Celsius)	=	273,15 Kelvin

Torque limits for screws.

Table

TORQUE LIMITS FOR SCREWS (IN Nm) ACCORDING TO ZF - STANDARDS 148

Friction value: μ total= 0,12 for screws and nuts **without** after treatment as well as **phosphatized** nuts. **Tightening by hand!** Torque limits, if not especially indicated, can be taken from the following list:

Metric ISO Standard thread

Size	8.8	10.9	12.9
M4	2,8	4,1	4,8
M5	5,5	8,1	9,5
M6	9,5	14	16,5
M7	15	23	28
M8	23	34	40
M10	46	68	79
M12	79	115	135
M14	125	185	215
M16	195	280	330
M18	280	390	460
M20	390	560	650
M22	530	750	880
M24	670	960	1100
M27	1000	1400	1650
M30	1350	1900	2250
M33	1850	2600	3000
M36	2350	3300	3900
M39	3000	4300	5100

Metric ISO Fine thread

Size	8.8	10.9	12.9
M 8 x 1	24	36	43
M 9 x 1	36	53	62
M 10 x 1	52	76	89
M 10 x 1,25	49	72	84
M 12 x 1,25	87	125	150
M 12 x 1,5	83	120	145
M 14 x 1,5	135	200	235
M 16 x 1,5	205	300	360
M 18 x 1,5	310	440	520
M 18 x 2	290	420	490
M 20 x 1,5	430	620	720
M 22 x 1,5	580	820	960
M 24 x 1,5	760	1100	1250
M 24 x 2	730	1050	1200
M 27 x 1,5	1100	1600	1850
M 27 x 2	1050	1500	1800
M 30 x 1,5	1550	2200	2550
M 30 x 2	1500	2100	2500
M33 x 1,5	2050	2900	3400
M 33 x 2	2000	2800	3300
M 36 x 1,5	2700	3800	4450
M 36 x 3	2500	3500	4100
M 39 x 1,5	3450	4900	5700
M 39 x 3	3200	4600	5300

Technical data

Description:

Engine speed: max. min $^{-1}$.....750 - 2600

Starting torque multiplication: .....2 to 3,0

Mass (without oil): kg about 900

The Transmissions 6 WG-310 are composed of a hydrodynamic torque converter and a rear-mounted multi-speed powershift transmission with integrated transfer case
(See: Transmission cross section next page)

The torque converter is a wear-free starting device which is infinitely variable adapting itself to the required situations (necessary input torque).
Input via universal shaft with Mechanic flange.

Between engine and torque converter, a Retarder (fluid brake) is arranged whereby a good braking effect will be achieved in all speeds.

The transmission is shifted manually or fully-automatically by means of the Electronic unit EST-37.

Torque converter:

Unit with torque multiplication according to the version and a WK.

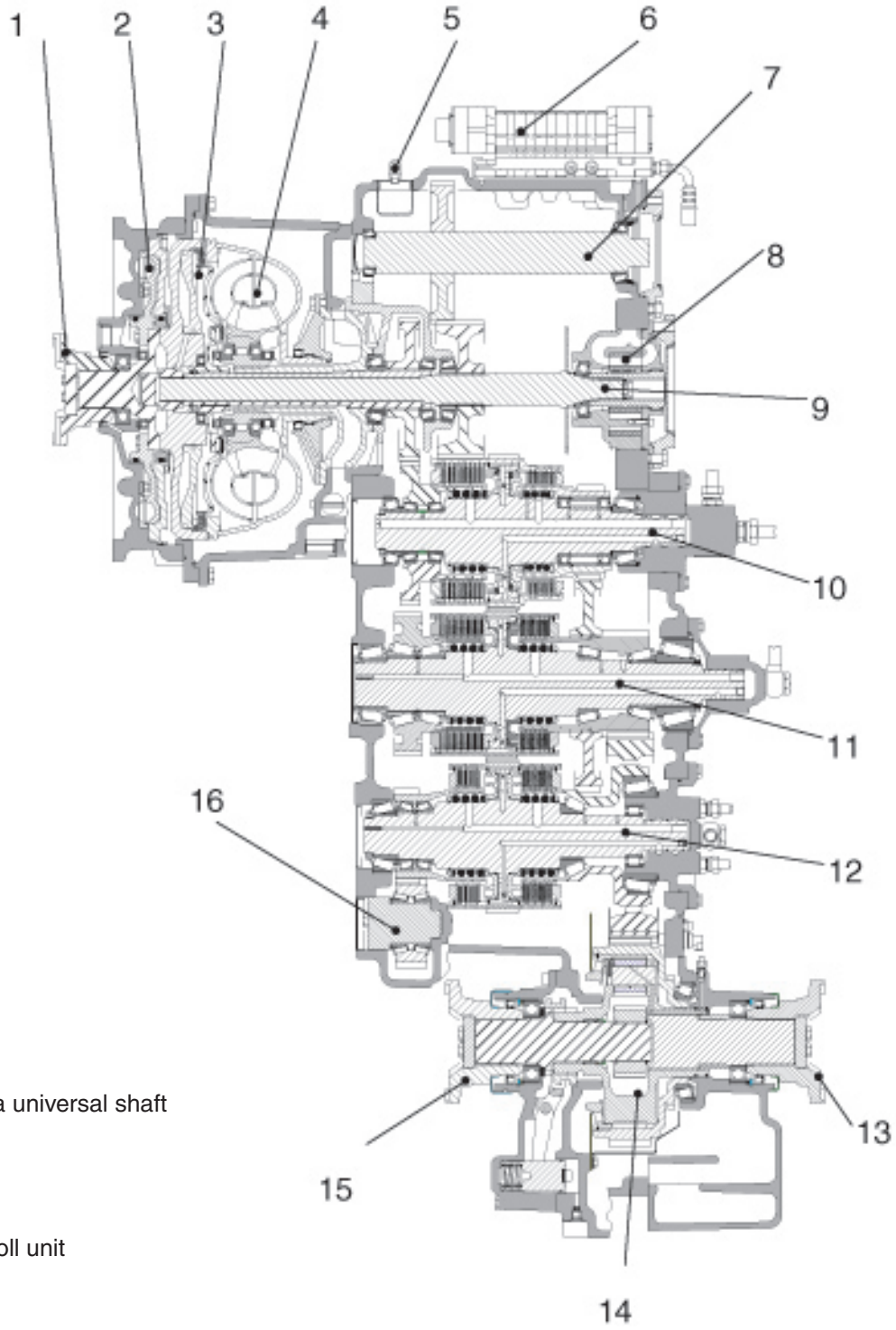
Powershift transmission:

6 Forward speeds and 3 Reverse speeds.

Transmission ratio mechanical.

SPEED	DRIVING DIRECTION	RATIO
1	Forward	5,350
2	Forward	3,445
3	Forward	2,206
4	Forward	1,421
5	Forward	0,969
6	Forward	0,624
1	Reverse	5,350
2	Reverse	2,206
3	Reverse	0,969

Transmission cross section



1 = Input flange - Drive via universal shaft
2 = Retarder
3 = WK
4 = Converter
5 = Breather
6 = Electrohydraulic controll unit
7 = 2nd Power take- off
8 = Transmission pump
9 = 1st Power take- off
10 = Clutch axle "KV/K1"
11 = Clutch axle "KR/K2"
12 = Clutch axle "K4/K3"
13 = Output flange (rear side)
14 = Crawler speed
15 = Output flange (converter side)
16 = Countershaft

Oil temperatures:

Normal operation:

- Minimum temperature behind the heat exchanger is 50° C

- Operating temperature behind the converter at least 65° C, and the maximally permitted permanent temperature is 105° C.
  In case of exceptions, 120° C are short-time (max. 5 minutes) permitted.

Retarder operation:

- Maximally permitted permanent temperature behind Retarder is 145° C,
  in case of exceptions, 150° C are short-time (max. 5 minutes) permitted.

In case of irregularities on the transmission, put the vehicle out of service and ask for Specialists.

Protective measures for the ZF-Electronics at electrical operations

on the vehicle:



At the following operations, the ignition must be switched off and the control unit plug must be pulled off from the ZF-Electronics:

- At any kind of electrical operations on the vehicle.

- At welding operations on the vehicle.

- At insulation tests on the electric system.

Oil grade

The List of lubricants will be updated every two years and can be requested, resp. inspected as follows:
Moxy Engineering as
6440 Elnesvågen
Norway

Oil level check:

At the oil level check, the prescribed safety directions according to § 6 of the rules for accident prevention for power plants in Germany, and in all other countries the respective national regulations have to be absolutely respected.
For example, the vehicle has to be secured against rolling with blocks, articula-ted vehicles additionally against unintended turning-in.
The oil level check must be carried out as follows:
- Oil level check accordance to the **MT40B Instruction Manual**
- at horizontally standing vehicle
- Transmission in Neutral position „N“
- in the cold start phase, the engine must be running about 2 – 3 minutes at idling speed, and the marking on the oil dipstick must then be lying above the cold start mark „COLD MIN“ (see Figure-next page)

- at operating temperature of the transmission (about 80° - 90 °C)
- at engine idling speed
- loosen oil dipstick by counterclock rotation, remove and clean it
- insert oil dipstick slowly into the oil level tube until contact is obtained, and pull it out again.
- On the oil dipstick, the oil level must be lying in the zone „HOT“ (see Figure-next page)
- insert the oil dipstick again, and tighten it by clockwise rotation

If the oil level has dropped in operating temperature condition below the „HOT“ Zone, it is absolutely necessary to replenish oil according to the oil list of lubricants TE-ML-03.

An oil level above the „HOT“ marking, is leading to a too high oil temperature.

List of lubricants

Converter transmissions for off-road equipment

List of lubricantsTE-ML 03

Product groups Ergopower		Lubricants authorized for service fills (1)
WG 310	**(I) Transmissions adapted to suit to ATF**	**Lubricant class 03D**
	(II) Transmission to suit to ENGINE OIL	**Lubricant class 03A / 03B**

Note: TCU is set to meet classes (I) and (II).

By changing between ATF and Engine oil, the transmission oil system must be completely drained. The oil coolers and hoses must be drained as well.
When the new oil is filled up, a flushing of the system is necessary; Start the engine, warm up the transmission and drain the oil again.
This is done to be sure that the old oil is completely out of the system.
Fill up with new oil and check the oil level.

Temperature range:

Viscosity class	Use at outside temperatures as of
- ATF	- 40°C
- SAE 5W-30, 5W-40	- 35°C
- SAE 10W, 10W-30, 10W-40	- 30°C
- SAE 15W-30, 15W-40	- 25°C
- SAE 20W-20	- 20°C
- SAE 30	- 10°C

(*) See overleaf for approved trade products.

Lubricant class 03A

Mineral oil-based engine oil in accordance with Group standard ZFN 13030 (API CD/CE/CF-4/CF/CG-4/SF/SG/SH/SJ or ACEA, categories A, B, E)

Viscosity class: SAE 20W-20 / 30 / 10W-30 / 10W-40 / 15W-30 / 15W-40 / 20W-40

Note: All mineral oil-based trade products which satisfy the above specifications may be used.

Lubricant class 03B

Engine oil in accordance with Group standard ZFN 13030 (API CD/CE/CF-4/CF/CG-4/SF/SG/SH/SJ or ACEA, categories A, B, E)

Viscosity class: SAE 10W / 5W-30 / 5W-40

Manufacturer	Product designation
ADDINOL MINERALÖL GMBH, KRUMPA/D	ADDINOL TURBO DIESEL
ARAL LUBRICANTS GMBH, BOCHUM/D	ARAL BASICTURBORAL
BUCHER AG, LANGENTHAL/CH	MOTOREX EXTRA
CALPAM GMBH, ASCHAFFENBURG/D	CALPAM FLEET HD
CALTEX AUSTRALIA PETR., SYDNEY/AUS	DEULUBE S3
CALTEX PETROLEUM CORP., LONDON/GB	CALTEX DELO 500
CASTROL BRASIL, RIO DE JANEIRO/BR	TFC 410
CASTROL INTERNATIONAL, SWINDON/GB	CASTROL CRD
CEPSA LUBRICANTES, MADRID/E	CEPSA SUPER SERIE 3
CEPSA LUBRICANTES, MADRID/E	ERTOIL SUPER SERIE 3
DEA MINERALÖL AG, HAMBURG/D	DEA CRONOS SUPER
ELF LUBRIFIANTS, PARIS/F	PERFORMANCE SUPER D
ELF LUBRIFIANTS, PARIS/F	ANTAR TRAXOLIA Z
ELF LUBRIFIANTS, PARIS/F	PERFORMANCE XR
ELF LUBRIFIANTS, PARIS/F	HRD PREXIMA
ELLER-MONTAN-COMP., DUISBURG/D	ELLMOTOL HD C3
ESSO BRASILEIRA, SAO PAULO/BR	ESSOLUBE D3+
FINA EUROPE SA, BRÜSSEL/B	FINA KAPPA SUPER
FL GROUP, VILLASTELLONE/I	URANIA C
FUCHS DEA SCHMIERSTOFFE, MANNHEIM/D	TITAN UNIVERSAL HD (EB)
FUCHS DO BRASIL, JANDIRA/BR	TITAN HD
FUCHS LUBRICANTS (UK), DERBY/GB	HARDWICK 10
FURUKAWA CO LTD, JAPAN	FK 310W
GINOUVES GEORGES SA, LA FARLEDE/F	YORK 730
HAFA, PARIS/F	HAFA IONODEX 500
IGOL FRANCE, PARIS/F	IGOL TRANS TURBO 4 MONO
ISU CHEMICAL CO. LTD, SEOUL/KOREA	TOTAL RUBIA S
ITALIANA PETROLI, GENOVA/I	IP AXIA D
KOMPRESSOL-OEL, KÖLN/D	KOMPRESSOL-HD-S3-C-OEL
KRAFFT SA, ANDOAIN/E	MONOGRADO SUPER S-3

Manufacturer	Product designatio
KUWAIT PETROLEUM, EUROPOORT/NL	Q8 T 400 MONOGRADE
LIQUI MOLY GMBH, ULM/D	THT MOTOROIL HD SAE 30
LUBRICATION ENGIN., FORT WORTH/USA	MONOLEC GFS ENGINE OIL
MEGUIN GMBH, SAARLOUIS/D	MEGOL MOTORENÖL HD-C3
MIN.ÖL-RAFFIN. DOLLBERGEN, UETZE/D	PENNASOL MOTOR OIL EXT
MOBIL OIL COMPANY LTD., CORYTON/GB	MOBIL DELVAC 1300
MOBIL OIL DO BRASIL, SAO PAULO/BR	MOBIL DELVAC DIESEL 130(
MORRIS LUBRICANTS, SHREWSBURY/GB	MORRIS RING FREE XHD
NESTE OY, ESPOO/SF	NESTE DIESEL CD
NOVA STILMOIL SPA, MODENA/I	ORION PLUS
OEST G. MIN.ÖLWERK, FREUDENSTADT/D	DIMO HDC-MOTORÖL
OMV AG, SCHWECHAT/A	OMV TRUCK
ORLY INTERNATIONAL, VIEUX-THANN/F	ORLY DRACO 3001
PAKELO MOTOR OIL, SAN BONIFACIO/I	PAKELO PKO HD 4
PANOLIN AG, MADETSWIL/CH	PANOLIN EXTRA DIESEL
PETROBRAS, DUOUE DE CAXIAS/BR	LUBRAX MD-400
RAIFFEISEN HG NORD AG, HANNOVER/D	HG UNIVERSAL HD
SHELL ASEOL AG, BERN/CH	ASEOL MONOGRADE CF
SHELL BRASIL SA, RIO DE JANEIRO/BR	SHELL RIMULA D
SHELL INTERNATIONAL, LONDON/GB	SHELL RIMULA X MONOGRA
STATOIL MARKET. LUBR., NYNÄSHAMN/S	DIESELWAY
STRUB+CO AG, REIDEN/CH	STRUB MOTOR OIL TURBO
SUN OIL COMPANY, AARTSELAAR/B	SUNOCO SUPER C
TOTAL RAFFINAGE DISTR., PARIS/F	TOTAL RUBIA S
TURBOTANK BÖSCHE+BÖDEKER, BREMEN/D	TURBO HD MOTORENÖL CI
VALVOLINE COMPANY, DORDRECHT/NL	ALL FLEET
VEEDOL INTERNATIONAL, SWINDON/GB	VEEDOL DIESEL HDC
YACCO SA, ST PIERRE-LES-ELBEUF/F	YACCO AS3-SERIE YY, Y, M
ZENEX OIL, RIVONIA/ZA	ZENEX SINGLEGRADE

See also the next page

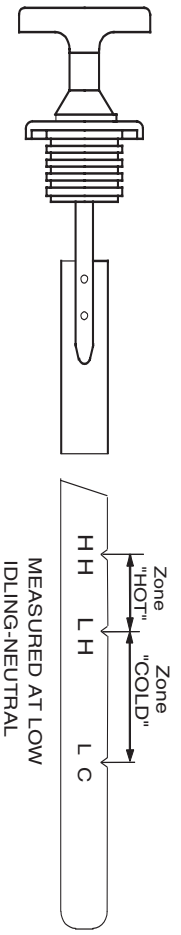
Lubricant class 03D

Automatic Transmission Fluids (ATF) in accordance with Group standard ZFN 13030

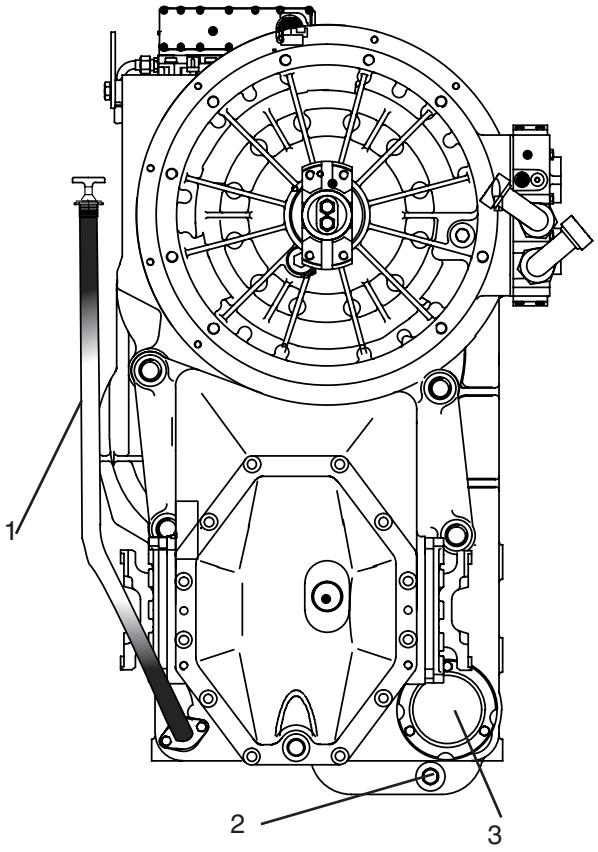
Manufacturer	Product designation
AGIP PETROLI SPA, ROM/I	AGIP ATF D 309
AGIP PETROLI SPA, ROM/I	AGIP ATF IIE
ALEXANDRIA CO.FOR PET.ADD. CAIRO/ET	ACPA 2000
ARAL LUBRICANTS GMBH, BOCHUM/D	ARAL GETRIEBEÖL ATF 22
AVIA MINERALÖL-AG, MÜNCHEN/D	AVIA FLUID ATF 86
BAYWA AG, MÜNCHEN/D	BAYWA ATF 3000
BLASER SWISSLUBE, HASLE-RÜEGSAU/CH	BLASOL ATF "GM"
BP OIL INTERNATIONAL, LONDON/GB	AUTRAN DX II
BP OIL INTERNATIONAL, LONDON/GB	FRONTOL UNIVERSAL-ATF 100
CALPAM GMBH, ASCHAFFENBURG/D	CALPAM PAMATIC FLUID 289
CALTEX AUSTRALIA PETR., SYDNEY/AUS	AUTOTRANS FLUID IID
CALTEX PETROLEUM CORP., LONDON/GB	CALTEX ATF-HDM
CASTROL INTERNATIONAL, SWINDON/GB	CASTROL TQ-D (22765)
CASTROL INTERNATIONAL, SWINDON/GB	CASTROL TQ-D (21289)
CEPSA LUBRICANTES, MADRID/E	CEPSA ATF 2000
DE OLIEBRON B.V., ZWIJNDRECHT/NL	ATF 289
ELLER-MONTAN-COMP., DUISBURG/D	ELLMO-AUTOMATIK-FLUID 22233
ESSO LUBRICANTS EUROPE, BRÜSSEL/B	ESSO ATF D (21611)
ESSO SAPA, BUENOS AIRES/RA	ESSO ATF D (22079)
FINA EUROPE SA, BRÜSSEL/B	FINAMATIC II D-22307
FINA EUROPE SA, BRÜSSEL/B	FINAMATIC II D-22233
FL GROUP, VILLASTELLONE/I	TUTELA GI/A
FL GROUP, VILLASTELLONE/I	TUTELA GI/E
FL GROUP, VILLASTELLONE/I	TUTELA TRUCK GEARLITE
FUCHS DEA SCHMIERSTOFFE, HAMBURG/D	DEAFLUID 4011
FUCHS DEA SCHMIERSTOFFE, HAMBURG/D	DEAMATIC
FUCHS DEA SCHMIERSTOFFE, MANNHEIM/D	TITAN ATF 3000
GINOUVES GEORGES SA, LA FARLEDE/F	YORK LT 785
HANDEL-MIJ NOVIOL B.V., NIJMEGEN/NL	KENDALL ATF DEXRON IID
HYDROTEX, CARROLLTON/USA	HY-TORQUE Z
IGOL FRANCE, PARIS/F	IGOL ATF 420

Manufacturer	Product designation
KÄPPLER KARL, STUTTGART/D	SELECTOL FLUID GETR.ÖL IID 23
KUWAIT PETROLEUM, EUROPOORT/NL	Q8 AUTO 14
LEPRINCE+SIVEKE GMBH, HERFORD/D	LEPRINXOL FLUID CN
MAURAN SA, ODARS/F	INTER MATIC ATF D2
MIN.ÖL-RAFFIN. DOLLBERGEN, UETZE/D	PENNASOL FLUID-GETR.ÖL TYP PCN
MOL HUNGARIAN OIL, KOMARON/H	CARRIER ATF
MORRIS LUBRICANTS, SHREWSBURY/GB	LIQUIMATIC DII
NAFTEC, ALGIER/DZ	TASSILIA
OEST G. MIN.ÖLWERK, FREUDENSTADT/D	ATF T 4011
OMV AG, SCHWECHAT/A	OMV ATF D II (D22427)
PAKELO MOTOR OIL, SAN BONIFACIO/I	MULTIPURPOSE TRANSM. FLUID IID
PETROLEX, KWIDZYN/PL	VECO MATIC IID
RAFINERIA NAFTY JEDLICZE/PL	HIPOL ATF IID
RAIFFEISEN HG NORD AG, HANNOVER/D	HG AUTOMATIK TF 3000
SAEL, MADRID/E	GULF ATF D IID
SHELL ASEOL AG, BERN/CH	ASEOL ATF DB UNIVERSAL
SHELL INTERNATIONAL, LONDON/GB	SHELL DONAX TA (D-21666)
SHELL INTERNATIONAL, LONDON/GB	SHELL DONAX TA (D-21774)
SLOVNAFT VURUP A.S., BRATISLAVA/SLO	MADIT AUTOMATIC
SRS SALZBERGEN/D	WINTERSHALL ATF D
STATOIL MARKET. LUBR., NYNÄSHAMN/S	TRANSWAY DX II
SUN OIL COMPANY, AARTSELAAR/B	SUNAMATIC 153
SUOMEN PETROOLI OY, HAMINA/SF	TEBOIL FLUID D
TEXACO BELGIUM N.V., BRÜSSEL/B	TEXAMATIC 7080
TEXACO BELGIUM N.V., BRÜSSEL/B	TEXAMATIC 4291
TOTAL RAFFINAGE DISTR., PARIS/F	TOTAL FLUIDE ATX
TURBOTANK BÖSCHE+BÖDEKER, BREMEN/D	TURBO UNIV. ATF MERCON 4011
UNIL DEUTSCHLAND GMBH, BREMEN/D	UNIL MATIC CN T 4011
VEBA OEL AG, GELSENKIRCHEN/D	MOVARA ATF-GETRIEBEÖL DIID
VEEDOL INTERNATIONAL, SWINDON/GB	VEEDOL ATF-M (D-22764)
YACCO SA, ST PIERRE-LES-ELBEUF/F	YACCO ATF D

Oil dipstick



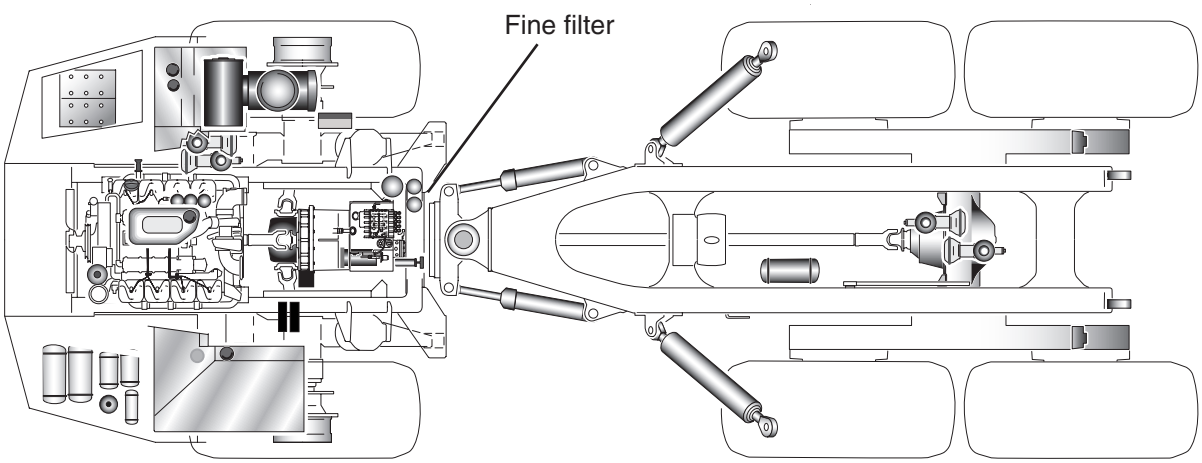
Legende:
1 = Oil filler tube with oil dipstick
2 = Oil drain plug M38x1,5
3 = Coarse filter



Oil change and Filter replacement interval:

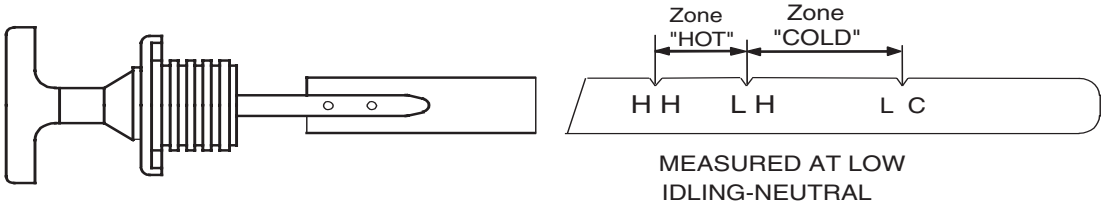
First oil change after 100 operating hours in application.
Every further oil change after 1000 operating hours in application, however at least once a year !

At every oil change, the Fine filter (pressure filter) has to be replaced.



Oil level check.

In the cold start phase, the engine must be running about 2 – 3 minutes at idling speed and the marking on the oil dipstick must then be above the cold start mark.



The oil level check in the transmission must be carried out at engine idling speed and operating temperature of the transmission (80° to 90° C).

At every oil change, the Fine filter must be exchanged. In addition, ZF recommends to start the automatic calibration of the shifting elements (AEB). (See at chapter 2.2)

The automatic calibration of the shifting elements (AEB) must be started after every replacement of the transmission, the electrohydraulic control or the TCU in case of a damage.

Put the Controller at the starting of the engine always to the Neutral position.
At running engine and transmission in Neutral, the parking brake must be engaged or the service brake be actuated, to prevent the vehicle from rolling.

Prior to every start off, loosen the parking brake.

The engagement of the speed out of Neutral is only possible below the programmed transmission input speed (turbine speed).

Reversing (Standard):

The reversing must be performed at standstill, resp. at **very low driving speed**.

Above the programmed reversing limit, the vehicle will be shifted to Neutral by the Electronic unit EST-37, and the vehicle continues rolling in the previous driving direction.

The gear of the new driving direction will be only engaged when the programmed reversing speed and the transmission input speed (turbine speed) has fallen below.

At cut-off engine, there is dispite preselected gear no powerflow between transmission and engine, i.e. the transmission is in idling position.

The parking brake must therefore be completely actuated !
When leaving the vehicle, secure it additionally by brake blocks !

The towing speed must in no case be higher than 10 km/h, the towing distance not longer than 10 km.

It is imperative to observe this Specification because otherwise the transmission will be damaged due to insufficient oil supply !

At a longer distance, the best solution would be to transport the vehicle with a Low loader.

Oil change and Oil filling capacity:

The oil change must be carried out as follows:
- At operating temperature of the transmission, horizontally standing vehicle, open the oil drain plug and drain the used oil.
- Clean the oil drain plug with magnetic insert and the sealing surface on the housing and install it along with new O-ring again.
- Fill in oil (about 33 liters) according to List of lubricants TE-ML 03. (See chapter 2.0) The indicated value is a guide value.



It is imperative to pay attention to absolute cleanliness of oil and filter !
Binding is in any case the marking on the oil dipstick !

- Start the engine, idling speed.
- Transmission in Neutral position „N“
- Top up oil up to the marking „COLD - MIN“
- Brake the vehicle securely in position and warm up the transmission
- Shift all Controller positions through
- Check the oil level once more and top up oil once more if necessary
- On the oil dipstick, the oil level must be lying in the Zone „HOT“ (see Figure previous side)
- Insert the oil dipstick again and tighten it by clockwise rotation.



At the initial filling of the transmission has to be considered that the oil cooler, the pressure filter as well as the pipes must get filled with oil. According to these cavities, the oil capacity tobe filled in is greater than at the later oil fillings in the course of the usual Maintenance service.
Moxy recommends, to start the AEB at every oil change.



If the oil quality are changed it is strongly necessery to run AEB !

(see Procedure to start AEB)

Filter replacement:

At the replacement of the Filter in the main oil stream, pay attention that no dirt or oil sludge can penetrate into the circuit. Besides, the parking brake has to be covered, resp. pro-tected from oil wetting.
At the mounting of the filter, any exertion of force has to be avoided.



Treat the filter carefully at the installation, the transport and the storage !
Damaged filters must no more be installed !



The filter differential pressure valve (bypass valve) is equipped with a filter contamination switch which is informing the driver about the contamination of the Fine filter.
At the lighting up of the symbol, the Fine filter must be replaced.

The mounting of the filter must be carried out as follows:
- Cover the gasket with a small amount of oil.
- Screw the filter in until contact with the sealing surface is obtained and tighten it now by hand about 1/3 to 1/2 turn.



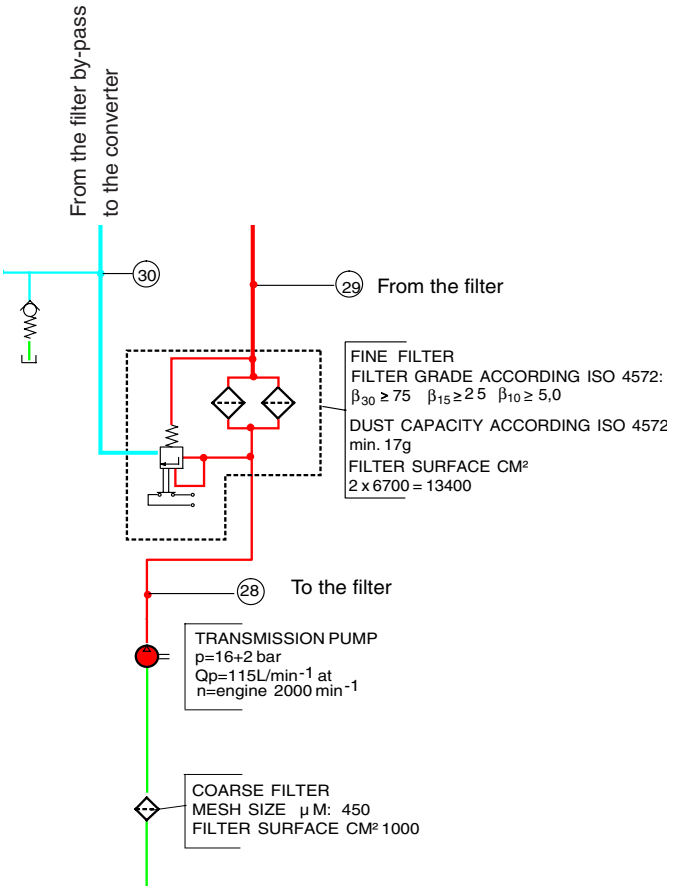
The coarse filter (see Figure previous side) is located in the suction line for the transmission pump in the manual transmission,
and must be cleaned at every oil change !

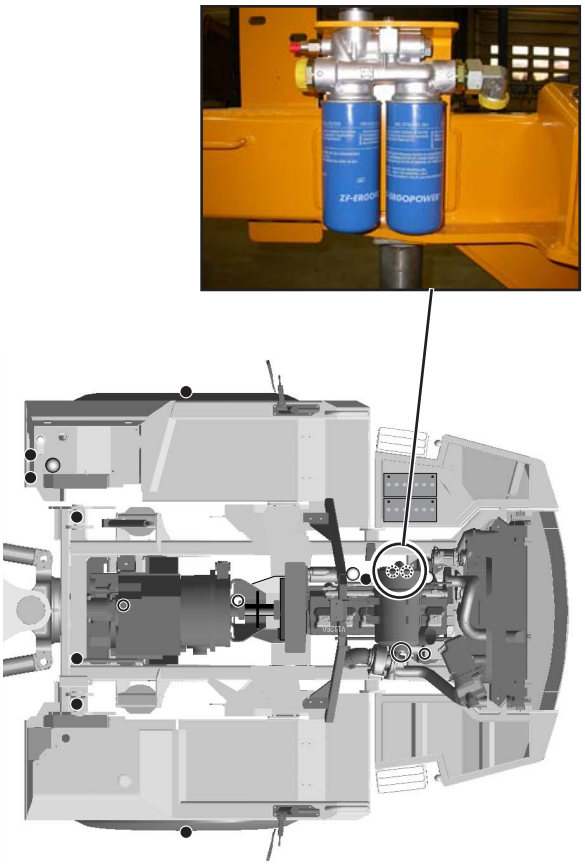
Fine filter:

Filtration ratio according to ISO 4572: $ß_{30} > 75\ ß_{15} = 25\ ß_{10} = 5{,}0$

Filter surface at least: 2 x 6700 cm^2 = 13 400 cm^2

Dust capacity according to ISO 4572 at least: 17 g





To avoid cavitation, the converter must be always completely filled with oil.
This is achieved by a converter pressure back-up valve, rear-mounted to the converter, with an opening pressure of about 5 bar.

The oil, escaping out of the converter, is directed to a heat exchanger.

From the heat exchanger, the oil is directed to the transmission and there to the lubricating oil circuit so that all lubricating points will be supplied with cooled oil.
In the electrohydraulic control unit, 6 pressure regulators are installed

(See the section: Electro hydraulic shift control)

The allocation of the pressure regulators to the single gears can be seen on the Clutch chart.

(See Index for page number)

Axle insert „LK“:

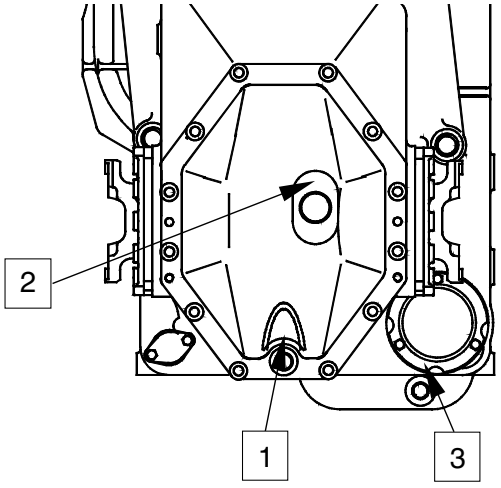
Oil specification:

Oils according to List of Lubricants TE-ML 05 are allowed to be used.

Oil level check:

- With the vehicle standing in a horizontal plane open the screw plug (2) on the transmission, the oil level must reach the upper edge of the check hole (2) .
  If required, fill up oil acc. to the List of Lubricants TE-ML 05.
- Clean sealing surface on the housing and on the screw plug.
- Place the screw plug with a new O-ring again into the oil level check hole (2) and tighten it.

Legend:
1 = Oil drain plug M24x1,5
2 = Oil filler- and oil level plug M42x1,5
3 = Oil drain plug M38x1,5



Oil change:

Pay attention to utmost cleanness, so that no dirt can penetrate inside the axle insert!

- With the vehicle placed in a horizontal plane open the screw plugs (1 and 2) and drain the used oil.
- Clean screw plug (1) and sealing surface on the housing, install the screw plug with a new O-ring and tighten it.
- Fill up the oil according to the ZF List of Lubricants TE-ML 05 on (2) until it starts over-flowing on the oil level check hole.
- Install the screw plug (2) with a new O-ring and tighten it.

Controller

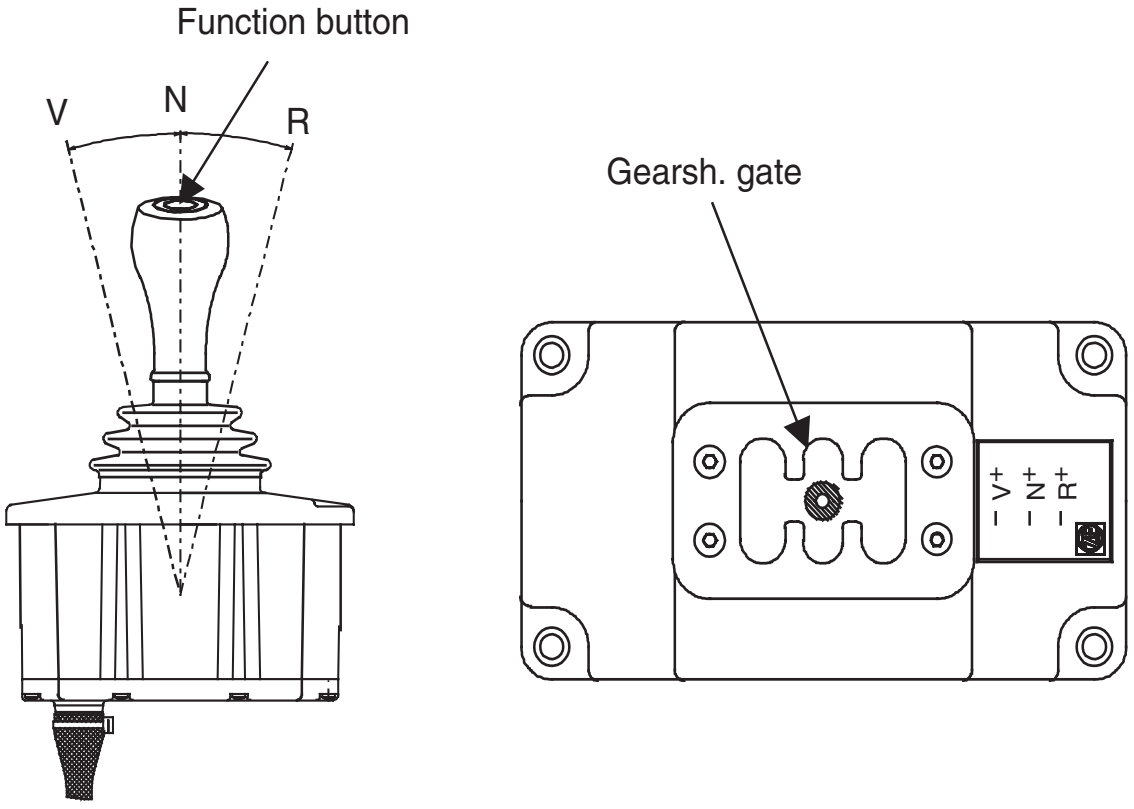
General:

Due to the great number of the available Controllers, the precise Technical Data must be taken from the respective installation drawing.

Controller VTS-3

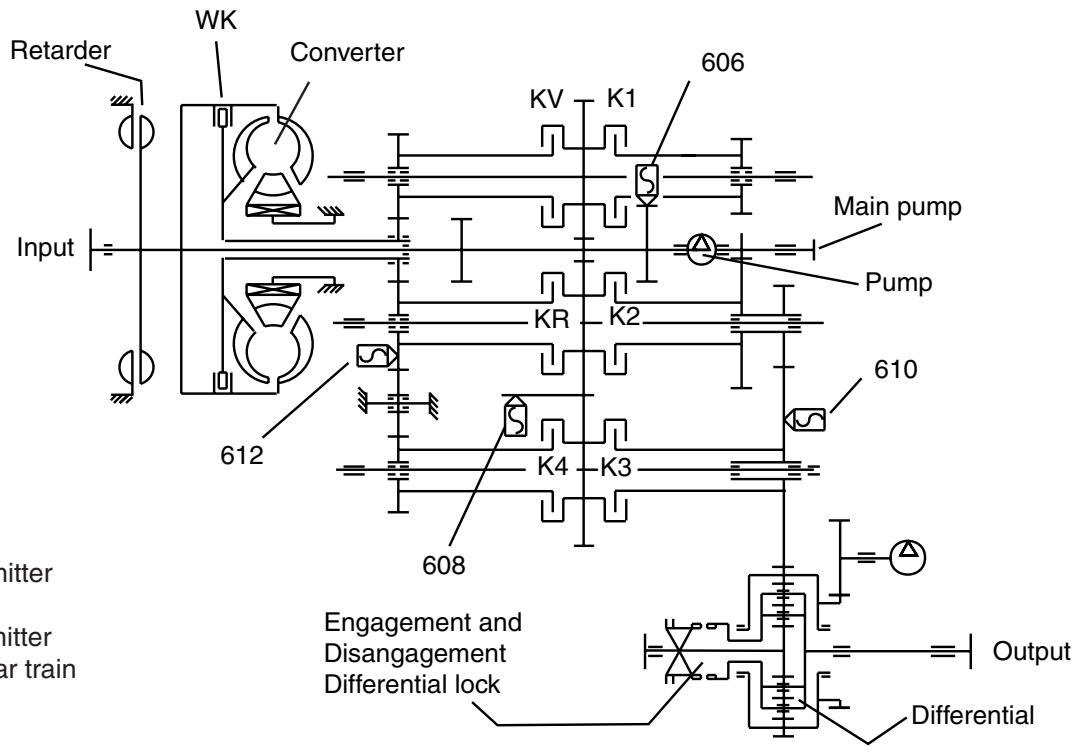
See: Clutch chart next page.

At the Console selector VTS-3 (preselection pushbutton switch), the driving direction will be preselected by horizontal tilting of the Controller lever.
By pressing the Controller lever to the right (+) or to the left (-), the gears can be preselected.
The Controller is equipped with a function button, it serves according to the driving mode as kickdown button or release button for the start off and for the automatic and manual driving mode.



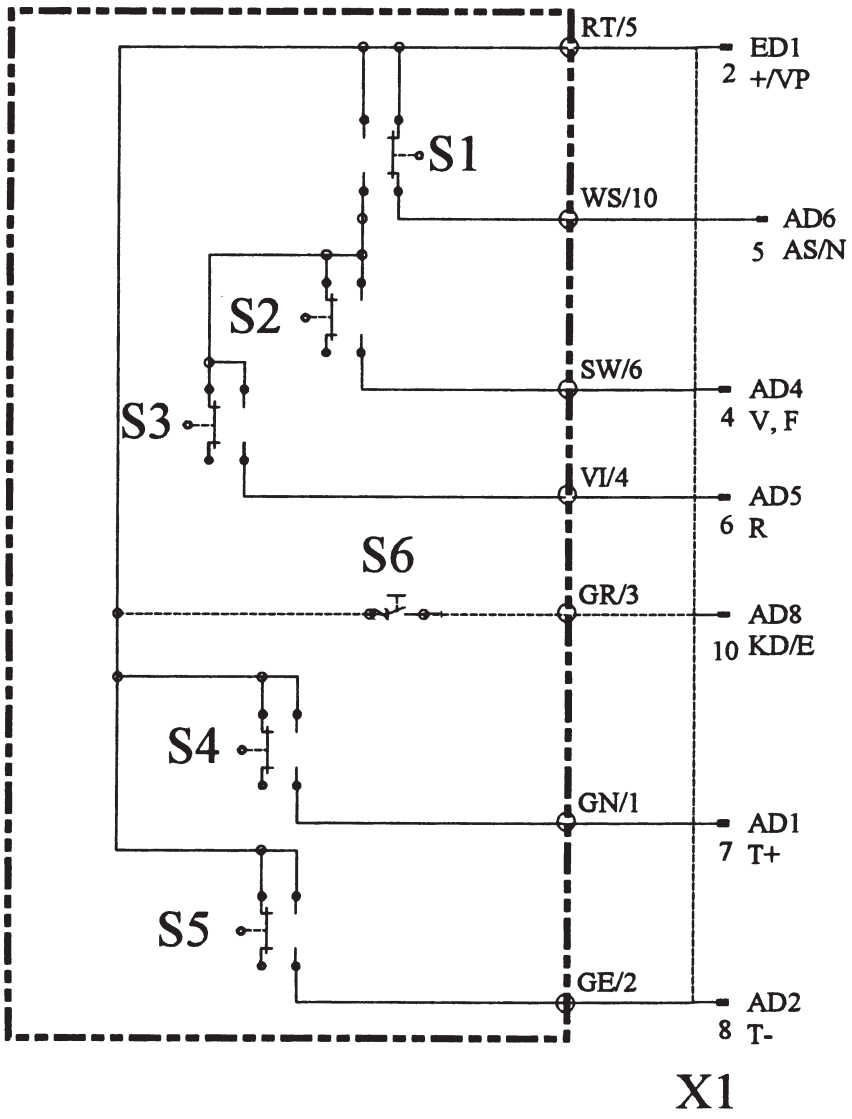
Clutch chart

DRIVING DIRECTION	Speed	PRESSURE REGULATOR UNDER VOLTAGE Y1	Y2	Y3	Y4	Y5	Y6	ENGAGED CLUTCHES	
FORWARD	1			●		●		K1	KV
	2		●	●				K4	K1
	3					●	●	KV	K2
	4		●				●	K4	K2
	5				●	●		K3	KV
	6		●		●			K4	K3
REVERSE	1	●		●				KR	K1
	2	●					●	KR	K2
	3	●			●			KR	K3
NEUTRAL									
ENGAGED CLUTCH		KR	K4	K1	K3	KV	K2		
POSTITIONS ON VALVE BLOCK		F	E	D	C	B	A		
CONSEC. NO. OF MEAS. POINTS		55	60	56	58	53	57		



606 = Inductive transmitter
n – Engine
608 = Inductive transmitter
n – Central gear train
610 = Speed sensor
n – Output
612 = Inductive transmitter
n – Turbine

Circuit diagram controller



Coding controller

			Position					
			V	R	N	T+	T-	KD/E
FUNK-	AD1	T+				●		
	AD2	T-					●	
TION								
	AD4	V	●					
SWI-	AD5	R		●				
	AD6	AS/N			●			
TCH	AD8	KD/E						●

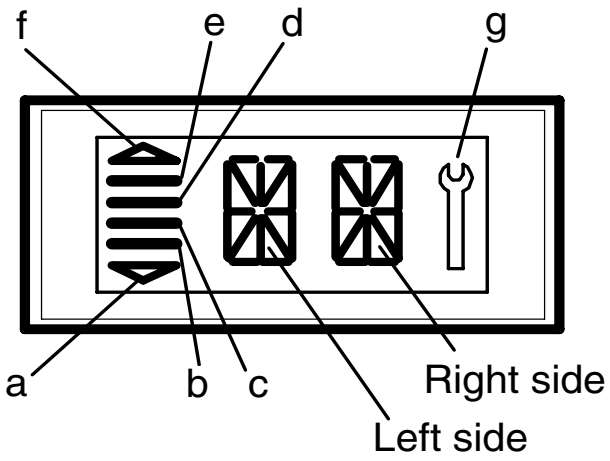
Display

Possible Indications on the Display

Preselected Driving range:
The number of the lines indicates the driving range, (Special characters b, c, d, e) resp. the gear preselection:

1 Bar b:	Driving range 1
2 Barc b,c:	Driving range 2
3 Bars b,c,d:	Driving range 3
4 Bars b,c,d,e:	Driving range 4, 5 or 6

Display Manual / Automatic:
If the two Symbols a , f (Arrows) and the bars b, c, d, e (Special characters a, f) are indicated, the system is in the Automatic mode (automatic up- and downshiftings).



Spec. charact.	Display	
a, f	Automatic range (up- and downshifting)	
b, c, d, e	Preselected gear	
g	EST-37 has recognized an error, is flashing	
Left side	Shows engaged gear	Also, when the gear-selector is in neutral, a two-digit error code will be shown via these two segments.
Right side	Shows driving direction	

Display of the Driving direction: **(right Side)**
V or **F**: Vorwärts / Forward
N: Neutral
R: Reverse

Display of the engaged gear: Left side
Display 1, 2, ... 6

Waiting for Controller-Neutral:
Indication on the Display: **NN** (left and right Side).
In this condition, Neutral is pending on transmission.
To engage a gear, at first Neutral must be shifted on the Controller before the electronics allows to engage a gear again.

Display of the Cold-start phase: Transmission remains in Neutral

Bars are flashing: WK open

Error display: If the system is recognizing an error, the spanner (Spe-cial symbol „g“) is flashing.
If Neutral is preselected on the Controller, a two-digit error number appears on the two alphanumeric display points (central and right Side).

If more than one error is pending, the different error numbers will be indicated one after the other on the Display in cycles (about 1 second).



The error code will --be only then indicated if the Controller is in Neutral !

Warning display: At exceeding the warning threshold Temperature – Sump / Retarder / behind the Converter and the war-ning threshold Speed – Engine, changes the indication on the Display to the actual gear and the corresponding warning indicator.



If several warnings are simultaneously active, only the warning with the highest priority will be indicated.



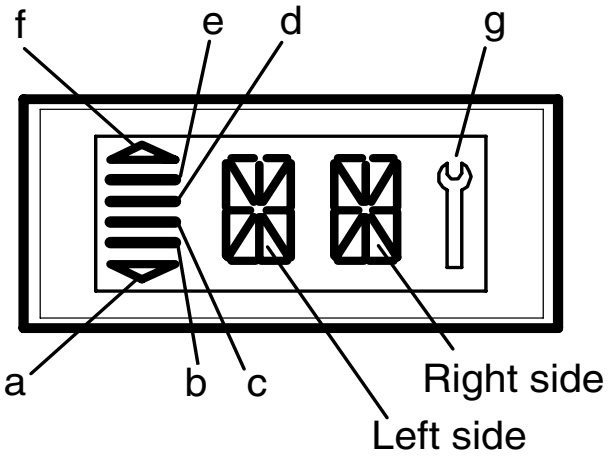
Warning indicator	Warning	Priority
WR	Temp behind Retarder	1
WT	Temp behind Converter	1
WS	Temp in Sump	2
WE	Engine speed	3

Display EE

Indication on the Display: **EE** . In this state, the Display has a timeout, i. e. it receives no Data from the EST-37.

Main reasons:

- EST-37 is in TOTAL RESETTING MODE (e.g. because of output train disconnection or external power supply at the lines to the gear-solenoid valves).
- EST-37 without supply
- Data line not correctly connected, etc.



Error code definition:

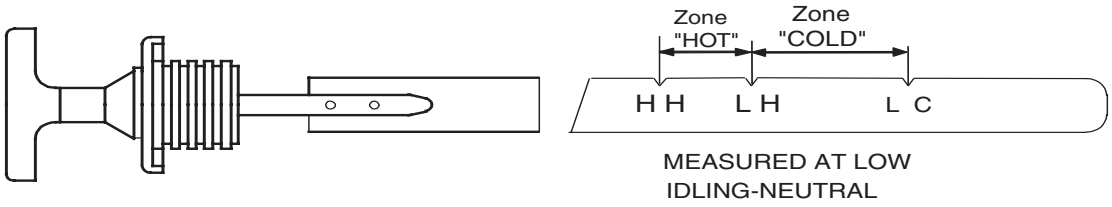
The error codes are composed of two hexadecimal numbers.
The first number indicates the type of signal, the second number the signal and the type of error.

Look in the shop manual chapter 2.5 Troubleshooting, Fault finding code list

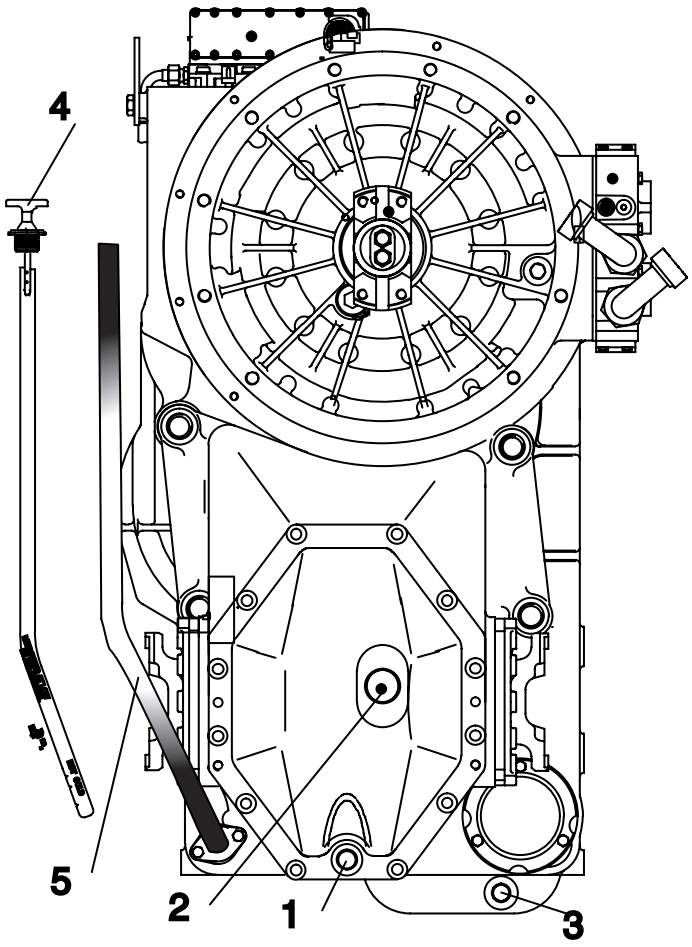
OPERATION

Driving preparation and Maintenance

Prior to the commissioning of the transmission, take care that the prescribed oil grade will be filled in with the correct quantity. At the initial filling of the transmission has to be considered that the oil cooler, the pressure filter as well as the pipes must get filled with oil.
According to these cavities, the quantity of oil to be filled in, is greater than at the later oil fillings in the course of the usual Maintenance service.



Oil level check transmision:
Because the converter and also the oil cooler, installed in the vehicle, as well as the pipes can empty at standstill into the transmission, the oil level check must be carried out at engine idling speed and operating temperature of the transmission
- loosen oil dipstick by counterclock rotation, remove and clean it
- insert oil dipstick slowly into the oil level tube until contact is obtained, and pull it out again.
- On the oil dipstick, the oil level must be lying in the zone „HOT“
- insert the oil dipstick again, and tighten it by clockwise rotation



Legend:

1 = Oil drain plug M24x1,5
2 = Oil filler- and oil level plug M42x1,5
3 = Oil drain plug M38x1,5
4 = Oil dipstick
5 = Dip stick pipe

Oil level check front differential:
- With the vehicle standing in a horizontal plane open the screw plug (2) on the transmission, the oil level must reach the upper edge of the check hole (2 .If required, fill up oil acc. to the ZF List of Lubricants TE-ML 05.
- Clean sealing surface on the housing and on the screw plug. - Place the screw plug with a new O-ring again into the oil level check hole (2) and tighten it**.**

Driving and Shifting

- **Neutral position:**
  Neutral position will be selected via the Controller.
  After the ignition is switched on, the electronics remains in the waiting state.
  By the position NEUTRAL of the Controller, resp. by pressing the pushbutton NEUTRAL, the EST-37 becomes ready for operation.
  Now, a gear can be engaged.

- **Starting:**
  The starting of the engine has to be always carried out in the NEUTRAL POSITION of the Controller.
  For safety reasons, it is to recommend to brake the vehicle always securely in position with the parking brake prior to start the engine.
  After the starting of the engine and the preselection of the driving direction and the gear, the vehicle can be set in motion by acceleration.
  At the start off, the converter takes over the function of a main clutch.
  On a level road it is possible to start off also in higher gears.

- **Upshifting under load.**
  Under load will be then upshifted, if the vehicle can continue to accelerate by it.

- **Downshifting under load.**
  Under load will be then downshifted, if more traction force will be needed.

- **Upshifting under coasting condition.**
  In the coasting mode, upshifting will be suppressed, if the vehicle speed on a downgrade shall not be further increased by accelerator position idling speed.

- **Downshifting under coasting condition.**
  Downshiftings in the coasting mode will be then carried out, if the vehicle shall be retarded.

- **Reversing**
  The reversing must be performed at standstill, resp. at very low driving speed.
  Above the programmed reversing limit, the vehicle will be shifted to Neutral by the Electronic unit EST-37, and the vehicle continues rolling in the previous dri-ving direction.
  The gear of the new driving direction will be only engaged when the program-med reversing speed and the transmission input speed (turbine speed) has fallen below.
  The programming is customized and can therefore be different from standard.
  Therefore, the exact procedure must be taken from the Operating Instructions manual

- **Shifting of the various outputs.**

- **Axle disconnection/Interaxle differential.**
  Both interlocks can be preselected during the drive via a switch. At exceeding the driving speed below 5 km/h and unloaded transmission, the interlocks engage of automatically.

Attention:

The engagement is only then permitted, if no speed difference between the axles is prevailing.

If the vehicle will be stopped and is standing with running engine and engages transmission, the engine cannot be stalled.
On a level and horizontal road, it is possible that the vehicle begins to crawl because the engine is creating at idling speed via the converter a slight drag moment.

It is convenient to brake the vehicle at every stop securely in position this the parking brake.
At longer stop periods, the Controller must be put to the **NEUTRAL POSITION.**

At the start off, the parking brake has to be released. We know from experience that at a converter transmission it might not immediately be noted to have forgotten this quite normal operating step because a converter, due to its high ratio, can easily overcome the braking moment of the parking brake.
Temperature increases in the converter oil as well as overheated brakes will be the consequences to be find out later.

Cold start:
At an oil temperature in the shifting circuit < -12° C, the transmission must be warmed-up for some minutes.
This must be carried out in Neutral with an increased engine speed (about 1500 min -1).
Until this oil temperature is reached, the Electronics remains in Neutral, and the symbol of the cold start phase will be indicated on the ZF-Display.

Indication on the Display: ✳✳

After the indication on the ZF-Display is extinguished, the full driving program can be utilized out of „NEUTRAL“.

Transmission control in the Driving mode Automatic:

A manual intervention into the automatic shifting sequence is only then practical if the road condition or the shape of the terrain is suitable.

Stopping and Parking:
Since due to the converter there is no rigid connection existing from the engine to the axle, it is recommended to secure the vehicle on upgrades, resp. downgrades against unintended rolling not only by applying the parking brake but additionally by a block on the wheel, if the driver has the intention to leave the vehicle.

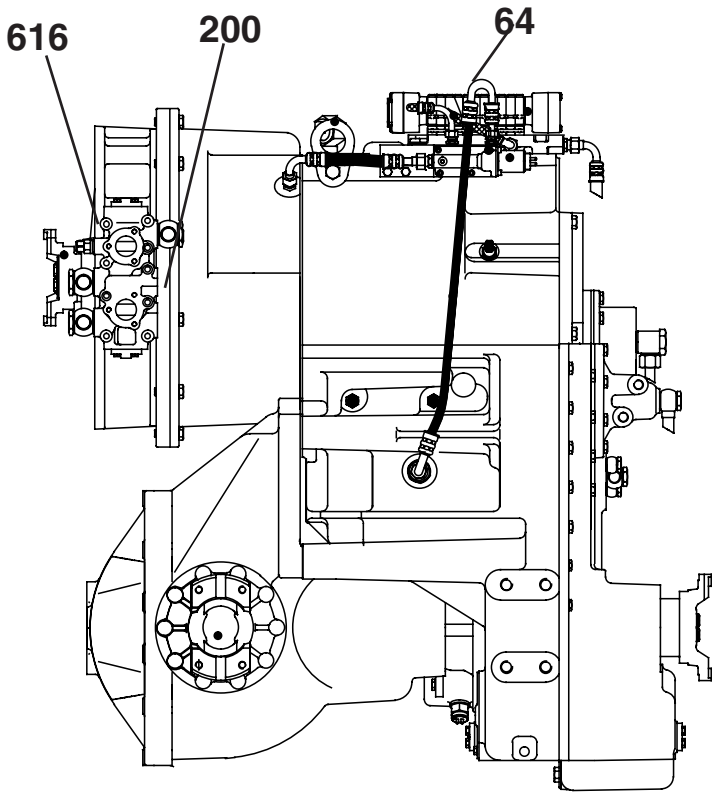
Oil temperature:
The oil temperature in the transmission sump is monitored by a temperature sensor in the electrohydraulic control unit **(64)**.
The service temperature in the sump of 60° - 90° C must not be exceeded (error indication appears on the Display in the driver's cabin) !

At a trouble-free unit and an adequate driving mode, a higher temperature will not occur. If the temperature is rising above 90° C, the vehicle has to be stopped, controlled for external oil loss and the engine must run with a speed of 1200 - 1500 min -1 at NEUTRAL POSITION of the transmission.
Now, the temperature must drop quickly (in about 2 – 3 minutes) to normal values. If this is not the case, there is a trouble pending, with must be eliminated prior to continue working.

The supervision of the oil temperature behind the converter is additionally realized with an indication on the Display

Service temperature behind the converter at least 65° and 100° C in continuous operation, a short-time increase (max. 5 minutes) up to max. 120° C is permitted.
The temperature will be measured on the measuring point **200** and showed at the instrument.

The maximally permitted permanent temperature behind the Retarder is 145° C.
In exceptional cases, are short-time (max. 5 minutes) 150° C permitted.
The temperature will be measured on the measuring point **616** and transmit the signal to EST37.



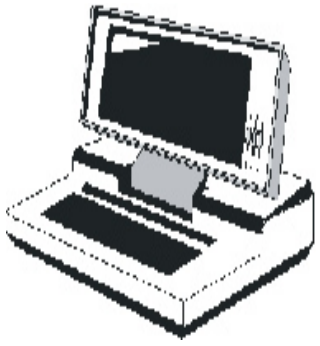
Testing system, ZF

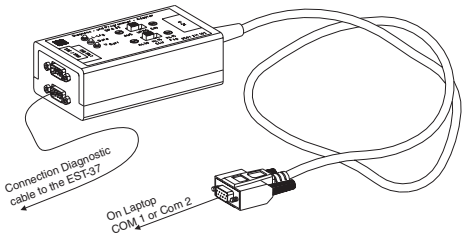
MOXY®

SERVICE

Installation Manual and Summary
for the Diagnostic

Software







Safety notice

Companies who repair ZF units are responsible for their own work safety.
To avoid injury to personnel and damage to products, all safety regulations and legal requirements which apply to repair and maintenance work must be adhered to.
Before starting work, mechanics must familiarize themselves with these regulations.

Personnel required to carry out repairs on ZF products must receive appropriate training in advance. It is the responsibility of each company to ensure that their repair staff is properly trained.

The following safety instructions appear in this manual:

NOTE
Refers to special processes, techniques, data, use of auxiliary equipment etc.

CAUTION
This is used when incorrect, unprofessional working practices could damage the product.



D A N G E R
This is used when lack of care could lead to personal injury or death.

General information

Read this manual carefully before starting any tests or repair work.

CAUTION
Pictures and drawings of components do not always represent the original object, but are used to illustrate working procedures.
Pictures and drawings of components are not to scale and no information about size and weight should be inferred (even within a complete illustration).
Always follow the working steps as described in the text.

After completion of repair work and testing, skilled staff must satisfy themselves that the product is functioning correctly.



THREATS TO THE ENVIRONMENT

Lubricants and cleaning agents must not be allowed to enter the soil, ground water or sewerage system.

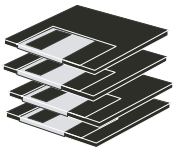
- **Ask your local environment agency for safety information on the relevant products and adhere to their requirements.**
- **Collect used oil in a suitably large container.**
- **Dispose of used oil, dirty filters, lubricants and cleaning agents in accordance with environmental protection guidelines.**
- **When working with lubricants and cleaning agents, always refer to the manufacturer's instructions.**

Diagnostic - set

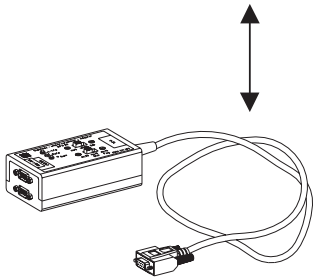
Needed hardvare and softvare



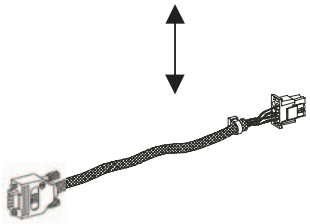
Pentium Laptop min. > 90 MHz
and Windows 95/98



Basic - Software
Testman
504672



Programming
Adapter DPA – 03
504673

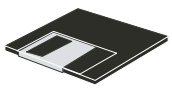


Adapter cabel
EST - 37
504674

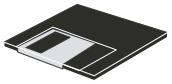
Diagnostic – Set
STANDARD
504671

Diagnosis
Software

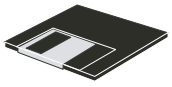
EST - 37
WG 260
WG 310



German
504675



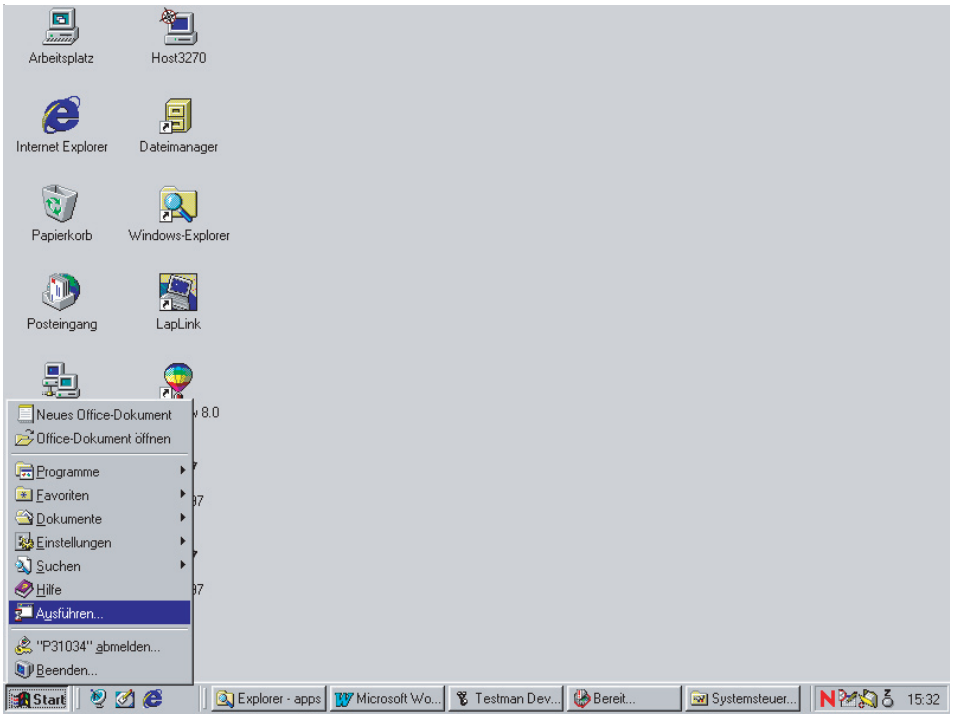
English
504676



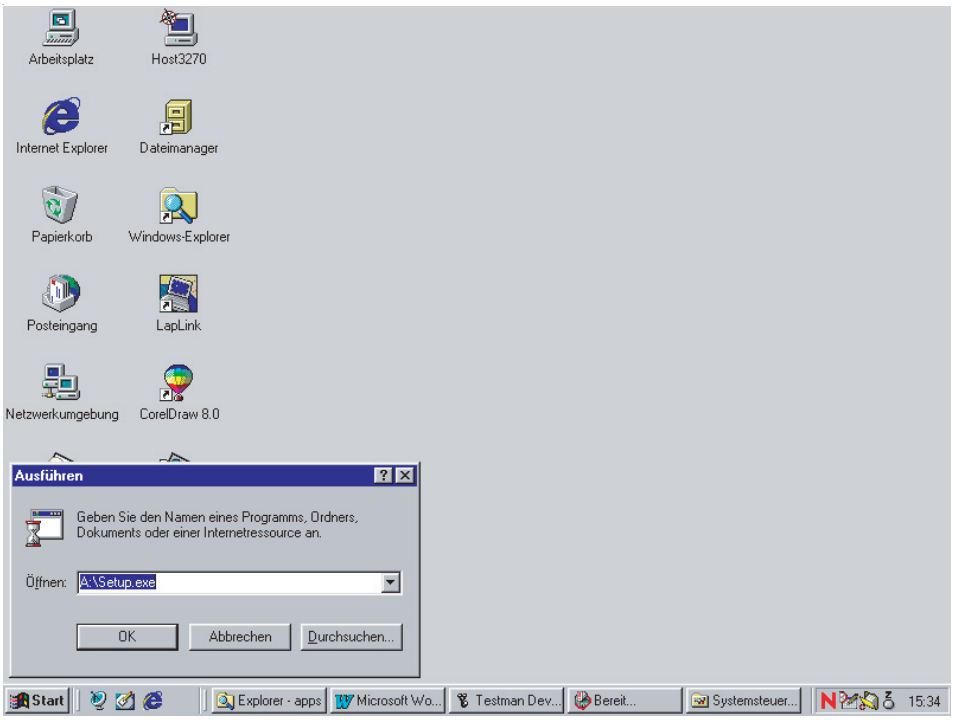
French
504677

Installation of Diagnostic Software --> Testman

a) Mount floppy disk “1” of “Testman” into drive “A”
b) Go under “START” to “Execute” ! (See figure)

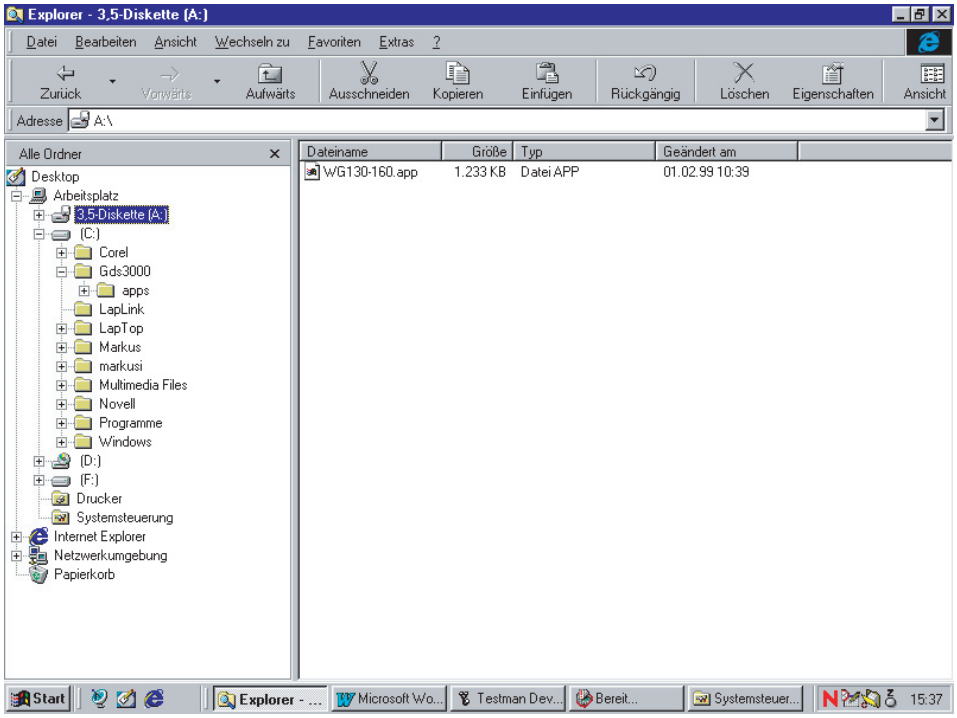


c) There, enter “A:\Setup.exe” ! (See figure)

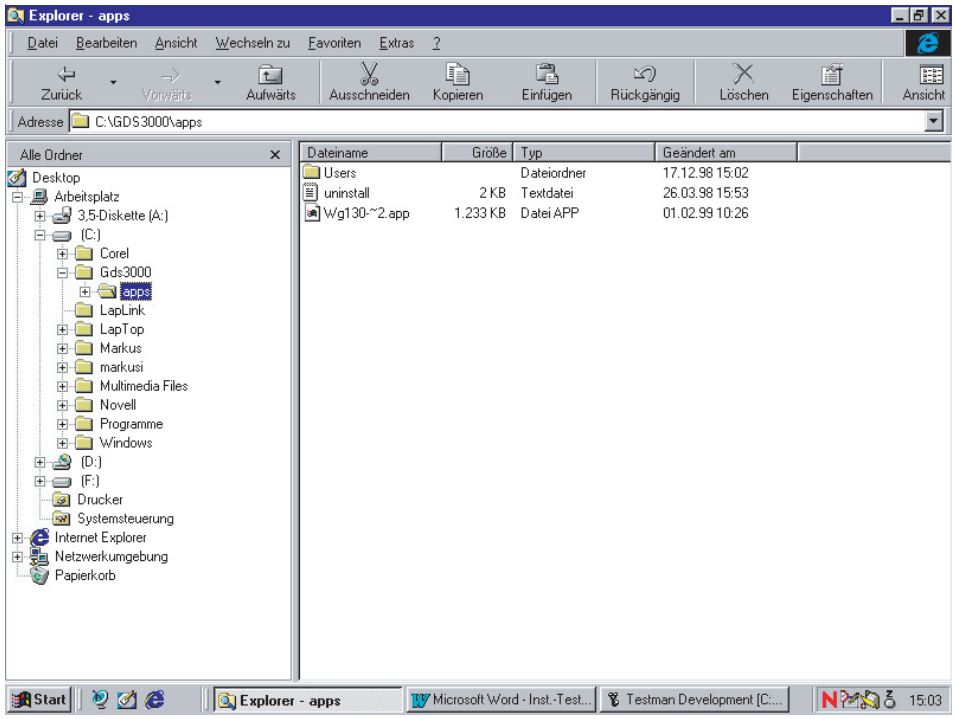


d) Nov, follow the next installation steps and mount upon request the floppy disks 2,3 and 4, one after the other
e) Now, you should have in the directory “C”\ “a subdirectory with the name “GDS3000”.
f) The installation of “Testman” is now terminated.

g) Now, you must copy the actual applications (e.g,,; Appl. WG 260 - 310) into the directory “C:\GDS 3000\ apps” copy. (See figure)



h) Now, you must have a Directory “C\GDS 3000\apps\WG 260 - 310.apps (See figure!)



i) Now, “Testman” and the actually desired Application of WG 130--> 310 should be installed.

j) If you restart the computer now, you will see on the Desktop an Icon with name “Testman”, independently created by “Testman”

Start of Testman

Prosedure

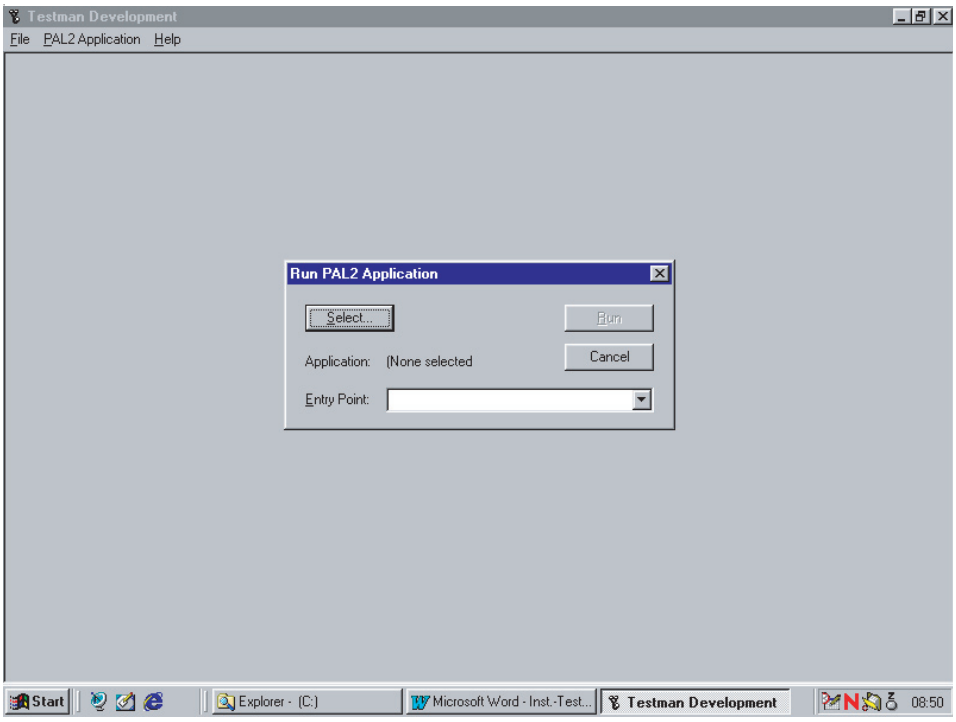
a) Switch off the ignition !
b) Connect the Laptop via the programming adapter “DPA-03” (Order -No.: 504673) and the standard adapter cable (order No.:504674 with the diagnostic connector of the vehicle.
c) Switch on the ignition!
d) Now, start the “Testman” with a double-click on the icon on the Laptop!
e) If the “Testman” is started, you will have a bar with three item:

⇨ File (For the termination of the Testman)

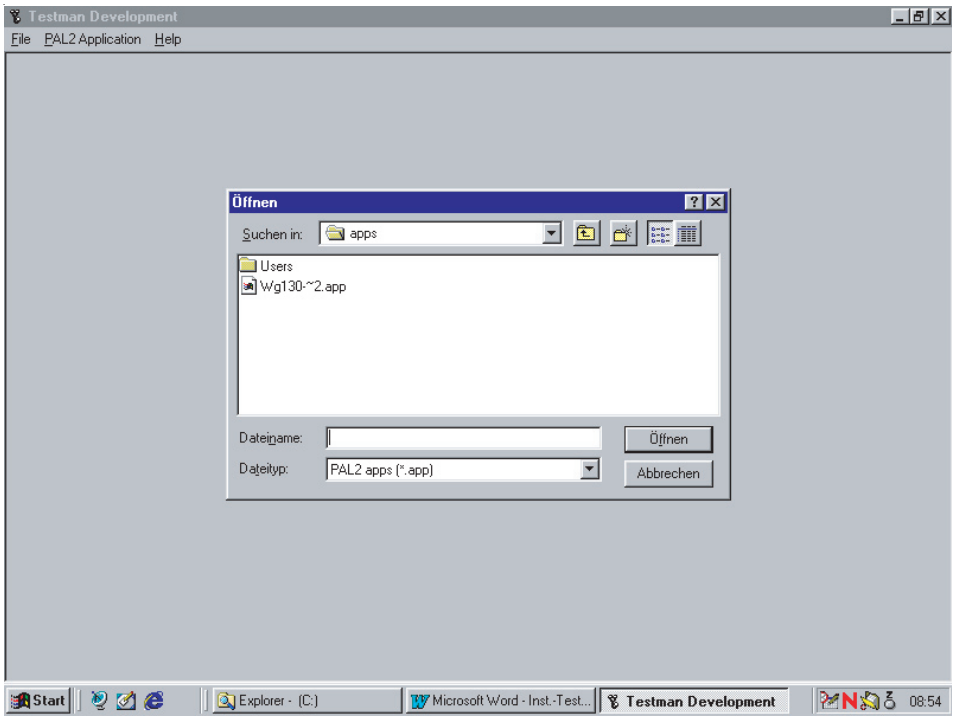
⇨ Pal2Application (for the selection of the application)

⇨ Help (for assistanse)

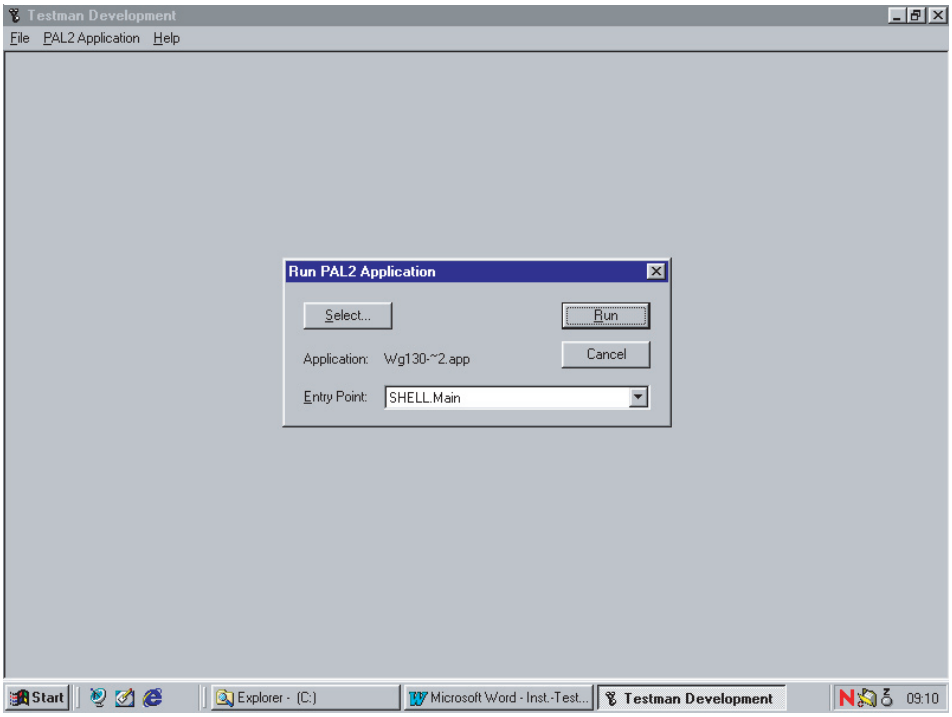
f) To load an application, actuate with the mouse the selection “Pal2Application”.
g) A selection bar opens with the menu item “RUN”.
h) Actuate “RUN”.
i) Now you have the figure as shown below.
Now, click here on “Select...,”



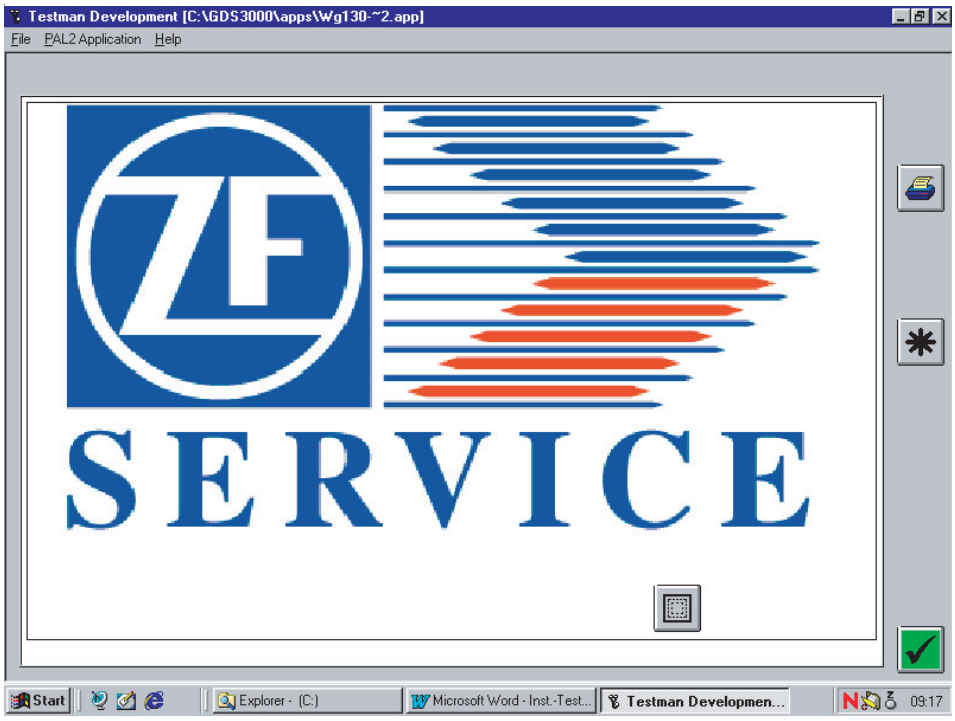
k) Now, select the desired Application, which you start with a double-click, or you are using the command „Open“!



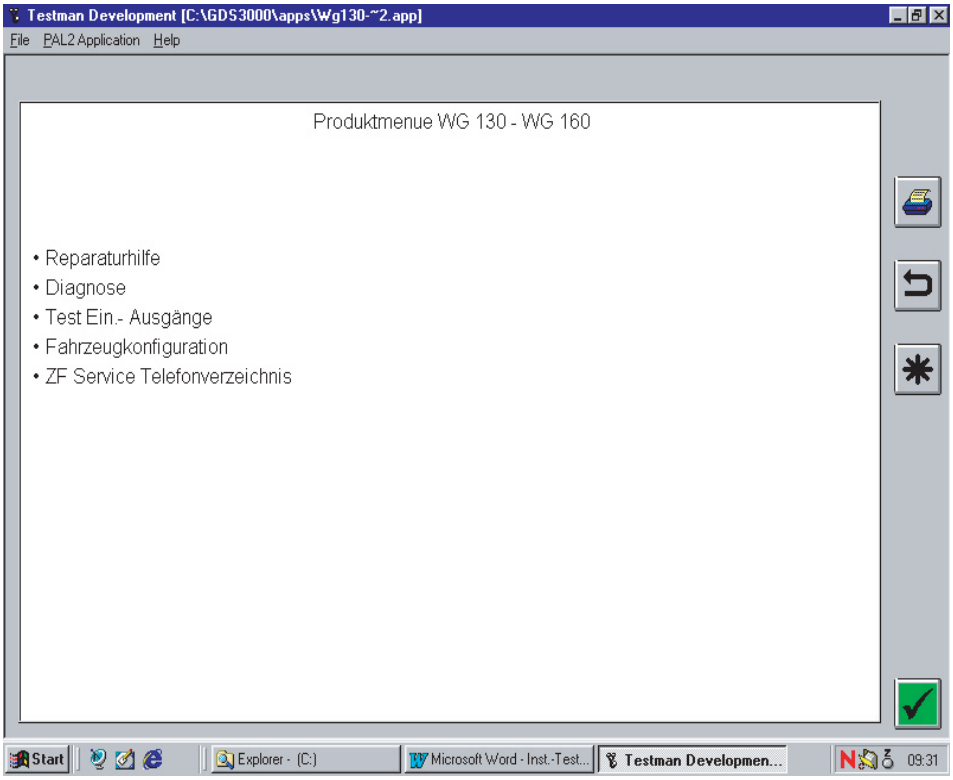
l) Now, start the application (e.g.:WG 260 - 310) by the command „Run“.



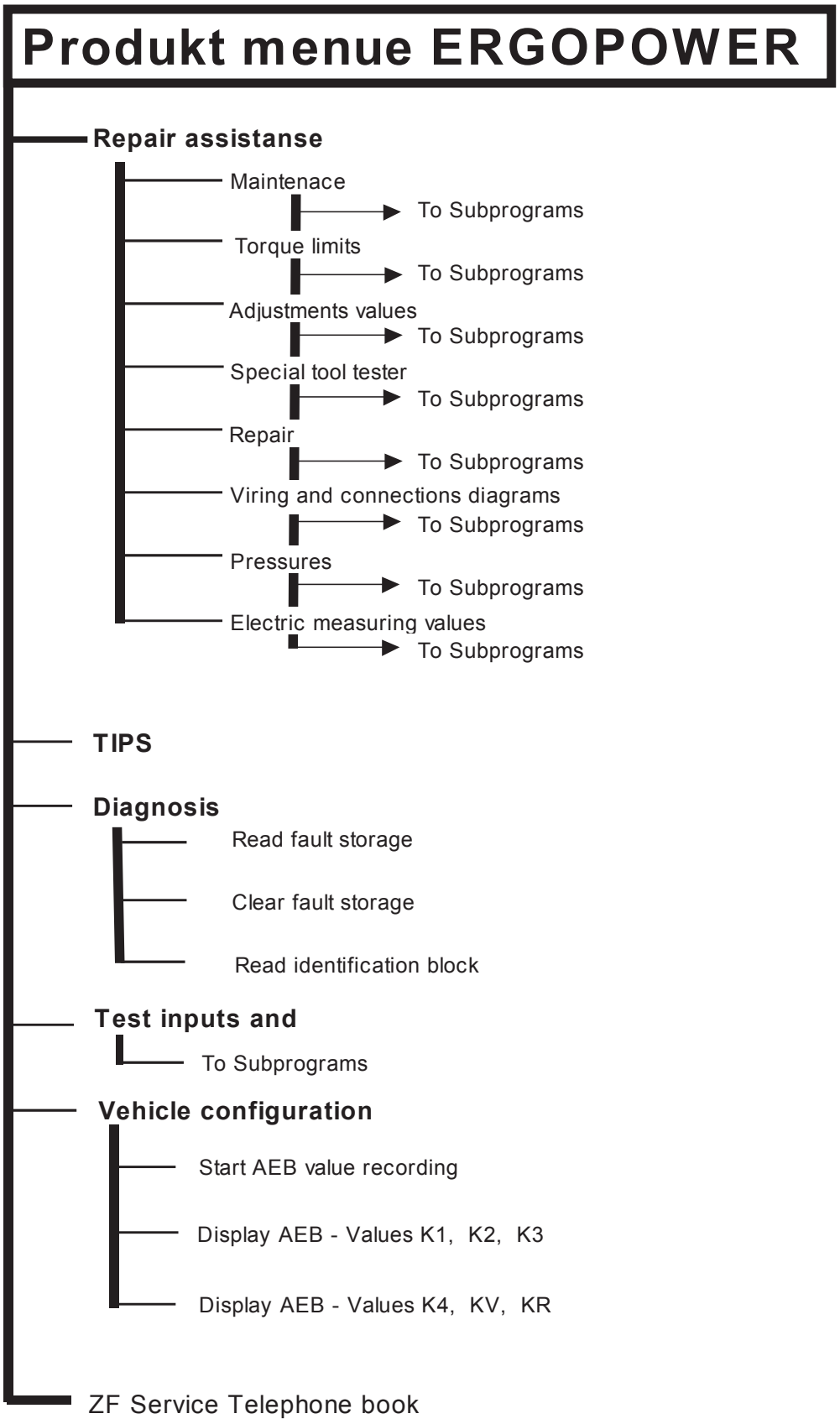
m) Now, appears the Company logo „ZF-Service“, which you acknowledge which „Enter“ or by mouse click on the Arrow down on the right („Forward-Button“).
(As the next step, the Version of „Testman“ and some Instructions will be illustrated to you, which you acknowledge by „Enter“.)



n) Now, you are in the main menu of „Testman”, where you have the selection between the single menu items.
⇒ Click with the mouse on an item and acknowledge it with „Enter"



Produkt menue Ergopower



AEB starter

AEB calibration

Introduction



The AEB - Starter is a tool to start the AEB of ergopower transmissions by an easy way. It's useful to work with the ZF - Display, because you get all messages about the AEB state via the ZF - Display.
The AEB-Starter itself doesn't show any information.
The AEB-Starter works with the diagnostic plug.

List of abbreviations:
AEB:automatic filling parameter adjustment
TCU: transmission control unit.



Moxy recommends, to start the AEB

at every oil change.

<u>If the oil quality are changed it is strongly necessery</u>

<u>to run AEB !</u>

Automatic calibration of the Shifting elements

The AEB serves to compensate tolerances (plate clearance and pressure level), which are in fluencing the filling procedure of the clutches. For each clutch, the correct filling parameters for:

* Period of the rapid-filling time
* Level of the filling equalizing pressure

are defined in a test cycle.

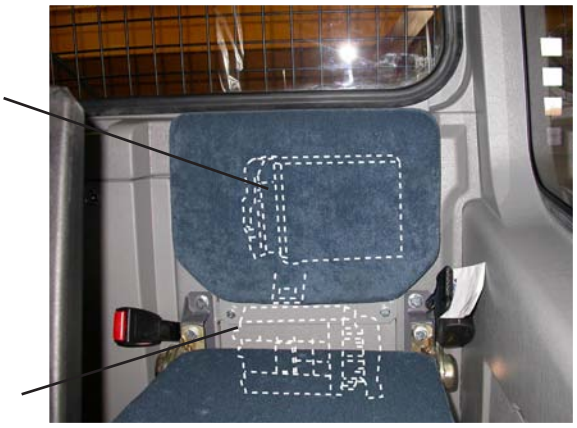
The filling parameters are stored, together with the AEB-Program and the driving program in the transmission electronics. Because the Electronics will be separately supplied, the AEB-Cycle must be started only after the installation of both components in the vehicle, thus ensuring the correct mating (Transmission and Electronics).

Due to the operation of the transmission, the paper friction linings, installed in the Er-gopower transmissions are settling, i.e. the plate clearance becomes greater.
Because these settling appearances can interfere the shifting quality, Moxy trucks recommends to repeat the AEB-Cycle at the Maintenance intervals (see 4.3.1)

The ZF recommends likewise at a reduced shifting quality as first measure to repeat the AEB-Cycle.

NOTE: **To use the AEB see : Procedure to start AEB (next page)**

Procedure to start AEB



Disassemble 2 screws for the seat back.

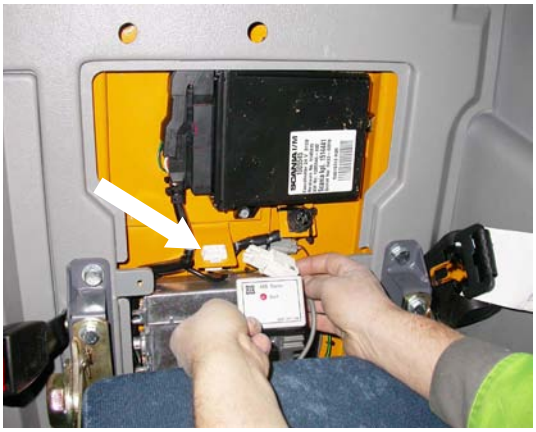
Push (knock) down the seat back.



Take up the covering plate



Find the diagnostic contact (607) between the controller units



NOTE !

Before starting the AEB, the transmission-oil must have a temperature at 70 - 80°C

1 Connect the plug from AEB starter to the diagnostic contact without the ignition on.
2 Turn on the ignition.
3 Start the engine.



Note:

AEB will not start with any fault codes on display except fault „F6“

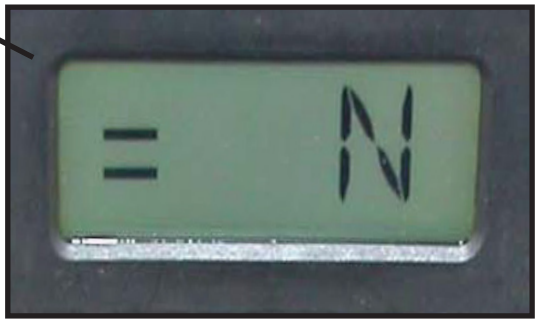
1 The engine running and the brake on

2 Push the button for AEB start

If malfunction the ignition had to turn off and stop the engine. Turn the ignotion on, and start the engine again.



The display show the action
(Display message)



If successfully , the disblay showing OK

See the table next page

	Step to do	Display message	Remark
1	warm up transmission	normal operating messages	
2	turn off ignition	nothing	
3	plug in AEB - starter		
4	move shift lever to N position engage parkbrake		
5	start engine	'PL'	TCU must recognize PL for at least 2s before you can press the button
6	set engine speed to low idle rpm	'PL' if start conditions are ok	
7	press button of the AEB-Starter	'ST' if start conditions are ok	The button must not be released before TCU has started the AEB or quit with an error code (see chapter 4)
8	hold button until AEB has started	'K1' ... (Information about the AEB state)	TCU has started the AEB, and goes on adjusting K1, K2, ..., KR. (Button may be released)
9	wait until AEB has finished	'OK' (AEB has been successful)	
10	turn off ingnition and unplug AEB - Starter	nothing	

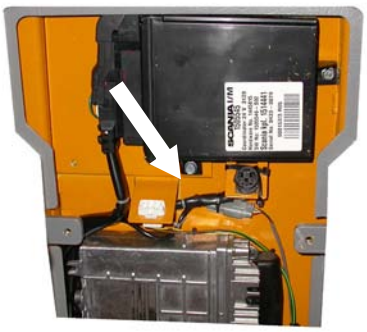
AEB code list

Symbol	Meaning	Remarks
PL	AEB - Starter is plugged at the diagnostic plug	
ST	AEB-Starter-button is pressed	
K1..K4,KV,KR	calibrating clutch K1..K4,KV,KR	
_ and Kx	wait for start, initialization of clutch Kx	
and Kx	fast fill time determination of clutch Kx	
= and Kx	compensating pressure determination of clutch Kx	
OK	calibration for all clutches finished	Transmissions stays in neutral, you have to restart the TCU (ignition off/on) after removing AEB-Starter
STOP	AEB canceled (activation stopped)	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
STOP and Kx	AEB stopped, clutch Kx can't be calibrated	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
Spanner and Kx	Kx couldn't be calibrated, AEB finished	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
E	engine speed too low, -> raise engine speed	
E	engine speed too high, -> lower engine speed	
T	transmission oil temperature too low, -> heat up transmission	
T	transmission oil temperature too high -> cool down transmission	
FT	transmission temperature not in defined range during calibration	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
FB	operating mode not NORMAL or transmission temperature sensor defective or storing of Calibrated values to EEPROM-has failed.	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
FO	Outputspeed_not_zero	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
FN	Shift lever not in Neutral position	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
FP	Parkbrake_not_applied	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
STOP	AEB - Starter was used incorrect or is defective	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)

Laptop - Start of AEB via Testman

(AEB ⇒ Automatic determination of Filling parameters)

1)
Remove the passenger seat back and the covering plate and find the diagnistic plug



2)
Connect the Programming Adapter DPA3 to the diagnostic plug between the controller units



3)
Connect the cabel from the Programming Adapter DPA3 to the laptop



4)
Select in the main menu the item „Vehicle configuration“!

5)
Pay attention to the prescribed Operating Instructions!
See : Start of Testman / Prosedure

6)
Start the AEB by the command:
„Start AEB – Value recording“!

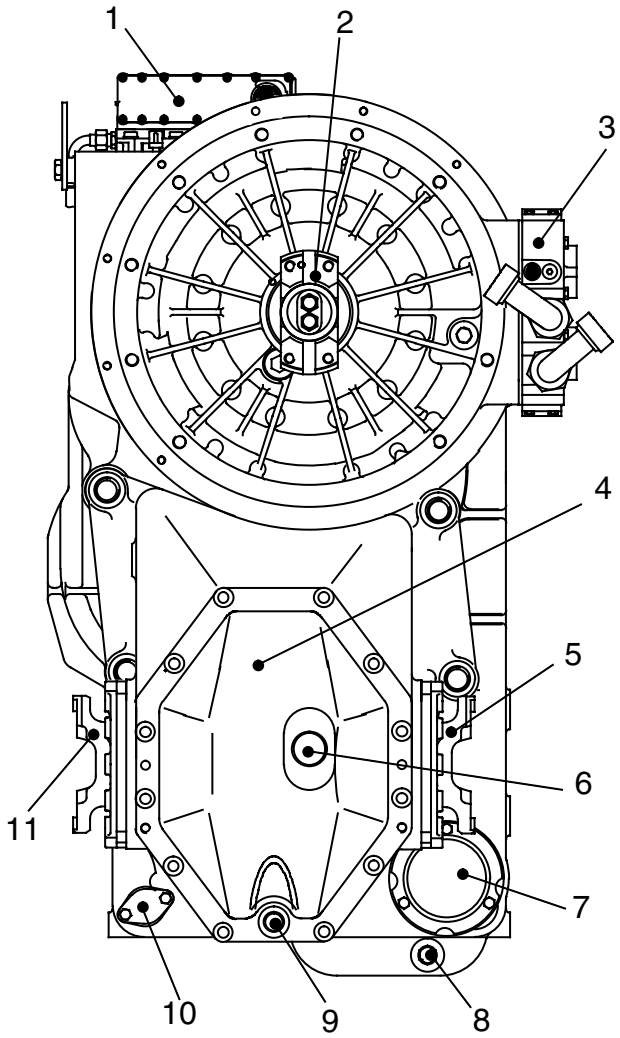
7)
After the performend run, an „OK“ must appear on the display.



Installation view

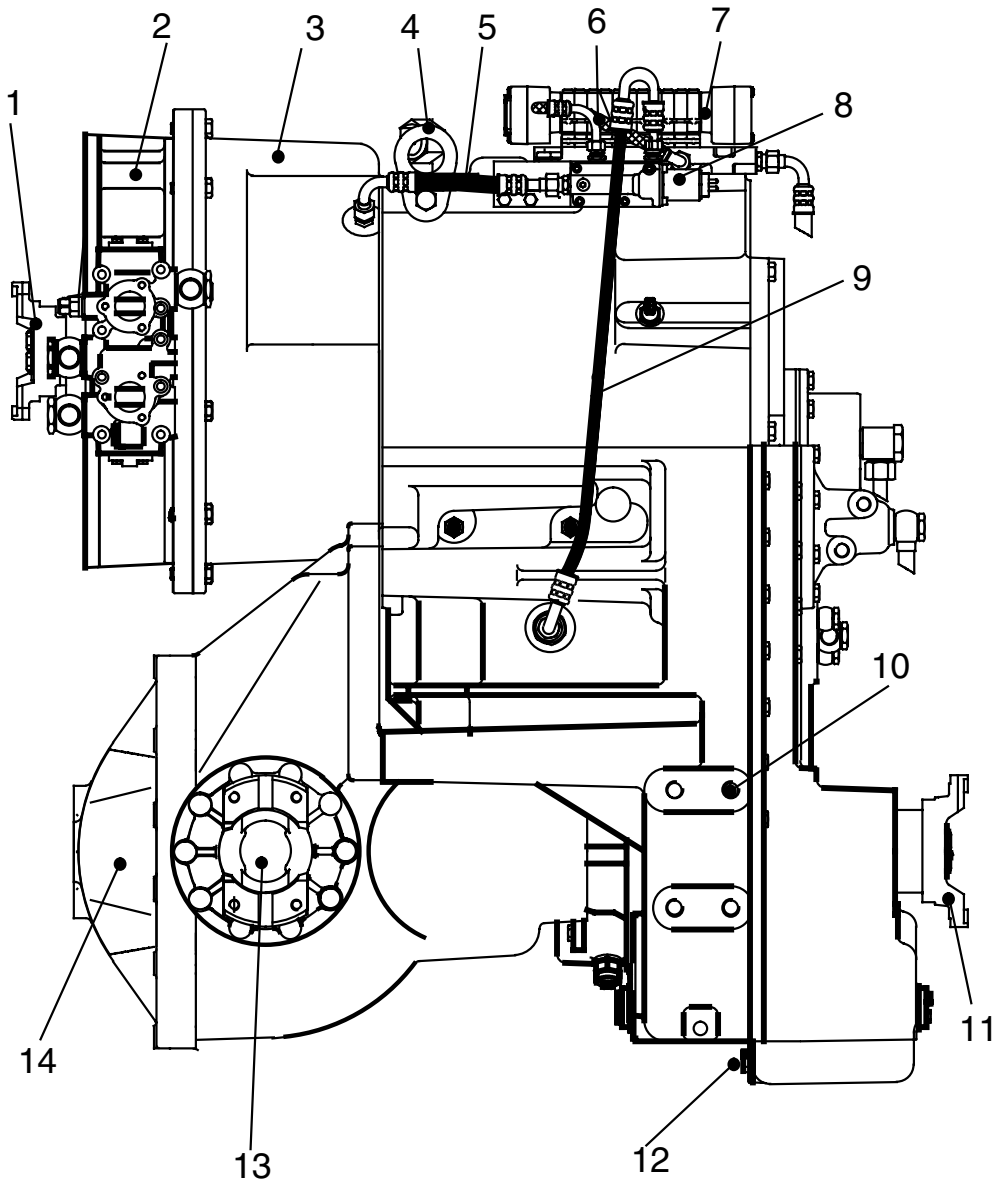
Front view

1 = Electro hydraulic shift control
2 = Input flange-Input trough prop shaft
3 = Retarder valve
4 = Axle insert “LK”
5 = Output flange- Front axle LH
6 = Oil filler hole Axle insert”LK” M42 x 1,5
7 = Coarse filter
8 = Oil drain plug Transmission with magnetic insert M38 x 1,5
9 = Oil drain plug Axle insert “LK” with magnetic insert M24x 1,5
10 = Attachment possibility for oil filler tube with oil dipstick
11 = Output flange - front axle RH



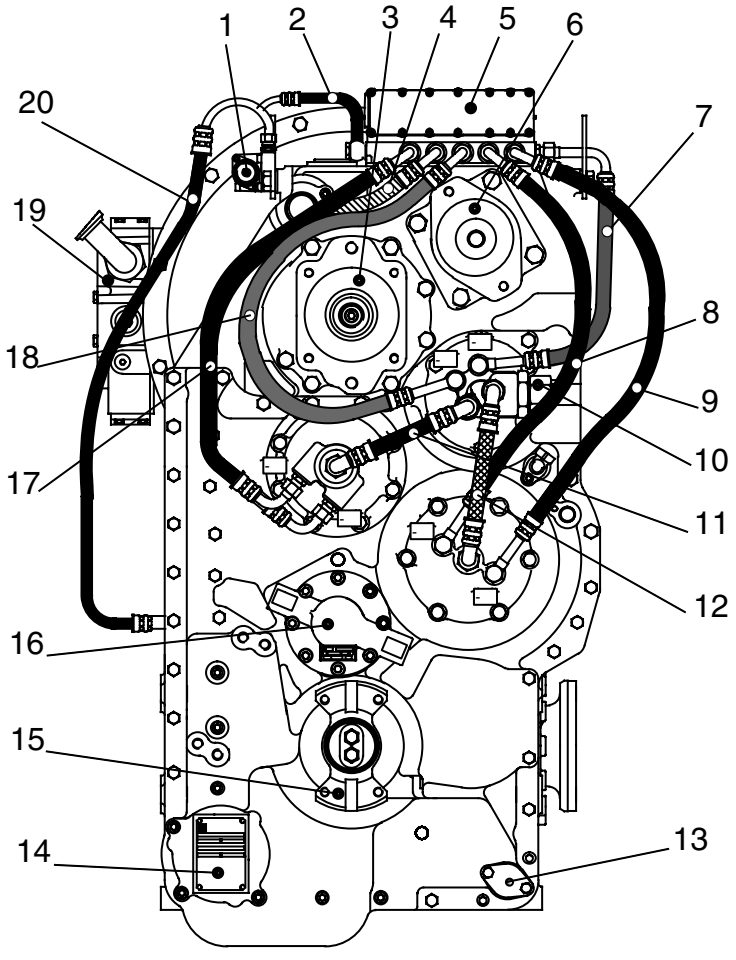
Left side view

1 = Input flange- Input trough prop shaft
2 = Stator
3 = Converter bell housing
4 = Lifting lugs
5 = Pressure oil line from converter clutch valve to converter clutch
6 = Pressure oil line from electro hydraulic shift control to converter clutch valve
7 = Electro-hydraulic shift controll
8 = Converter clutch valve
9 = Breather line Converter clutch
10 = Transmission suspension threads M20
11 = Output flange (rear side)
12 = Oil drain plug with magnetic insert M38 x 1,5
13 = Output flange Front axle LH
14 = Axle insert “LK”

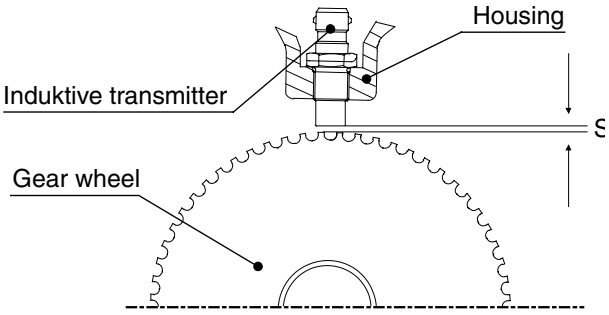


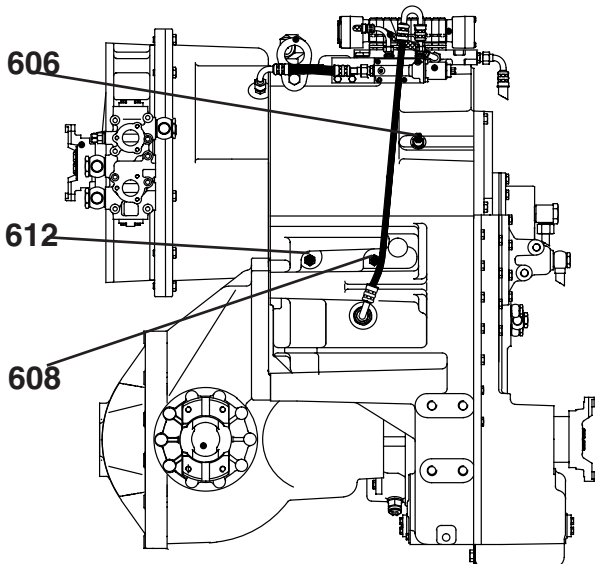
Rear side view

1 = Converter clutch valve
2 = Pressure oil line from electro-hydraulic shift control to converter cluth valve
3 = 1st Power take-off
4 = Pressure oil line Clutch KR
5 = Electro-hydraulic shift control
6 = 2nd Power take off
7 = Pressure oil line Clutch K1
8 = Pressure oil line Clutch K4
9 = Pressure oil line K3
10 = Connection libricating oil line from retarder valve
11 = Lube oil line “S1” Clutch KR/K2
12 = Lube oil line “S2” Clutch K4/K3
13 = Arrachment possibilityfor oil filler with oil dipstick
14 = Typeplate
15 = Output flange (rear side)
16 = Emergency steering pump
S = Suction pipe connection M26 x 1,5S =
D = Pressure connection M 22 x 1,5
17 = Pressure oil line Clutch K2
18 = Pressure oil line Clutch KV
19 = Retarder valve
20 = Breather line Converter clutch

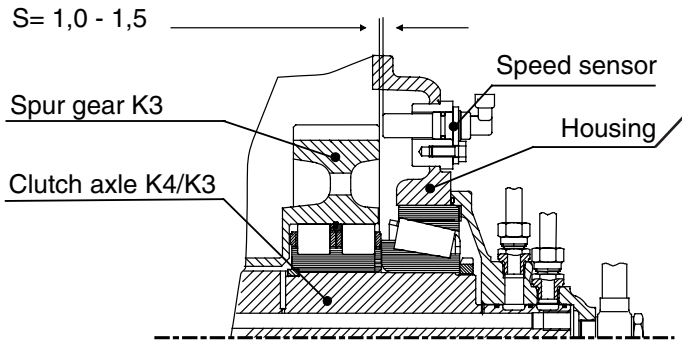


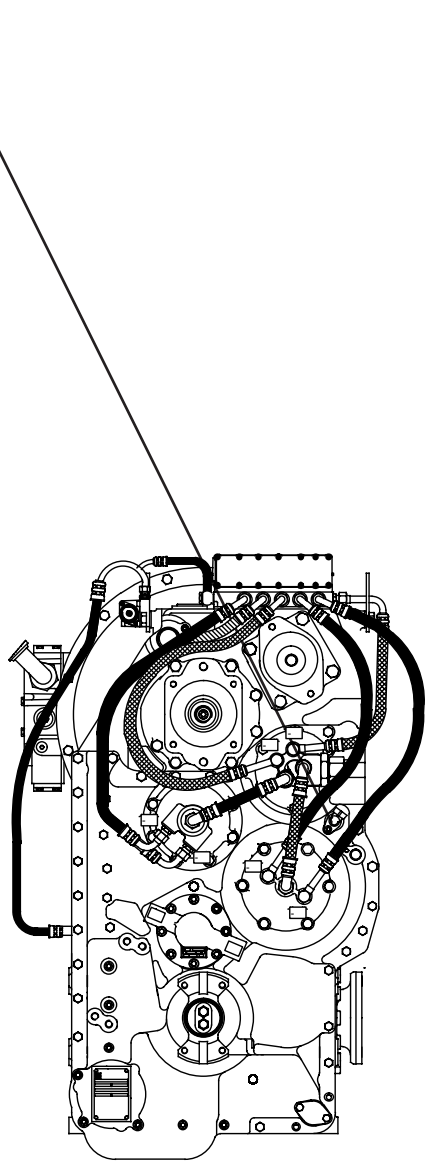
Inductive transmitter





608 = Induktive transmitter n-Central gear train
606 = Induktive transmitter n-Engine
612 = Induktive transmitter n-Turbine





The speeds required for the Electronic controll unit EST-37 are detected by the following transmotters:

606 = Inductive transmitter n – Engine and
608 = Inductive transmitter n – Central gear train
610 = Speed sensor n – Output
612 = Inductive transmitter n – Turbine

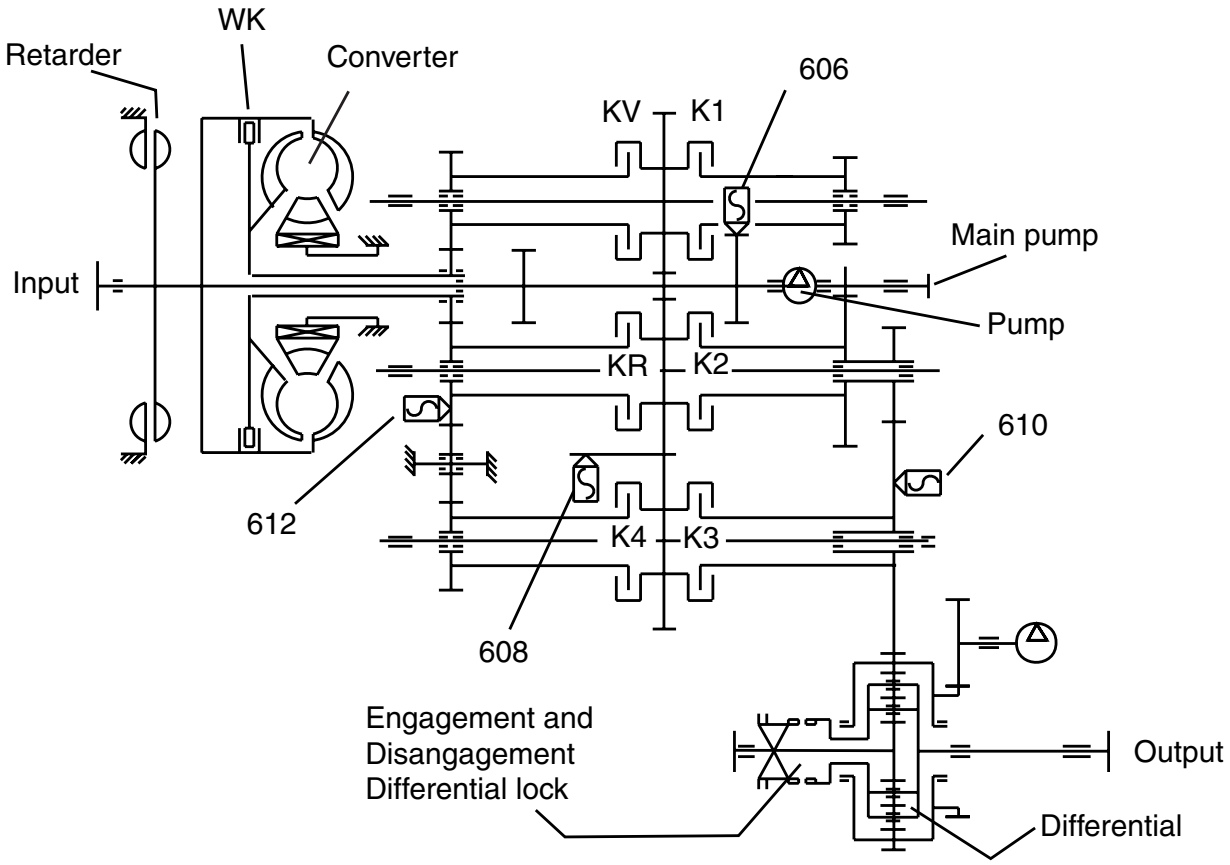
Attention:

For the inductive transmitters, the folloving different setting dimensions between the contact area-inductive transmitter and the tooth tip have to be observed:

606 n-Engine (14) A = $0{,}5^{+0{,}3}$
612 n-Turbine (39) A = $0{,}5^{+0{,}3}$
608 n-Central gear train (6) A = $0{,}3^{\pm 0{,}1}$

When adjusting and measure transmitter and sensor:
See in the section:
Inductive transmitters and speed sensor / Assembly and settings

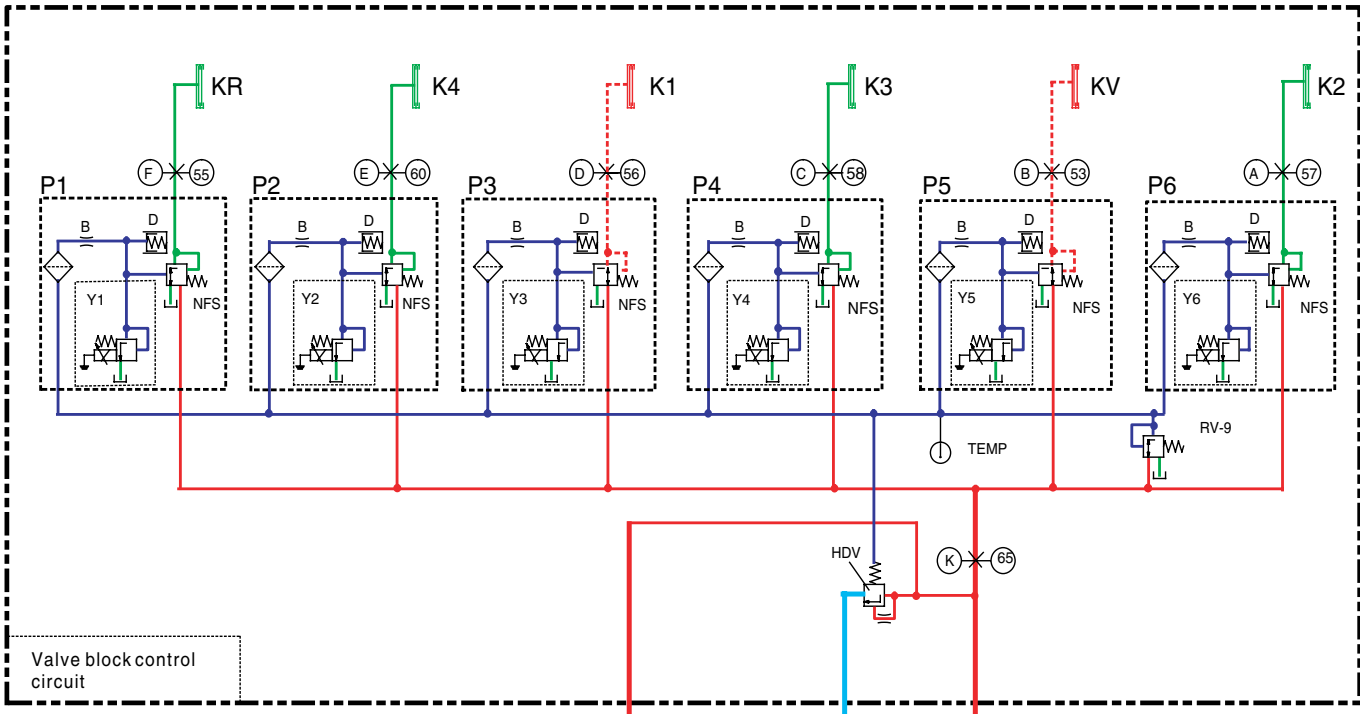
Transmission diagram



606 = Inductive transmitter
n – Engine and
608 = Inductive transmitter
n – Central gear train
610 = Speed sensor
n – Output
612 = Inductive transmitter
n – Turbine

Oil circuit diagram

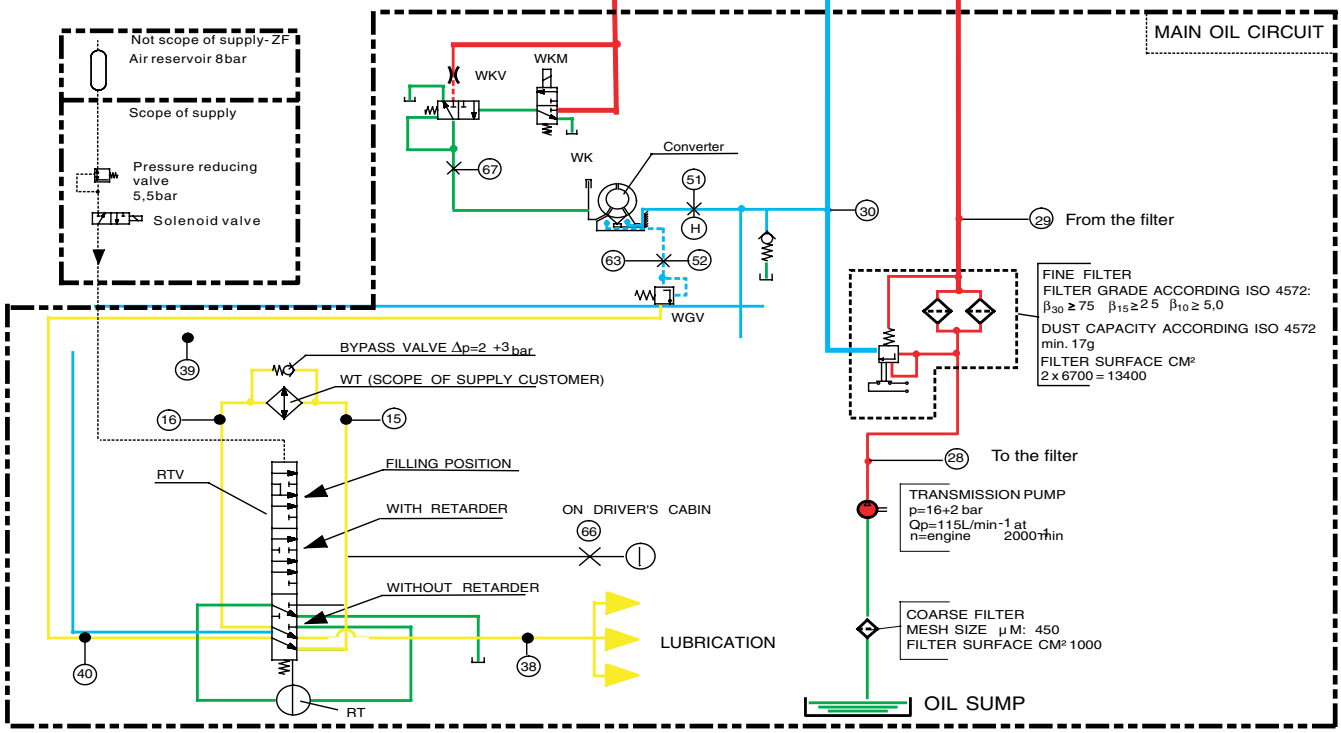
Valve block controll circuit



LEGENDE

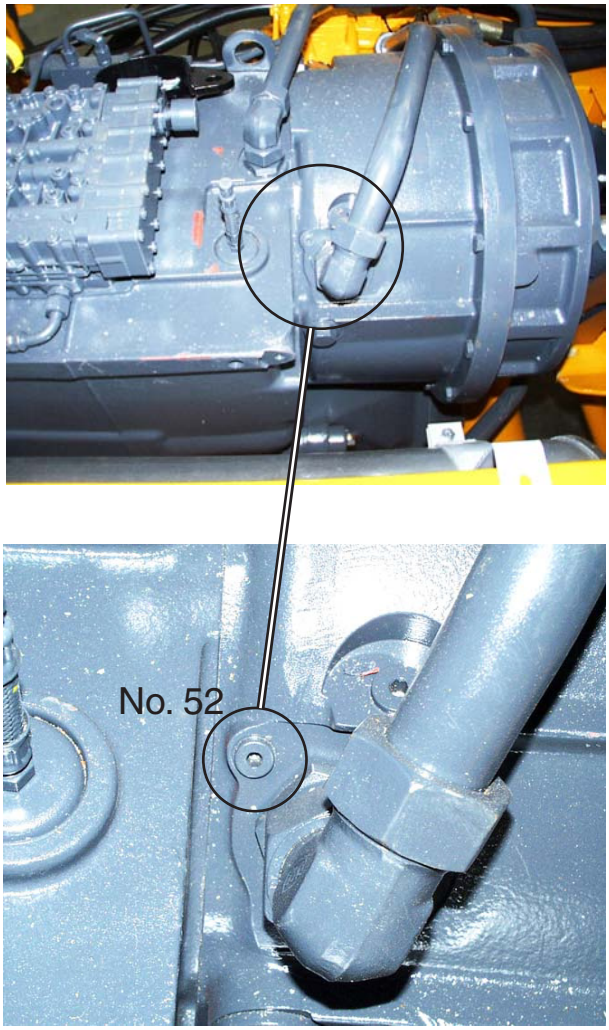
= Main pressure
= Regulated main pressure
= Pilot pressure
= Converter input pressure
= Converter output pressure
= Lubrication
= Return into the sump

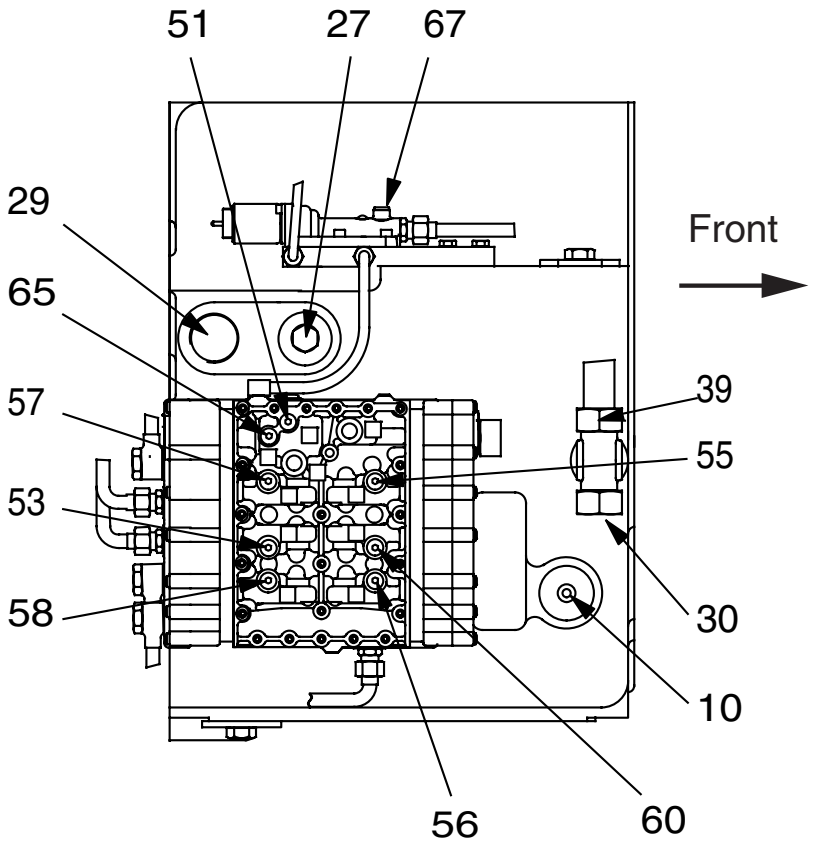
Main oil circuit



Measuring points and connections

No	Measuring point and values
10	Breather
15	To the cooler
16	From the cooler
28	To the ZF-filter
29	From the filter
30	From the filter bypass to the converter
38	From cooler lubrication (via retarder valve)
39	In front of conv. to cooler (via retarder valve)
40	After converter to cooler (via retarder valve)
51	In front of conv. – opening pressure 8,5 bar
52	After converter – opening pressure 5 bar
53	Clutch forward KV16 + 2 bar
55	Clutch reverse KR16 + 2 bar
56	Clutch K1 16 + 2 bar
57	Clutch K2 16 + 2 bar
58	Clutch K3 16 + 2 bar
60	Clutch K4 16 + 2 bar
63	Temp. after conv. (short time 120°C)
65	System pressure 16+2 bar
66	Temp. after retarder (short time 150°C)
67	LU – control pressure 12 + 2 bar





Troubleshooting

Prerequisites for the troubleshooting

1. **Oil level as well as oil quality must correspond with ZF-list of lubricants (TE-ML 03) for the new WG-Transmission Product range!**

2. **Transmission temperature from 80°C to 100°C !**

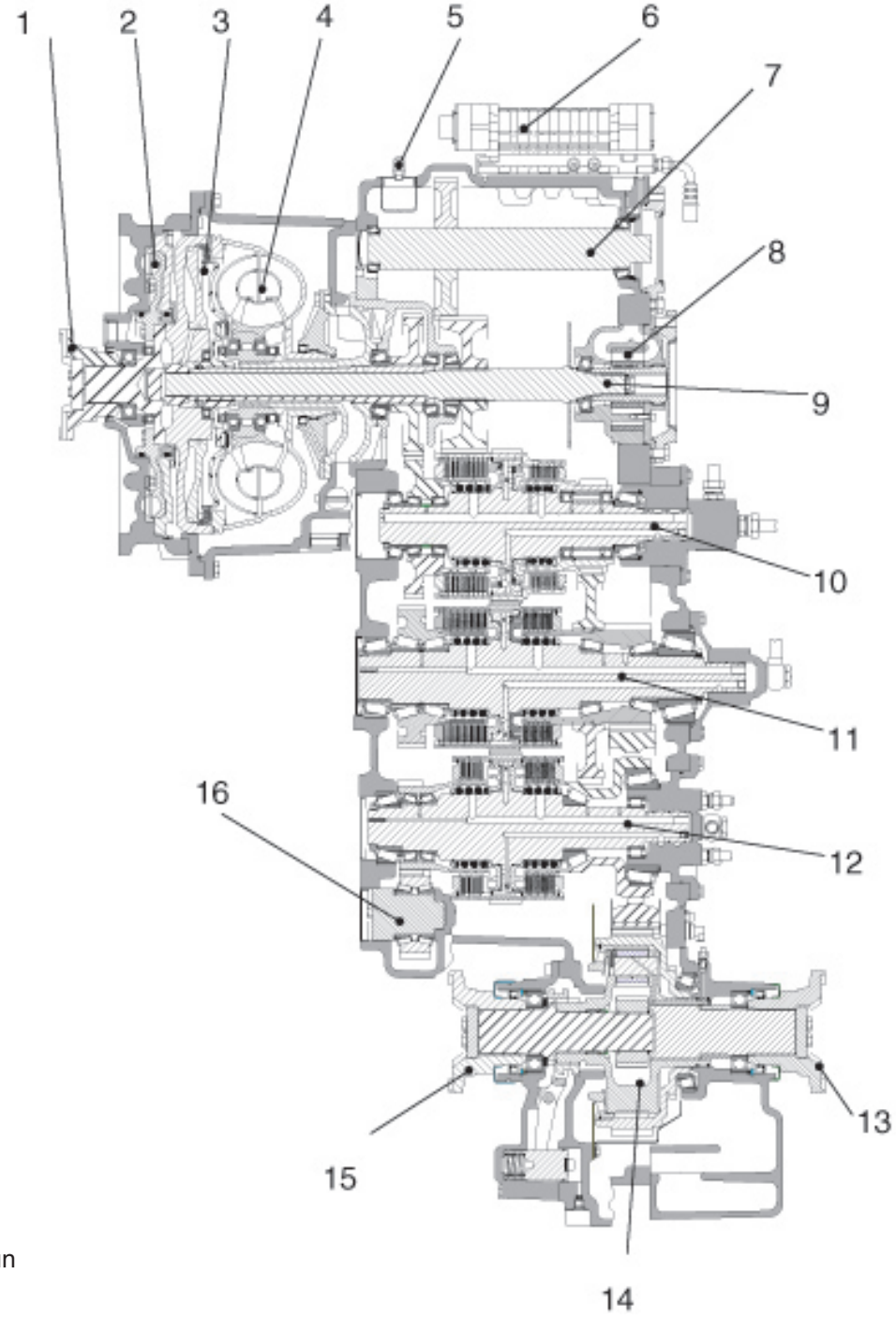
3. **Please, pay attention that the prescribed Operation Instructions habe been used.**
   (i.e.: correct connection of all lines)

4 **Functional check of the electric system only with tester recommended by ZF!**

5 **Fuse “F1” and “F2” (8 ampere; see Circuit diagram) are O.K.!**

6 **At all operations on the vehicle (such as e.g. welding) or works on the Electronic system (as e.G. connection of Testers), switch off the ignition or separate the Electronic box, resp. disconnect the battery.**

Lay out 6WG-260



1 = Input flange - Drive via un
2 = retarder
3 = WK
4 = Converter
5 = Breather
6 = Electrohydraulic controll unit
7 = 2nd Power take- off
8 = Transmission pump
9 = 1st Power take- off
10 = Clutch axle “KV/K1”
11 = Clutch axle “KR/K2”
12 = Clutch axle “K¤/K3”
13 = Output flange (rear side)
14 = Crawler speed
15 = Output flange (converter side)
16 = Countershaft

Introduction

Abbreviations

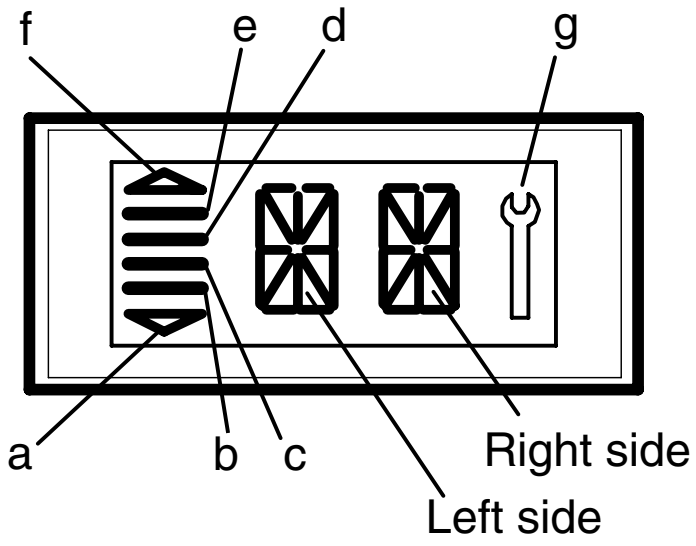
o.c.	open circuit
s.c.	short circuit
OP-Mode	operating mode
TCU	transmission control unit
EEC	electronic engine controller
PTO	power take off

ZF - Display:

If a fault is detected, the display shows a spanner symbol (g) for a fault.

The display shows the fault code, if the gear selector is on neutral position.

If more than one fault is detected, each fault code is shown for about 1 second.



Spec. charact.	Display	
a, f	Automatic range (up- and downshifting)	
b, c, d, e	Preselected gear	
g	EST-37 has recognized an error, is flashing	
Left side	Shows engaged gear	Also, when the gear-selector is in neutral, a two-digit error code will be shown via these two segments.
Right side	Shows driving direction	

Display during operation

symbol	meaning	remarks
1F, 1R 2F, 2R 3F, 3R 4F 5F 6F LF, LR	actual gear and direction left digit shows actual gear right digit shows actual direction limp home gear	
F or R, no gear	Clutch Cutoff	
F od R flashing	only 6WG: direction F or R selected while turbine speed is too high, CAUTION gear will engage if turbine speed drops	
NN	not neutral, waiting for neutral after power up or a severe fault	go engage a gear, first move shift selector to neutral position and again to F or R position
**	oil temperature too low, no gear available	warm up engine / transmission
*N	oil temperature low, only one gear available	warm up engine / transmission
1 bar (special symbol)	manual mode 1. gear	
2 bars	manual mode 2. gear	
3 bars	manual mode 3. gear	
4 bars	manual mode 4. gear	
4 bars and 2 arrows	automatic mode	
bars flashing	6 WG: converter lockup clutch open 4 WG: Downshift mode activ	difference of engine and turbine speed above a certain limit and lockup clutch not activated
spanner	at least one fault activ	select neutral to get fault code displayed
fault code	see faultcode list	
WS	warning sump temperature	changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
WR	warning retarder temperature	changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
WT	warning torque converter temperature	changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
WE	warning high engine speed	changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
PN	direction F or R selected while parking brake engaged	transmission in neutral until parking brake is released CAUTION: vehicle starts to move after release of parking brake
F od R flashing	direction F or R selected while turbine speed is to high, CAUTION gear will engage if turbine speed drops	
EE flashing	no communication with display	checked wiring from TCU to display

Display during AEB-Mode

symbol	meaning	remarks
PL	AEB - Starter is plugged at the diagnostic plug	
ST	AEB-Starter-button is pressed	
K1..K4,KV,KR	calibrating clutch K1..K4,KV,KR	
_ and Kx	wait for start, initialization of clutch Kx, x: 1, 2, 3, 4, V, R	
and Kx	fast fill time determination of clutch Kx	
= and Kx	compensating pressure determination of clutch Kx	
OK	calibration for all clutches finished	Transmissions stays in neutral, you have to restart the TCU (ignition off/on) after removing AEB-Starter
STOP	AEB canceled (activation stopped)	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
STOP and Kx	AEB stopped, clutch Kx can't be calibrated	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
Spanner and Kx	Kx couldn't be calibrated, AEB finished	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
E	engine speed too low, -> raise engine speed	
T	transmission oil temperature too low, -> heat up transmission	
T	transmission oil temperature too high -> cool down transmission	
FT	transmission temperature not in defined range during calibration	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
FB	operating mode not NORMAL or transmission temperature sensor defective or storing of Calibrated values to EEPROM-has failed.	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
FO	Outputspeed_not_zero	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
FN	Shift lever not in Neutral position	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
FP	Parkbrake_not_applied	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
STOP	AEB - Starter was used incorrect or is defective	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)

Definition of operating modes

Normal:

There's no failure detected in the transmission-system or the failure has no or slight effects on transmission control. TCU will work without or in special cases with little limitations. (see following table)

Substitute clutch control:
TCU can't change the gears or the direction under the control of the normal clutch modulation. TCU uses the substitute strategy for clutch control. All modulations are only time controlled. (Comparable with EST 25)

Limp-home:

The detected failure in the system has strong limitations to transmission control. TCU can engage only one gear in each direction. In some cases only one direction will be possible.
TCU will shift the transmission into neutral at the first occurrence of the failure. First, the operator must shift the gear selector into neutral position.
If output speed is less than a threshold for neutral to gear and the operator shifts the gear selector into forward or reverse, the TCU will select the limp-home gear .
If output speed is less than a threshold for reversal speed and TCU has changed into the limp-home gear and the operator selects a shuttle shift, TCU will shift immediately into the limp-home gear of the selected direction.
If output speed is greater than the threshold, TCU will shift the transmission into neutral. The operator has to slow down the vehicle and must shift the gear selector into neutral position.

Transmission-shutdown:

TCU has detected a severe failure that disables control of the transmission.
TCU will shut off the solenoid valves for the clutches and also the common power supply (VPS1). Transmission shifts to Neutral. The park brake will operate normally, also the other functions which use ADM 1 to ADM 8.
The operator has to slow down the vehicle. The transmission will stay in neutral.

TCU-shutdown:

TCU has detected a severe failure that disables control of system.
TCU will shut off all solenoid valves and also both common power supplies (VPS1, VPS2). The park brake will engage, also all functions are disabled which use ADM 1 to ADM 8.
The transmission will stay in neutral.

Table of fault codes

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
11	LOGICAL ERROR AT GEAR RANGE SIGNAL TCU detected a wrong signal combination for the gear range *cable from shift lever to TCU is broken* *cable is defective and is contacted to battery voltage or vehicle ground* *shift lever is defective*	TCU shifts transmission to neutral OP-Mode: transmission shutdown	check the cables from TCU to shift lever check signal combinations of shift lever positions for gear range	failure cannot be detected in systems with DW2/DW3 shift lever fault is taken back if TCU detects a valid signal for the position
12	LOGICAL ERROR AT DIRECTION SELECT SIGNAL TCU detected a wrong signal combination for the direction *cable from shift lever to TCU is broken* *cable is defective and is contacted to battery voltage or vehicle ground* *shift lever is defective*	TCU shifts transmission to neutral OP-Mode: transmission shutdown	check the cables from TCU to shift lever check signal combinations of shift lever positions F-N-R	fault is taken back if TCU detects a valid signal for the direction at the shift lever
15	LOGICAL ERROR AT DIRECTION SELECT SIGNAL 2. SHIFT LEVER TCU detected a wrong signal combination for the direction *cable from shift lever 2 to TCU is broken* *cable is defective and is contacted to battery voltage or vehicle ground* *shift lever is defective*	TCU shifts transmission to neutral if selector activ OP-Mode: transmission shutdown if selector activ	check the cables from TCU to shift lever 2 check signal combinations of shift lever positions F-N-R	fault is taken back if TCU detects a valid signal for the direction at the shift lever
16	LOGICAL ERROR AT AXLE CONNECTION feedback axle connection measured by TCU and output signal axle connection don't fit *axle can't be connected or disconnected due to mechanical problem* *one of the cables from feedback axle connection -switch to TCU is broken*	OP-Mode: normal	check the cables from TCU to feedback axle connection switch check signals of the feedback axle connection switch	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
17	S.C. TO GROUND AT TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground *Cable is defective and is contacted to vehicle ground* *Device has an internal defect* *Connector pin is contacted to vehicle ground*	Customer specific	Check the cables from TCU to feedback axle connection switch Check signals of the feedback axle connection switch	1) See chapter 4
18	S.C. TO BATTERY VOLTAGE AT TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage *Cable is defective and is contacted to battery voltage* *Device has an internal defect* *Connector pin is contacted to battery voltage*	Customer specific	Check the cable from TCU to device Check the connectors from to TCU Check the resistance of device	1) See chapter 4
19	O.C. AT TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin *Cable is defective and has no connection to TCU* *Device has an internal defect* *Connector has no connection to TCU*	Customer specific	Check the cable from TCU to device Check the connectors from device to TCU Check the resistance of device	1) See chapter 4
23	S.C. TO BATTERY VOLTAGE AT LOAD SENSOR INPUT the measured voltage is too high: *cable is defective and is contacted to battery voltage* *load sensor has an internal defect* *connector pin is contacted to battery voltage*	Retarder function is affected TCU uses default load OP-Mode: normal	Check the cable from TCU to the sensor check the connectors check the load sensor sensor check the assembly tolerances of load sensor	availability of retarder depends on default load

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
24	S.C. TO GROUND OR O.C. AT LOAD SENSOR INPUT the measured voltage is too low: *cable is defective and is contacted to vehicle ground* *cable has no connection to TCU* *load sensor has an internal defect* *connector pin is contacted to vehicle ground or is broken*	retarder function is affected TCU uses default load OP-Mode: normal	check the cable from TCU to the sensor check the connectors check the load sensor sensor check the assembly tolerances of load sensor	availability of retarder depends on default load
25	S.C. TO BATTERY VOLTAGE OR O.C. AT TRANSMISSION SUMP TEMPERATURE SENSOR INPUT the measured voltage is too high: *cable is defective and is contacted to battery voltage* *cable has no connection to TCU* *temperature sensor has an internal defect* *connector pin is contacted to battery voltage or is broken*	no reaction, TCU uses default temperature OP-Mode: normal	check the cable from TCU to the sensor check the connectors check the temperature sensor	'
26	S.C. TO GROUND AT TRANSMISSION SUMP TEMPERATURE SENSOR INPUT the measured voltage is too low: *cable is defective and is contacted to vehicle ground* *temperature sensor has an internal defect* *connector pin is contacted to vehicle ground*	no reaction, TCU uses default temperature OP-Mode: normal	check the cable from TCU to the sensor check the connectors check the temperature sensor	
27	S.C. TO BATTERY VOLTAGE OR O.C. AT RETARDER TEMPERATURE SENSOR INPUT the measured voltage is too high: *cable is defective and is contacted to battery voltage* *cable has no connection to TCU* *temperature sensor has an internal defect* *connector pin is contacted to battery voltage or is broken*	no reaction, TCU uses default temperature OP-Mode: normal	check the cable from TCU to the sensor check the connectors check the temperature sensor	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
28	S.C. TO GROUND AT RETARDER /TORQUE CONVERTER TEMP. SENSOR INPUT the measured voltage is too low: Cable is defective and is contacted to vehicle ground Temperature sensor has an internal defect Connector pin is contacted to vehicle ground	No reaction, TCU uses default temperature OP-Mode: normal	Check the cable from TCU to the sensor Check the connectors Check the temperature sensor	
29	S.C. TO BATTERY VOLTAGE OR O.C. AT PARKING BRAKE SENSOR INPUT The measured voltage is too high: Cable is defective and is contacted to battery voltage Cable has no connection to TCU Sensor has an internal defect Connector pin is contacted to battery voltage or is broken	TCU uses default value OP-Mode: normal	Check the cable from TCU to the sensor Check the connectors Check the parking brake sensor	
2A	S.C. TO GROUND PARKING BRAKE SENSOR INPUT The measured voltage is too low: Cable is defective and is contacted to vehicle ground Sensor has an internal defect Connector pin is contacted to vehicle ground	TCU uses default value OP-Mode: normal	Check the cable from TCU to the sensor Check the connectors Check the parking brake sensor	
2B	INCHSENSOR-SIGNAL MISMATCH The measured voltage from CCO and CCO2 signal don't match: Cable is defective Sensor has an internal defect	During inching mode: TCU shifts to neutral While not inching: no change OP-Mode: normal	Check the cable from TCU to the sensor Check the connectors Check sensor	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
2C	S.C. TO BATTERY VOLTAGE OR O.C. AT DLM TRACTION ADJUST DASHBOARD DEVICE INPUT The measured voltage is too high: Cable is defective and is contacted to battery voltage Cable has no connection to TCU Sensor has an internal defect Connector pin is contacted to battery voltage or is broken	TCU uses default value OP-Mode: normal	Check the cable from TCU to the sensor Check the connectors Check the DLM Traction Adjust dashboard device	
2D	S.C. TO GROUND DLM TRACTION ADJUST DASHBOARD DEVICE INPUT The measured voltage is too low: Cable is defective and is contacted to vehicle ground Sensor has an internal defect Connector pin is contacted to vehicle ground	TCU uses default value OP-Mode: normal	Check the cable from TCU to the sensor Check the connectors Check the DLM Traction Adjust dashboard device	
2E	S.C. TO BATTERY VOLTAGE OR O.C. AT DLM STEERING ANGLE SENSOR INPUT The measured voltage is too high: Cable is defective and is contacted to battery voltage Cable has no connection to TCU Sensor has an internal defect Connector pin is contacted to battery voltage or is broken	TCU uses default value OP-Mode: normal	Check the cable from TCU to the sensor Check the connectors Check the DLM STEERING ANGLE SENSOR	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
2F	S.C. TO BATTERY VOLTAGE OR O.C. AT DLM TRACTION ADJUST DASHBOARD DEVICE INPUT The measured voltage is too high: Cable is defective and is contacted to battery voltage Cable has no connection to TCU Sensor has an internal defect Connector pin is contacted to battery voltage or is broken	TCU uses default value OP-Mode: normal	Check the cable from TCU to the sensor Check the connectors Check the DLM Traction Adjust dashboard device	
31	S.C. TO BATTERY VOLTAGE OR O.C. AT ENGINE SPEED INPUT TCU measures a voltage higher than 7.00 V at speed input pin *cable is defective and is contacted to battery voltage* *cable has no connection to TCU* *speed sensor has an internal defect* *connector pin is contacted to battery voltage or has no contact*	OP-Mode: substitute clutch control	check the cable from TCU to the sensor check the connectors check the speed sensor	
32	S.C. TO GROUND AT ENGINE SPEED INPUT TCU measures a voltage less than 0.45V at speed input pin *cable / connector is defective and is contacted to vehicle ground* *speed sensor has an internal defect*	OP-Mode: substitute clutch control	check the cable from TCU to the sensor check the connectors check the speed sensor	
33	LOGICAL ERROR AT ENGINE SPEED INPUT TCU measures a engine speed over a threshold and the next moment the measured speed is zero *cable / connector is defective and has bad contact* *speed sensor has an internal defect* *sensor gap has the wrong size*	OP-Mode: substitute clutch control	check the cable from TCU to the sensor check the connectors check the speed sensor check the sensor gap	This fault is reset after power up of TCU

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault	Reaction of the TCU	Possible steps to repair	Remarks
34	S.C. TO BATTERY VOLTAGE OR O.C. AT TURBINE SPEED INPUT TCU measures a voltage higher than 7.00 V at speed input pin *cable is defective and is contacted to battery voltage* *cable has no connection to TCU* *speed sensor has an internal defect* *connector pin is contacted to battery voltage or has no contact*	OP-Mode: substitute clutch control if a failure is existing at output speed, TCU shifts to neutral OP-Mode: limp home	check the cable from TCU to the sensor check the connectors check the speed sensor	
35	S.C. TO GROUND AT TURBINE SPEED INPUT TCU measures a voltage less than 0.45V at speed input pin *cable / connector is defective and is contacted to vehicle ground* *speed sensor has an internal defect*	OP-Mode: substitute clutch control if a failure is existing at output speed, TCU shifts to neutral OP-Mode: limp home	check the cable from TCU to the sensor check the connectors check the speed sensor	
36	LOGICAL ERROR AT TURBINE SPEED INPUT TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero *cable / connector is defective and has bad contact* *speed sensor has an internal defect* *sensor gap has the wrong size*	OP-Mode: substitute clutch control if a failure is existing at output speed, TCU shifts to neutral OP-Mode: limp home	check the cable from TCU to the sensor check the connectors check the speed sensor check the sensor gap	This fault is reset after power up of TCU
37	S.C. TO BATTERY VOLTAGE OR O.C. AT INTERNAL SPEED INPUT TCU measures a voltage higher than 7.00 V at speed input pin *cable is defective and is contacted to battery voltage* *cable has no connection to TCU* *speed sensor has an internal defect* *connector pin is contacted to battery voltage or has no contact*	OP-Mode: substitute clutch control	check the cable from TCU to the sensor check the connectors check the speed sensor	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
38	S.C. TO GROUND AT INTERNAL SPEED INPUT TCU measures a voltage less than 0.45V at speed input pin *cable / connector is defective and is contacted to vehicle ground* *speed sensor has an internal defect*	OP-Mode: substitute clutch control	check the cable from TCU to the sensor check the connectors check the speed sensor	
39	LOGICAL ERROR AT INTERNAL SPEED INPUT TCU measures a internal speed over a threshold and at the next moment the measured speed is zero *cable / connector is defective and has bad contact* *speed sensor has an internal defect* *sensor gap has the wrong size*	OP-Mode: substitute clutch control	check the cable from TCU to the sensor check the connectors check the speed sensor check the sensor gap	This fault is reset after power up of TCU
3A	S.C. TO BATTERY VOLTAGE OR O.C. AT OUTPUT SPEED INPUT TCU measures a voltage higher than 12.5 V at speed input pin *cable is defective and is contacted to battery voltage* *cable has no connection to TCU* *speed sensor has an internal defect* *connector pin is contacted to battery voltage or has no contact*	special mode for gear selection OP-Mode: substitute clutch control if a failure is existing at turbine speed, TCU shifts to neutral OP-Mode: limp home	check the cable from TCU to the sensor check the connectors check the speed sensor	
3B	S.C. TO GROUND AT OUTPUT SPEED INPUT TCU measures a voltage less than 1.00V at speed input pin *cable / connector is defective and is contacted to vehicle ground* *speed sensor has an internal defect*	special mode for gear selection OP-Mode: substitute clutch control if a failure is existing at turbine speed, TCU shifts to neutral OP-Mode: limp home	check the cable from TCU to the sensor check the connectors check the speed sensor	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
3C	LOGICAL ERROR AT OUTPUT SPEED INPUT TCU measures a output speed over a threshold and at the next moment the measured speed is zero *cable / connector is defective and has bad contact* *speed sensor has an internal defect* *sensor gap has the wrong size*	special mode for gear selection OP-Mode: substitute clutch control if a failure is existing at turbine speed, TCU shifts to neutral OP-Mode: limp home	check the cable from TCU to the sensor check the connectors check the speed sensor check the sensor gap	This fault is reset after power up of TCU
3E	OUTPUT SPEED ZERO DOESN'T FIT TO OTHER SPEED SIGNALS if transmission is not neutral and the shifting has finished, TCU measures outputspeed zero and turbine speed or internal speed not equal to zero. *speed sensor has an internal defect* *sensor gap has the wrong size*	special mode for gear selection OP-Mode: substitute clutch control if a failure is existing at turbine speed, TCU shifts to neutral OP-Mode: limp home	check the sensor signal of output speed sensor check the sensor gap of output speed sensor check the cable from TCU to the sensor	This fault is reset after power up of TCU
56	ENGINE CONF TIMEOUT Timeout of CAN-message ENGINE CONF from engine controller *interference on CAN-Bus* *CAN wire/connector is broken* *CAN wire/connector is defective and has contact to vehicle ground or battery voltage*	OP-Mode: substitute clutch control	check engine controller check wire of CAN-Bus check cable to engine controller	
57	EEC1 TIMEOUT Timeout of CAN-message EEC1 from EEC controller *interference on CAN-Bus* *CAN wire/connector is broken* *CAN wire/connector is defective and has contact to vehicle ground or battery voltage*	OP-Mode: substitute clutch control	check EEC controller check wire of CAN-Bus check cable to EEC controller	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
58	EEC3 TIMEOUT Timeout of CAN-message EEC3 from EEC controller *interference on CAN-Bus* *CAN wire/connector is broken* *CAN wire/connector is defective an has contact to vehicle ground or battery voltage*	OP-Mode: substitute clutch control	check EEC controller check wire of CAN-Bus check cable to EEC controller	
65	ENGINGE TORQUE SIGNAL CAN signal for engine torque is defective *engine controller is defective* *interference on CAN-Bus*	OP-Mode:substitute clutch control	check engine controller check wire of CAN-Bus check cable to engine controller	
66	KICKDOWN SIGNAL CAN signal for kickdown is defective *engine controller is defective* *interference on CAN-Bus*	no reaction	check engine controller check wire of CAN-Bus check cable to engine controller	
69	REFERENCE ENGINE TORQUE SIGNAL CAN signal for reference of engine torque is defective *engine controller is defective* *interference on CAN-Bus*	OP-Mode:substitute clutch control	check engine controller check wire of CAN-Bus check cable to engine controller	
6A	ACTUAL ENGINE TORQUE SIGNAL CAN signal for actual engine torque is defective *engine controller is defective* *interference on CAN-Bus*	OP-Mode:substitute clutch control	check engine controller check wire of CAN-Bus check cable to engine controller	
6B	NOM FRICTION TORQUE SIGNAL CAN signal for nominal friction torque is defective *engine controller is defective* *interference on CAN-Bus*	OP-Mode:substitute clutch control	check engine controller check wire of CAN-Bus check cable to engine controller	
6E	EEC2 TIMEOUT Timeout of CAN-message EEC2 from EEC controller *interference on CAN-Bus* *CAN wire/connector is broken* *CAN wire/connector is defective and has contact to vehicle ground or battery voltage*	no reaction, TCU uses default signal accelerator pedal in idle position OP-Mode: normal	check EEC controller check wire of CAN-Bus check cable to EEC controller	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
6F	ACCELERATOR LOW IDLE SWITCH SIGNAL CAN signal for manual downshift is defective *EEC controller is defective* *interference on CAN-Bus*	no reaction, TCU uses default signal accelerator pedal in idle position OP-Mode: normal	check EEC controller check wire of CAN-Bus check cable to EEC controller	if this signal is not transmitted via CAN, TCU uses default signal
71	S.C. TO BATTERY VOLTAGE AT CLUTCH K1 the measured resistance value of the valve is out of limit, the voltage at K1 valve is too high. *cable / connector is defective and has contact to battery voltage* *cable / connector is defective and has contact to another regulator output of the TCU* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from TCU to the gearbox check the regulator resistance [1)] check internal wire harness of the gearbox	[1)] see chapter 4
72	S.C. TO GROUND AT CLUTCH K1 the measured resistance value of the valve is out of limit, the voltage at K1 valve is too low. *cable / connector is defective and has contact to vehicle ground* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance [1)] check internal wire harness of the gearbox	[1)] see chapter 4
73	O.C. AT CLUTCH K1 the measured resistance value of the valve is out of limit. *cable / connector is defective and has no contact to TCU* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance [1)] check internal wire harness of the gearbox	[1)] see chapter 4
74	S.C. TO BATTERY VOLTAGE AT CLUTCH K2 the measured resistance value of the valve is out of limit, the voltage at K2 valve is too high. *cable / connector is defective and has contact to battery voltage* *cable / connector is defective and has contact to another regulator output of the TCU* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance [1)] check internal wire harness of the gearbox	[1)] see chapter 4

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
75	S.C. TO GROUND AT CLUTCH K2 the measured resistance value of the valve is out of limit, the voltage at K2 valve is too low. *cable / connector is defective and has contact to vehicle ground* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance [1] check internal wire harness of the gearbox	[1] see chapter 4
76	O.C. AT CLUTCH K2 the measured resistance value of the valve is out of limit. *cable / connector is defective and has no contact to TCU* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance [1] check internal wire harness of the gearbox	[1] see chapter 4
77	S.C. TO BATTERY VOLTAGE AT CLUTCH K3 the measured resistance value of the valve is out of limit, the voltage at K3 valve is too high. *cable / connector is defective and has contact to battery voltage* *cable / connector is defective and has contact to another regulator output of the TCU* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance [1] check internal wire harness of the gearbox	[1] see chapter 4
78	S.C. TO GROUND AT CLUTCH K3 the measured resistance value of the valve is out of limit, the voltage at K3 valve is too low. *cable / connector is defective and has contact to vehicle ground* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance [1] check internal wire harness of the gearbox	[1] see chapter 4

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
79	O.C. AT CLUTCH K3 the measured resistance value of the valve is out of limit. *cable / connector is defective and has no contact to TCU* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance [1] check internal wire harness of the gearbox	[1] see chapter 4
81	S.C. TO BATTERY VOLTAGE AT CLUTCH K4 the measured resistance value of the valve is out of limit, the voltage at K4 valve is too high. *cable / connector is defective and has contact to battery voltage* *cable / connector is defective and has contact to another regulator output of the TCU* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance [1] check internal wire harness of the gearbox	[1] see chapter 4
82	S.C. TO GROUND AT CLUTCH K4 the measured resistance value of the valve is out of limit, the voltage at K4 valve is too low. *cable / connector is defective and has contact to vehicle ground* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance [1] check internal wire harness of the gearbox	[1] see chapter 4
83	O.C. AT CLUTCH K4 the measured resistance value of the valve is out of limit. *cable / connector is defective and has no contact to TCU* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance [1] check internal wire harness of the gearbox	[1] see chapter 4
84	S.C. TO BATTERY VOLTAGE AT CLUTCH KV the measured resistance value of the valve is out of limit, the voltage at KV valve is too high. *cable / connector is defective and has contact to battery voltage* *cable / connector is defective and has contact to another regulator output of the TCU* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance [1] check internal wire harness of the gearbox	[1] see chapter 4

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
85	S.C. TO GROUND AT CLUTCH KV the measured resistance value of the valve is out of limit, the voltage at KV valve is too low. *cable / connector is defective and has contact to vehicle ground* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance [1)] check internal wire harness of the gearbox	[1)] see chapter 4
86	O.C. AT CLUTCH KV the measured resistance value of the valve is out of limit. *cable / connector is defective and has no contact to TCU* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance [1)] check internal wire harness of the gearbox	[1)] see chapter 4
87	S.C. TO BATTERY VOLTAGE AT CLUTCH KR the measured resistance value of the valve is out of limit, the voltage at KR valve is too high. *cable / connector is defective and has contact to battery voltage* *cable / connector is defective and has contact to another regulator output of the TCU* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance [1)] check internal wire harness of the gearbox	[1)] see chapter 4
88	S.C. TO GROUND AT CLUTCH KR the measured resistance value of the valve is out of limit, the voltage at KR valve is too low. *cable / connector is defective and has contact to vehicle ground* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance [1)] check internal wire harness of the gearbox	[1)] see chapter 4

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
89	O.C. AT CLUTCH KR the measured resistance value of the valve is out of limit. *cable / connector is defective and has no contact to TCU* *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance [1)] check internal wire harness of the gearbox	[1)] see chapter 4
8A	S.C. TO GROUND AT DLM TRANSVERSAL OUTPUT TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground Cable is defective and is contacted to vehicle ground Device has an internal defect Connector pin is contacted to vehicle ground	Output will be on until TCU power down even if fault vanishes (loose connection) OP-Mode: normal	Check the cable from TCU to the valve Check the connectors Check the resistance of valve	[1)] see chapter 4
8B	S.C. TO BATTERY VOLTAGE AT DLM TRANSVERSAL OUTPUT TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage Cable is defective and is contacted to battery voltage Device has an internal defect Connector pin is contacted to battery voltage	No reaction OP-Mode: normal	Check the cable from TCU to the valve Check the connectors Check the resistance of valve	[1)] see chapter 4

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
8E	S.C. TO BATTERY VOLTAGE AT DLM INDICATOR LAMP OUTPUT TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage Cable is defective and is contacted to battery voltage Device has an internal defect Connector pin is contacted to battery voltage	No reaction OP-Mode: normal	Check the cable from TCU to the device Check the connectors Check the resistance of device	1) see chapter 4
8F	O.C. DLM INDICATOR LAMP OUTPUT TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin Cable is defective and has no connection to TCU Device has an internal defect Connector has no connection to TCU	No reaction OP-Mode: normal	Check the cable from TCU to the device Check the connectors Check the resistance of device	1) see chapter 4
93	O.C. AT RELAY REVERSE WARNING ALARM TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin Cable is defective and has no connection to TCU Backup alarm device has an internal defect Connector has no connection to TCU	No reaction OP-Mode: normal	Check the cable from TCU to the backup alarm device Check the connectors from backup alarm device to TCU Check the resistance 1) of backup alarm device	1) see chapter 4

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
94	S.C. TO GROUND AT RELAY STARTER INTERLOCK TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground Cable is defective and is contacted to vehicle ground Starter interlock relay has an internal defect Connector pin is contacted to vehicle ground	No reaction OP-Mode: normal	Check the cable from TCU to the starter interlock relay Check the connectors from starter interlock relay to TCU Check the resistance 1) of starter interlock relay	1) see chapter 4
95	S.C. TO BATTERY VOLTAGE AT RELAY STARTER INTERLOCK TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage Cable is defective and is contacted to battery voltage Starter interlock relay has an internal defect Connector pin is contacted to battery voltage	No reaction OP-Mode: normal	Check the cable from TCU to the starter interlock relay Check the connectors from starter interlock relay to TCU Check the resistance 1) of starter interlock relay	1) see chapter 4
96	O.C. AT RELAY STARTER INTERLOCK TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin Cable is defective and has no connection to TCU Starter interlock relay has an internal defect Connector has no connection to TCU	No reaction OP-Mode: normal	Check the cable from TCU to the starter interlock relay Check the connectors from starter interlock relay to TCU Check the resistance 1) of starter interlock relay	1) see chapter 4

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
9A	S.C. TO GROUND AT CONVERTER LOCK UP CLUTCH TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground *cable is defective and is contacted to vehicle ground* *converter clutch solenoid has an internal defect* *connector pin is contacted to vehicle ground*	no reaction OP-mode: normal	check the cable from TCU to the converter clutch solenoid check the connectors from converter clutch solenoid to TCU check the resistance [1] of converter clutch solenoid	[1] see chapter 4
9B	O.C. AT CONVERTER LOCK UP CLUTCH TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin *cable is defective and has no connection to TCU* *converter clutch solenoid has an internal defect* *connector has no connection to TCU*	converter clutch always open, retarder not available OP-mode: normal	check the cable from TCU to the converter clutch solenoid check the connectors from converter clutch solenoid to TCU check the resistance [1] of converter clutch solenoid	[1] see chapter 4
9C	S.C. TO BATTERY VOLTAGE AT CONVERTER LOCK UP CLUTCH TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage *cable is defective and is contacted to battery voltage* *converter clutch solenoid has an internal defect* *connector pin is contacted to battery voltage*	no reaction OP-mode: normal	check the cable from TCU to the converter clutch solenoid check the connectors from converter clutch solenoid to TCU check the resistance [1] of converter clutch solenoid	[1] see chapter 4
9D	S.C. TO GROUND AT RETARDER TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground *cable is defective and is contacted to vehicle ground* *retarder solenoid has an internal defect* *connector pin is contacted to vehicle ground*	no reaction OP-mode: normal	check the cable from TCU to the retarder solenoid check the connectors from retarder solenoid to TCU check the resistance [1] of retarder solenoid	[1] see chapter 4

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
9E	O.C. AT RETARDER TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin *cable is defective and has no connection to TCU* *retarder solenoid has an internal defect* *connector has no connection to TCU*	no reaction OP-mode: normal	check the cable from TCU to the retarder solenoid check the connectors from retarder solenoid to TCU check the resistance [1] of retarder solenoid	[1] see chapter 4
9F	S.C. TO BATTERY VOLTAGE AT RETARDER SOLENOID TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage *cable is defective and is contacted to battery voltage* *retarder solenoid has an internal defect* *connector pin is contacted to battery voltage*	no reaction OP-mode: normal	check the cable from TCU to the retarder solenoid check the connectors from retarder solenoid to TCU check the resistance [1] of retarder solenoid	[1] see chapter 4
A1	S.C. TO GROUND AT DIFFLOCK OR AXLE CONNECTION SOLENOID TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground *cable is defective and is contacted to vehicle ground* *difflock solenoid has an internal defect* *connector pin is contacted to vehicle ground*	no reaction OP-mode: normal	check the cable from TCU to the difflock solenoid check the connectors from difflock solenoid to TCU check the resistance [1] of difflock solenoid	[1] see chapter 4
A2	S.C. TO BATTERY VOLTAGE AT DIFFLOCK OR AXLE CONNECTION SOLENOID TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage *cable is defective and is contacted to battery voltage* *difflock solenoid has an internal defect* *connector pin is contacted to battery voltage*	no reaction OP-mode: normal	check the cable from TCU to the difflock solenoid check the connectors from difflock solenoid to TCU check the resistance [1] of difflock solenoid	[1] see chapter 4

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
A3	O.C. AT DIFFLOCK OR AXLE CONNECTION SOLENOID TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin *cable is defective and has no connection to TCU* *difflock solenoid has an internal defect* *connector has no connection to TCU*	no reaction OP-mode: normal	check the cable from TCU to the difflock solenoid check the connectors from difflock solenoid to TCU check the resistance [1] of difflock solenoid	[1] see chapter 4
A4	S.C. TO GROUND AT WARNING SIGNAL OUTPUT TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground *cable is defective and is contacted to vehicle ground* *warning device has an internal defect* *connector pin is contacted to vehicle ground*	no reaction OP-mode: normal	check the cable from TCU to the warning device check the connectors from warning device to TCU check the resistance [1] of warning device	[1] see chapter 4
A5	O.C. AT WARNING SIGNAL OUTPUT TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin *cable is defective and has no connection to TCU* *warning device has an internal defect* *connector has no connection to TCU*	no reaction OP-mode: normal	check the cable from TCU to the warning device check the connectors from warning device to TCU check the resistance [1] of warning device	[1] see chapter 4
A6	S.C. TO BATTERY VOLTAGE AT WARNING SIGNAL OUTPUT TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage *cable is defective and is contacted to battery voltage* *warning device has an internal defect* *connector pin is contacted to battery voltage*	no reaction OP-mode: normal	check the cable from TCU to the warning device check the connectors from warning device to TCU check the resistance [1] of warning device	[1] see chapter 4

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
B1	SLIPPAGE AT CLUTCH K1 TCU calculates a differential speed at closed clutch K1. If this calculated value is out of range, TCU interprets this as slipping clutch. *low pressure at clutch K1* *low main pressure* *wrong signal at internal speed sensor* *wrong signal at output speed sensor* *wrong size of the sensor gap* *clutch is defective*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check pressure at clutch K1 check main pressure in the system check sensor gap at internal speed sensor check sensor gap at output speed sensor check signal at internal speed sensor check signal at output speed sensor replace clutch	
B2	SLIPPAGE AT CLUTCH K2 TCU calculates a differential speed at closed clutch K2. If this calculated value is out of range, TCU interprets this as slipping clutch. *low pressure at clutch K2* *low main pressure* *wrong signal at internal speed sensor* *wrong signal at output speed sensor* *wrong size of the sensor gap* *clutch is defective*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check pressure at clutch K2 check main pressure in the system check sensor gap at internal speed sensor check sensor gap at output speed sensor check signal at internal speed sensor check signal at output speed sensor replace clutch	
B3	SLIPPAGE AT CLUTCH K3 TCU calculates a differential speed at closed clutch K3. If this calculated value is out of range, TCU interprets this as slipping clutch. *low pressure at clutch K3* *low main pressure* *wrong signal at internal speed sensor* *wrong signal at output speed sensor* *wrong size of the sensor gap* *clutch is defective*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check pressure at clutch K3 check main pressure in the system check sensor gap at internal speed sensor check sensor gap at output speed sensor check signal at internal speed sensor check signal at output speed sensor replace clutch	
B4	SLIPPAGE AT CLUTCH K4 TCU calculated a difference speed at TCU calculates a differential speed at closed clutch K4. If this calculated value is out of range, TCU interprets this as slipping clutch. *low pressure at clutch K4* *low main pressure* *wrong signal at internal speed sensor* *wrong signal at turbine speed sensor* *wrong size of the sensor gap* *clutch is defective*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check pressure at clutch K4 check main pressure in the system check sensor gap at internal speed sensor check sensor gap at turbine speed sensor check signal at internal speed sensor check signal at turbine speed sensor replace clutch	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
B5	SLIPPAGE AT CLUTCH KV TCU calculates a differential speed at closed clutch KV. If this calculated value is out of range, TCU interprets this as slipping clutch. *low pressure at clutch KV* *low main pressure* *wrong signal at internal speed sensor* *wrong signal at turbine speed sensor* *wrong size of the sensor gap* *clutch is defective*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check pressure at clutch KV check main pressure in the system check sensor gap at internal speed sensor check sensor gap at turbine speed sensor check signal at internal speed sensor check signal at turbine speed sensor replace clutch	
B6	SLIPPAGE AT CLUTCH KR TCU calculates a differential speed at closed clutch KR. If this calculated value is out of range, TCU interprets this as slipping clutch. *low pressure at clutch KR* *low main pressure* *wrong signal at internal speed sensor* *wrong signal at turbine speed sensor* *wrong size of the sensor gap* *clutch is defective*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	check pressure at clutch KR check main pressure in the system check sensor gap at internal speed sensor check sensor gap at turbine speed sensor check signal at internal speed sensor check signal at turbine speed sensor replace clutch	
B7	OVERTEMP SUMP TCU measured a temperature in the oil sump that is over the allowed threshold.	no reaction OP-Mode: normal	cool down machine check oil level check temperature sensor	
B8	OVERTEMP RETARDER TCU measured a temperature in the retarder oil that is over the allowed threshold.	TCU disables retarder OP-Mode: normal	cool down machine check oil level check temperature sensor	
B9	OVERSPEED ENGINE	retarder applies OP-Mode: normal	-	
BA	DIFFERENTIAL PRESSURE OIL FILTER TCU measured a voltage at differential pressure switch out of the allowed range *oil filter is polluted* *cable/connector is broken or* *cable/connector is contacted to battery voltage or vehicle ground* *differential pressure switch is defective*	no reaction OP-Mode: normal	check oil filter check wiring from TCU to differential pressure switch check differential pressure switch (measure resitance)	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
BB	SLIPPAGE AT CONVERTER LOCKUP CLUTCH TCU calculates a differential speed at closed converter lockup clutch. If this calculated value is out of range, TCU interprets this as slipping clutch. *low pressure at converter lockup clutch* *low main pressure* *wrong signal at engine speed sensor* *wrong signal at turbine speed sensor* *wrong size of the sensor gap* *clutch is defective*		Check pressure at converter lockup clutch Check main pressure in the system Check sensor gap at engine speed sensor Check sensor gap at turbine speed sensor Check signal at engine speed sensor Check signal at turbine speed sensor Replace clutch	
BC	OVERSPEED OUTPUT TCU messures an transmission output speed above the defined threshold	No reaction OP-Mode: normal		
BD	S.C. TO GROUND AT ENGINE BRKAE SOLENOID TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground *cable is defective and is contacted to vehicle ground* *engine brake solenoid has an internal defect* *connector pin is contacted to vehicle ground*	No reaction OP-mode: normal	Check the cable from TCU to the engine brake solenoid check the connectors from difflock solenoid to TCU check the resistance [1] of difflock solenoid	[1] see chapter 4
BE	S.C. TO BATTERY VOLTAGE AT ENGINE BRAKE TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage *cable is defective and is contacted to battery voltage* engine brake solenoid *has an internal defect* *connector pin is contacted to battery voltage*	No reaction OP-mode: normal	Check the cable from TCU to the engine brake solenoid check the connectors from engine brake solenoid to TCU check the resistance [1] of engine brake solenoid	[1] see chapter 4

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
BF	O.C. AT ENGINE BRAKE TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin *cable is defective and has no connection to TCU* engine brake solenoid *has an internal defect*	No reaction OP-mode: normal	Check the cable from TCU to the engine brake solenoid check the connectors from engine brake solenoid to TCU check the resistance [1] of engine brake solenoid	[1] see chapter 4
C0	ENGINE TORQUE OR ENGINE POWER OVERLOAD TCU calculates an engine torque or engine power above the defined thresholds	OP-Mode: normal		
C1	TRANSMISSION OUTPUT TORQUE OVERLOAD TCU calculates an transmission output torque above the defined threshold	OP-Mode: normal		
C2	TRANSMISSION INPUT TORQUE OVERLOAD TCU calculates an transmission input torque above the defined threshold	Programmable :No reaction or shift to neutral OP-Mode: normal		
C3	OVERTEMP CONVERTER OUTPUT TCU measured a oil temperature at the converter ouput that is over the allowed threshold.	No reaction OP-Mode: normal	Cool down machine Check oil level Check temperature sensor	
C4	S.C. TO GROUND AT JOYSTICK STATUS INDICATOR TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground Cable is defective and is contacted to vehicle ground Joystick status indicator has an internal defect Connector pin is contacted to vehicle ground	No reaction OP-Mode: normal	Check the cable from TCU to joystick status indicator Check the connectors from joystick status indicator to TCU Check the resistance [1] of joystick status indicator	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
C5	S.C. TO BATTERY VOLTAGE AT JOYSTICK STATUS INDICATOR TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage Cable is defective and is contacted to battery voltage Joystick status indicator has an internal defect Connector pin is contacted to battery voltage	No reaction OP-Mode: normal	Check the cable from TCU to joystick status indicator Check the connectors from joystick status indicator to TCU Check the resistance 1) of joystick status indicator	
C6	O.C. AT JOYSTICK STATUS INDICATOR TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin. Cable is defective and has no connection to TCU Joystick status indicator has an internal defect Connector has no connection to TCU	No reaction OP-Mode: normal	Check the cable from TCU to joystick status indicator Check the connectors from joystick status indicator to TCU Check the resistance 1) of joystick status indicator	
CA	ENGINE_RETARDER CONFIG_TIMEOUT Timeout of CAN-message ENGINE_RETARDER CONFIG from EEC controller Interference on CAN-Bus CAN wire/connector is broken CAN wire/connector is defective an has contact to vehicle ground or battery voltage	OP-Mode: substitute clutch control	Check EEC controller Check wire of CAN-Bus Check cable to EEC controller	
CB	ERC1 TIMEOUT Timeout of CAN-message ERC1 from EEC controller	OP-Mode: substitute clutch control	Check EEC controller Check wire of CAN-Bus Check cable to EEC controller	

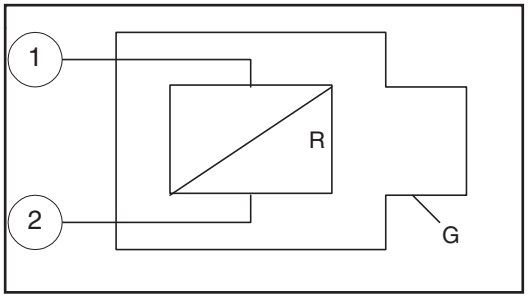
Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
D1	S.C. TO BATTERY VOLTAGE AT POWER SUPPLY FOR SENSORS TCU measures more than 6V at the pin AU1 (5V sensor supply)	see fault codes no. 21 to 2C	check cables and connectors to sensors, which are supplied from AU1 check the power supply at the pin AU1 (should be appx. 5V)	fault codes no. 21 to no. 2C may be a reaction of this fault
D2	S.C. TO GROUND AT POWER SUPPLY FOR SENSORS TCU measures less than 4V at the pin AU1 (5V sensor supply)	see fault codes no. 21 to 2C	check cables and connectors to sensors, which are supplied from AU1 check the power supply at the pin AU1 (should be appx. 5V)	fault codes no. 21 to no. 2C may be a reaction of this fault
D3	LOW POWER AT BATTERY measured voltage at power supply is lower than xx V	shift to neutral OP-Mode: TCU shutdown	check power supply battery check cables from batteries to TCU check connectors from batteries to TCU	
D4	HIGH POWER AT BATTERY measured voltage at power supply is higher than xx V	shift to neutral OP-Mode: TCU shutdown	check power supply battery check cables from batteries to TCU check connectors from batteries to TCU	
D5	ERROR AT SWITCH 1 FOR VALVE POWER SUPPLY VPS1 TCU switched on VPS1 and measured VPS1 is off or TCU switched off VPS1 and measured VPS1 is still on *cable or connectors are defect and are contacted to battery voltage* *cable or connectors are defect and are contacted to vehicle ground* *permanent power supply KL30 missing* *TCU has an internal defect*	shift to neutral OP-Mode: TCU shutdown	check fuse check cables from gearbox to TCU check connectors from gearbox to TCU replace TCU	
D6	ERROR AT SWITCH 2 FOR VALVE POWER SUPPLY VPS2 TCU switched on VPS2 and measured VPS2 is off or TCU switched off VPS2 and measured VPS2 is still on *cable or connectors are defect and are contacted to battery voltage* *cable or connectors are defect and are contacted to vehicle ground* *permanent power supply KL30 missing* *TCU has an internal defect*	shift to neutral OP-Mode: TCU shutdown	check fuse check cables from gearbox to TCU check connectors from gearbox to TCU replace TCU	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
D7	S.C. TO GROUND AT DLM LONGITUDINAL OUTPUT TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground Cable is defective and is contacted to vehicle ground Device has an internal defect Connector pin is contacted to vehicle ground	Output will be on until TCU power down even if fault vanishes (loose connection) OP-Mode: normal	Check the cable from TCU to the valve Check the connectors Check the resistance of valve	1) see chapter 4
D8	S.C. TO BATTERY VOLTAGE AT DLM LONGITUDINAL OUTPUT TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage Cable is defective and is contacted to battery voltage Device has an internal defect Connector pin is contacted to battery voltage	No reaction OP-Mode: normal	Check the cable from TCU to the valve Check the connectors Check the resistance of valve	1) see chapter 4

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
E3	S.C. TO BATTERY VOLTAGE AT DISPLAY OUTPUT TCU sends data to the display and measures allways a high voltage level on the connector *cable or connectors are defective and are contacted to battery voltage* *display has an internal defect*	no reaction OP-Mode: normal	check the cable from TCU to the display check the connectors at the display change display	
E4	S.C. TO GROUND AT DISPLAY OUTPUT TCU sends data to the display and measures allways a high voltage level on the connector *cable or connectors are defective and are contacted to vehicle ground* *display has an internal defect*	no reaction OP-Mode: normal	check the cable from TCU to the display check the connectors at the display change display	
F1	GENERAL EEPROM FAULT TCU can't read non volantile memoy *TCU is defective*	no reaction OP-Mode: normal	replace TCU	often shown together with fault code F2
F3	APPLICATION ERROR something of this application is wrong	transmission stay neutral OP-Mode: TCU shutdown	replace TCU !!	This fault occurs only if an test engineer did something wrong in the application of the vehicle
F5	CLUTCH FAILURE AEB was not able to adjust clutch filling parameters One of the AEB-Values is out of limit	transmission stay neutral OP-Mode: TCU shutdown	check clutch	TCU shows also the affected clutch on the Display
F6	CLUTCH ADJUSTMENT DATA LOST TCU was not able to read correct clutch adjustment parameters *interference during saving data on non volatile memory* *TCU is brand new*	no reaction, default values = 0 for AEB offsets used OP-Mode: normal	execute AEB	

Measuring of resistance at actuator/sensors and cable

Actuator:

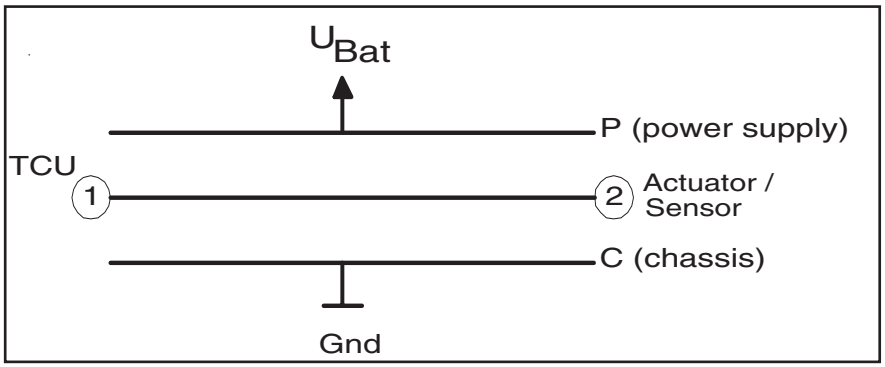


Open circuit: R_{12} » R_{1G} » R_{2G} » ¥

Short cut to ground: R_{12} » R; R_{1G} » 0, R_{2G} » R or R_{1G} » R, R_{2G} » 0
(for s.c. to ground, G is connected to vehicle ground)

Short cut to battery: R_{12} » R; R_{1G} » 0, R_{2G} » R or R_{1G} » R, R_{2G} » 0
(for s.c. to battery, G is connected to battery voltage)

Cable:



Open circuit: R_{12} » R_{1P} » R_{1C} » R_{2P} » R_{2C} » ¥

Short cut to ground: R_{12} » 0; R_{1C} » R_{2C} » 0, R_{1P} » R_{2P} » ¥

Short cut to battery: R_{12} » 0, R_{1C} » R_{2C} » ¥, R_{1P} » R_{2P} » 0

Electronic Control unit EST-37A

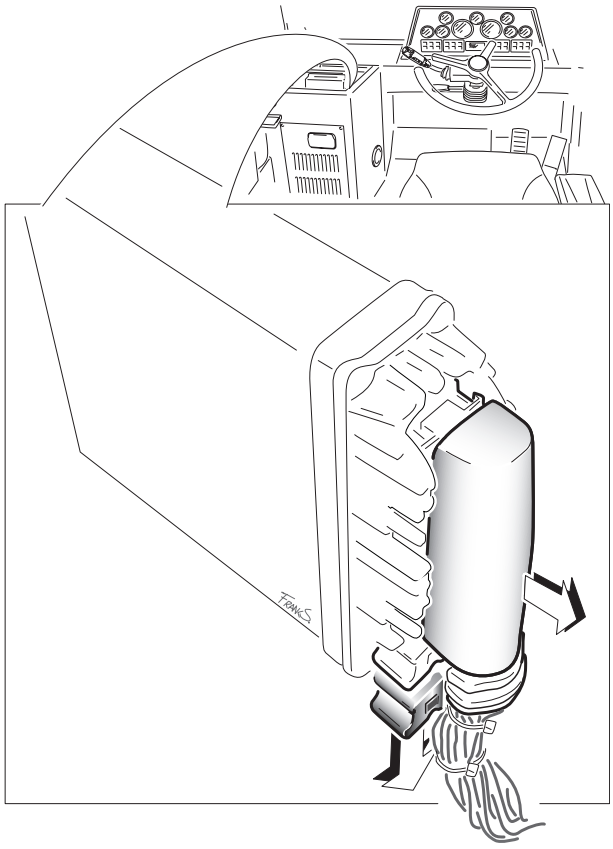
The basic functions of the automatic system are the automatic shifting of gears, adaption of the optimum shifting points, the comprehensive safety functions in relation to operating errors and overloads of the power-transmitting components with a comprehensive fault storage.
Due to the great number of the available TCU, the exact Technical Data must be taken from the respective installation drawing.

Description of the Basic functions:

The Powershift transmission of the Ergopower-Series 6 WG-310 is equipped with the Electronic transmission control EST-37A, developped for it.

The system is processing the desire of the driver according to the following criteria:

- Gear determination dependent on controller position driving speed and load condition.
- Protection from operating error as far as necessary, is possible via electronic protection (programming).
- Protection from over-speeds (on the base of engine and turbine speed).
- Automatic reversing (driving speed-dependent, depending on vehicle type).
- Pressure cut-off possible (vehicle-specific, only after contact with ZF).
- Change-over possibility for Auto- / Manual mode.

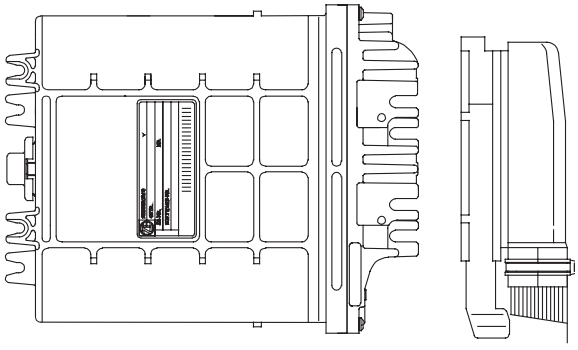


EST-37A; with filterbypass; Smart Software; CAN; engine brake; AutoRetarder; KD only via ED7
(TCU must be ordered separate)

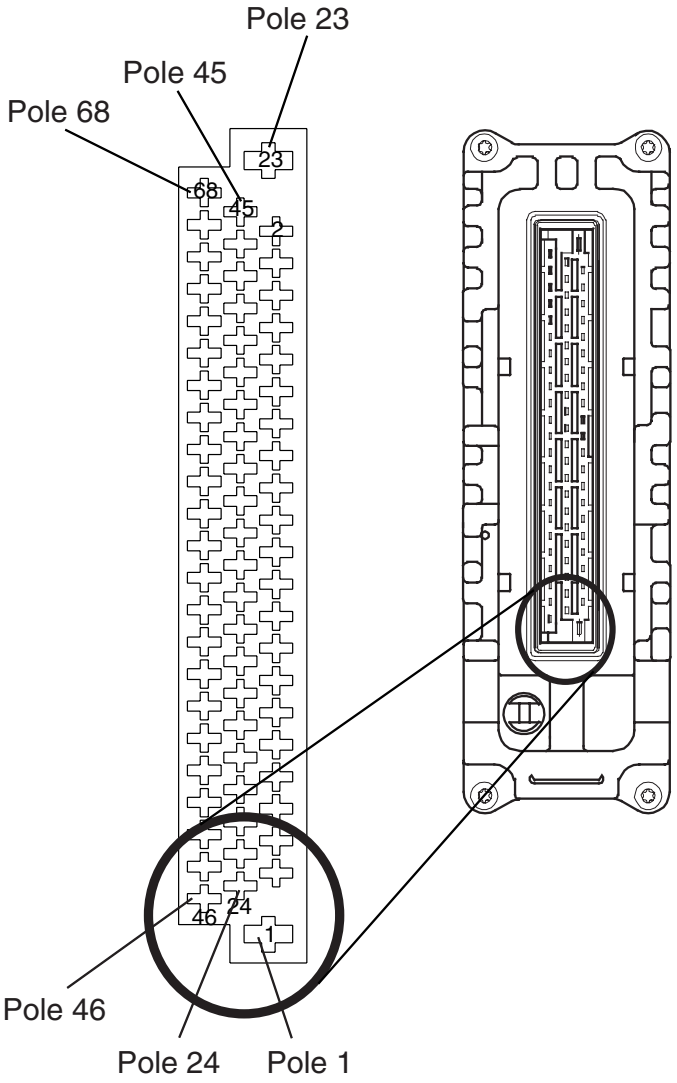
Important parts information

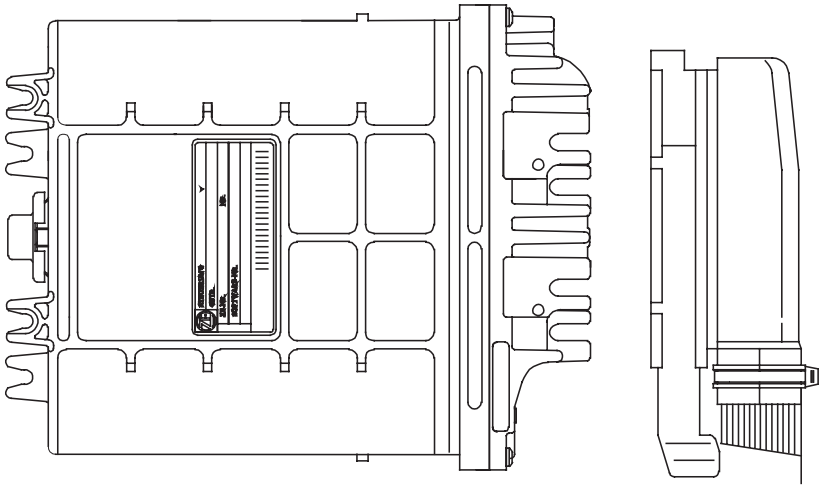
If the Transmission 6WG310 is to be returned to Moxy Trucks AS or ZF for repair or any others reasons, the Transmission controller EST-37A is to be returned together with the Transmission.

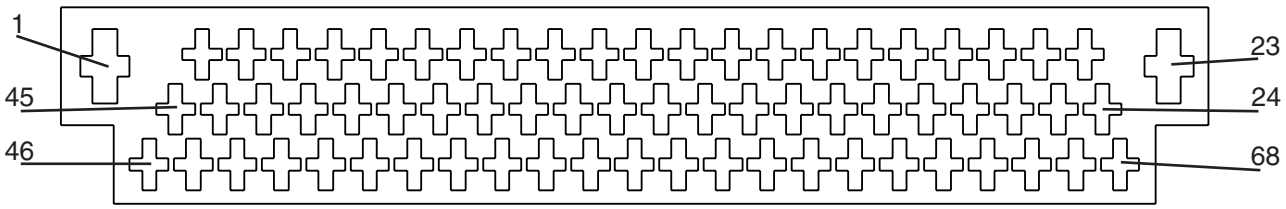
1.
Fasten the controller to the Transmission.
2.
Indicate in the delivery note the serial number of the **Transmission <u>and the controller.</u>**
This information will help us if the controller should be separated from the Transmission under transport.
3.
If the Transmission shoud have a waranty repair at other workshop, it is necessery that the testreport printing are following with the claim.



Pin in contact for the TCU



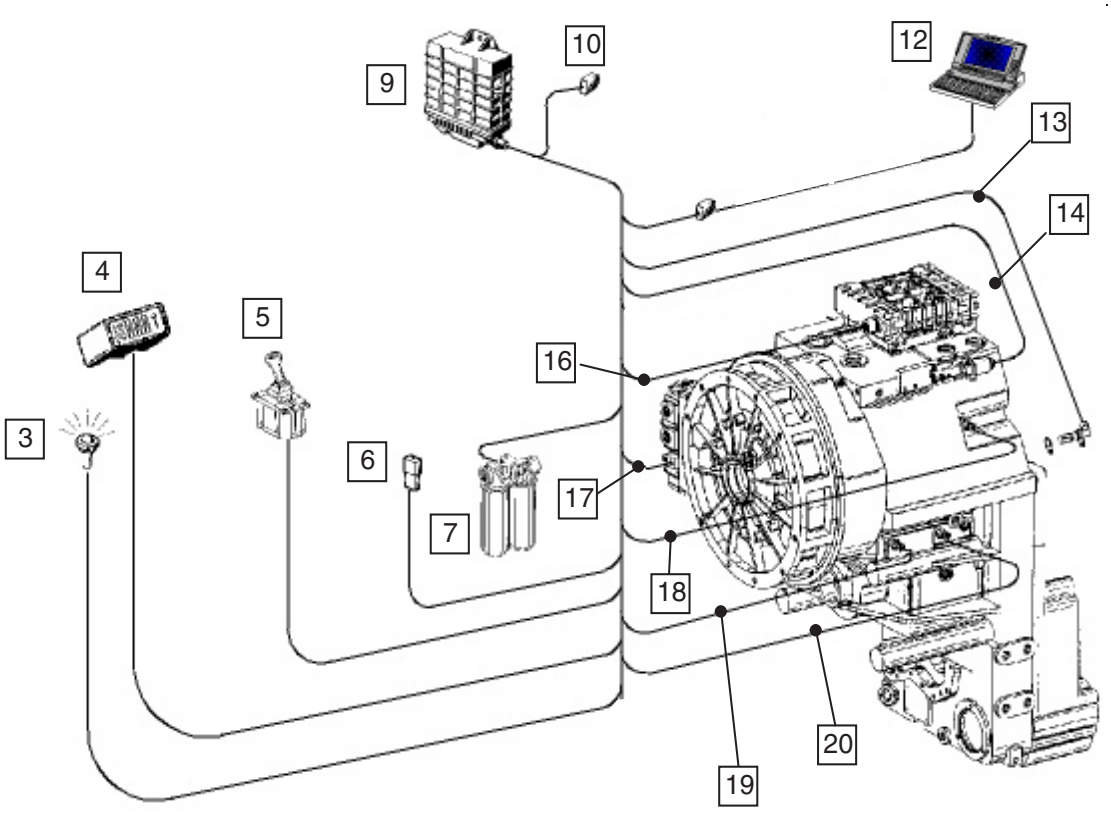




1	Ground connection
2	Ground connection
3	Joint
4	Rpm output shaft
5	Solenoid emergency retarder.
6	Not connected
7	Relay reverse light
8	Terminal block ???
9	Solenoid Y5
10	Solenoid Y1
11	Solenoid diff lock
12	Rpm Engine
13	Rpm Engine
14	Display
15	TCU Diagnosis port
16	Not connected
17	Front frame cable set
18	TCU Diagnosis port
19	Sensor Transmission input shaft
20	Not connected
21	Retarder brake
22	Kick down
23	Fuse transmission controller 30
24	Not connected
25	DEC2 Can-bus
26	DEC2 Can-bus
27	DEC2 Can-bus
28	DEC2 Can-bus
29	Gear selector manu/auto
30	Switch Diff. Lock
31	Not connected
32	Solenoid Y3
33	Solenoid Engine brake
34	Lock up light

35	Not connected
36	Speedometer
37	Not connected
38	Not connected
39	Temp sensor sump (156)
40	Not connected
41	Turbine RPM
42	Internal gear chain RPM
43	Gear selector forward
44	Engine brake
45	Relay TCU supply and control back up light
46	Temp sensor retarder
47	Not connected
48	Not connected
49	Temp sensor retarder
50	Not connected
51	Solenoid Y6
52	Main alarm
53	Terminal block ???
54	Not connected
55	Solenoid Y4
56	Solenoid Y2
57	Solenoid retarder
58	Not connected
59	Not connected
60	Not connected
61	Not connected
62	RPM output shaft
63	Gear selector T+
64	Gear selector Reverse
65	Gear selector T-
66	Gear restriction
67	Relay supply parking brake alarm
68	Fuse transmission controller 30

Family package of the EST-37A



Legend ref. Figure

3 = Warning lamp

4 = Display

5 = Controller VST-3

6 = Supply system connection

7 = Fine filter with maintenance switch / Cable to filter contamination switch

9 = Electro control unit EST37

10 = CAN-connection

12 = Diagnosis Laptop with ZF-Diagnostic system Testmann and AEB

13 = Cable to speed sensor output and speedometer

14 = Cable to lock-up

16 = Cable to Electro hydraulic control with proportional valves

17 = Cable to temperature measuring point behind the converter

18 = Cable to inductive transmitter – speed engine

19 = Cable to inductive transmitter – speed turbine

20 = Cable to inductive transmitter – speed central gear train

Electro-hydraulic shift control unit

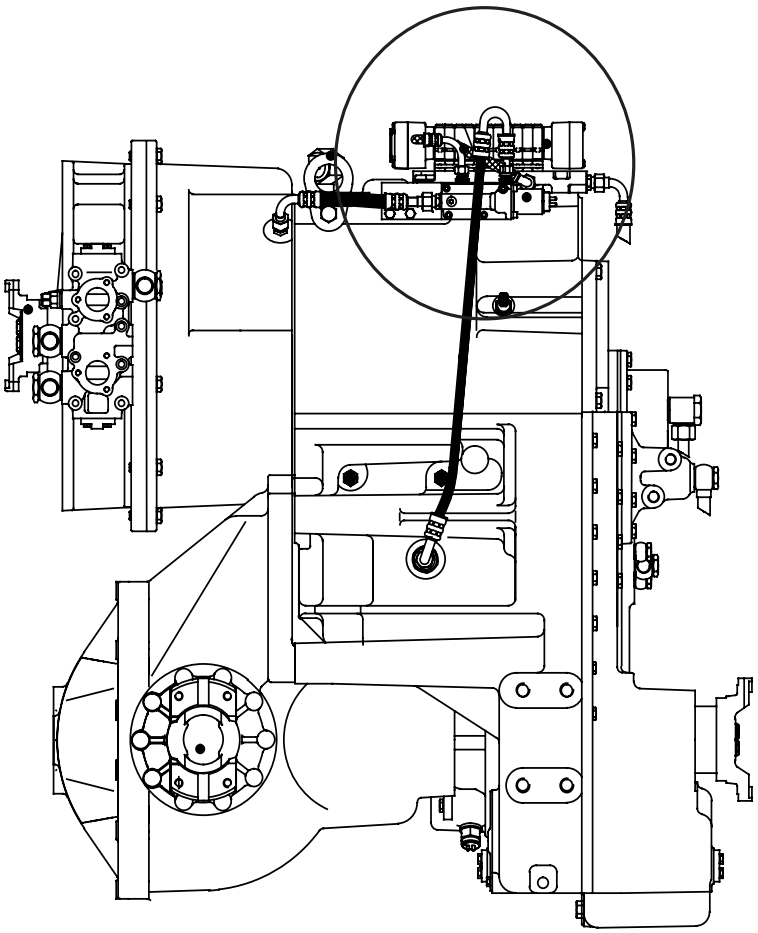
Transmission control:

The six clutches of the transmission are selected via the 6 proportional valves P1 to P6.
The proportional valve (pressure regulator unit) is composed of pressure regulator (e.g. Y6), follow-on slide and vibration damper.
The control pressure of 9 bar for the actuation of the follow-on slides is created by the pressure reducing valve.
The pressure oil (16+2 bar) is directed via the follow-on slide to the re-spective clutch.
Due to the direct proportional selection with separate pressure modulation for each clutch, the pressures to the clutches, which are engaged in the gear change, will be controlled. In this way, a hydraulic intersection of the clutches to be engaged and disengaged will become possible.
This is creating spontaneous shiftings without traction force interruption.

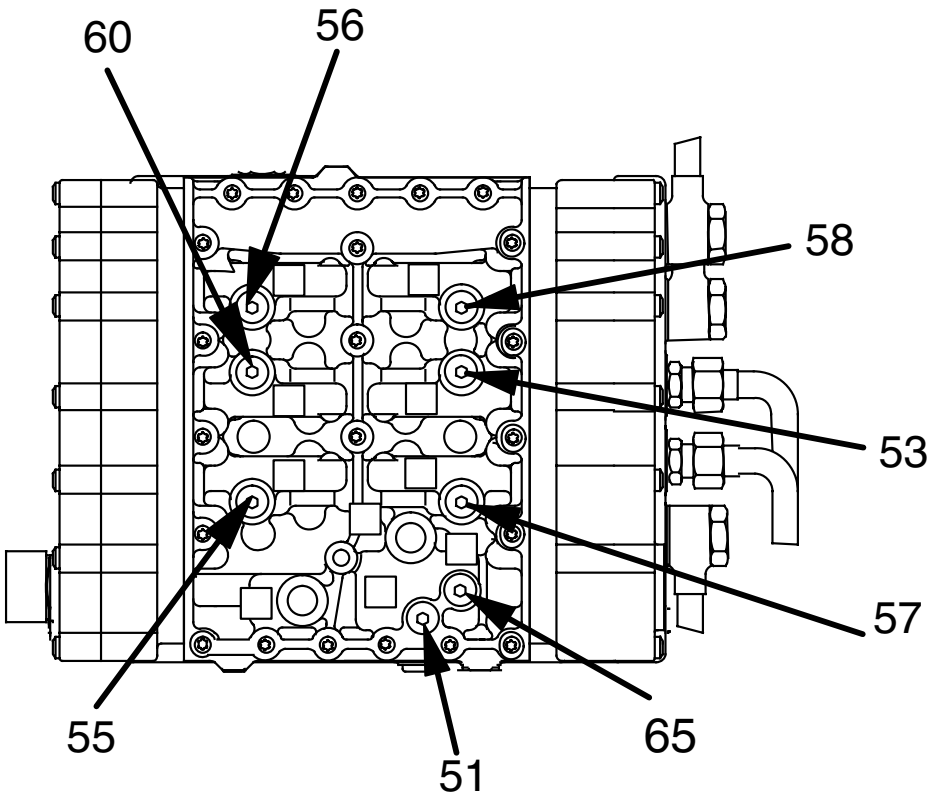
At the shifting, the following criteria will be considered:
- Speed of engine, turbine, central gear train and output.
- Transmission temperature.
- Shifting mode (up-, down-, reverse shifting and gear engagement out of Neutral).
- Load condition (full and part load, traction, thrust, inclusive consideration of load cycles during the gear change).

The main pressure valve is limiting the max. control pressure to 16+2 bar and releases the main flow to the converter and lubricating circuit.
In the inlet to the converter, a converter safety valve is installed which protects the converter from high internal pressures (opening pressure 8,5 bar).
Within the converter, the oil serves to transmit the power according to the well-known hydro-dynamic principle

See in the section: DESCRIPTION / Function of the Converter.



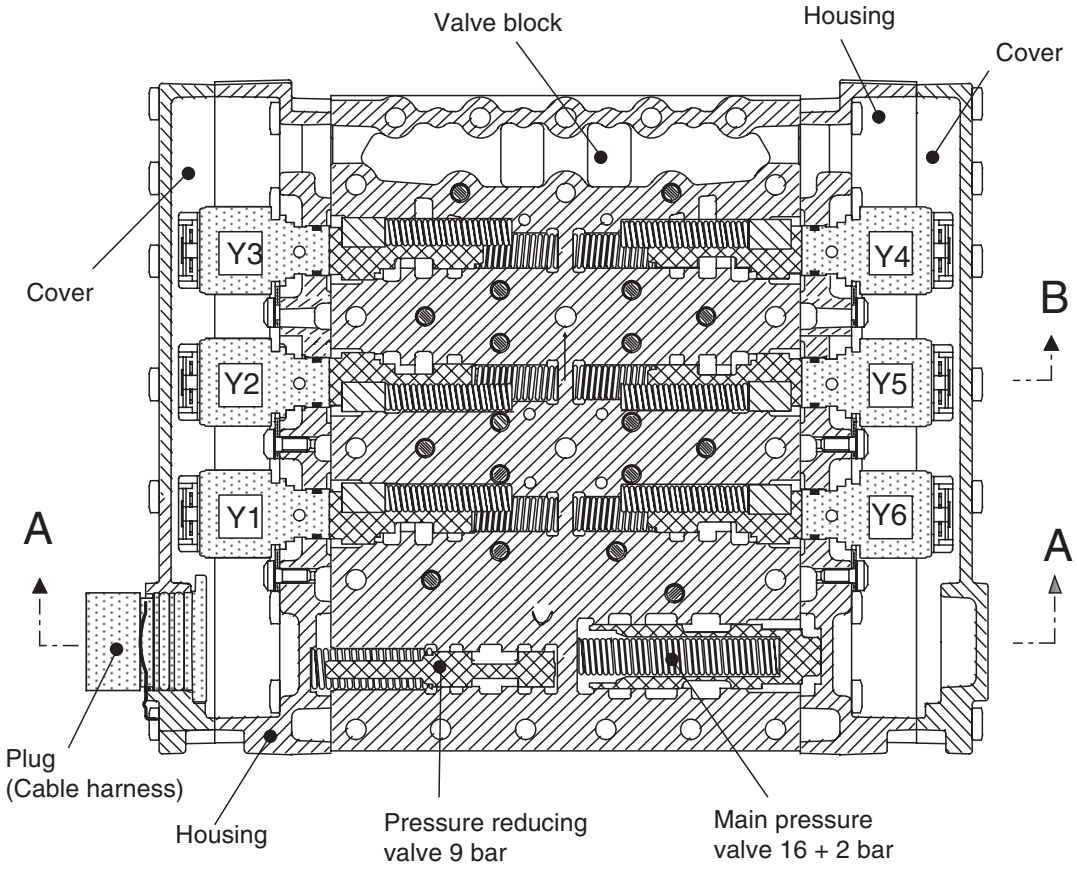
Electro-hydraulic control unit HSG-94

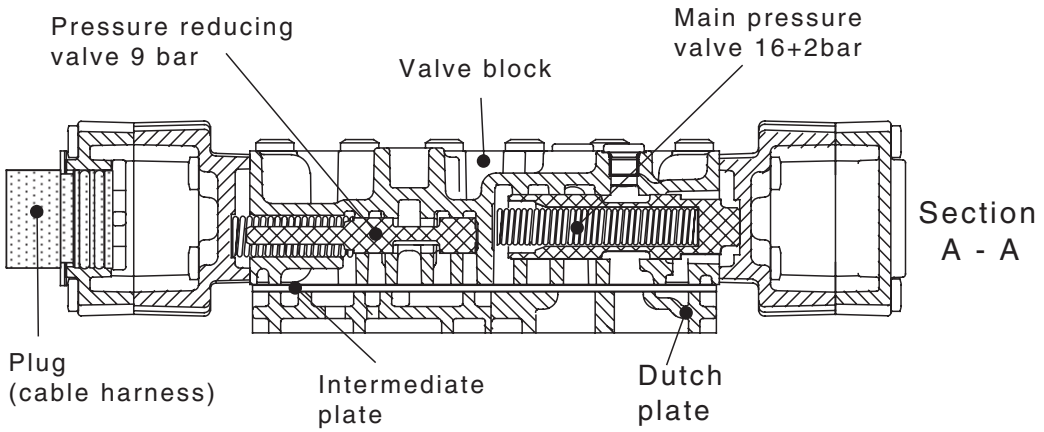


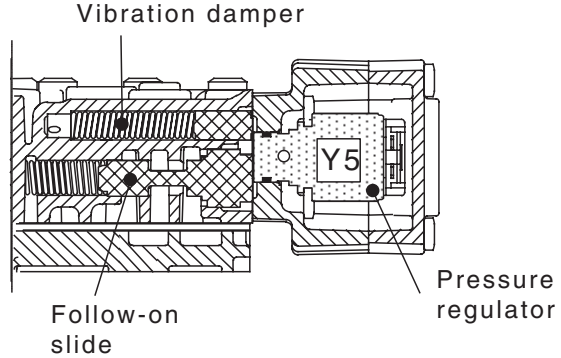
	Measuring point
51	In front of conv. – opening pressure
53	Clutch forward
55	Clutch reverse
56	Clutch K1
57	Clutch K2
58	Clutch K3
60	Clutch K4
65	System pressure

Electro hydr. shift control valve, cross section

The following drafts are showing the sectional Illustrations of the HSG-94







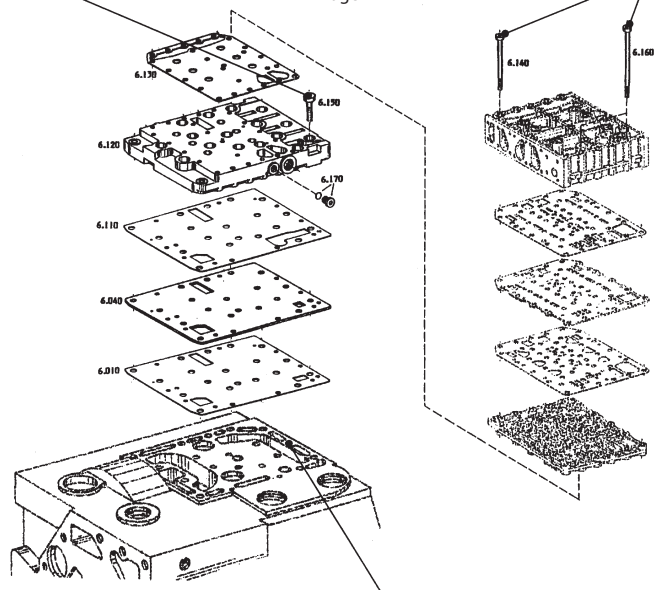
Section B - B
Proportional
valve P5

504254

Tool for the Electro-hydraulic
Control unit HSG-94

504253

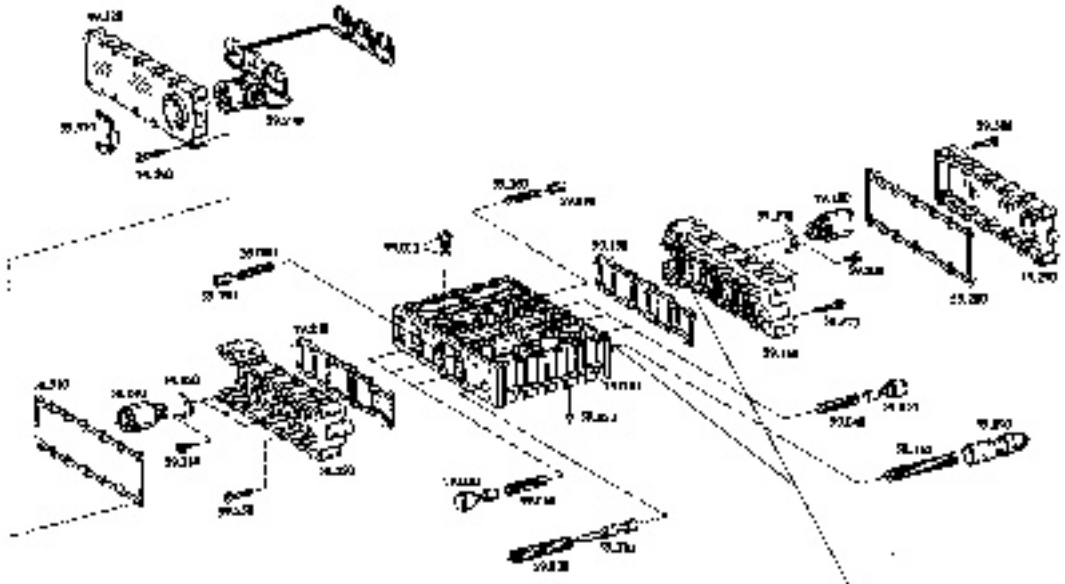
Page 1



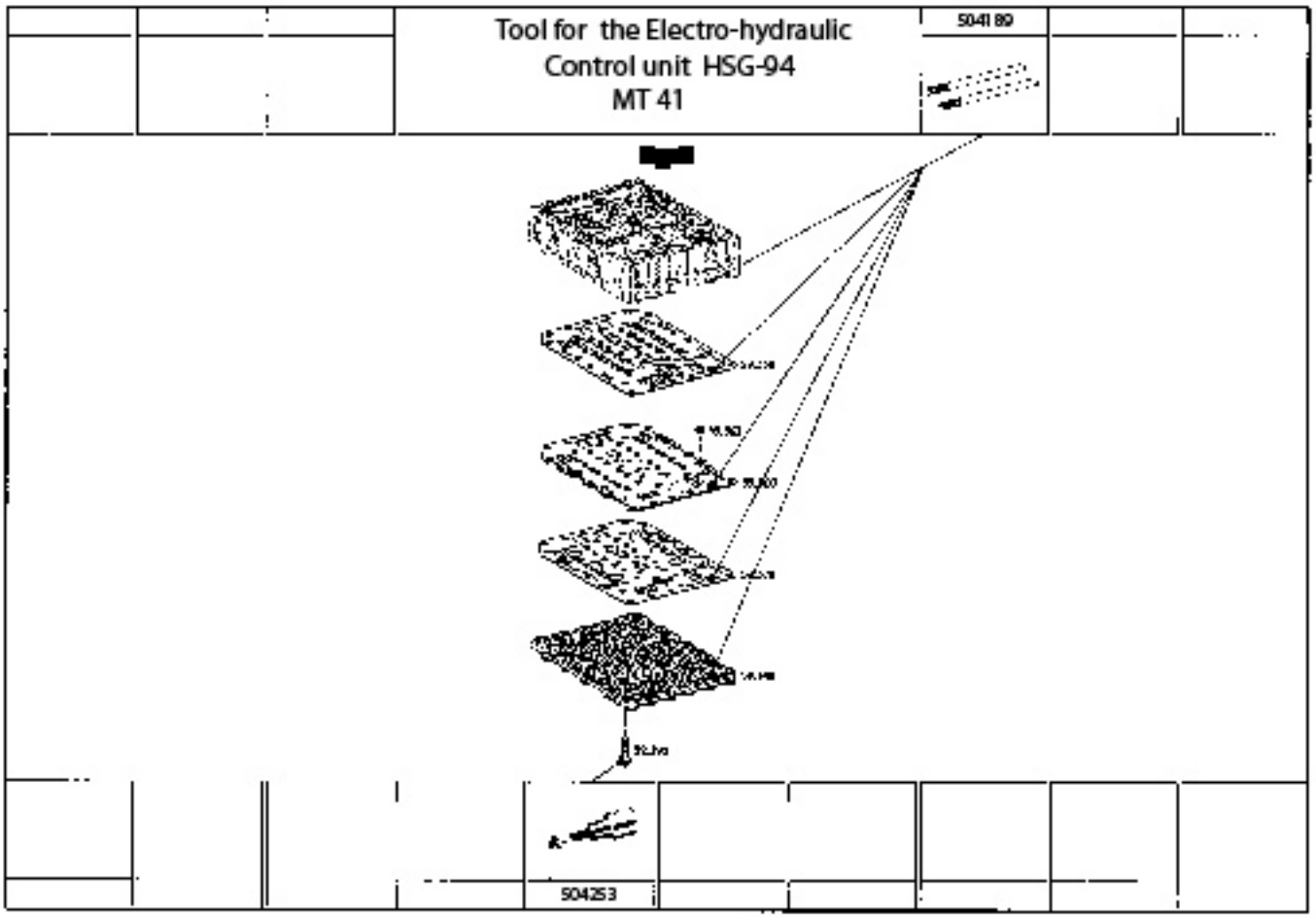


504185

Tool for the Electro-hydraulic
Control unit HSG-94
MT 41



504188


Tool for the Electro-hydraulic
Control unit HSG-94
MT 41
504189
504253

DISASSEMBLY

Summary for the Tool, see chapter 2.0

Loosen socket head screws and remove selector housing.

(S) Box spanner TX-27 504253

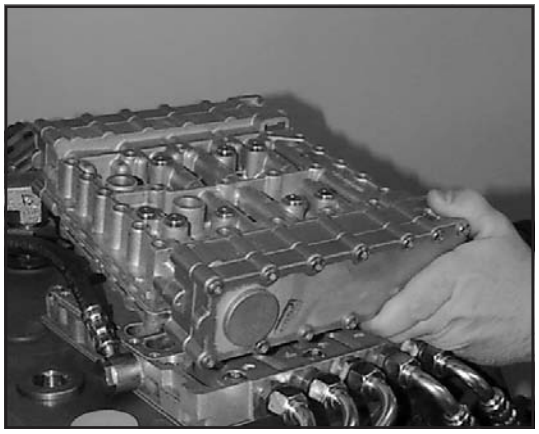


Figure1

Separate hose lines from the intermediate plate.
Loosen socket head screws and separate intermediate plate as well as gaskets and intermediate sheet from gearbox housing.

(S) Box spanner TX-40 504254

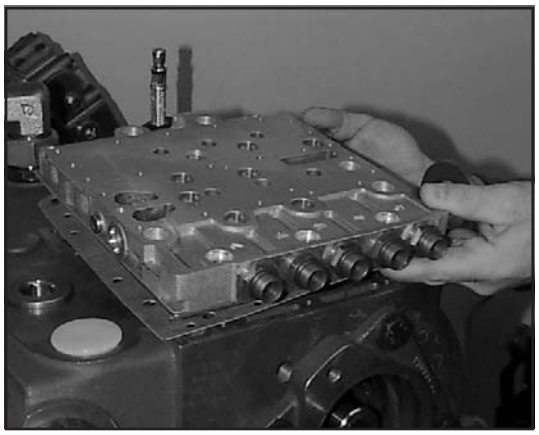


Figure 2

Mark installation position of the cable harness to the valve block.

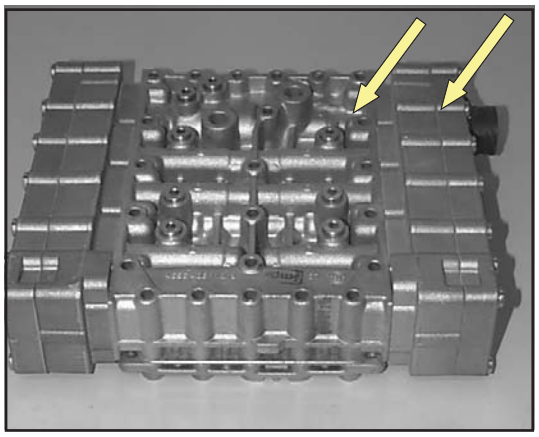


Figure 3

Loosen socket head screws.

Separate duct plate, gaskets and intermediate sheet from the valve block.

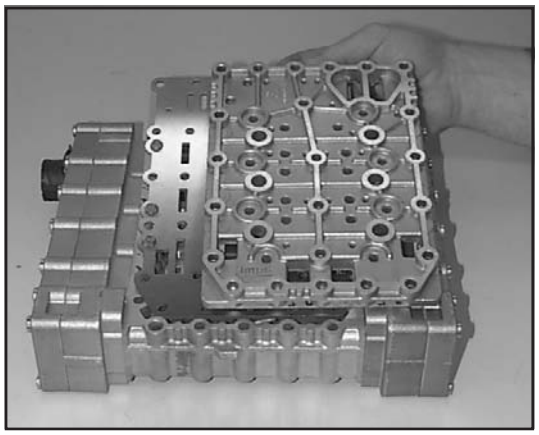


Figure 4

Remove retaining clip.

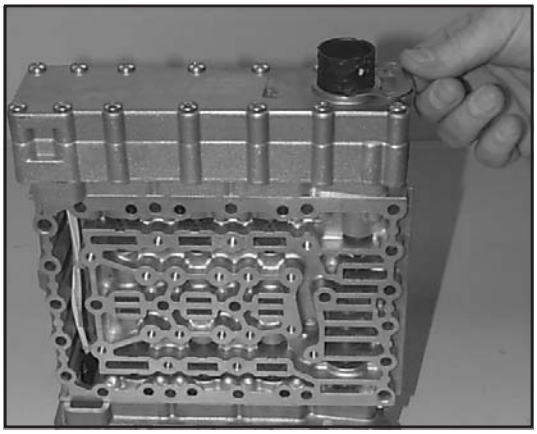


Figure 5

Losen socket head screws and remove cover.
Demount opposite cover.

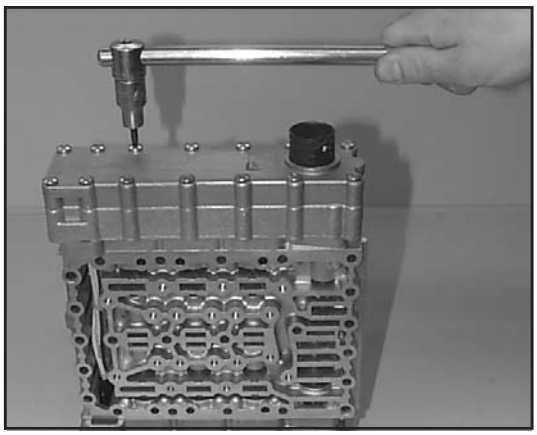


Figure 6

Demount pressure regulator and remove cable harness.

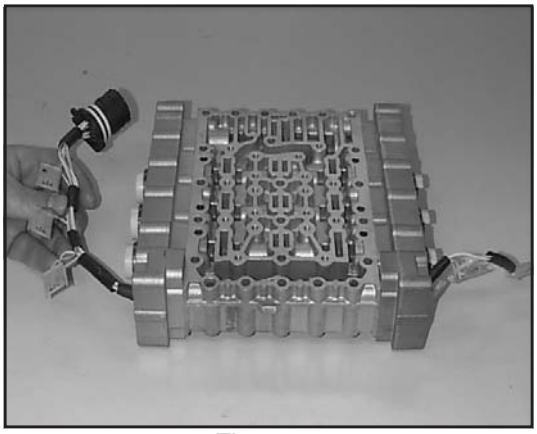


Figure 7

Loosen socket head screws, remove retaining plates and demount pressure regulator.

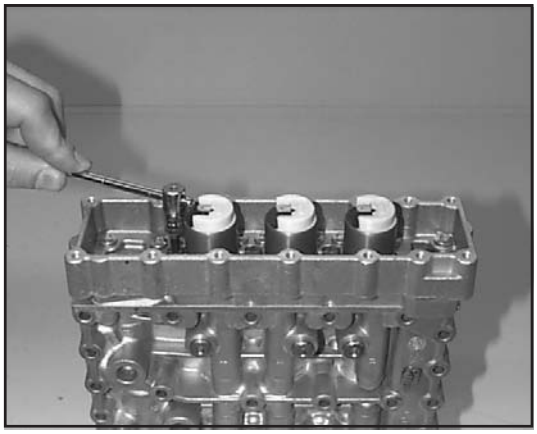


Figure 8

Loosen two socket head screws and locate the housing provisionally by means of adjusting screws.

(Housing is spring-loaded).
Now, loosen the remaining socket head screws.

(S) Adjusting screws 504188

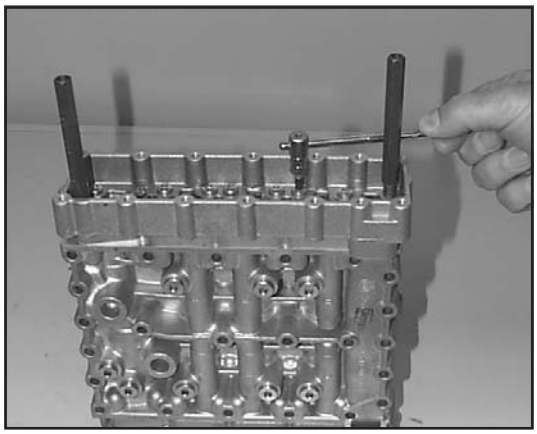


Figure 9

Separate housing from valve body by uniform loosening of the adjusting screws.

(S) Adjusting screws 504188

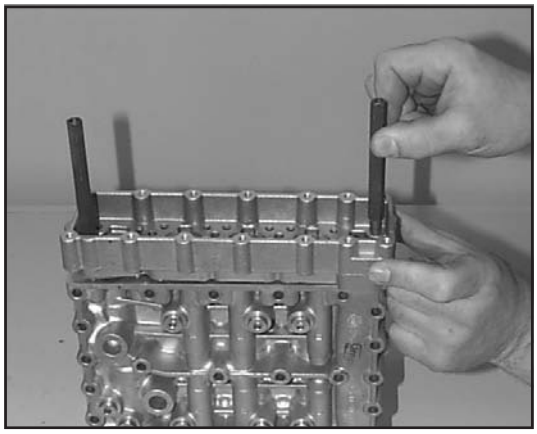


Figure 10

Remove components.

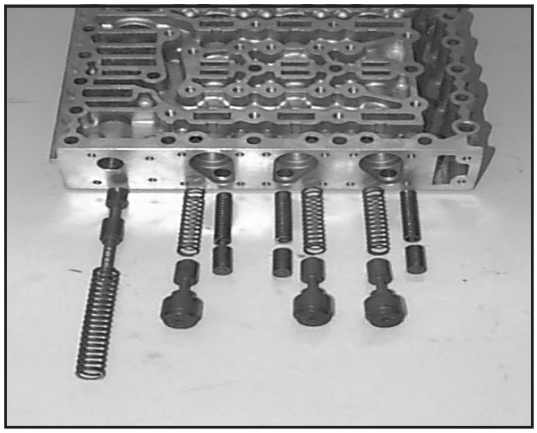


Figure 11

Remove opposite pressure regulators, housing as well as compo-nents accordingly.

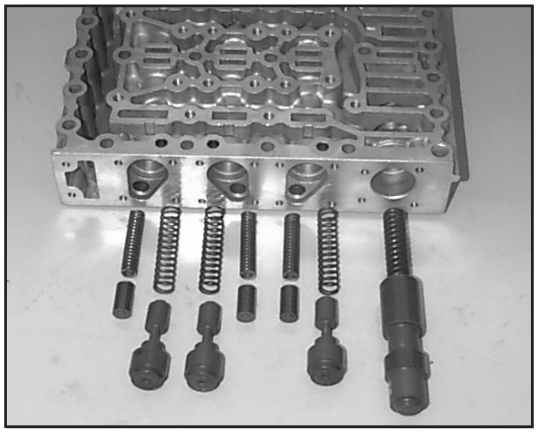


Figure 12

ASSEMBLY

Check all components for damage and renew if necessary !
Prior to the installation, check the free travel of the moving parts in the housing !
Spools can be exchanged individually !
Prior to the assembly, oil the components according to ZF-List of lubricants TE-ML 03 !

Insert orifices with the concave side showing upward, until contact is obtained !

Installation position, see Arrows !

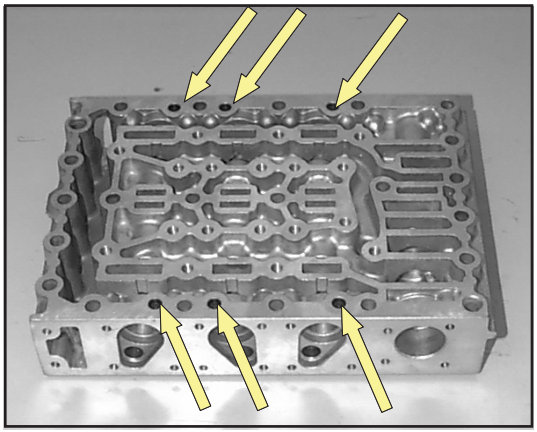


Figure13

The Figure on the left shows the following components:

1 = Vibration damper (3x spool and compression spri
2 = Follow-on slide (3x spool and compression spri
3 = Pressure reducing valve (1x spool and compression spri

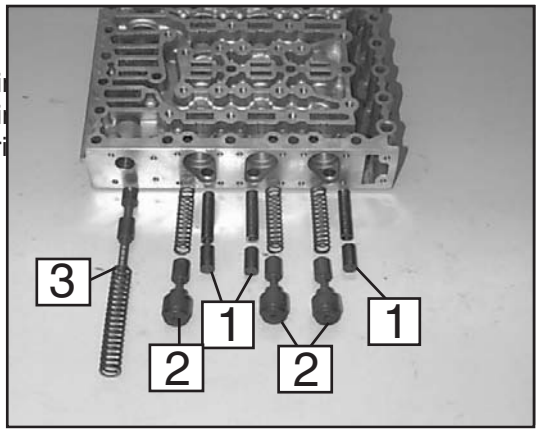


Figure 14

Install components according to Figure 14.

Preload the compression springs of the follow-on slides and locate the spools provisionally by means of cylindrical pins ∅ 5,0 mm (assembly aid), see Arrows/Figure 15 !

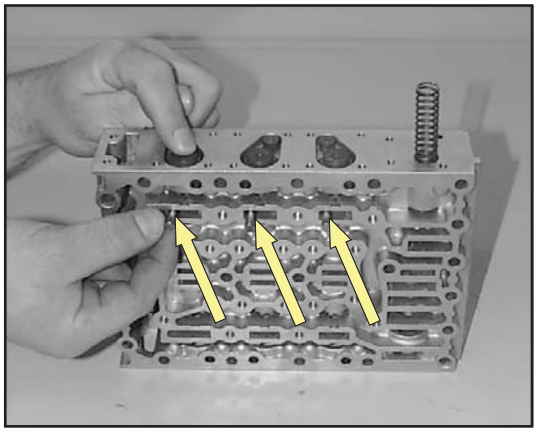


Figure 15

Install two adjusting screws.

Line up flat gasket (Arrow) and housing cover (see Figure16).

Now, bring housing cover by means of adjusting screws uniformly against shoulder (Figure 17).

(S) Adjusting screws 504188

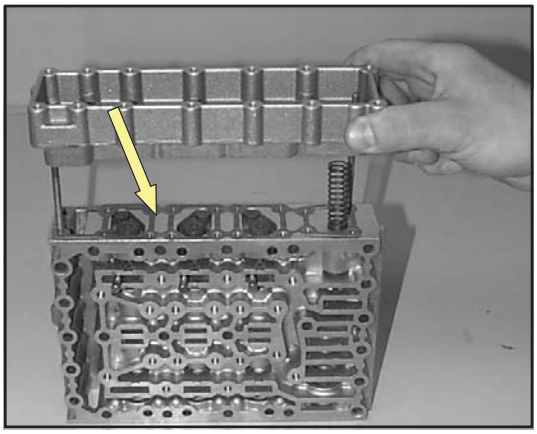


Figure 16

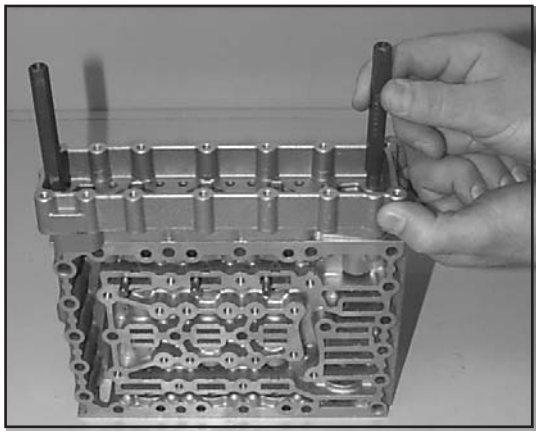


Figure17

Preload spool and remove the cylindrical pins (assembly aid) again.

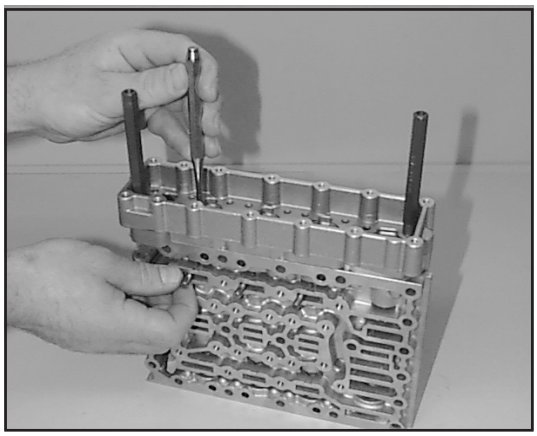


Figure 18

Fasten housing cover by means of socket head screws.

Torque limit..... 5,5 Nm

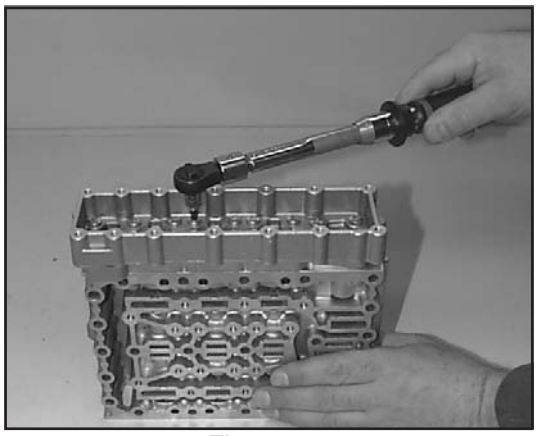


Figure 19

Introduce pressure regulators and fix them by means of retaining plates and socket head screws.

Install retaining plates, with the claw showing downward !
Pay attention to the radial installation position of the pres-sure regulators, see Figure !

Torque limit ..... 5,5 Nm

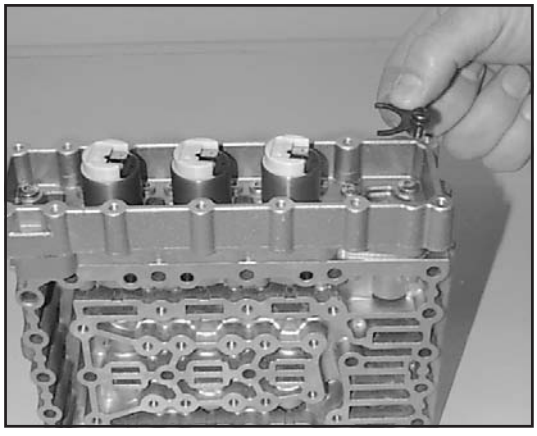


Figure 20

Pre-assemble opposite side

The Figure on the left shows the following components:

1 = Main pressure valve (1x spool and compression spring)
2 = Follow-on slide (3x spool and compression spring)
3 = Vibration damper (3x spool and compression spring

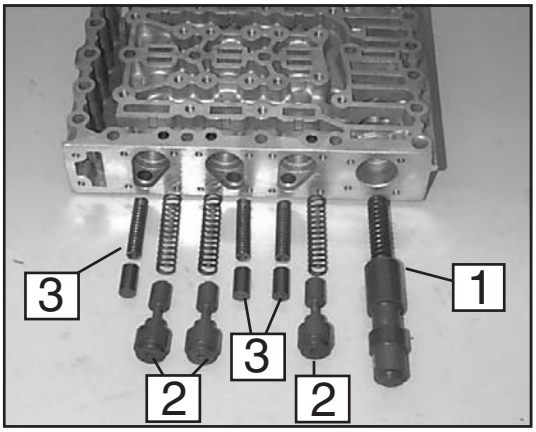


Figure 21

Install components according to Figure 21.

Preload compression springs of the follow-on slides and fix the spools provisionally with cylindrical pins Æ 5 mm (assembly aid), see Arrows !

Install two adjusting screws.

Line up flat gasket (Arrow 1) and housing cover and bring them uniformly against shoulder, using adjusting screws.

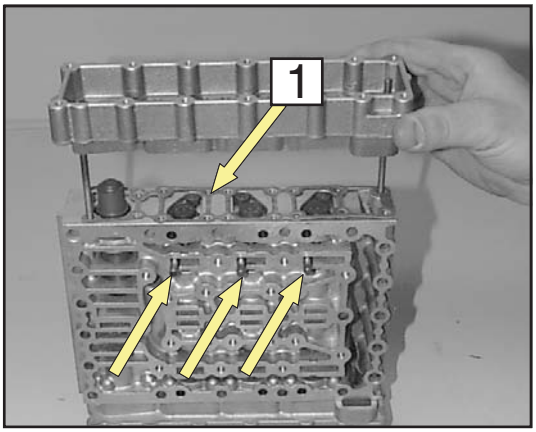


Figure 22

Now, fasten housing cover by means of socket head screws.

Torque limit ..... 5,5 Nm

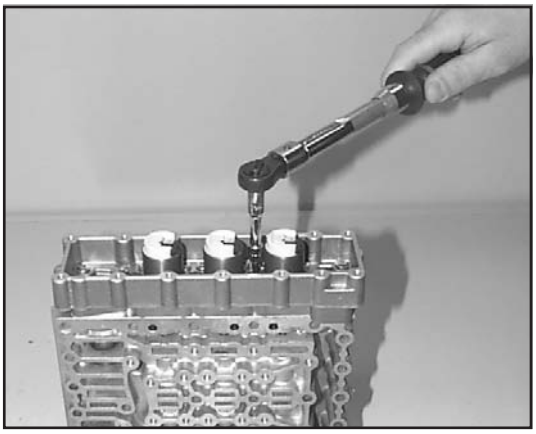
Remove cylindrical pins (assembly aid) again.

(S) Adjusting screws 504188

Introduce pressure regulators and fix them by means of retain-ing plates and socket head screws.

Install retaining plates, with the claw showing downward !
Pay attention to the radial installation position of the pres-sure regulators, see Figure !

Torque limit ..... 5,5 Nm


Figure 23

Introduce cable harness and connect pressure regulators (6x).

Pay attention to the installation position of the cable harness, see also markings (Figure 3) !

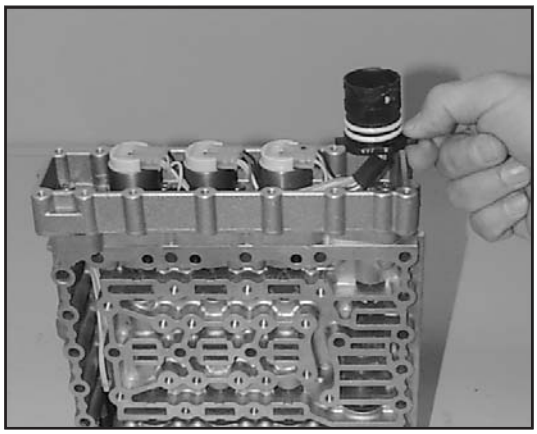


Figure 24

Mount flat gasket (Arrow).

Introduce femal connector, with the groove facing the guide nose of the cover, until contact is obtained.

Fasten cover with socket head screws.
Torque limit ..... 5,5 Nm

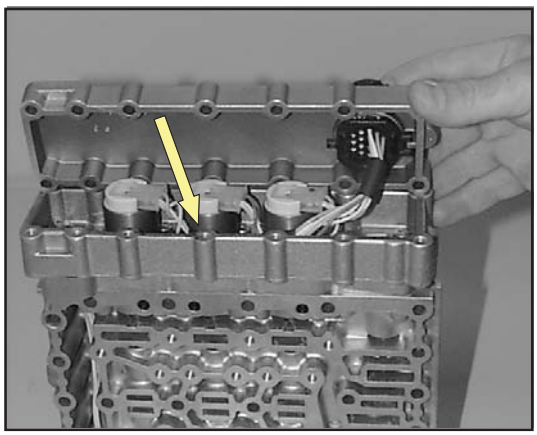


Figure 25

Locate the femal connector by means of retaining clip.

Install opposite cover.

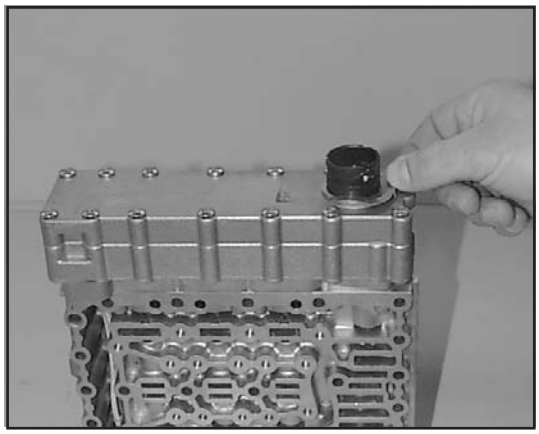


Figure 26

Install two adjusting screws and mount gasket I.

Pay attention to the different gaskets, see Figure 27 and 30 !

(S) Adjusting screws M6 504189

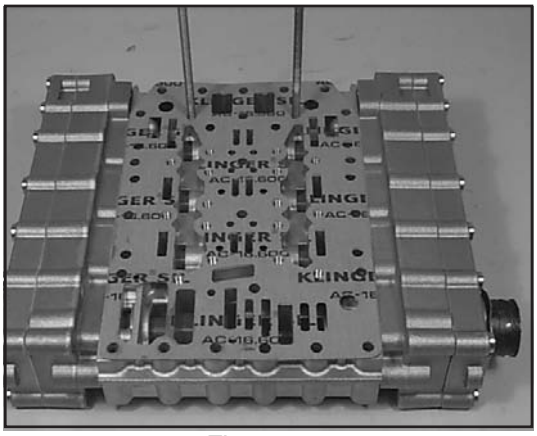


Figure 27

Intermediate plate – Version with strainers:

Insert strainers (6x) flush-mounted into the bores of the intermediate plate, see Arrows !

Pay attention to the installation position – strainers are showing upward (facing the duct plate) !

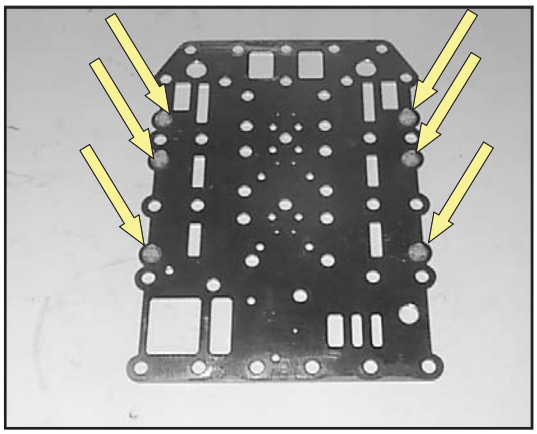


Figure 28

Mount intermediate with the strainers showing upward.

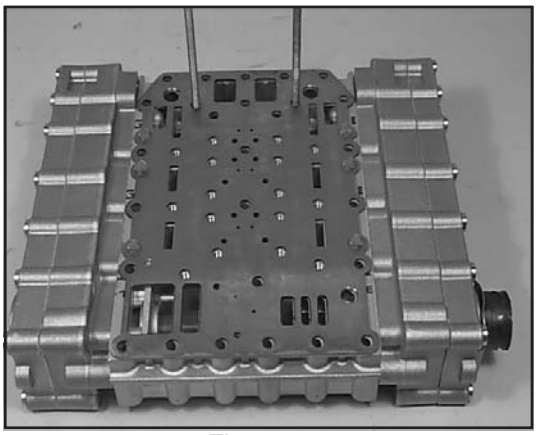


Figure 29

Mount gasket II.

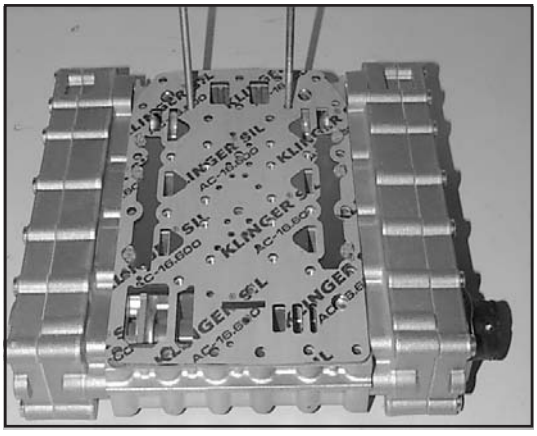


Figure 30

Mount duct plate (Arrow) and fasten it uniformly by means of socket head screws.

Torque limit ..... 11 Nm

(S) Box spanner TX-27 504253

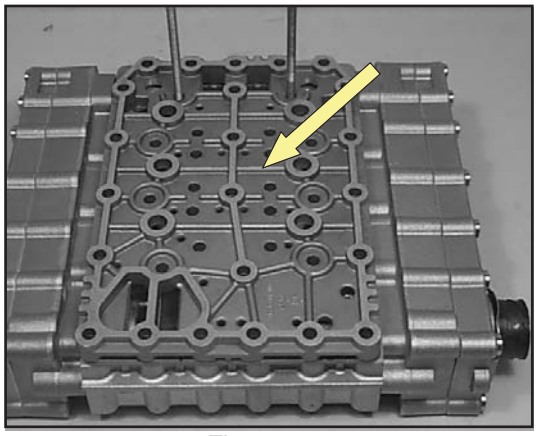


Figure 31

Equip screw plugs (8x) with new O-rings and install them.

Torque limit ..... 6 Nm

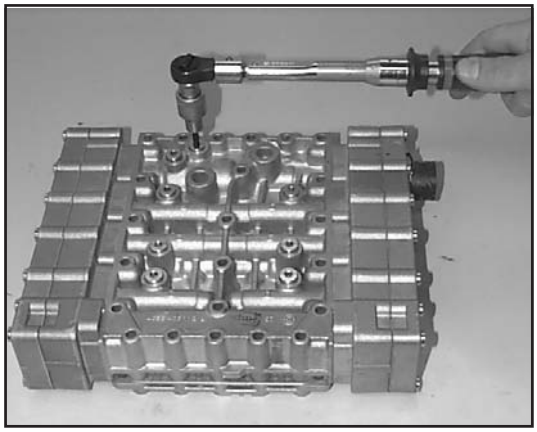


Figure 32

Attach Hydraulic control unit (HSG-94) (Figure 33 ... 40)

Screw orifice into the housing bore (Arrow) and secure it by means of center punch !

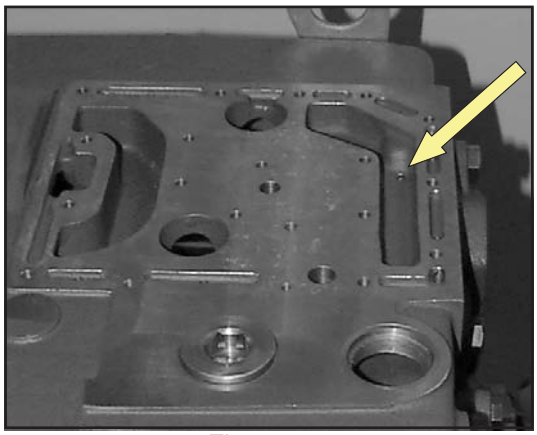


Figure 33

Install connecting fittings 1 ... 6.

Install screw plugs 7.

Torque limit Connecting fittings..... Nm
Torque limit Screw plugs (M10x1) ..... 6 Nm

Install always new O-rings !

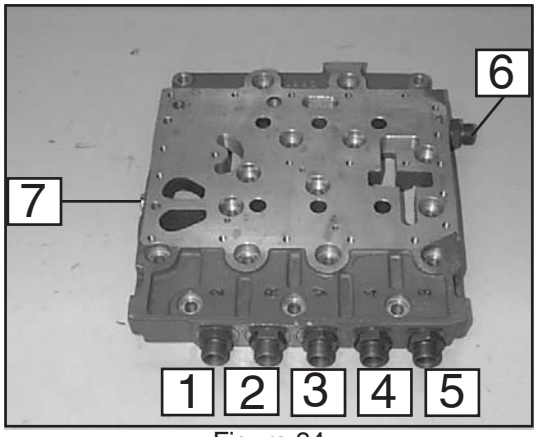


Figure 34

Install two adjusting screws (M8) and mount housing gasket.

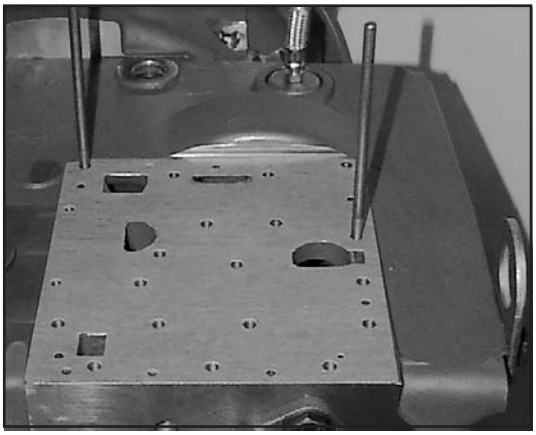


Figure 35



At the following steps (Figure 35 ... 39), pay attention to the installation positions of the different gaskets !

(S) Adjusting screws M8 504185

Mount intermediate plate.

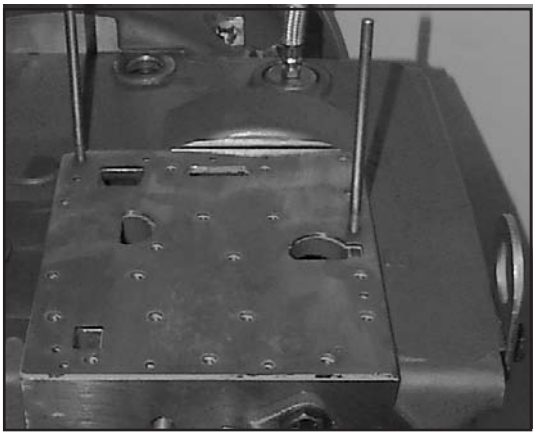


Figure 36

Mount 2nd gasket.

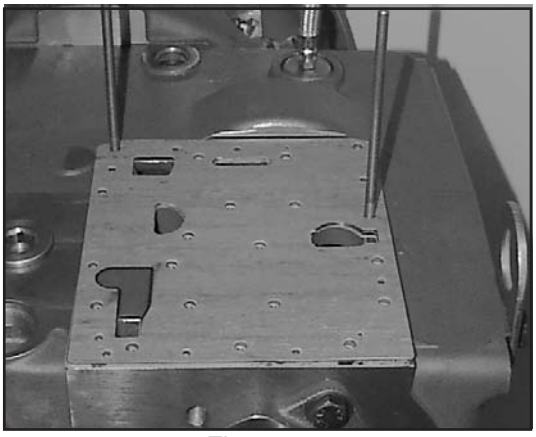


Figure 37

Mount plate and fasten it uniformly by means of socket head screws.

Torque limit (M8/10.9) ..... 23 Nm

(S) Box spanner TX-40 504254

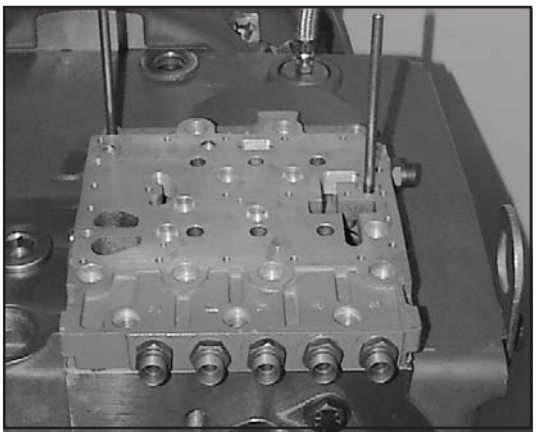


Figure 38

Install 2 adjusting screws (M6).

Mount gasket (Arrow).

(S) Adjusting screws M6 504189

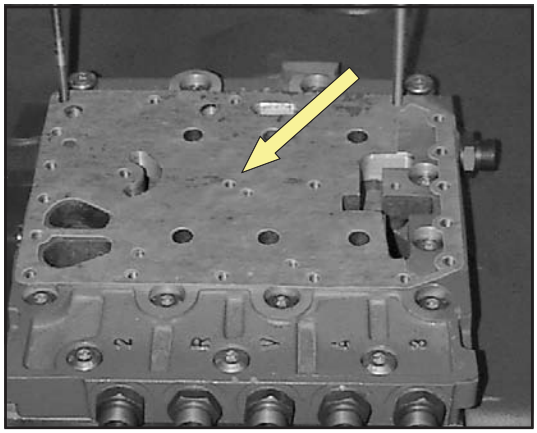


Figure 39

Fasten complete valve block uniformly with socket head screws (2 pieces M6 x 105 and 21 pieces M6 x 80 mm).

Pay attention to the position of the two socket head screws (M6 x 105), see Arrows !

Torque limit ..... 11 Nm

(S) Box spanner TX-27 504253

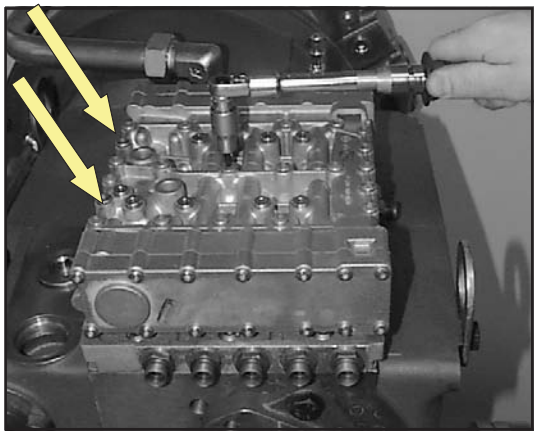
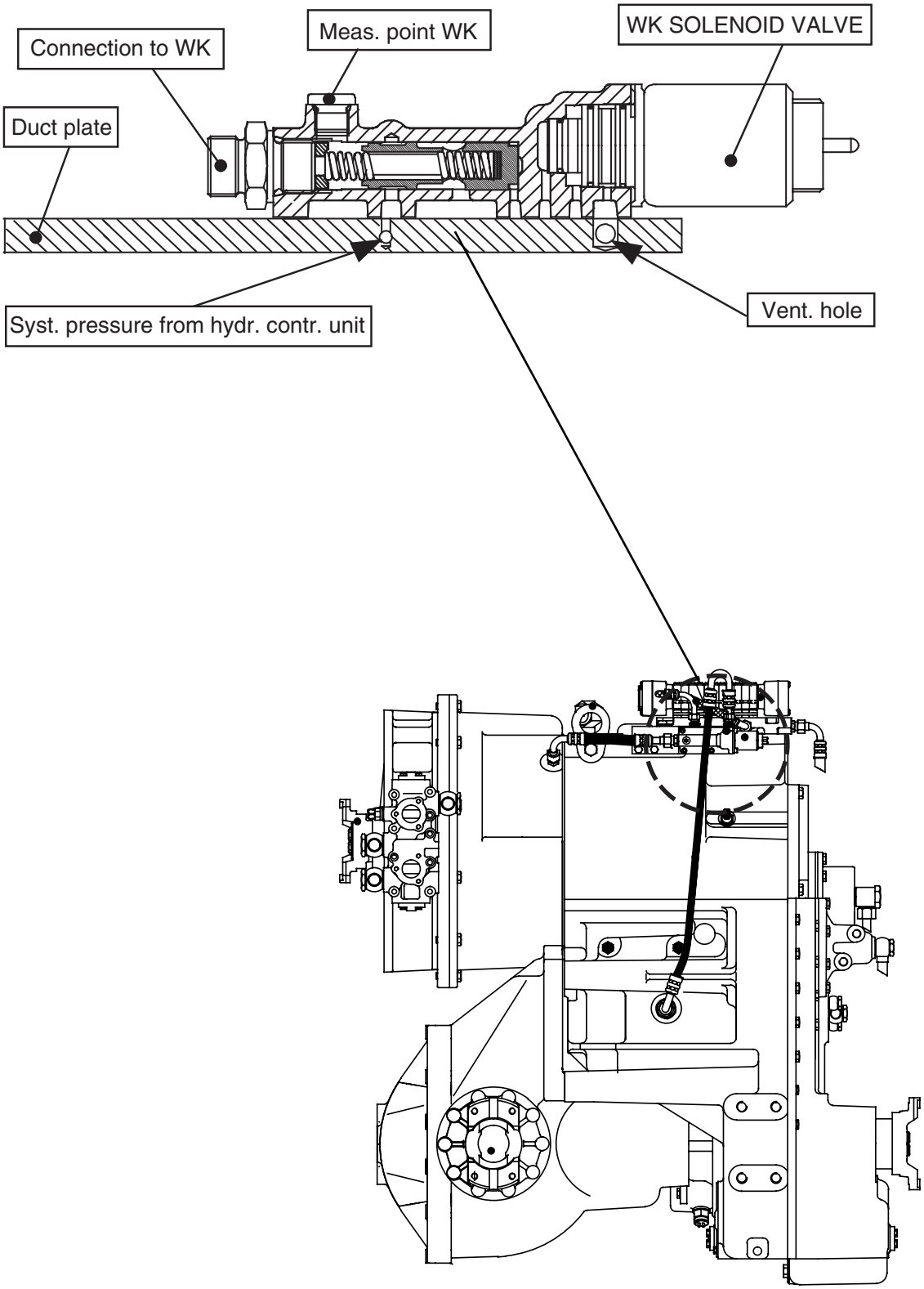


Figure 40

WK-Valve

WK Solenoid shift valve



DISASSEMBLY

Remove hose lines.

Loosen hex. head screws and separate WK-valve from housing

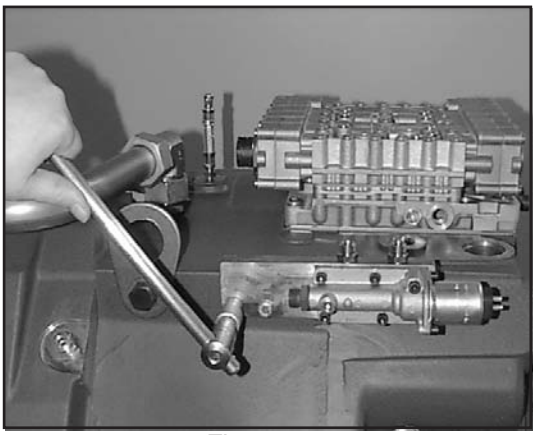


Figure 41

Loosen socket head screws, separate selector housing from adapter plate, and remove components.

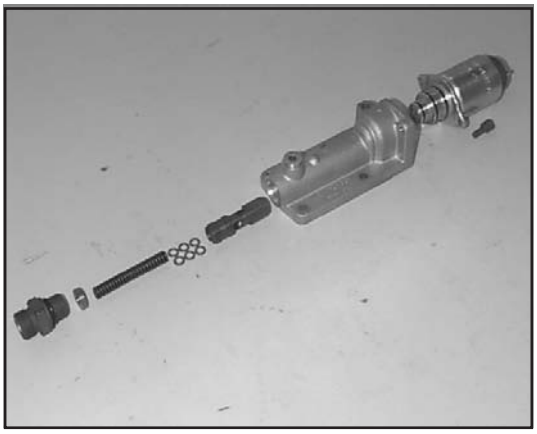


Figure 42

ASSEMBLY

Insert set screw 1 with Loctite (Type-No. 649).
Equip both connecting fittings 2 with new O-rings and install them.

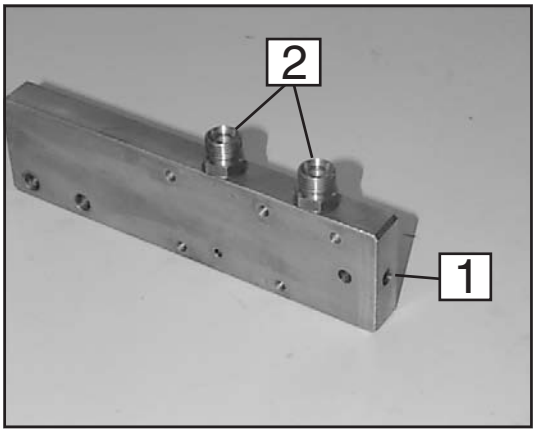


Figure 43

Install WK-Valve components according to the Figure on the left.
1 = Solenoid valve
2 = Socket head screw + Spring washer (2x)
3 = Selector housing
4 = Piston
5 = Shim rings (empirical value, 6 units/0,5 mm thick, each)
6 = Compression spring
7 = Stop (optional, empirical value A = 3,0 mm)
8 = Connecting fitting (install new O-ring)

With the shim rings 5 and the stop 7, the WK pressure 13 ±1 bar will be determined !
Install stop 7, with the stepped plane face facing the com-pression spring !

Torque limit socket head screws (M5/8.8) .... 5,5 Nm

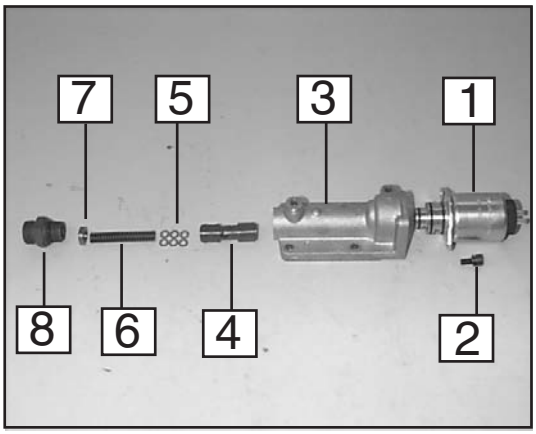
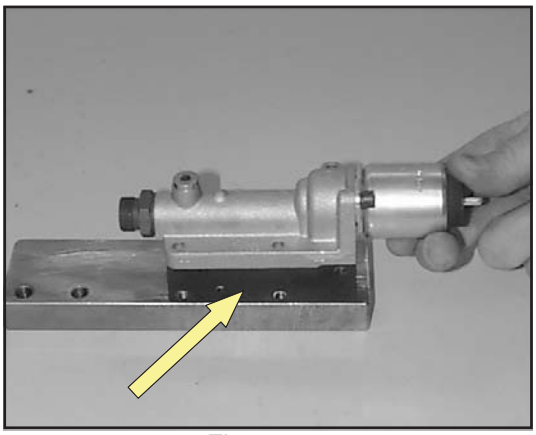


Figure 44

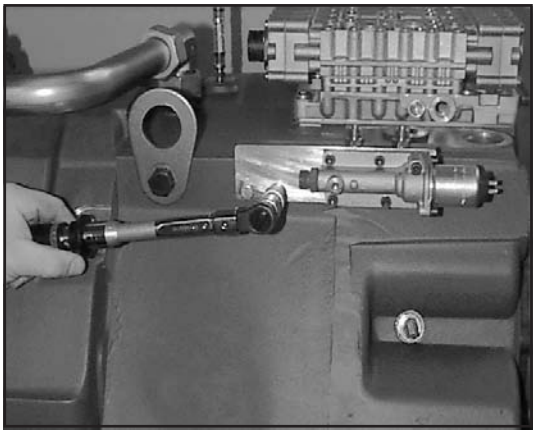
Mount gasket (Arrow) and fasten selector housing by means of socket head screws (mount flat washers).

Torque limit (M6/8.8) ..... 9,5 Nm


Figure 45

Fasten WK-valve on the gearbox housing, using hex. head screws.

Torque limit (M8/8.8) ..... 23 Nm


Figure 46

Retarder

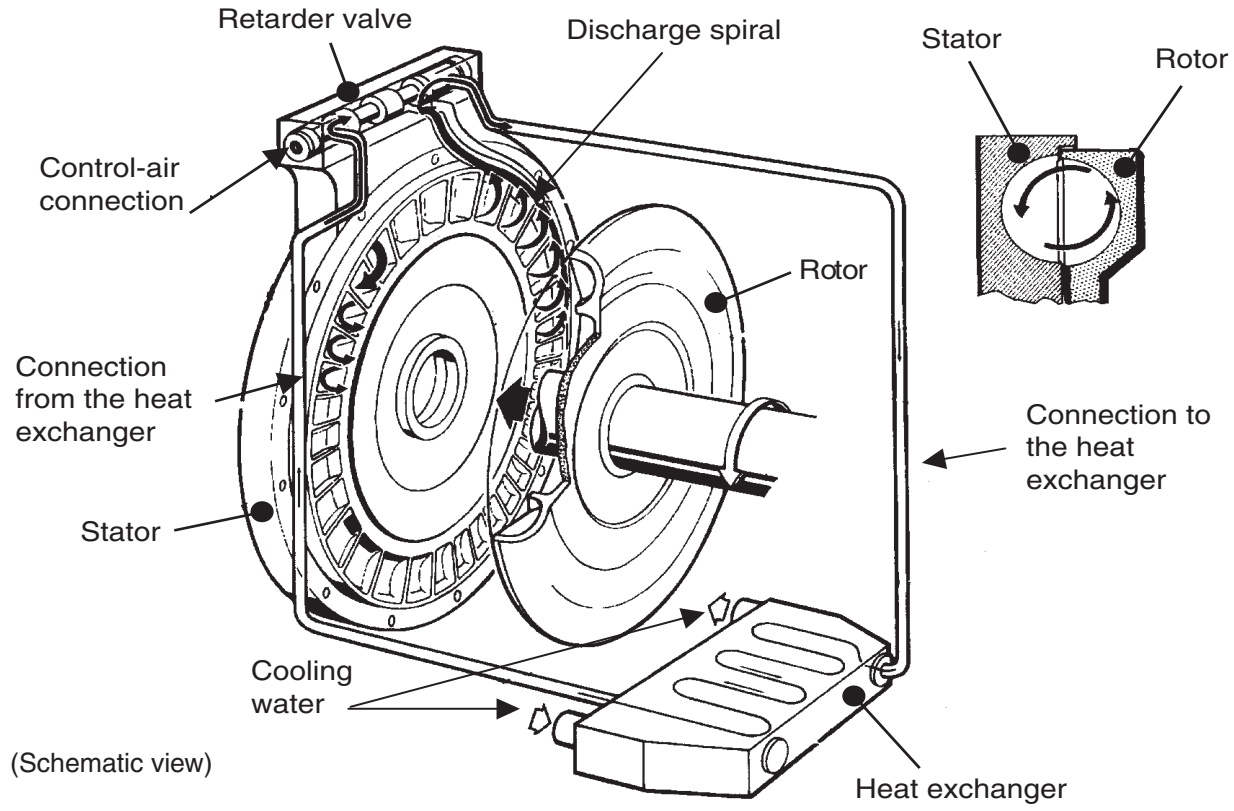
Function of a retarder

General:

The hydrodynamic Retarder (fluid brake), installed upon request, is arranged between engine and torque converter thus achieving a good braking effect in all gears.
The Retarder is a wear-free, gear-depending acting hydrodynamic-brake.
The application of the Retarder is therefore especially to recommend at longer downgrade drives or to brake down out of high driving speeds, because in this way, the service brake will be saved and in an emergency case, the full braking effect (no fading) of the service brake will be disponible.
This is the case of a so-called primary retarder, i.e. it is positively engaged with the engine. Therefore, in the lower gear, higher braking moments can be achieved then in the correspon-ding higher gears.
Because of this fact, it is necessary that the installed WK must be closed, so that the full retarder moment can become effective.

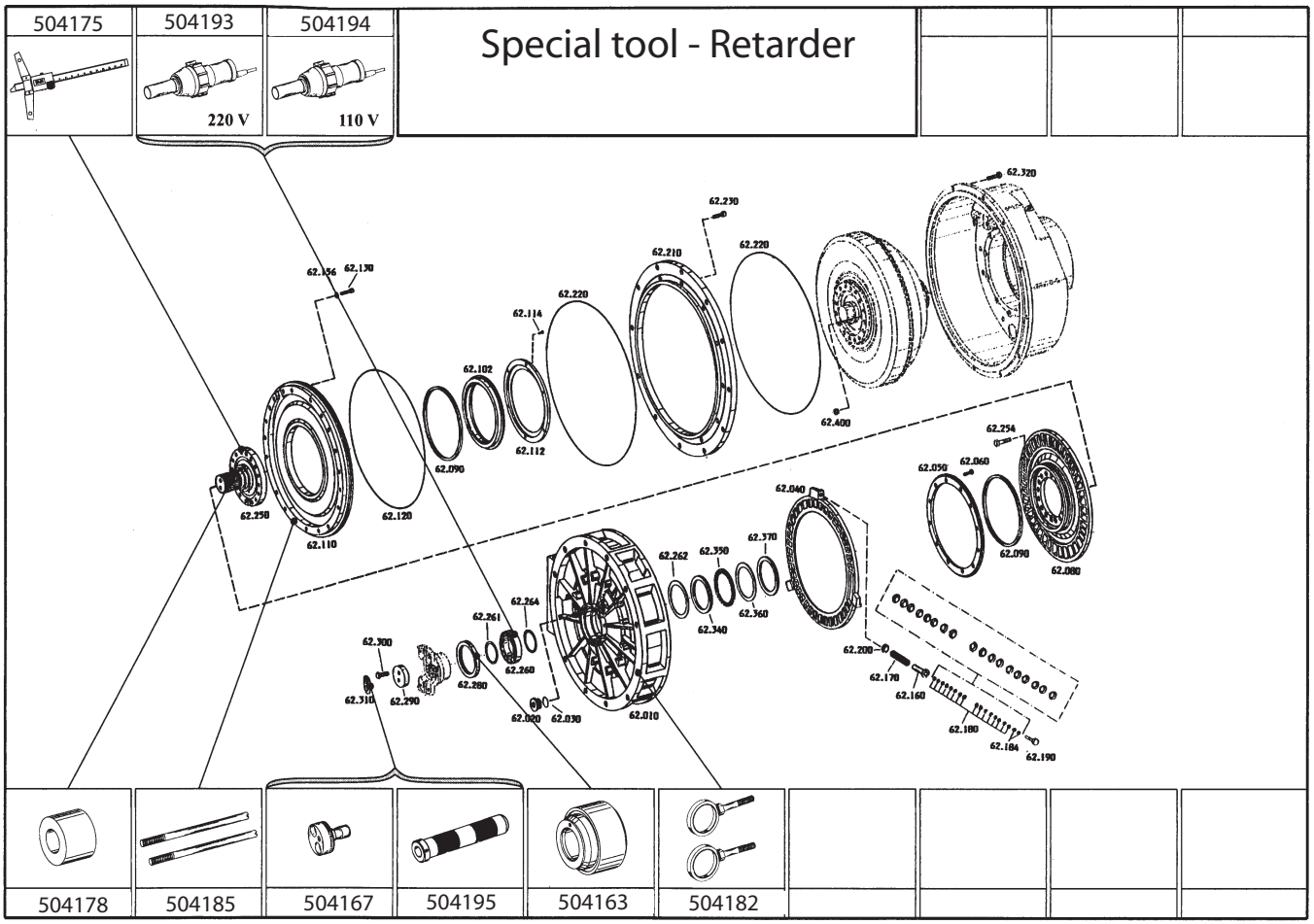
Layout and Function of the Retarder:

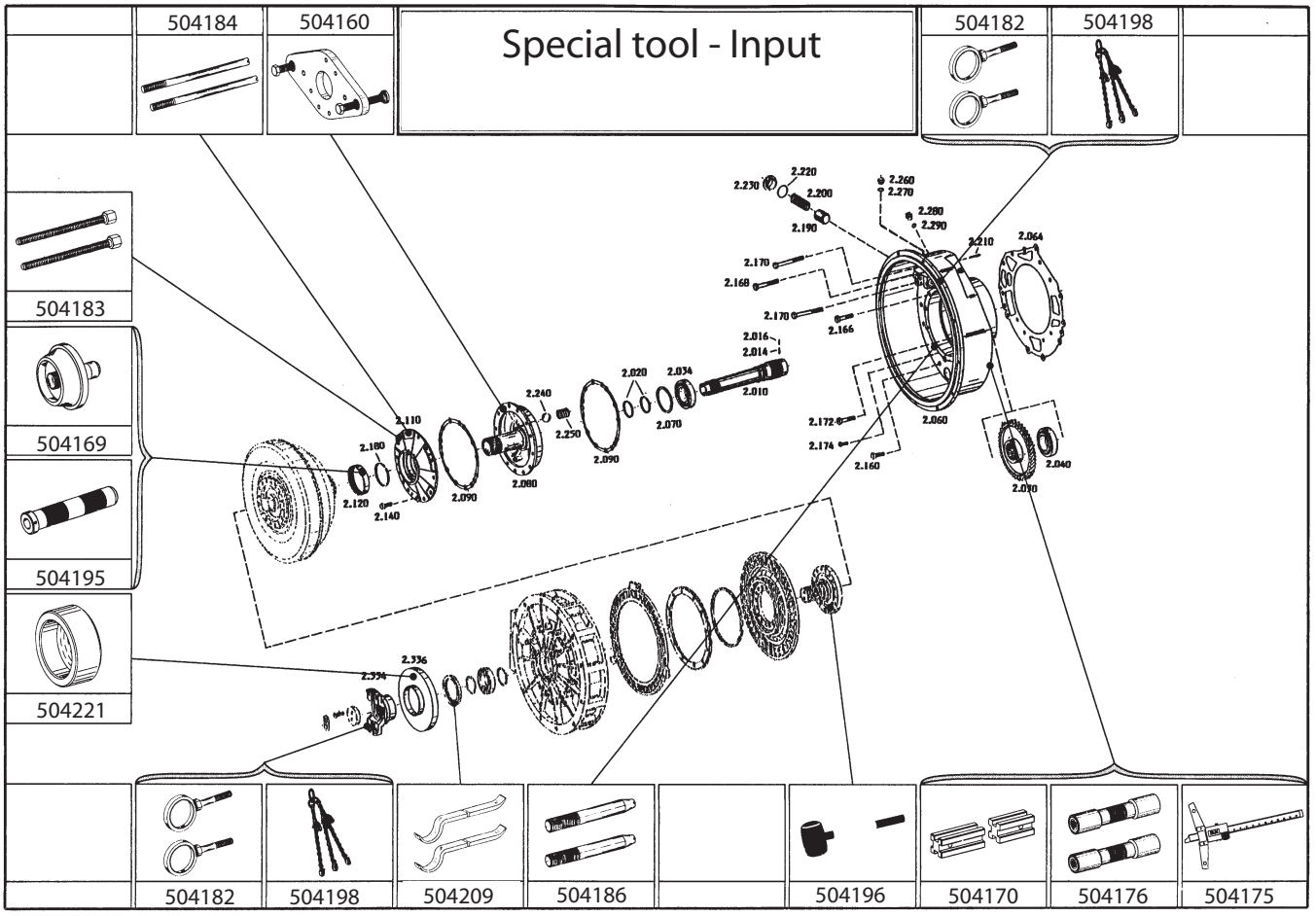
The Retarder in its functional components (see Draft) is composed of the Rotor, the Stator and the Control device. The Rotor (the rotating part of the retarder) is driven from the overrunning vehicle via axle, universal shaft, transmission and shift clutch.
The two-piece stator is composed of the stator itself, which is rigidly connected with the gear-box housing and the stator ring. This stator ring is a vane ring which is arranged between rotor and stationary stator, and serves to reduce the idling losses.
The control device is a valve block which is controlled by means of compressed air.
In shut off condition, i.e. without oil filling, the stator ring will be hold in a position by spring force by which bypass ducts between rotor and stator impellers will be created.
In the retarder mode, i.e. with oil filling, the stator ring will be displaced by the circulating oil by exceeding the spring forces up to a stop.
In this position, it is creating together with the stationary part of the stator a closed impeller ring „counter-rotating“, to the rotor.



(Schematic view)

Retarder reconditioning tool





Disassembly the retarder

Summary for the Tools for retarder disassembly and assembly, see previous side

Fasten the complete transmission on the assembly car.

(S) Assembly car	504213
(S) Clamping bracket	504214

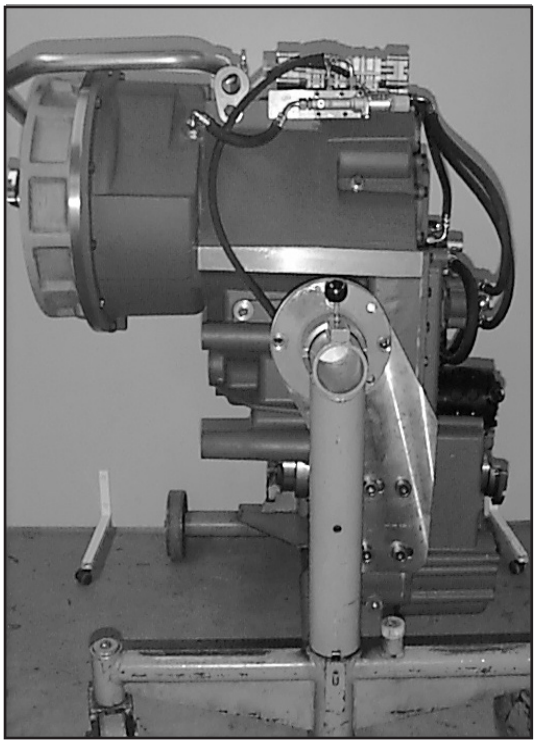


Figure 50

Separate pipes from selector housing.
Loosen hex. head screws and separate pressure regulator from housing.

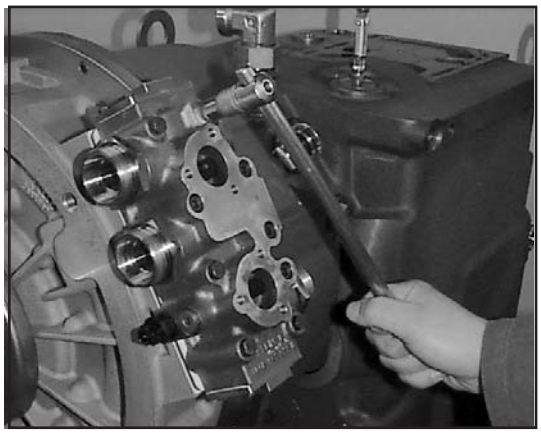


Figure 51

Remove components.

Cover is spring-loaded.

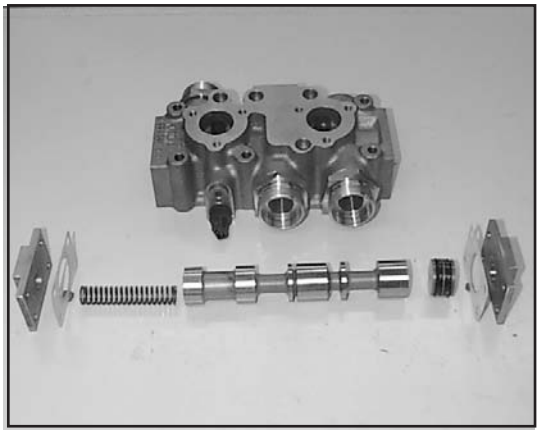


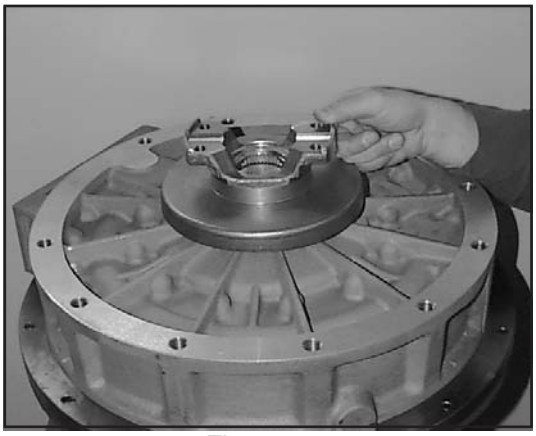
Figure 52

Tilt gearbox housing 90°.

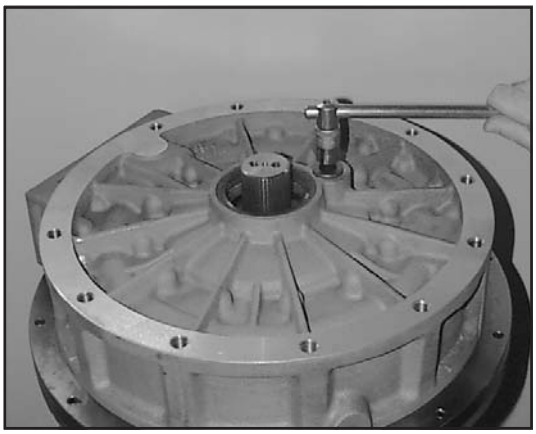
Remove lock plate.
Loosen hex. head screws and pull off input flange.

If only operations on the transmission are necessary, the complete retarder can be separated, along with the converter, from the converter connecting housing by loosening the screw connection (Figure 56) !

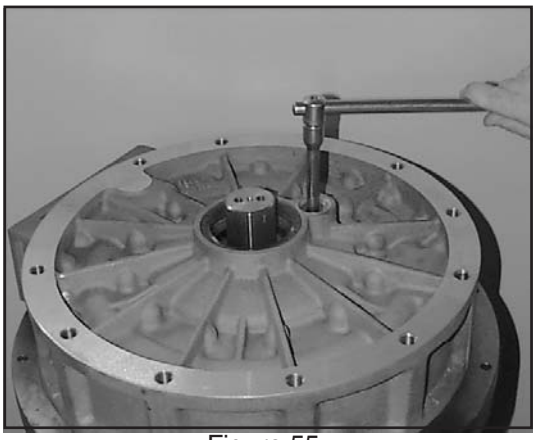
.


Figure 53

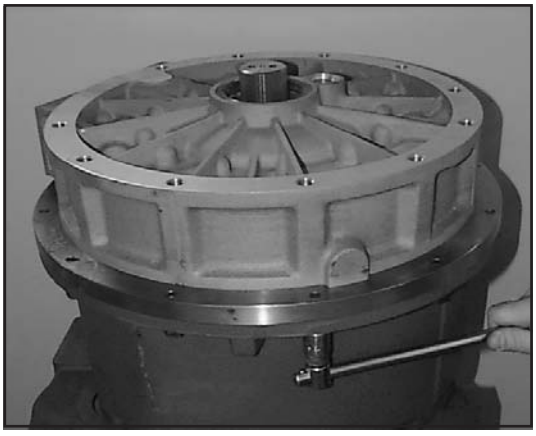
Loosen screw plug.


Figure 54

Loosen the first hex. head screw and remove it by means of magnetic rod.
Demount the remaining hex. head screws accordingly


Figure 55

Loosen screw connection.


Figure 56

Mark the radial installation position of the retarder to the converter connecting housing !

Separate the complete retarder from the converter connecting housing, using lifting device.

(S) Set of eye bolts 504182



Figure 57

Loosen socket head screws, separate spacer ring from stator housing.

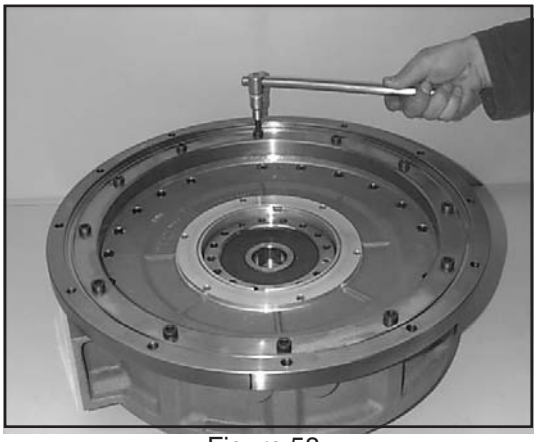


Figure 58

Loosen socket head screws and separate cover from stator housing.

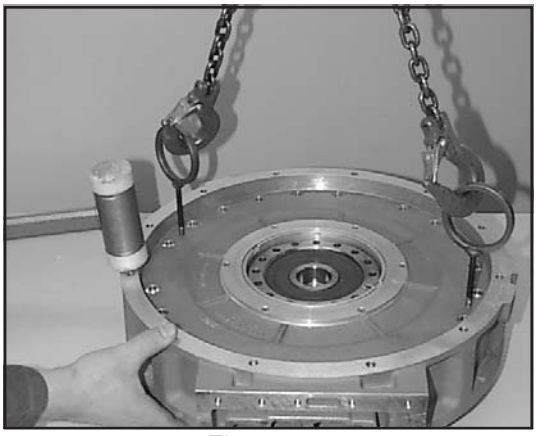


Figure 59

Drive flange shaft out.

Pay attention to the released components !

(S) Plastic mallet 504196

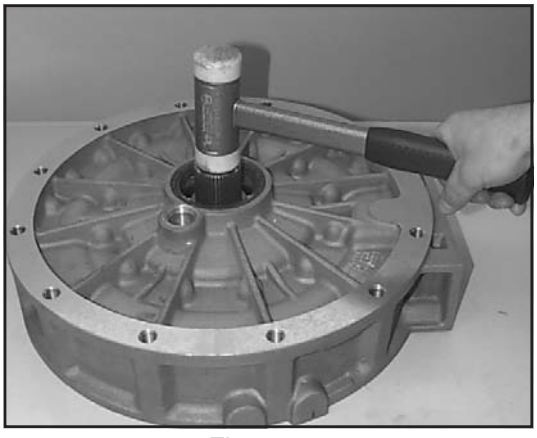


Figure 60

Separate rectangular ring from rotor.

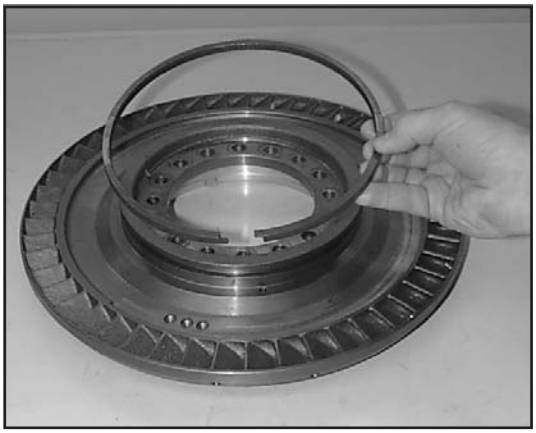


Figure 61

Remove the rectangular ring on the opposite side.
If necessary, separate the ring (Arrow) from the rotor.

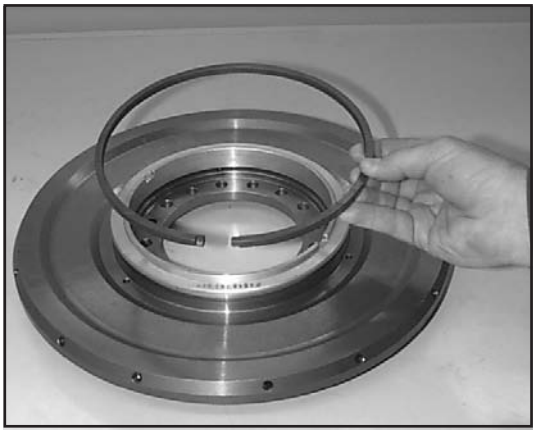


Figure 62

Loosen hex. head screws and remove thrust ring.

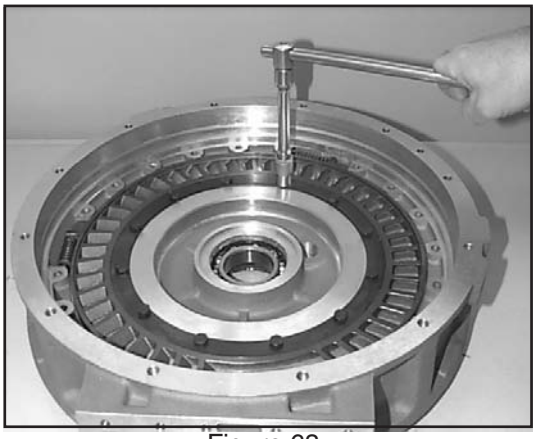


Figure 63

Remove stator ring.

Pay attention to the released components !

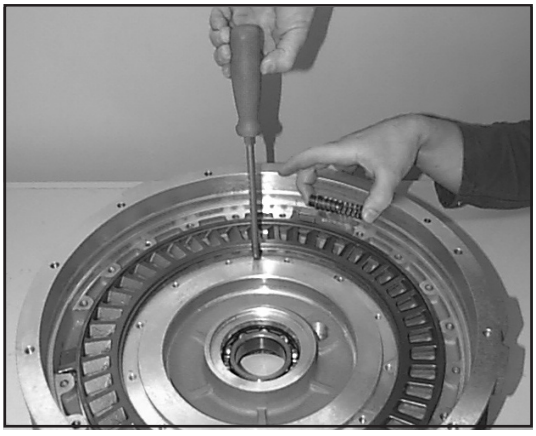


Figure 64

Pry shaft seal out of the bore.

(S) Pry bar 504209

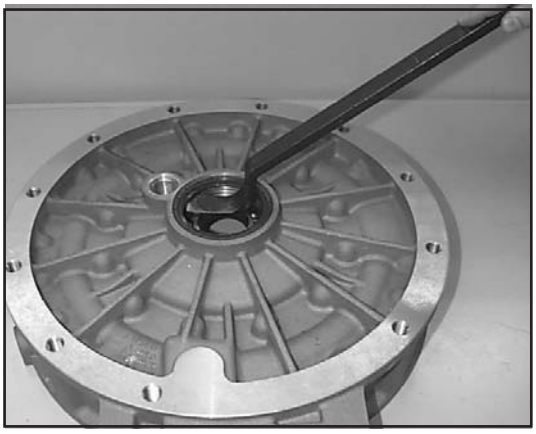


Figure 65

Drive ball bearing out.

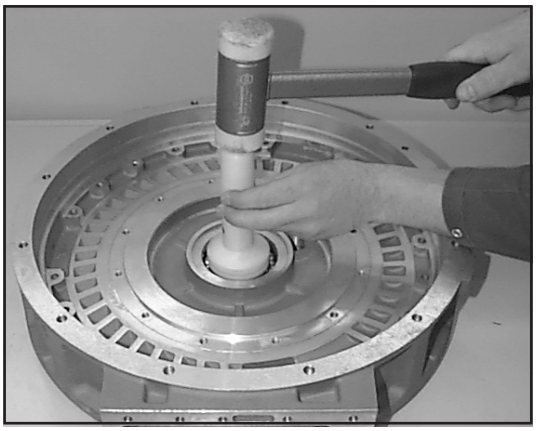


Figure 66

ASSEMBLY

Insert ball bearing until contact is obtained.

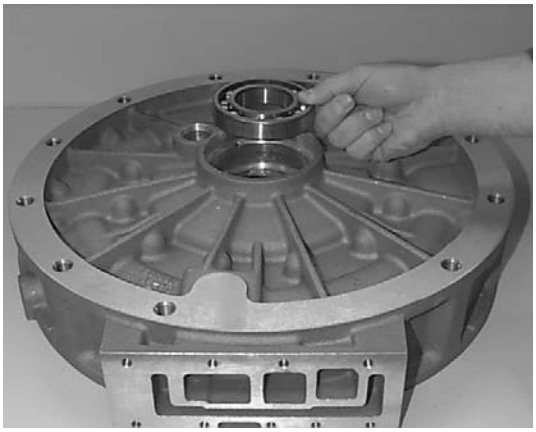


Figure 71

Insert ball bearing until contact is obtained.

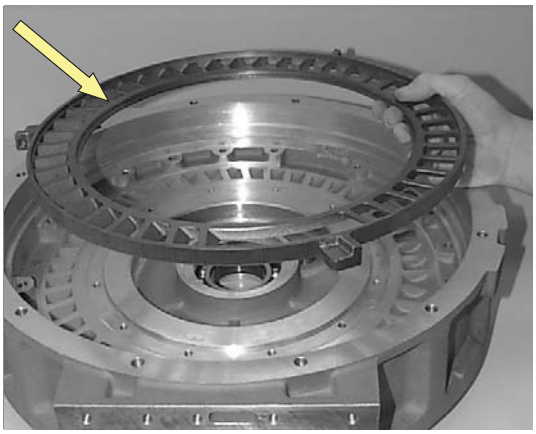


Figure 72

Fasten thrust ring by means of hex. head screws.

Torque limit (M8/8.8) .....23 Nm

Pay attention to the installation position – shoulder (Arrow) is showing upward !
Secure hex. head screws with Loctite (Type-No. 243) !

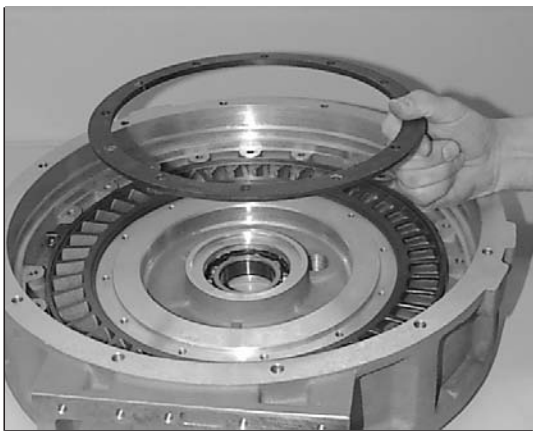


Figure 73

Pre-assemble dampers (3 pieces) according to Figure 25 and Figure 26.

The Installation dimension B = 1,6 $^{+0,5}$ mm results from the alternating stacking of the cup spring packs (8 packs with 6 cup springs each) !

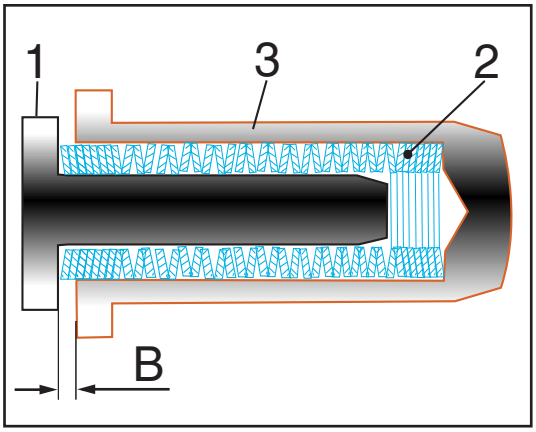


Figure 74

Ref. Figure 74 and 75:

1 = Guide pin
2 = Cup spring packs (8 packs with 6 cup springs each)
3 = Spring guide
4 = Compression spring
5 = Spring guide

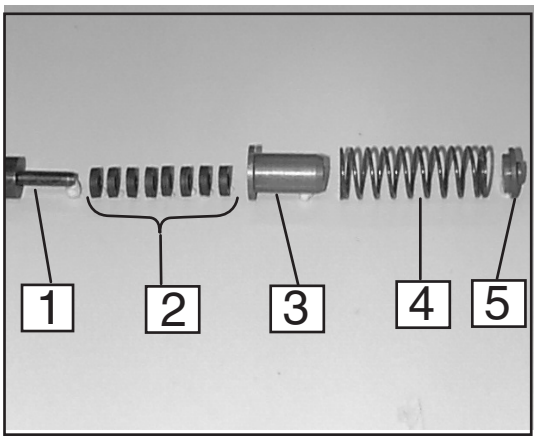


Figure 75

Install the pre-assembled dampers, see Arrows.

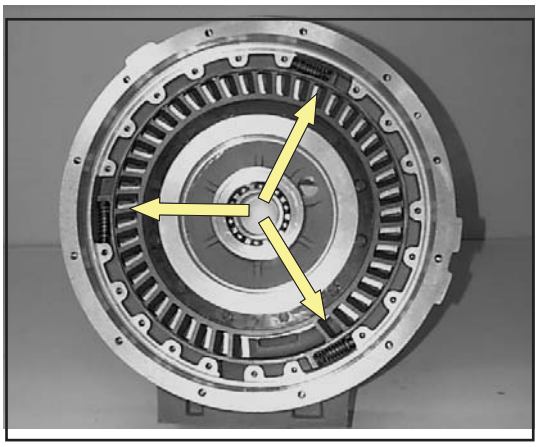


Figure 76

Introduce rectangular ring into the recess of the rotor (Figure 77) and preload it by means of cylindrical pins Æ 6 mm (assembly aid), see Figure 78 !

Install rectangular ring with the marking „Top“ see Arrow, showing upward (to the prime mover) !

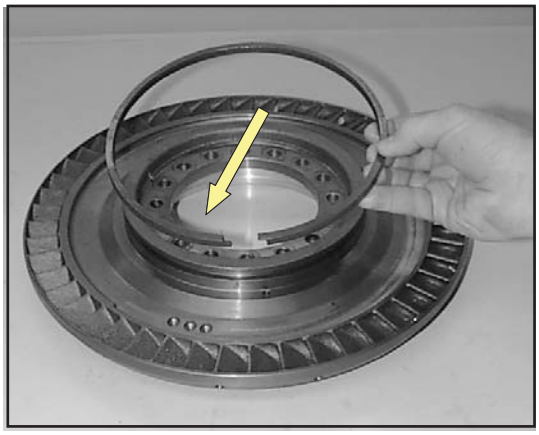


Figure 77

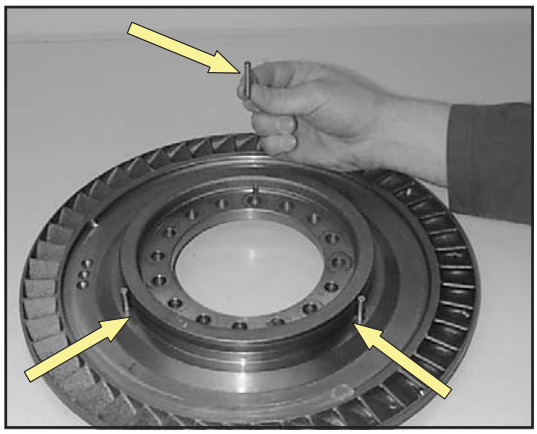


Figure 78

Grease rectangular ring.
Introduce rotor into the stator housing until contact is obtained and remove cylindical pins again.

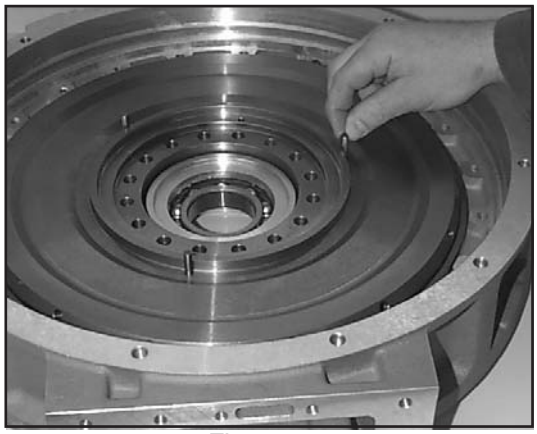


Figure 79

Grease rectangular ring.

Introduce rotor into the stator housing until contact is obtained and remove cylindical pins again.

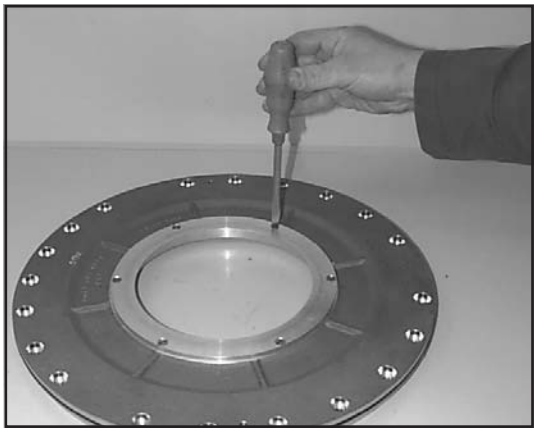


Figure 80

Insert ring into the cover, with the oil grooves showing downward.



Figure 81

Introduce rectangular ring.

Install rectangular ring with the marking „Top“ see Arrow, showing upward (to the prime mov er) !

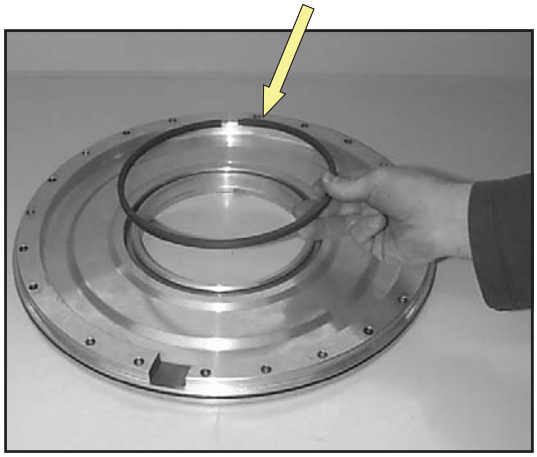


Figure 82

Insert O-ring into the annular groove of the cover (Arrow) and grease it.

Install two adjusting screws and pull cover uniformly against shoulder, using 3 socket head screws.

Pay attention to the radial installation position !

(S) Adjusting screws M8 504185

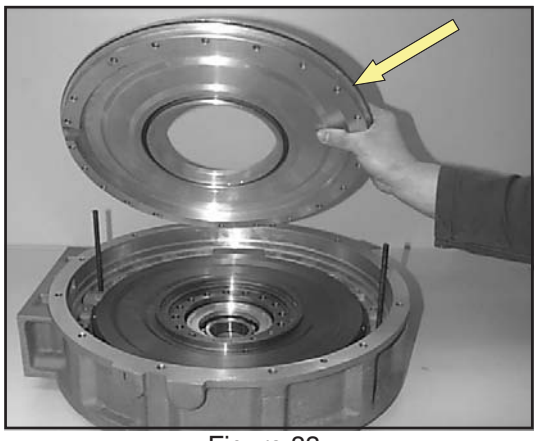


Figure 83

Fasten cover finally by means of socket head screws (install flat washers).

Secure socket head screws with Loctite (Type-No. 243) !

Torque limit (M8/10.9) ..... 23 Nm

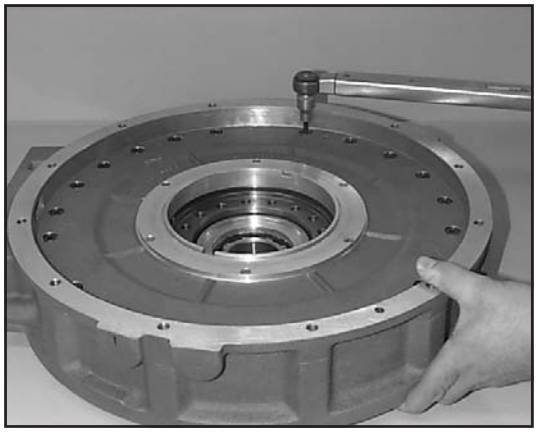


Figure 84

Adjust Rotor dimension

(distance between Rotor – Stator ring) = 1,5 ... 2,0 mm

(Figure 85 ... 89):

Line up axial washer s = 1,0 mm, axial roller cage and housing disk s = 5,75 mm.

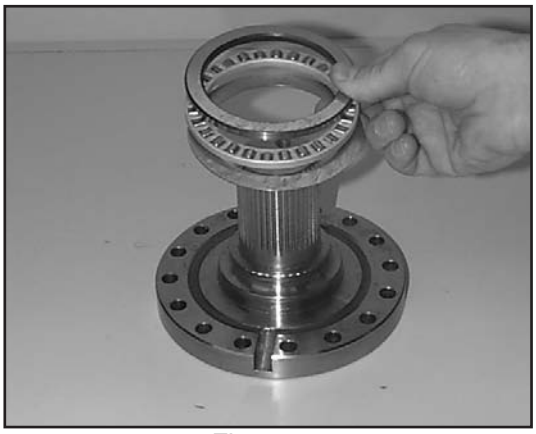


Figure 85

Determine Dimension I from the housing disk to the mounting face.

Dimension I e.g. ..... 13,10 mm

(S) Digital Depth gauge 504175

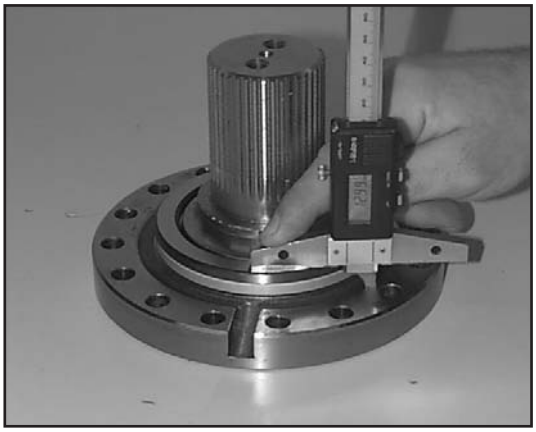


Figure 86

Determine Dimension II from the mounting face (flange shaft) to the plane face/stator (contact face – axial bearing).

Dimension II e.g. ..... 14,00 mm

EXAMPLE A:

Dimension II		14,00 mm
Dimension I	–	13,10 mm
Difference		0,90 mm
Rotor play e.g.	+	1,60 mm
gives Shim e.g.	s =	2,50 mm

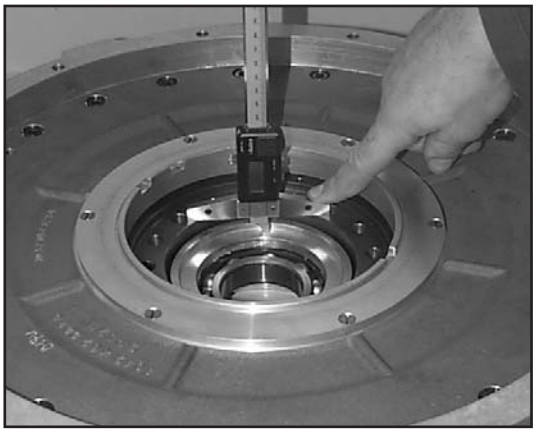


Figure 87

Insert housing disk s = 5,75 mm, axial roller cage and axial washer s = 1,0 mm..

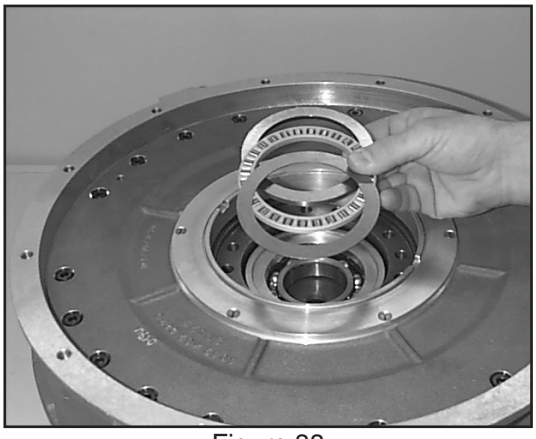


Figure 88

Mount shim s = 2,5 mm (see Example A, Figure 85 - 88

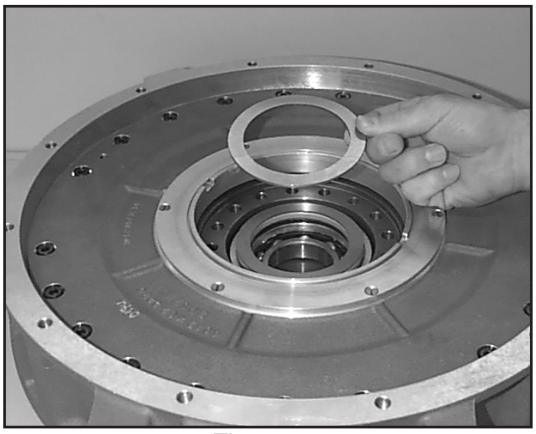


Figure 89

Adjust Axial play – Ball bearing 0,10 ... 0,20 mm
(Figure 90 ... 93):

Check exact contact of ball bearing (Arrow) once more and place pre-assembled stator housing over the plug gauge.

The ball bearing must be resting on the whole plane face (bearing inner and outer race) !

(S) Plug gauge 504178

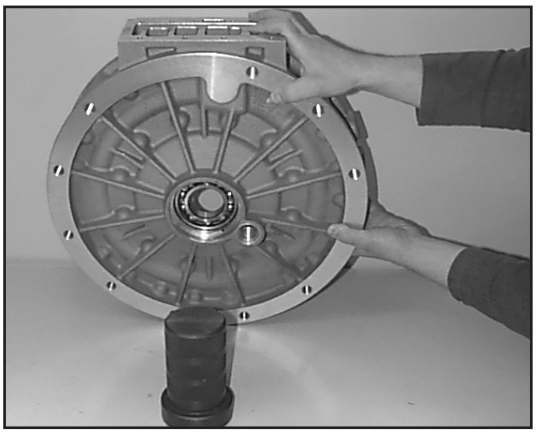


Figure 90

Determine Dimension I from the shim to the bearing inner race.

Dimension I e.g. ..... 25,20 mm

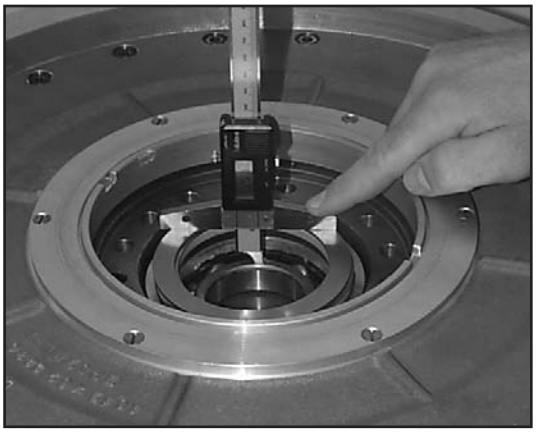


Figure 91

Determine Dimension II from the locating face (ball bearing) to the contact face (shim).

Dimension II e.g. ..... 25,05 mm

EXAMPLE B_1:

Dimension II - Dimension I **= Dimension X**
25,05 mm - 25,20 mm **= - 0,15 mm**

Minus dimension (X = - 0,15 mm) corresponds with the pressure !

EXAMPLE B_2:

Required play - Dimension X **= Shim**
0,15 - (- 0,15) **= 0,30 mm**

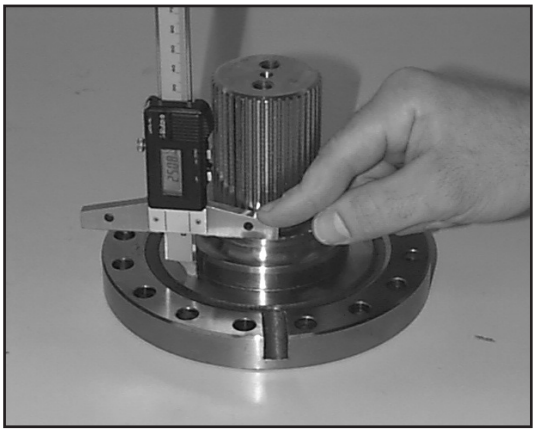


Figure 92

Mount shim s = 0,3 mm (see Example $B_{2,}$ Page 2.11) with grease.

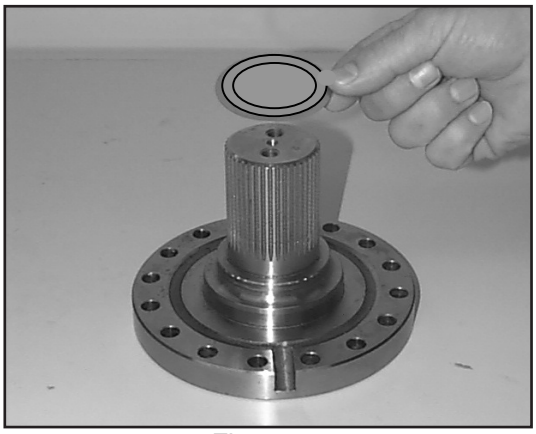


Figure 93

Heat bearing inner race.

(S) Hot-air blower 230 V 504193
(S) Hot-air blower 115 V 504194

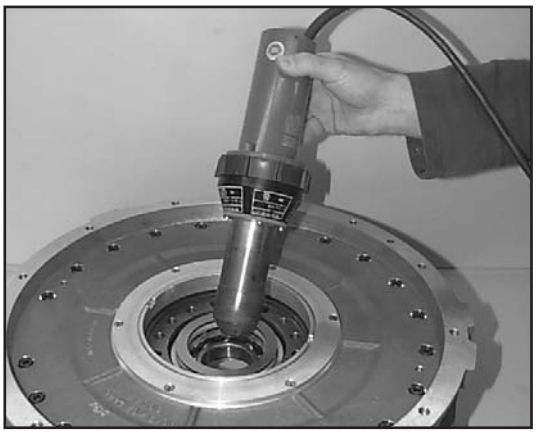


Figure 94

Introduce flange shaft until contact is obtained.

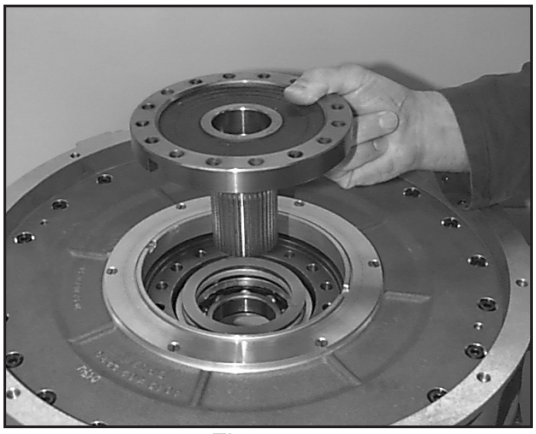


Figure 95

Install shaft seal (Arrow), using driver.

At application of the prescribed driver (S), the exact installation position is obtained !
Grease the sealing lip of the shaft seal !
Wet outer diameter with spirit !

(S) Driver 504163

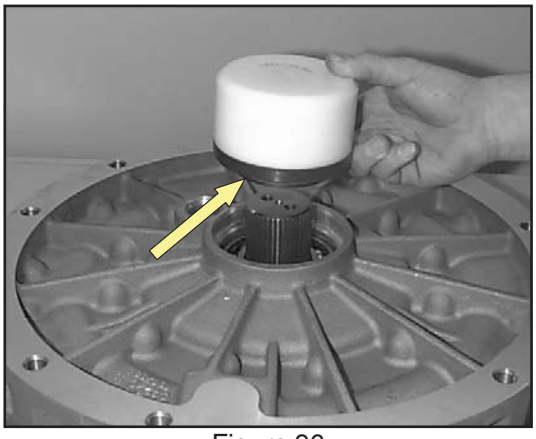


Figure 96

Clean O-ring.

O-ring groove must be perfectly clean

Grease O-ring (Arrow) and insert it into the annular groove of the spacer ring.

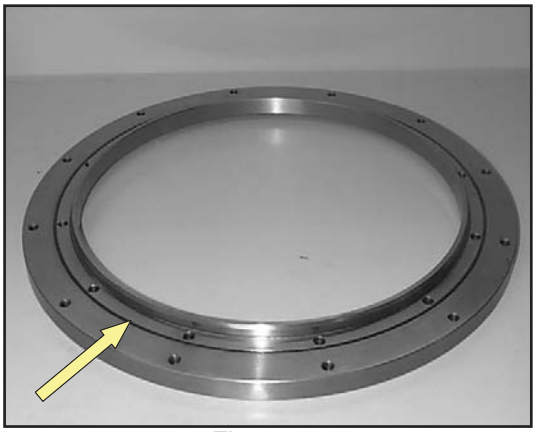


Figure 97

Fasten spacer ring by means of socket head screws.

Torque limit (M10/8.8, DIN 6912) ..... 46 Nm
and secured with Loctite 262.

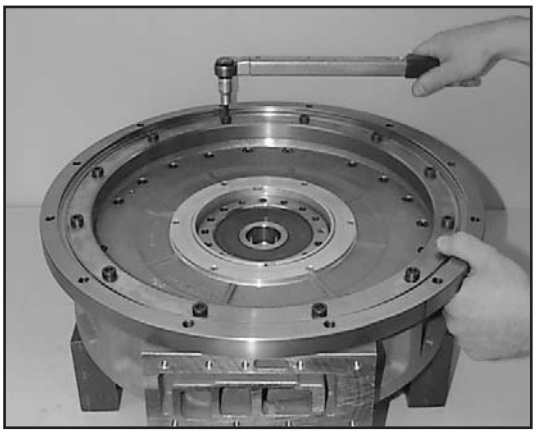


Figure 98

Insert O-ring (Arrow) into the annular groove of the converter bell.

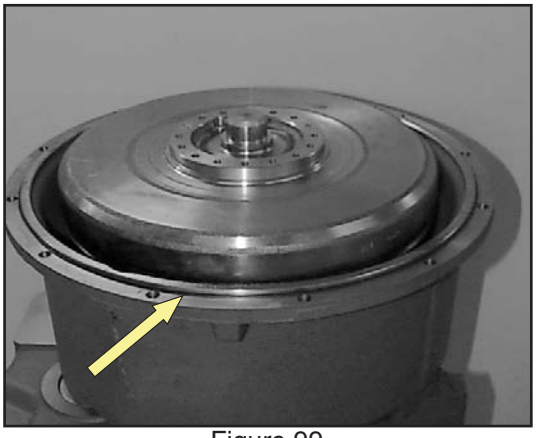


Figure 99

Place the complete retarder on the converter bell until contact is obtained, using lifting device, and fasten it by means of hex. head screws.

Pay attention to the radial installation position of the retarder.
Binding are the Specifications of the Vehicle Manufacturer, resp. the markings applied at the disassembly !

Torque limit (M12/8.8) ..... 79 Nm
(S) Set of eye bolts 504182



Figure 100

Fasten rotor and flange shaft on the converter, using hex. head screws.

Tighten hex. head screws uniformly (180° displaced) as well as secure them with Loctite (Type-No. 243) !

Torque limit (M10/8.8) ..... 46 Nm

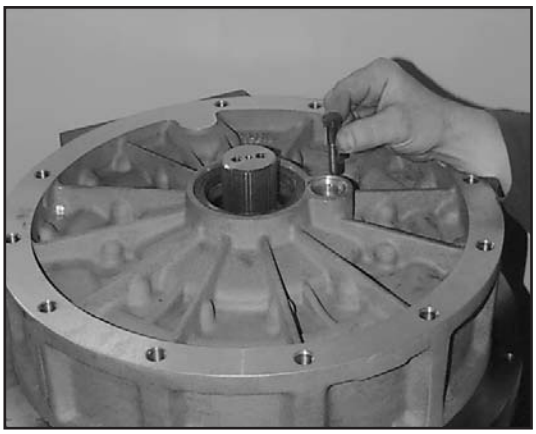


Figure 101

Equip screw plug with new O-ring and install it.

Torque limit (M30x1,5) ..... 90 Nm

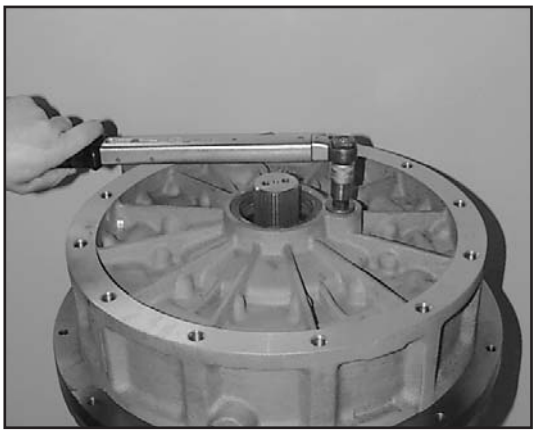


Figure 102

Line up shim (s = 1,5 mm).

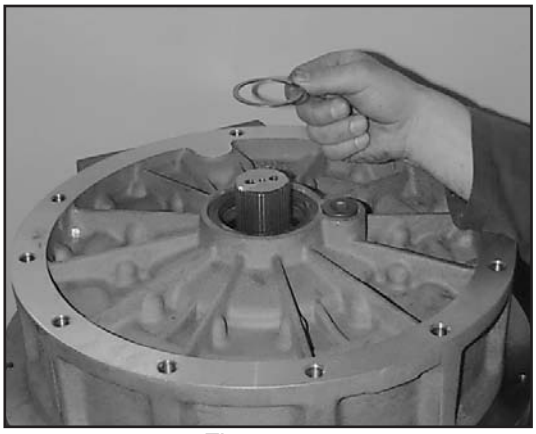


Figure 103

Install dust plate (Arrow).

At application of the prescribed driver (S), the exact installation position is obtained !

(S) Driver 504221

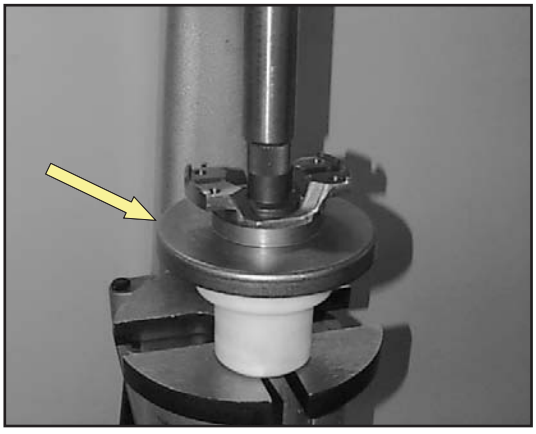


Figure 104

Line up input flange and fasten it by means of disk and hex. head screws.

Wet contact face of the disk with Loctite (Type-No. 574) !

Torque limit (M10/8.8) ..... 46 Nm

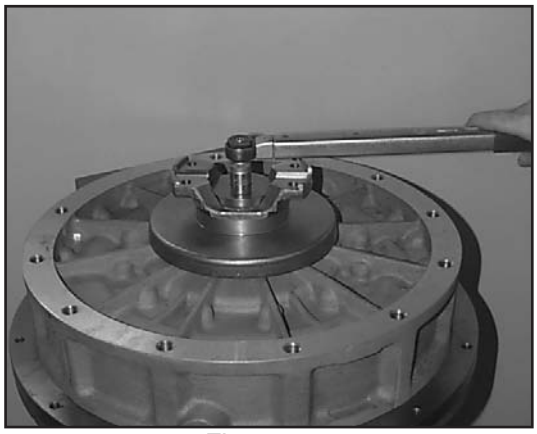


Figure 105

Fix hex. head screws with lock plate.

(S) Driver	504167
(S) Handle	504195

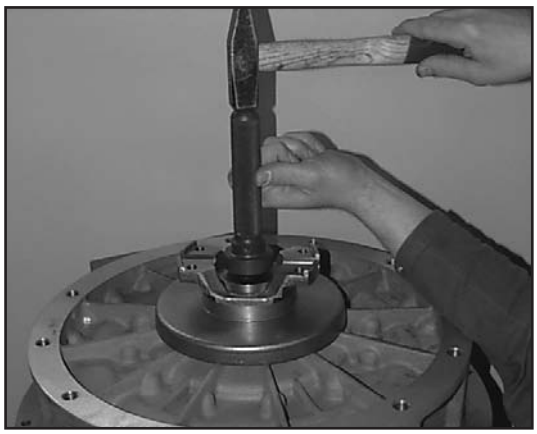


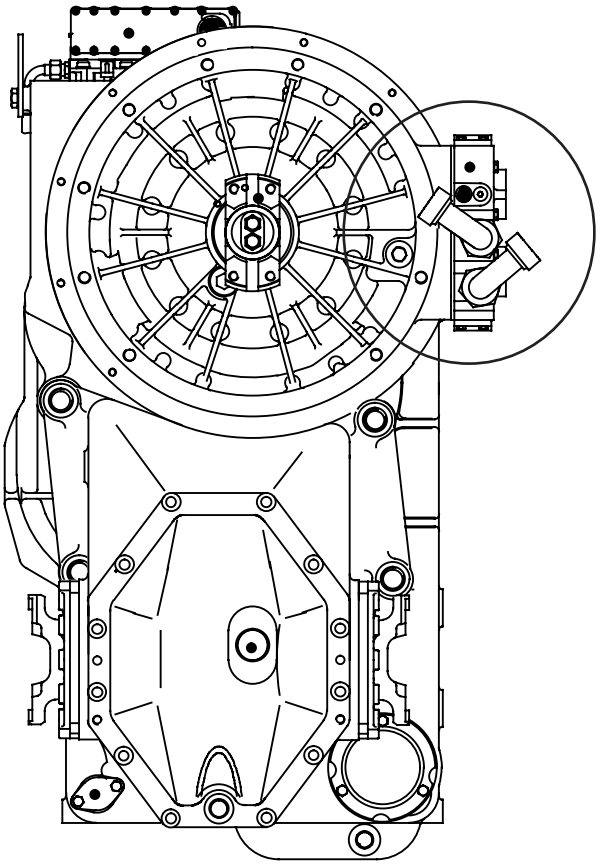
Figure 106

Retarder valve

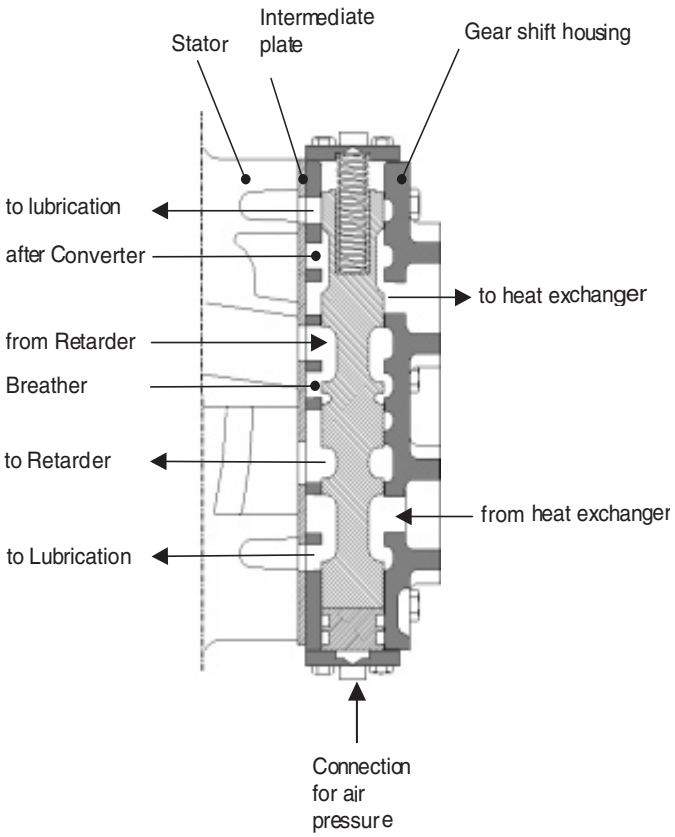
The braking procedure itself will be started via a hand- or foot-actuated control valve.
With this valve it is possible to adjust a certain air pressure and with it the desired brake performance infinitely variable. The possible air pressure value is in this situation between 3,5 and 8 bar, because only from about 3 bar on, the existing preload of the cooling circuit is overcome.
The retarder control valve, pressurized with this compressed air, released by it the correspon-ding oil stream into the retarder circuit.

Due to the rotation and the impeller configuration of the rotor, the oil will be directed into the stator and comes from there back again to the rotor, in order to start the circuit anew (see Draft).

Due to the actual reversion of the oil, the rotary motion of the rotor and with it the speed of the vehicle will be retarded.
This energy, converted in this way from speed into pressure, will be finally transfered by fluid friction into thermal energy and then delivered via a heat exchanger to the cooling water.
If during the retarder operation the shift clutch will be actuated, a 3/2-way valve is blocking the compressed air supply to the control valve, in this way, the retarder will be cut-off, thus saving the shift clutch.

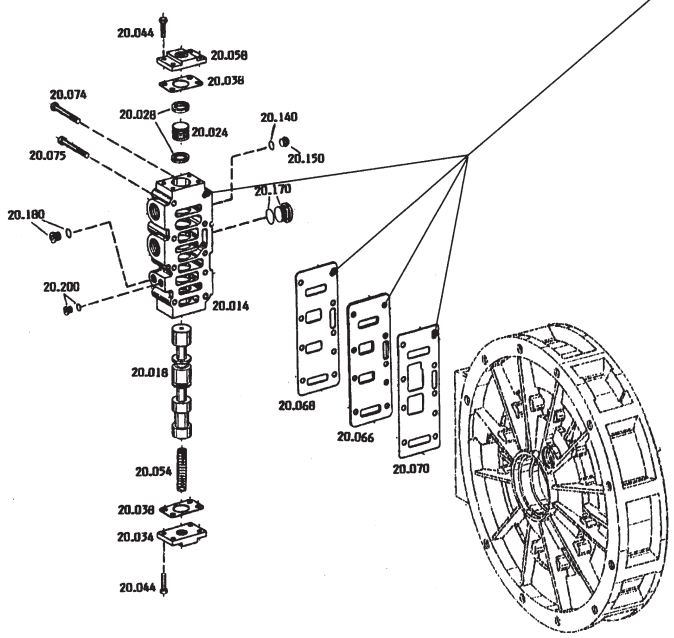


Retarder valve not connected



Special tool - Press. regulator

504185



Pre-assemble and mount Retarder:

Install components according to Figure 107 and 108.

1	=	Selector housing	
2	=	Screw plug (M14x1,5,	Torque limit 35 Nm
3	=	Screw plug (M26x1,5,	Torque limit 80 Nm
4	=	Screw-in sleeve	
5	=	Temperature sensor	Torque limit 35 Nm
6	=	Screw plug (M14x1,5,	Torque limit 35 Nm

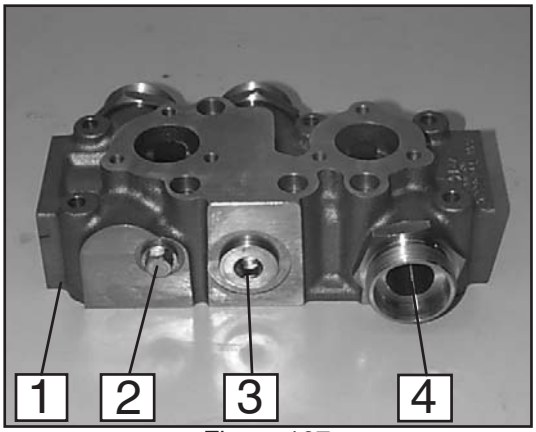


Figure 107

Equip screw plugs (2, 3 and 6) as well as temperature sensor (5) with new O-rings !
Wet thread of the screw-in sleeves (4) with Loctite (Type-No. 262) !

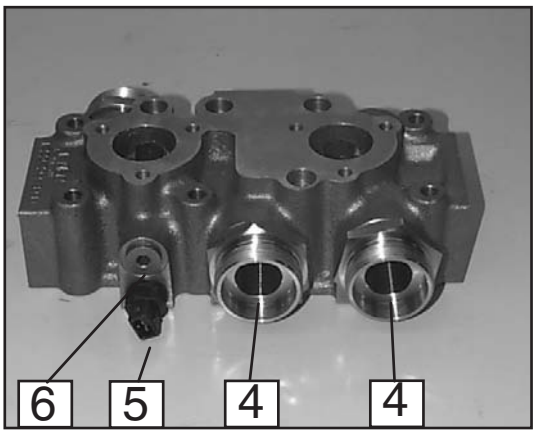


Figure 108

Install components according to the Figure on the left:

1	=	Selector housing
2	=	Cover
3	=	Gasket
4	=	Compression spring
5	=	Spool
6	=	Spool
7	=	Grooved rings (2x)
8	=	Gasket
9	=	Cover (with pressure port)

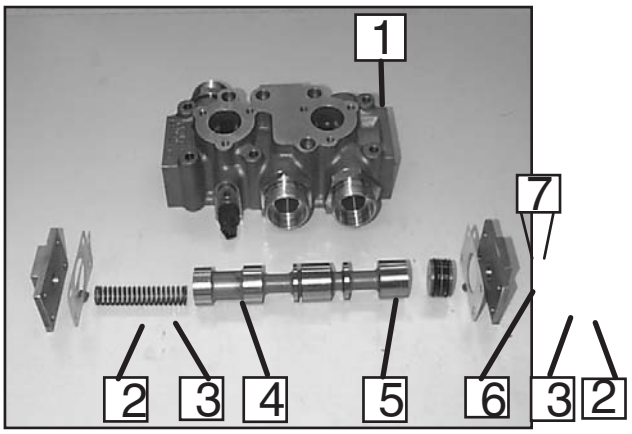
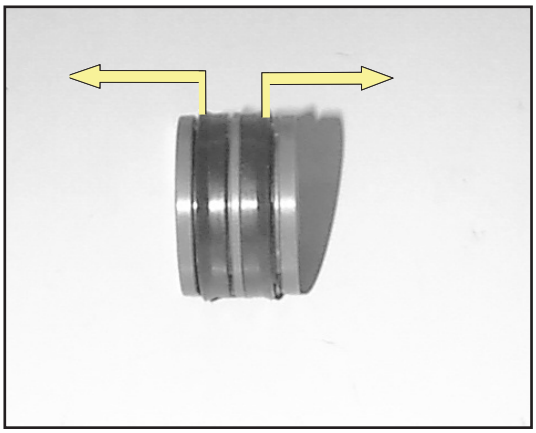


Figure 109

Install grooved rings 7, with the sealing edge always showing in Arrow direction, see Figure 110 !


Figure 110

Install two adjusting screws and line up the gasket.

(S) Adjusting screws M8 504185

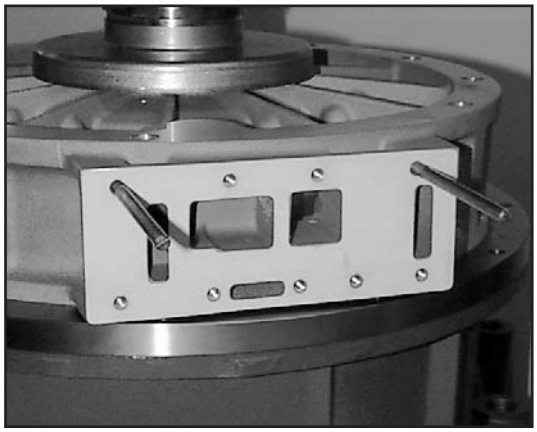


Figure 111

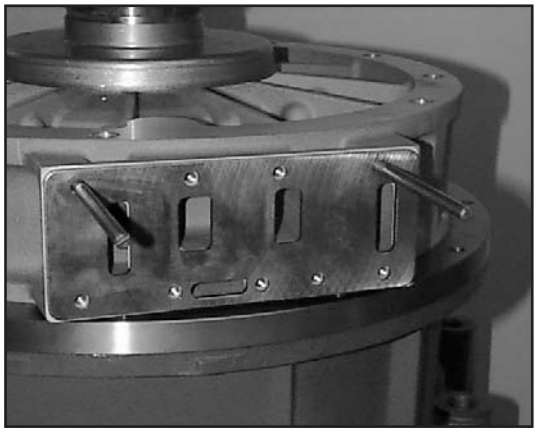


Figure 112

Install 2nd gasket.

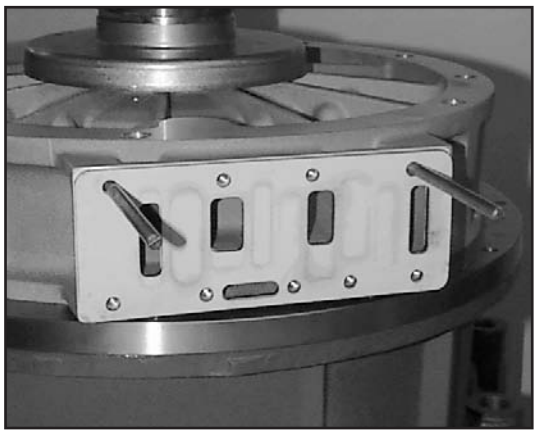


Figure 113

Line up the pre-assembled selector housing and fasten it with hex. head screws and socket head screws.

Torque limit (M8/8.8) ..... 23 Nm

Install retarder - oil lines according to the Perspective Illustration of the respective Spare Parts List.

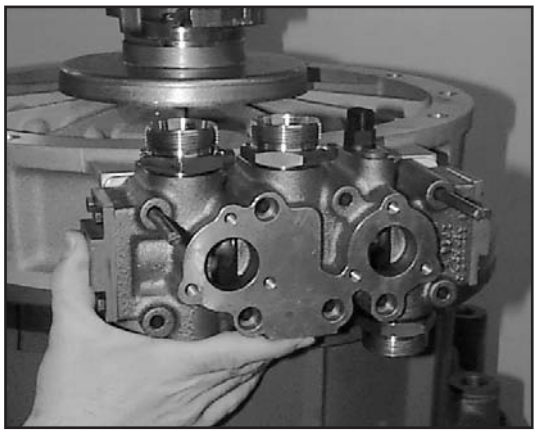
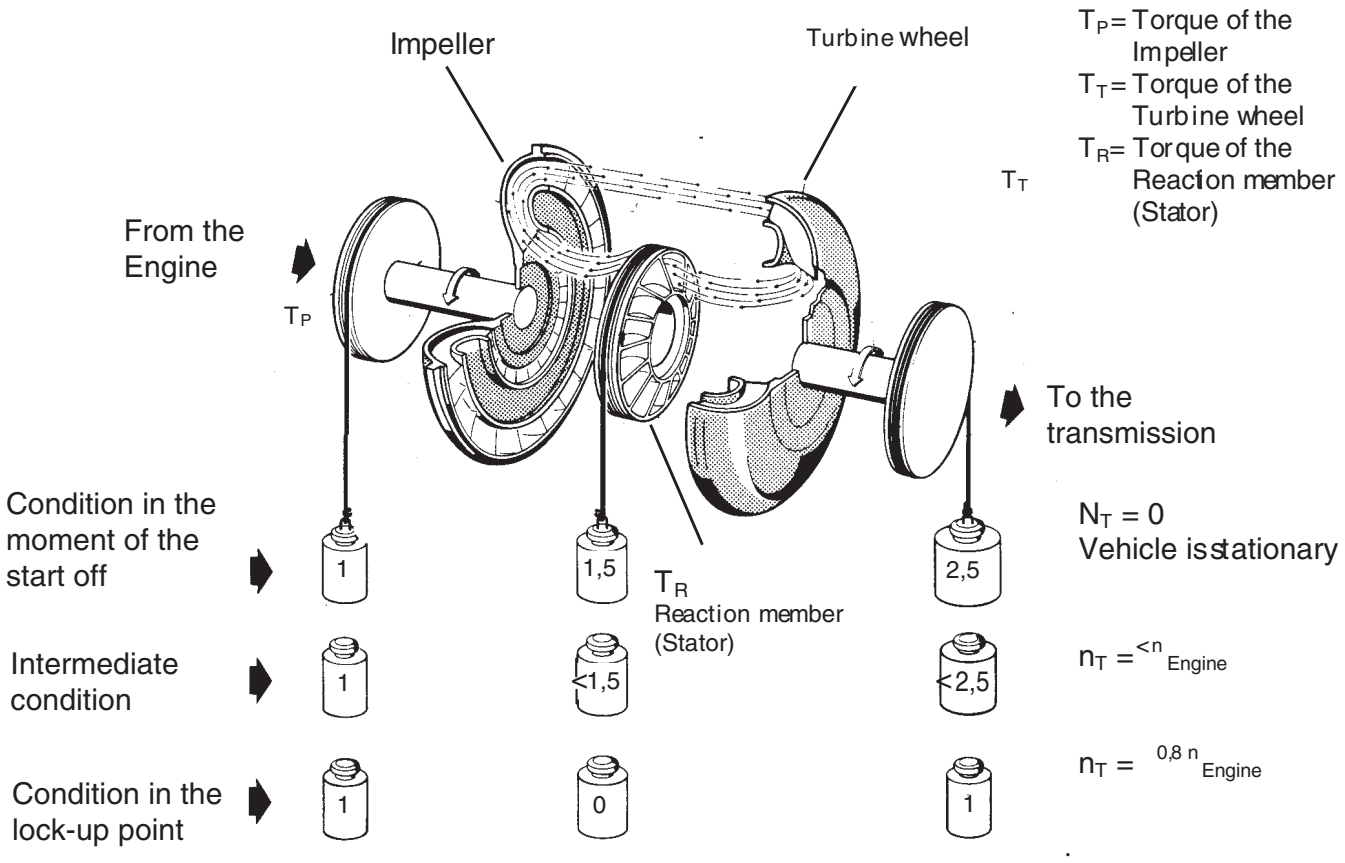


Figure 114

Converter

Function of the Converter:

FUNCTION OF A HYDRODYNAMIC TORQUE CONVERTER (SCHEMATIC VIEW)



The converter is working according to the Trilok-System, i.e. it assumes at high turbine speed the characteristics, and with it the favourable efficiency of a fluid clutch.
The converter is designed according to the engine power so that the most favourable operating conditions are obtained for each installation case.

The Torque converter is composed of 3 main components:

Impeller – Turbine wheel – Stator (Reaction member)

These 3 impellers are arranged in such a ring-shaped system that the fluid is streaming through the circuit components in the indicated order.

Pressure oil from the transmission pump is constantly streaming through the converter. In this way, the converter can fulfill its task to multiply the torque of the engine and at the same time, the heat created in the converter is dissipated via the escaping oil.
The oil which is streaming out of the impeller, enters into the turbine wheel and is there rever-sed in the direction of flow.
According to the rate of reversion, the turbine wheel and with it also the output shaft is receiv-ing a more or less high reaction moment.

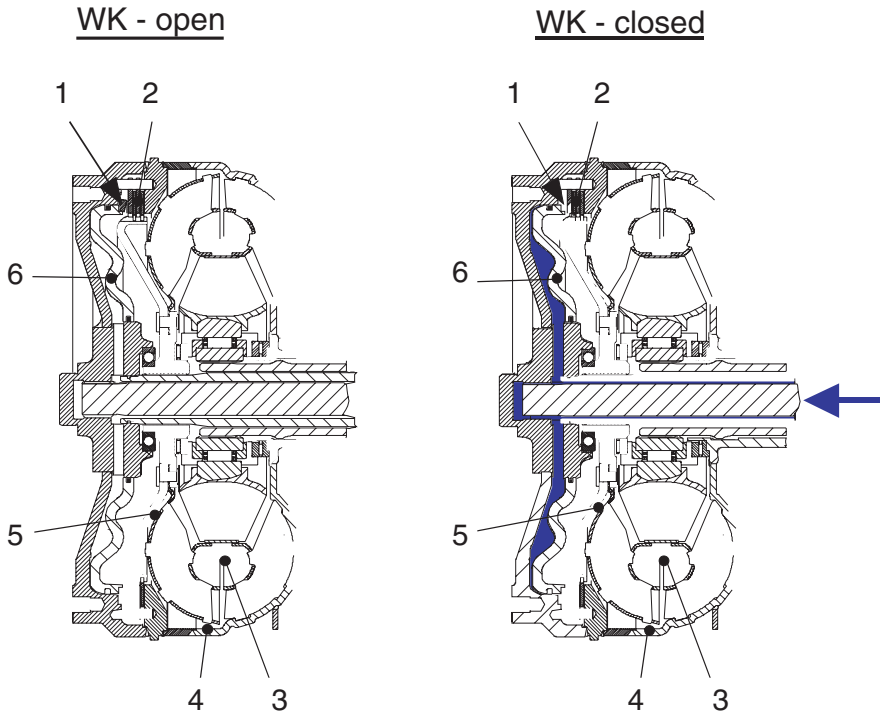
The stator (reaction member) following the turbine, has the task to reverse the oil, streaming out of the turbine once more and to deliver it under the suitable discharge direction to the im-peller.

Due to the reversion, the stator is receiving a reaction moment.
The relation turbine moment/impeller moment is called torque multiplication. This is the hig-her, the greater the speed difference of impeller and turbine wheel will be.

Therefore, the maximum torque multiplication is created at stationary turbine wheel.
With increasing output speed, the torque multiplication is decreasing. The adaption of the output speed to a certain required output moment will be infinitely variable and automatically achieved by the torque converter.
When the turbine speed is reaching about 80% of the impeller speed, the torque multiplication becomes 1,0 i.e. the turbine moment becomes equal to that of the impeller moment.
From this point on, the converter is working similar to a fluid clutch.

A stator freewheel serves to improve the efficiency in the upper driving range, in the torque multiplication range it is backing-up the moment upon the housing, and is released in the clutch range.
In this way, the stator can therefore rotate freely.

Converter (WK)



At closed WK, the slip between impeller and turbine wheel, and with it the hydraulic loss in the converter is equal to „Zero“ (see Figure WK-open/closed)

The WK will be automatically shifted dependent on the turbine speed.
The pressure oil (12 + 2 bar) for the closing of the WK, is directed via a solenoid shift valve (see Figure next page) to the piston (6), which is compressing the plate pack.

Removal of transmission, ass'y

NOTE!
Place the dump truck on level ground and apply parking brake

Start with the propeller shaft in the articulation hinge.

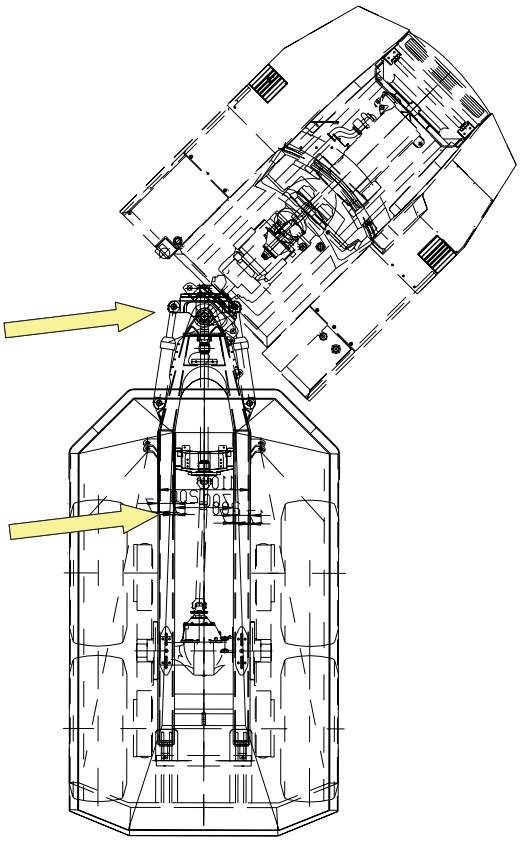
For best working, start the engine and turn the machine to full right direction.

Release articulation propeller shaft from the transmission output flange.
Start the engine and line up the machine

Apply articulation lock.

Turn off main switch in battery case.

Raise the dump body and lock it with the safety support.



Place wheel chocks to the front wheel

Prepare to drain the hydraulic oil:

By pumping a several times (20 - 25) with the brake pedal, to emptying the 5 brake accumulators.



Drain both hydraulic oil reservoirs, see chapter 7 maintenance - 2000 hour service in the Operating & Maintenance Manual.

1 Main reservoir
2 Emergency steering reservoir

(**Oil capacity approx. 190-200 l.)**

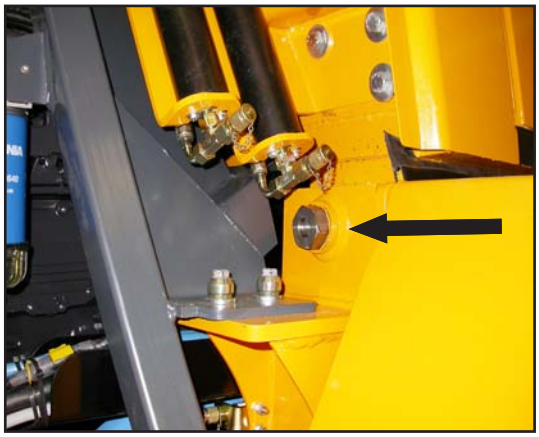
NOTE:
See in the hydraulic chapter about the filling procedure.



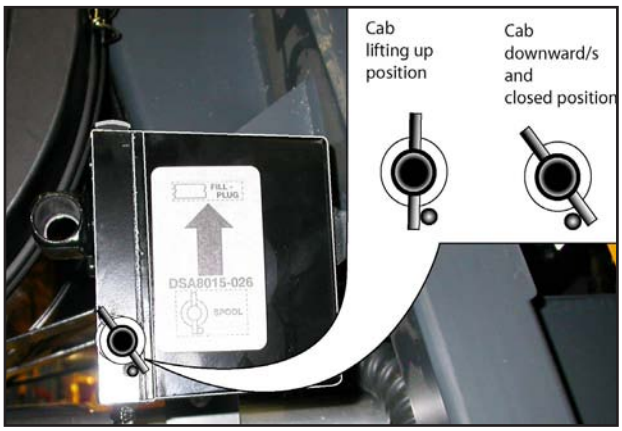


Tilting the cab:
Open the bonnet and take away the cab bolt, left and right hand side.

Nv 46 mm



Turn the direction valve on the pump in lifting up position.



With the handle, pump and raise the cab.

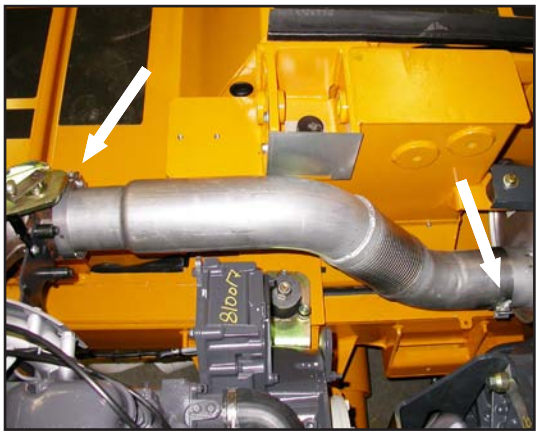
When lower the cab, turn the direction valve to the down position and with the handle lower the cab.





Disassemble the exhaust parts

Disassemble the front V-clamp and the rear clamp, remove the exhaust pipe.



Disassemble the rear pipe V-clamp and the front and rear suspensions.

Screw M12x30 ISO4017-10.9

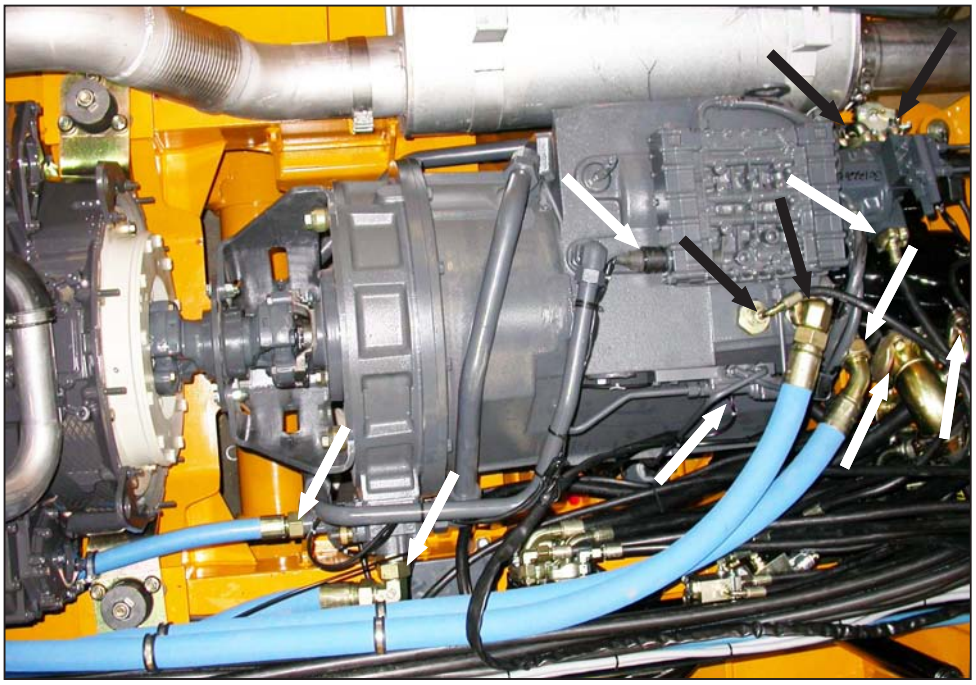
Lift out the muffler with the suspension bracket



Disassemble of the hydraulic hoses at the transmission

Realease all (19 pcs) of the hydraulic hoses connected to the transmission.

Realease all of the wiring on the electrical points. (Total included ground cabel are 11 electrical connections have to disconnected.)

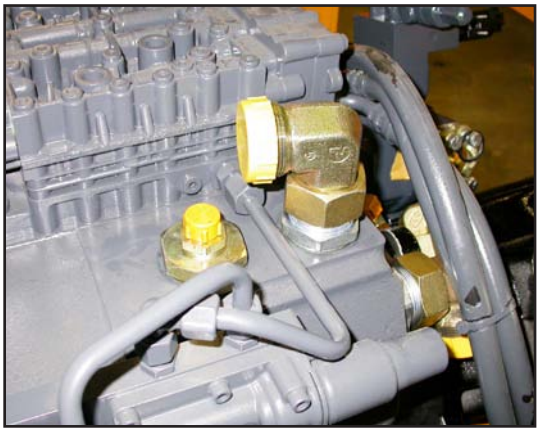


Disconnect both of the hoses and the L-nipple from the emergency steering pump from the articulated hinge side.

Protect the hydraulic nipple on the pump with plastic plug or similar.

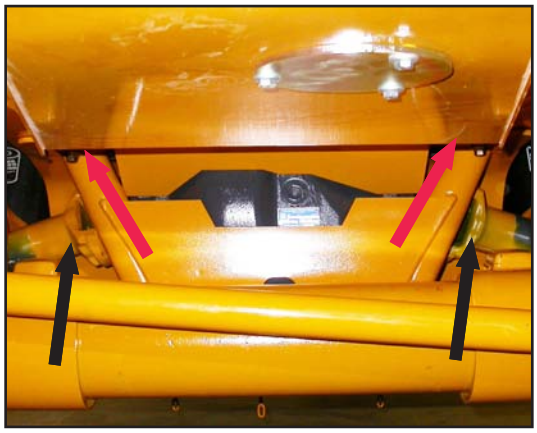
NOTE!
Remember to mark the hoses.



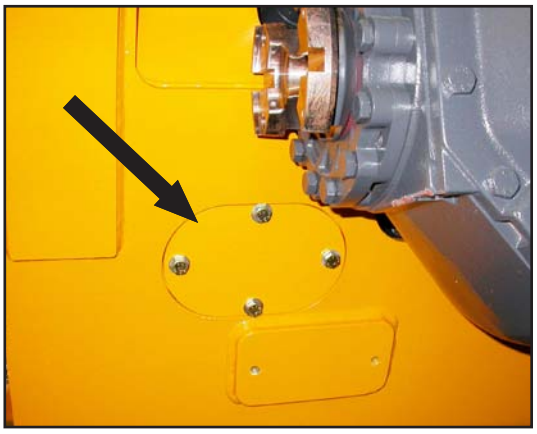


Dismount the protection guard for the diff and both front axle propeller shaft at differential side.

From machine 810013 are screws for the propeller shaft changed to UNF thread on outer and inner sides:



- **When assembling, use Loctite 262 or ThreeBond medium 1374 on thread.**
- **Tightening torque (1/2" x 2 1/4" -10.9 UNF): 120 Nm.**



Remove from the rear bottom guard the inspection cover plate (arrow).



Disassemble the lower rear transmission attachment.
If shim are assembled, use the shims at the same place when assemblying.

Hold with combonation wrench 36 mm and from the lower side, trough the opening the bottom guard use standard tool as shown at the picture.

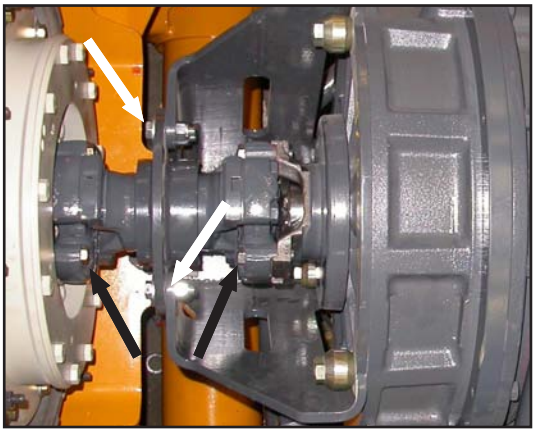
Assembly:
Torque limit: 960 Nm



Pipe 36 mm ¾#
Extension L= 4"
Arm with ¾#
Combination wrench 36 mm



Dismount the axle catcher bow. (white arrow)



Dismount converter prop. shaft. (red arrow)

Front screw: M12x50 ISO4014-10.9 EL

Rear screw: ½" UNF x2" NS 965--8.8

Disassemble the front transmission bracket attachment.

If shim are assembled, use the shims at the same place when assemblying.

Use standard tool as shown on the picture below or similar.



Assembly:
Torque limit 560 Nm



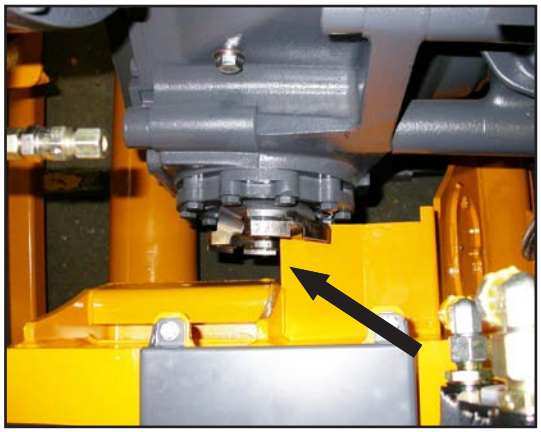
Pipe 30 mm ¾#
Extension L= 4"
Arm with ¾#
Combination
wrench 30 mm

Check around the transmission that all connections to the front frame equipment not are connected to the transmission.

Assemble the lifting device and start lifting the transmission out of the frame.

Carefylly !

Be aware that the transmission have to be moved frontwards, twisted to the right side on front. In this position carefully lift up the transmission.
Be specially aware of the transmission differential otput flange and the back side.



Picture show the left side, front diff, output flange.

Place the transmission safely on a rack or similar.

Secure the transmission.

Manual transmission

Disassembly

Fasten the complete transmission on the assembly car.

(S) Assembly car	504213
(S) Support	504214

Remove all oil lines.

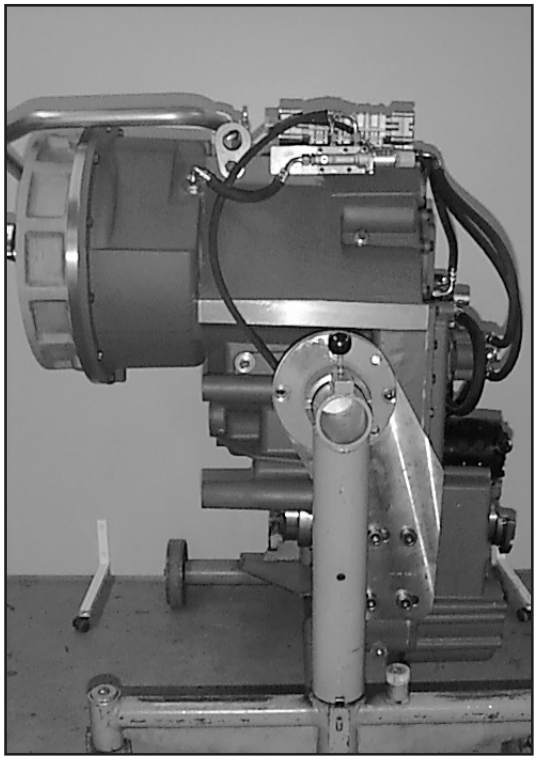
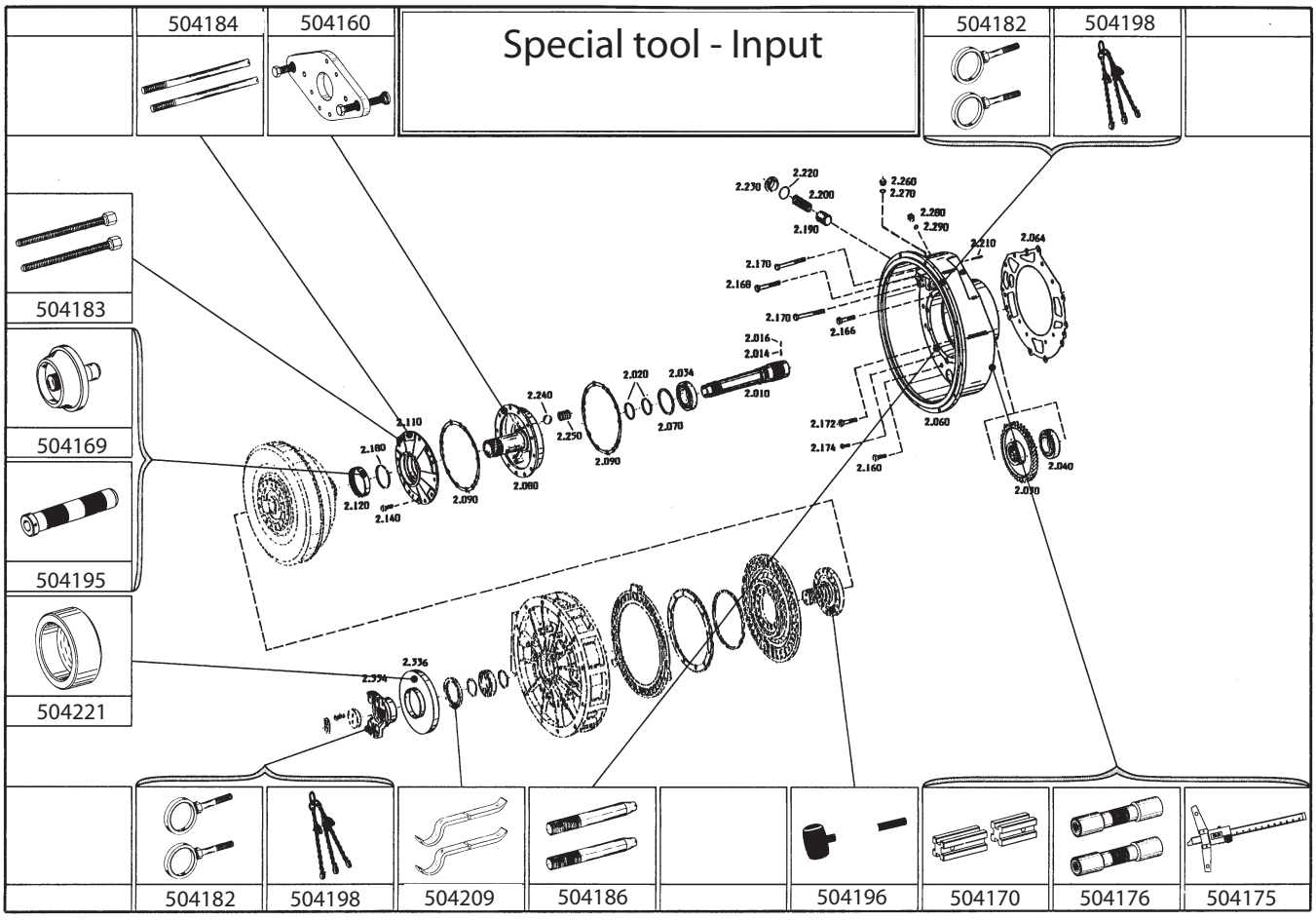


Figure 120



Loosen hex. head screws and lift complete retarder along with converter out of the converter bell using a lifting device.

(S) Lifting chain 504198
(S) Set of eye bolts 504182

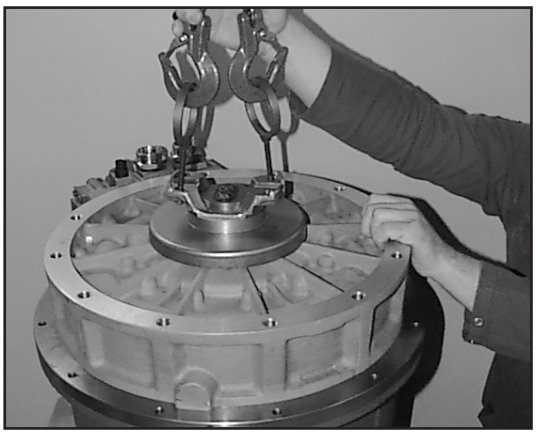


Figure 121

Drive

Unfix screw union and separate cover from converter bell by means of forcing screws (3xM10).

(S) Forcing screws 504183

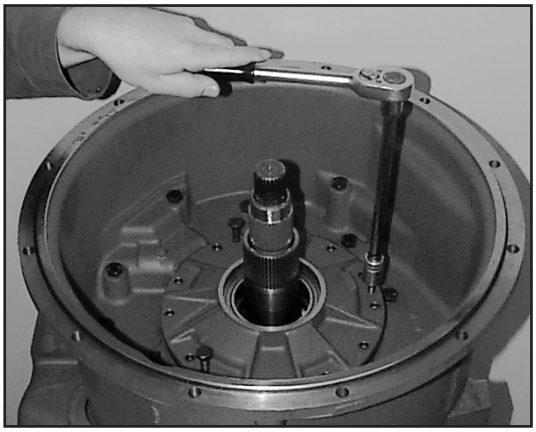


Figure 122

Pull oil feed flange by means of special device out of the converter bell.

(S) Puller device 504160

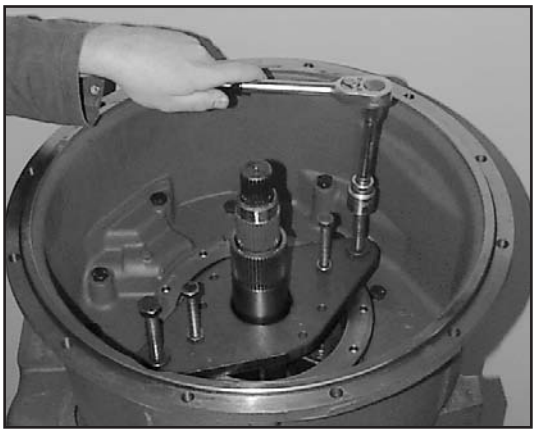


Figure 123

Remove converter safety valve (ball + spring, see arrow).

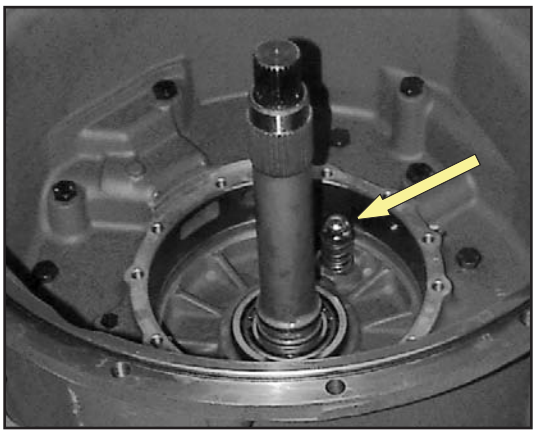


Figure 124

Loosen screw connection (M8 and M12). Separate converter bell from the transmission using lifting device.

(S) Lifting chain 504198
(S) Set of eye bolts 504182



Figure 125

Remove shim.



Figure 126

Remove both rectangular rings (arrow).

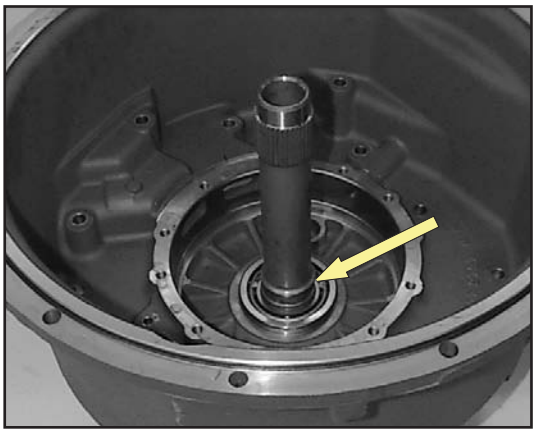


Figure 127

Press input shaft out of the spur gear bearing.
Remove released bearing inner race and spur gear.

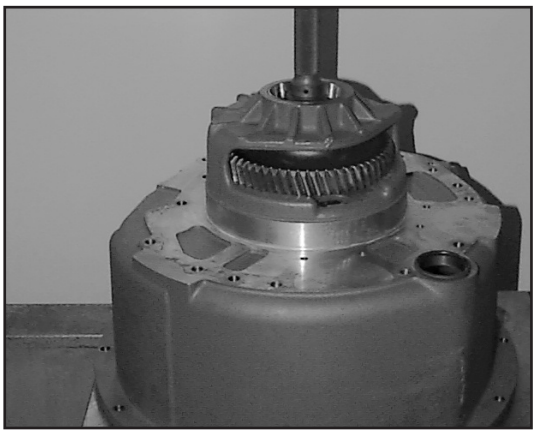


Figure 128

Press bearing inner race off the input shaft.

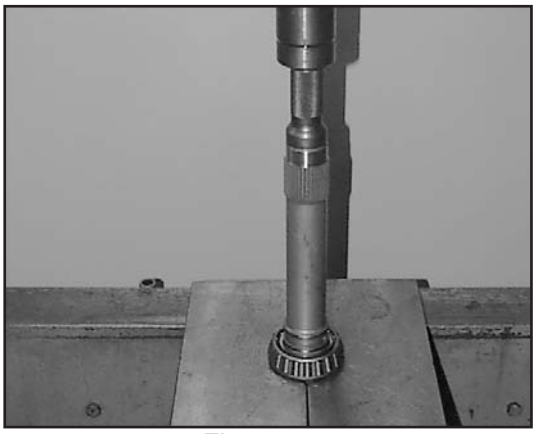


Figure 129

Remove pressure back-up valve.

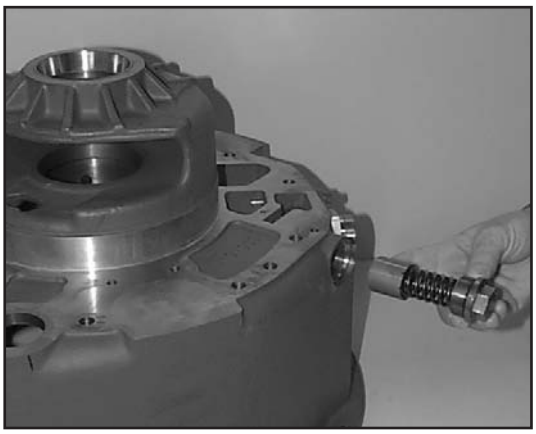


Figure 130

Pull the complete input shaft out of the gearbox housing or out of the pump.



Figure 131

Squeeze out rectangular ring (arrow).

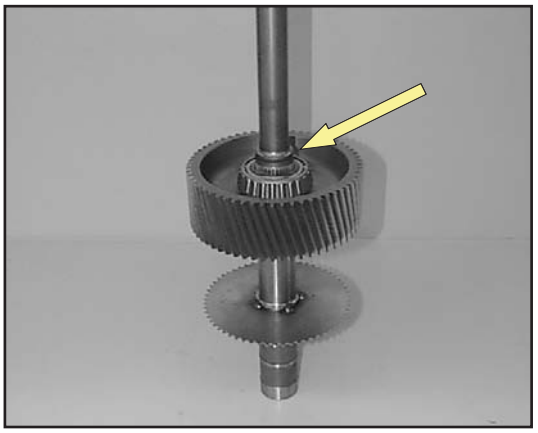


Figure 132

Separate spur gear from shaft and squeeze out circlip (arrow).

(S) Set of pliers 504232

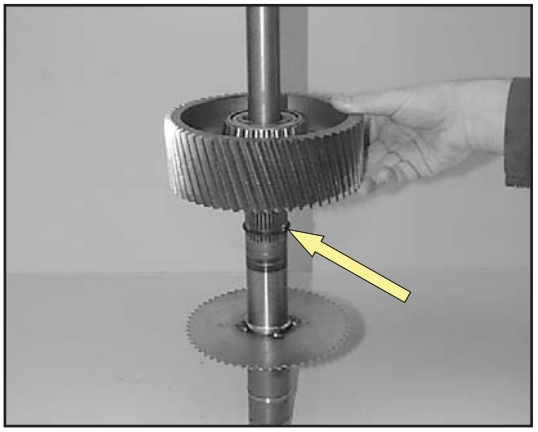


Figure 133

Pull bearing inner race off the spur gear.

(S) Grab sleeve 504239
(S) Basic tool 504238



Figure 134

Fasten shaft in vice.
Unscrew socket head screw and remove clamping disc.

Use protective jaws!

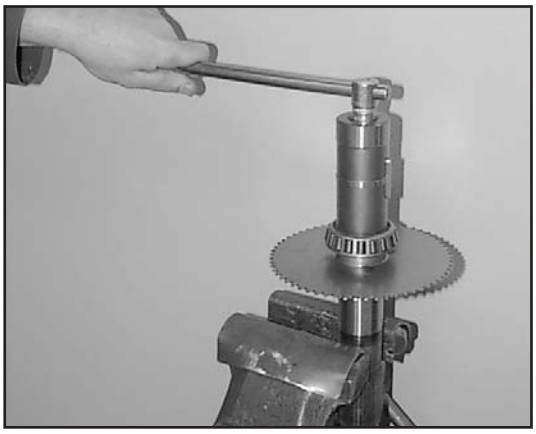


Figure 135

Pull bearing inner race and driver off the shaft.

Support puller on the end face – input shaft!
Pay attention to the released shims!

(S) 3-leg-puller 504236

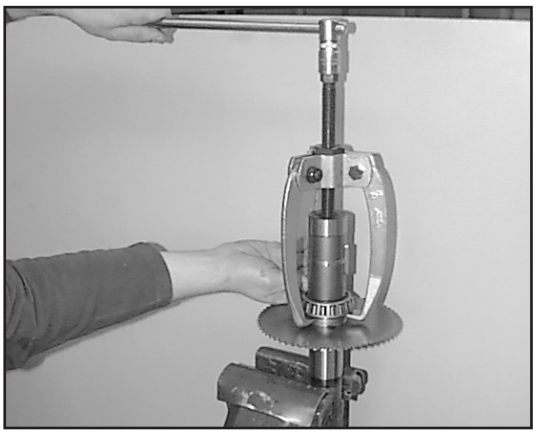


Figure 136

Separate bearing inner race from driver.

Pay attention to the released washers !

If necessary, squeeze out circlips (3x).

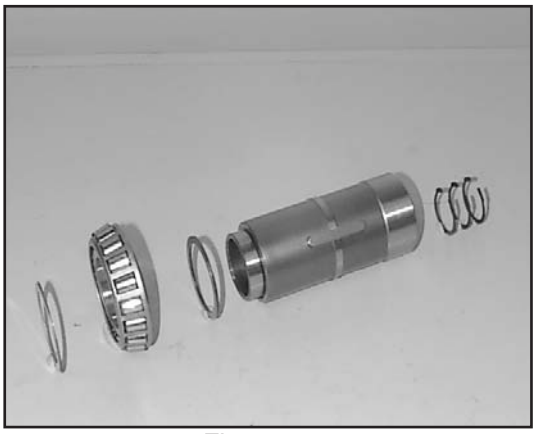


Figure 137

Transmission pump

Tilt gearbox housing by 180°.

Loosen hex. head screws and separate both pump flanges from the housing.

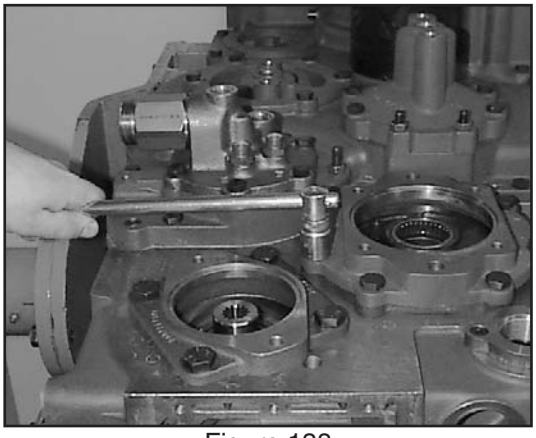
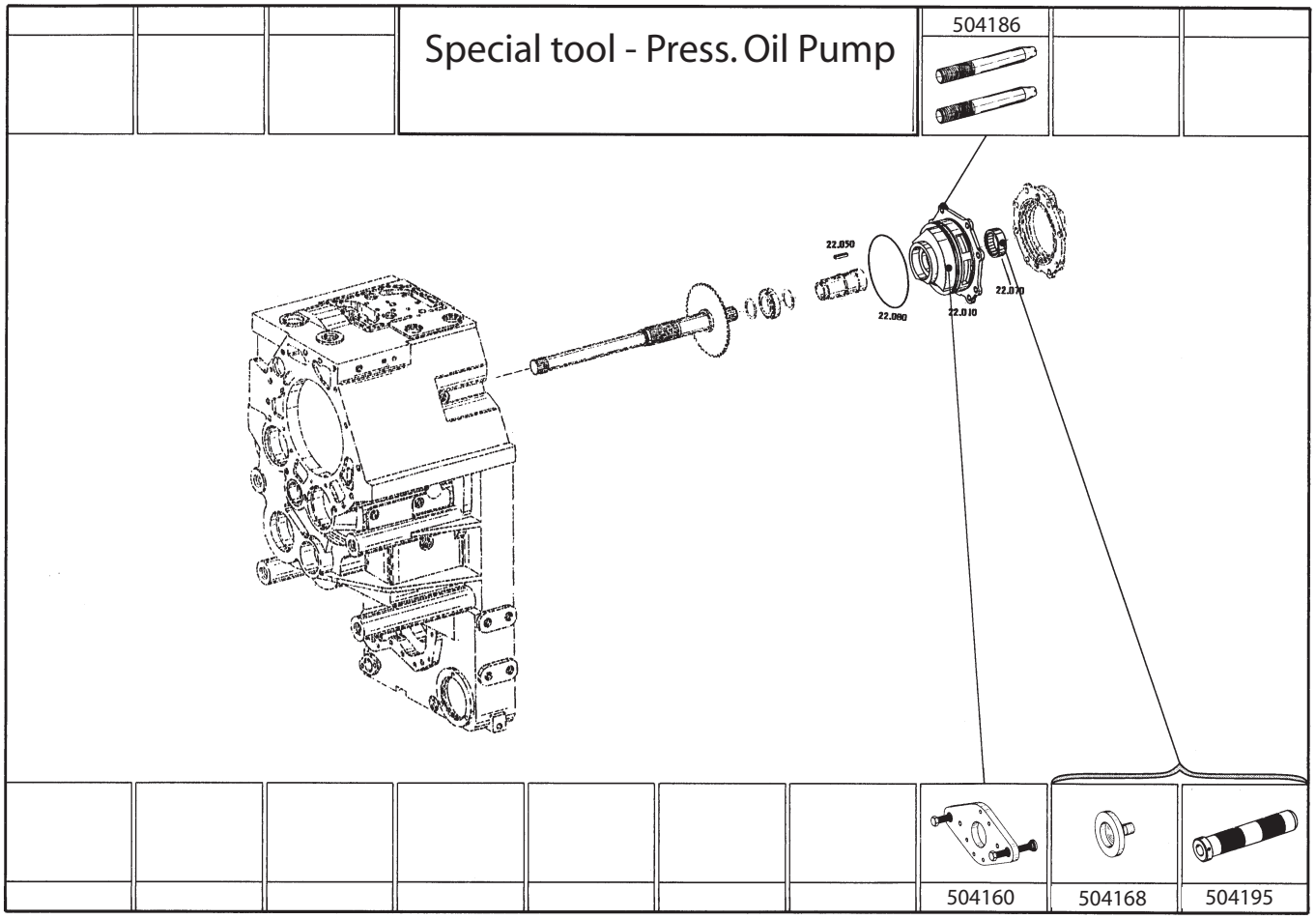
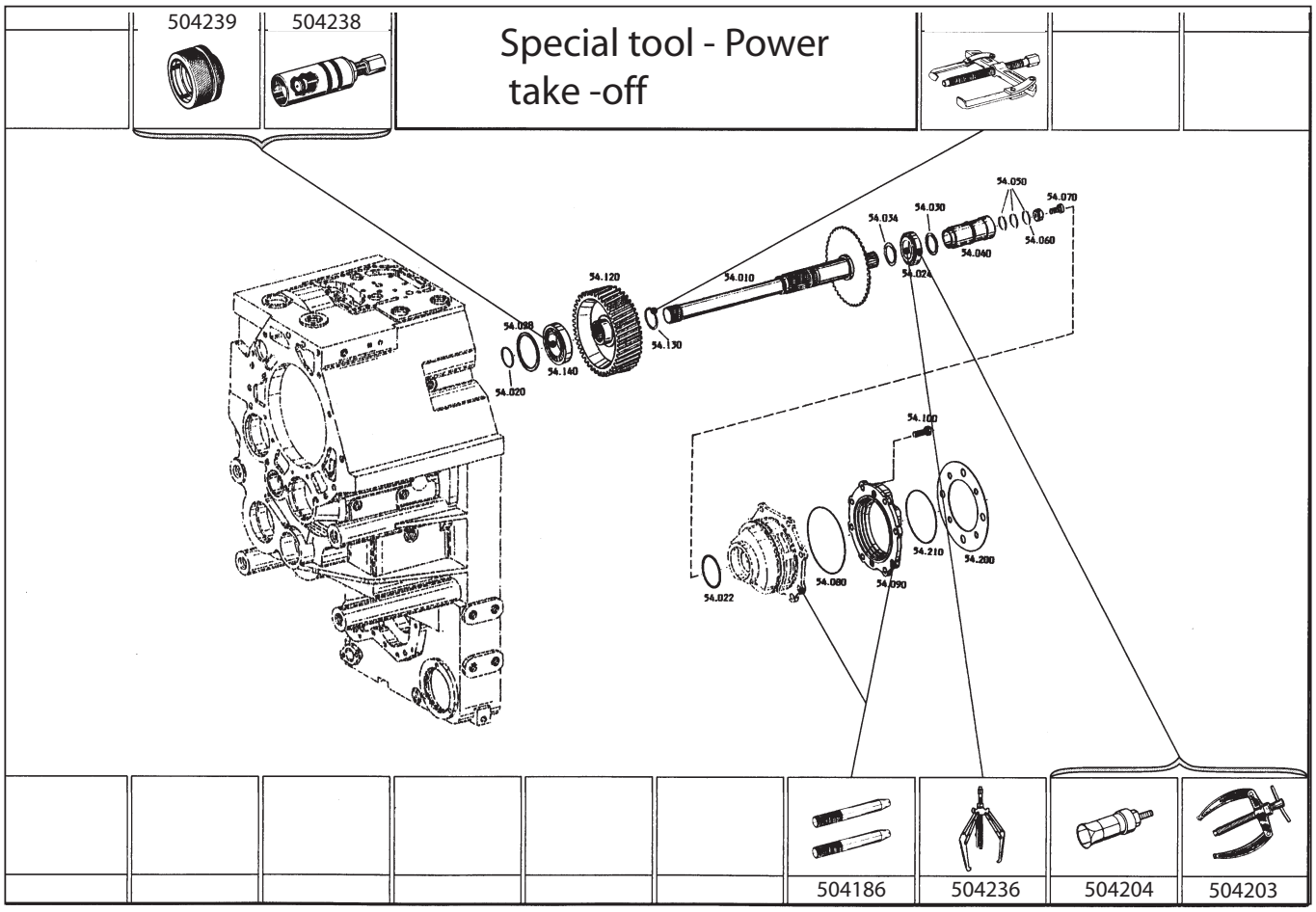


Figure 138

Special tool - Press. Oil Pump



Special tool - Power take -off



Loosen socket head screws (M8) and position puller device. Pull transmission pump out of the housing bore.

Tapping onto the housing face will support pulling out!

(S) Puller device 504160

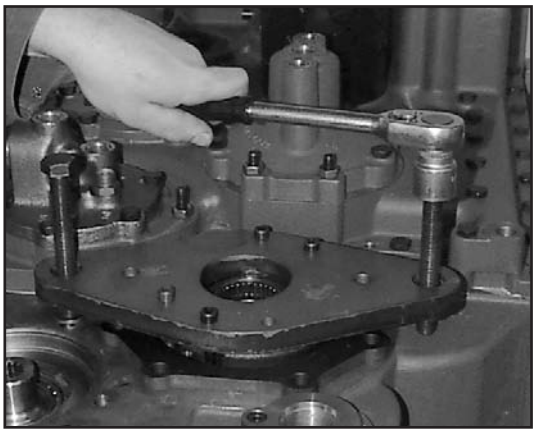


Figure 139

Pull bearing outer race out of the bore and remove spacer.

(S) Internal puller 504204
(S) Counter support 504203

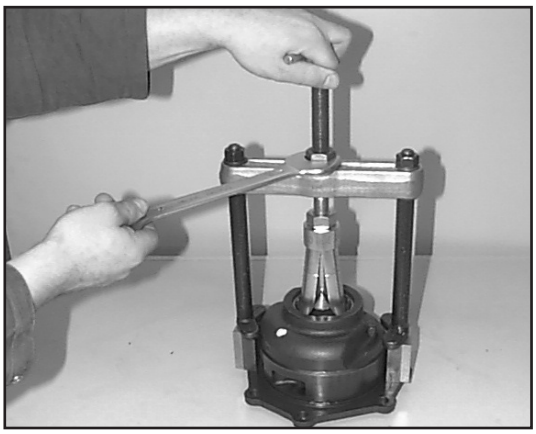


Figure 140

Loosen socket head screw, dismantle pump cover and remove rotor set

If traces of wear should be encountered in the pump housing or the housing cover, the complete pump has to be renewed!

Now, introduce the rotor set with the chamfer on the tooth crest showing downwards and install housing cover again.

Torque limit (M8/8.8) ..... M_A = 23 Nm
Torque limit (M6/8.8) ..... M_A = 9,5 Nm

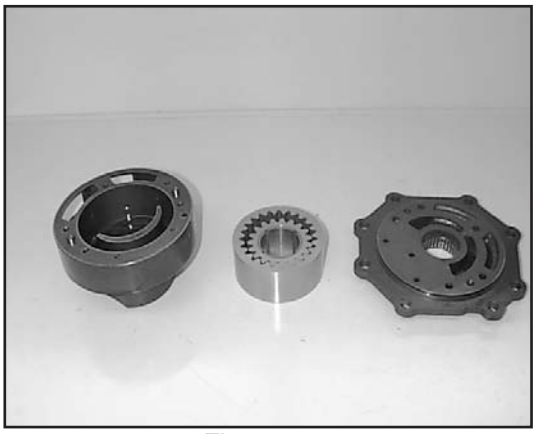


Figure 141

3.1.3 Emergency steering pump

Loosen hex. head screws and pry emergency steering pump out of the housing.

(S) Crow bar 504210

Mark installation position!

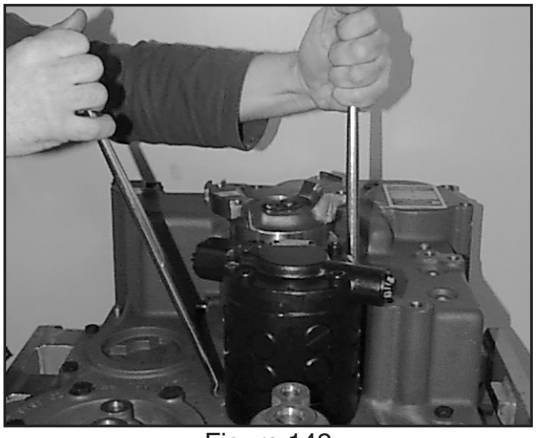
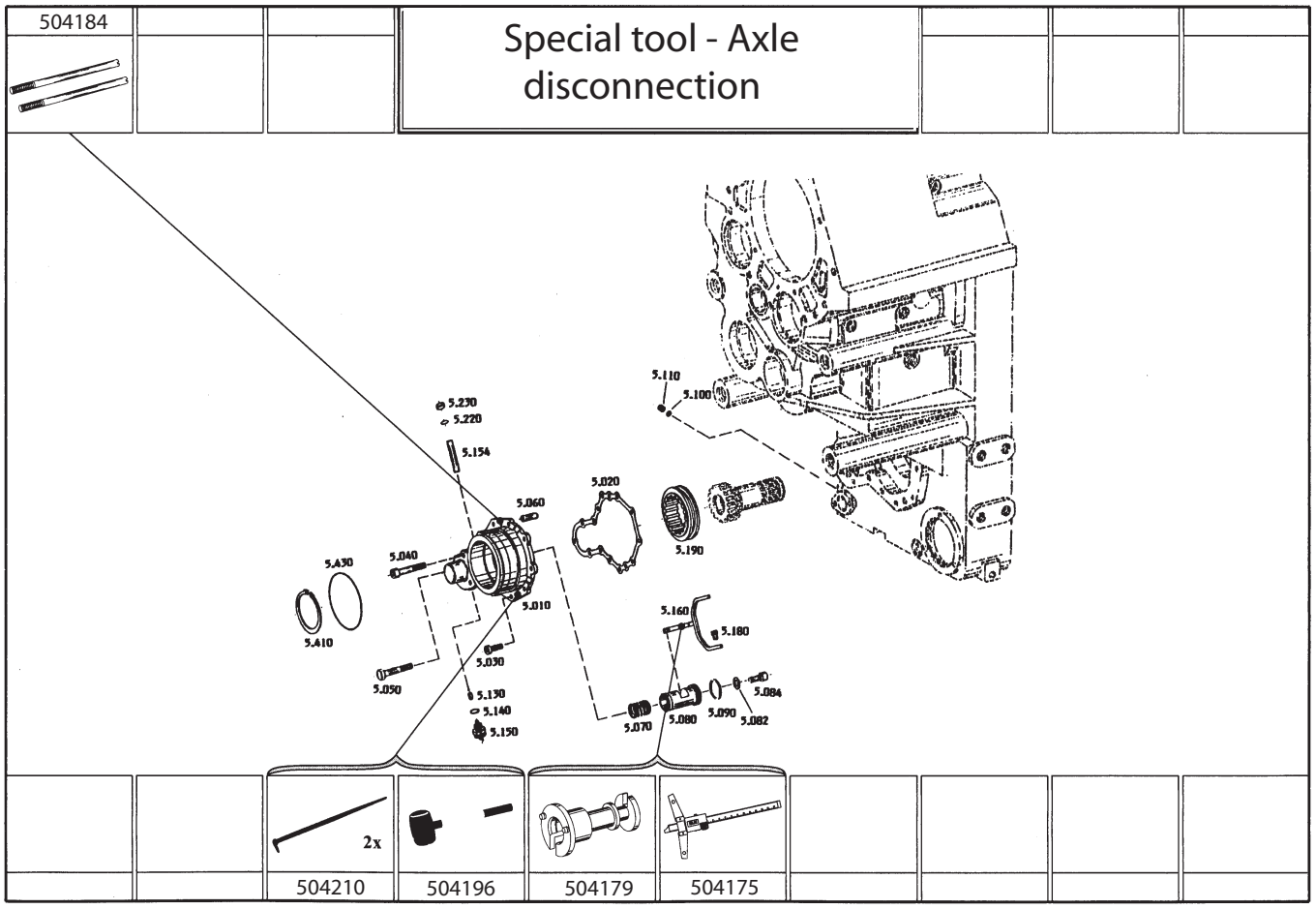
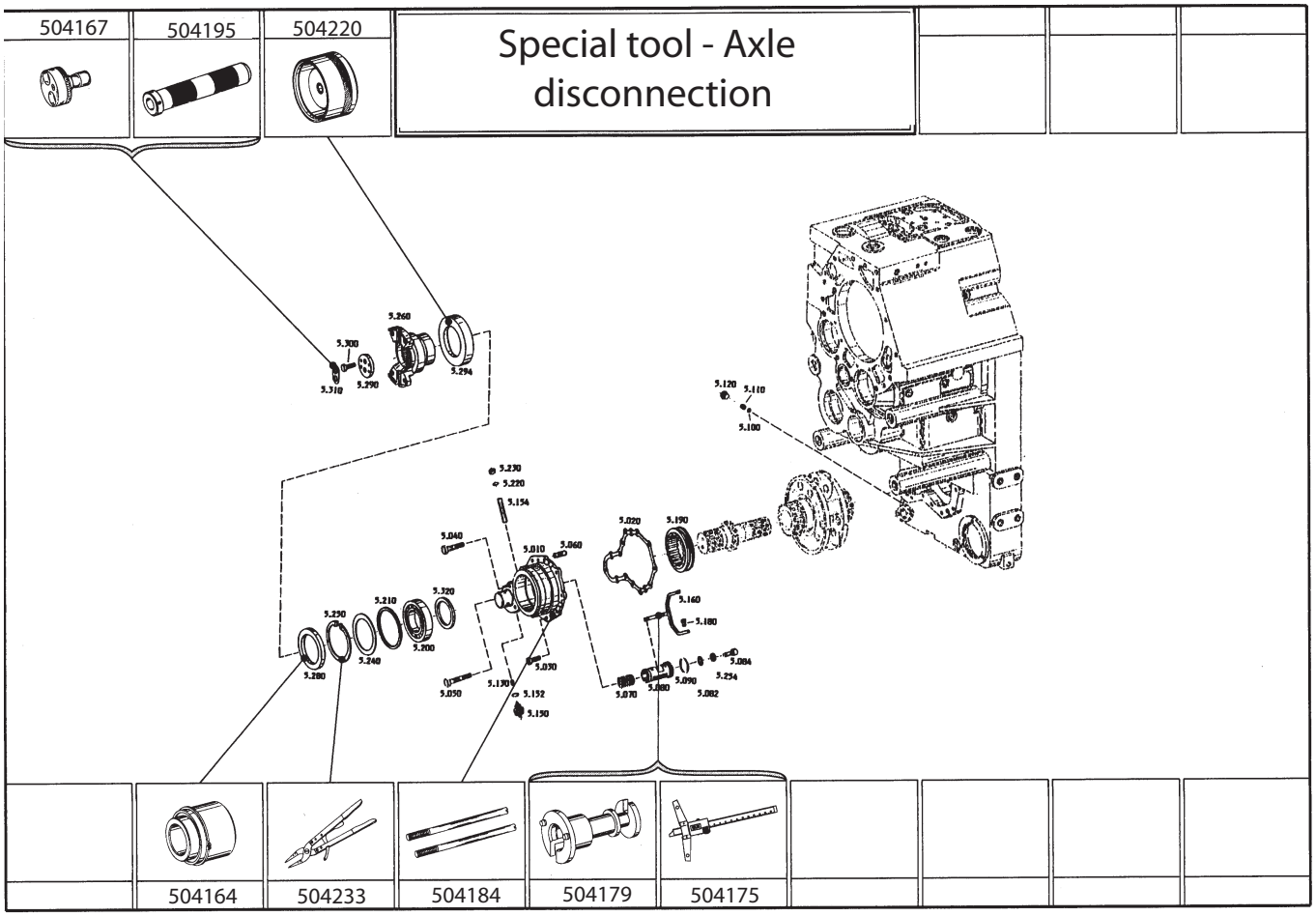


Figure 142

Axle disconnection





Remove lock plate.

Loosen hex. head screws and remove disc.
Pull output flange off the shaft.

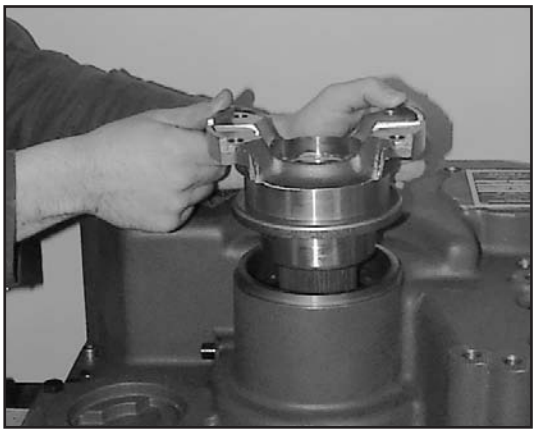


Figure 143

Tilt gearbox housing by 180°.

Loosen hex. head screws, dismantle cover and remove filter.

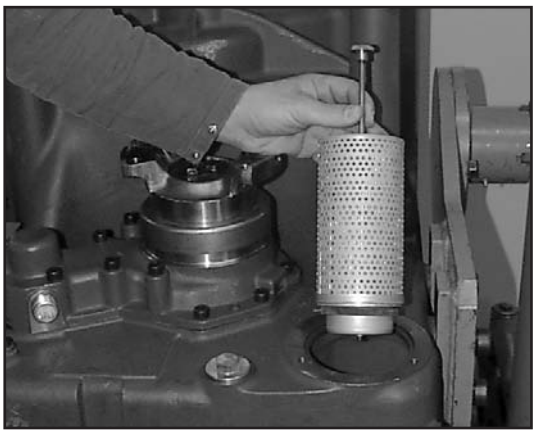


Figure 144

Axle disconnection device – design with intermediate axle differential

Remove lock plate, loosen hex. head screws and pull off output flange.

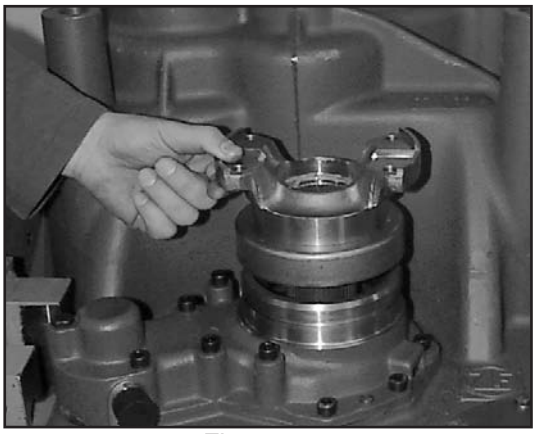


Figure 145

Loosen socket head screws and hex. head screws.

Separate axle disconnection device from the housing using pry bars.

During the separating procedure, drive out the output shaft by tapping downward!

(S) Pry bar	504210
(S) Plastic hammer	504196

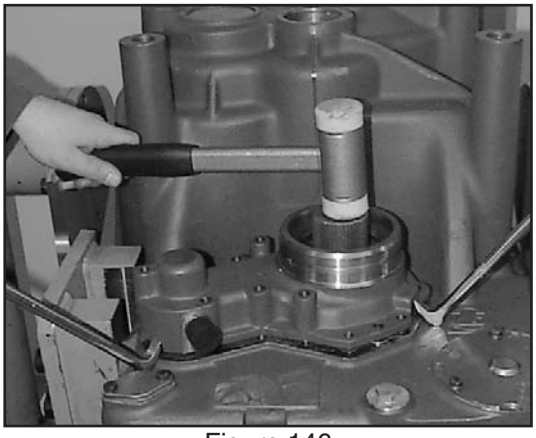


Figure 146

Dismantle switch and detent pin.

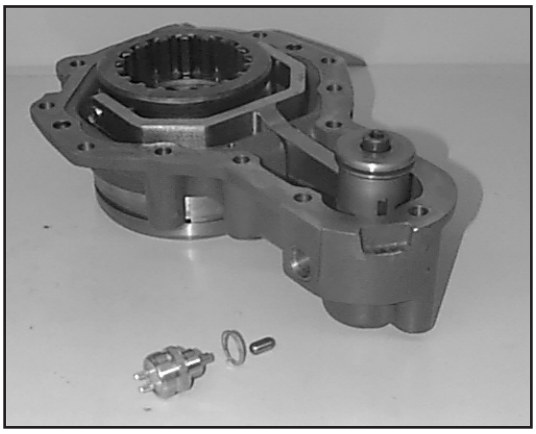


Figure 147

Disassemble switch and detent pin.

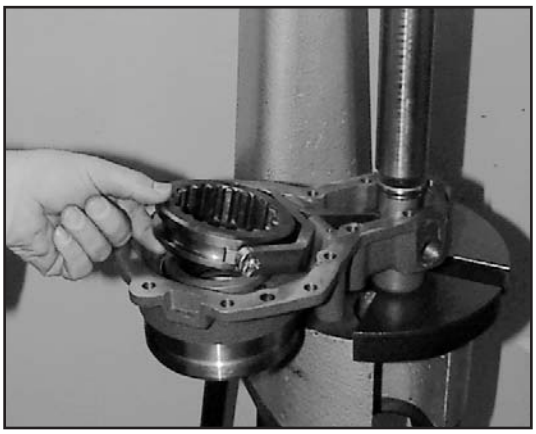


Figure 148

Remove cover as well as circlip and drive pin out of the bore using a striker.

Remove the released components.

(S) Striker 504224

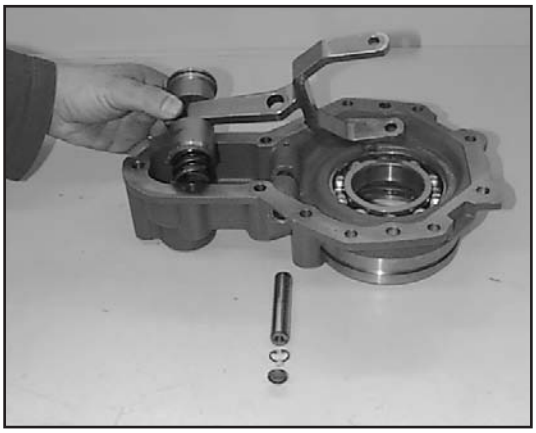


Figure 149

Remove shaft seal.

Squeeze out circlip and remove spacer as well as shim (Figure 150).

Now, remove the ball bearing.

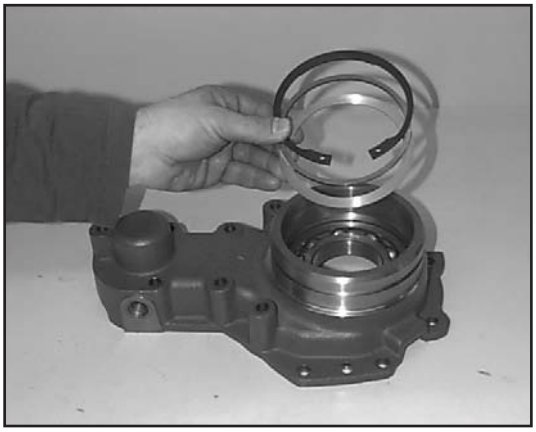
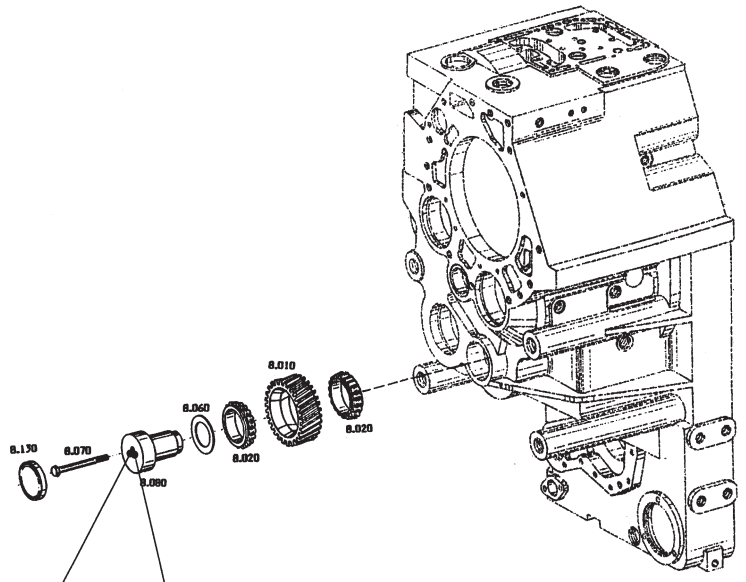
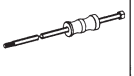


Figure 150

Special tool - Gearbox housing




504187


504225

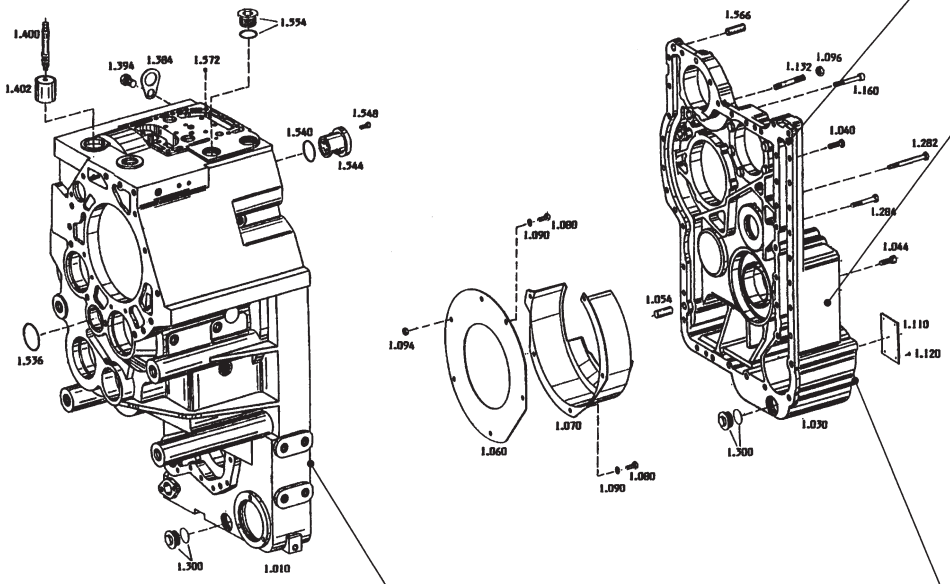
Special tool - Gearbox housing

504183



504196






504184

3.1.5 Countershaft

Remove sealing cover and loosen hex. head screws.

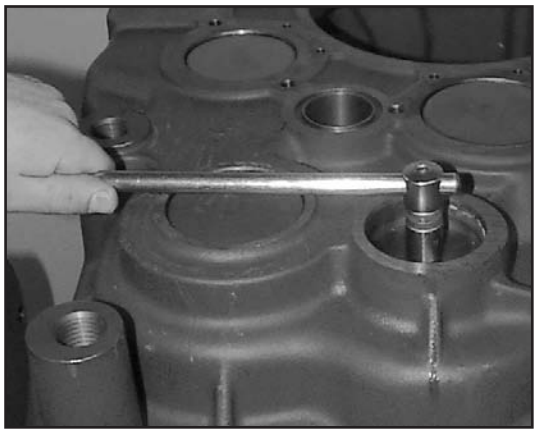


Figure 151

Tilt gearbox housing by 90°.

Drive countershaft axle off the housing bore or the countershaft support by means of a striker.

(S) Striker 504225

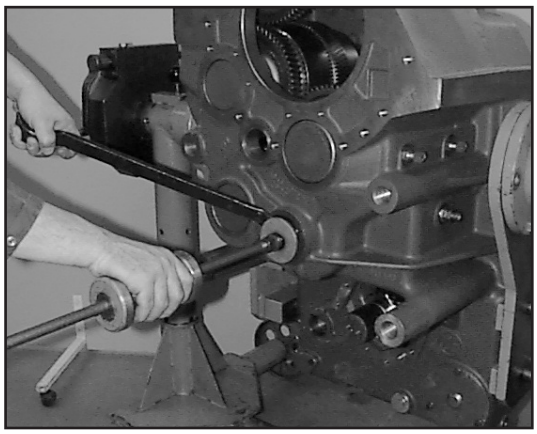


Figure 152

3.1.6 Disassemble inductive transmitter (3x)

612 = n – Turbine
608 = n – Central gear train
606 = n – Engine

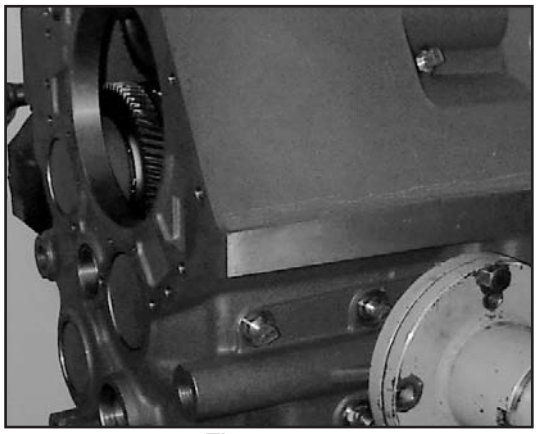


Figure 153

Tilt gearbox housing by 90°

Loosen hex. head screw and pull bearing cover KV/K1, KR/K2 and K4/K3 from the housing bore.

Mark installation position of the bearing covers!

(S) Striker 504225
(S) Set of threads 504191

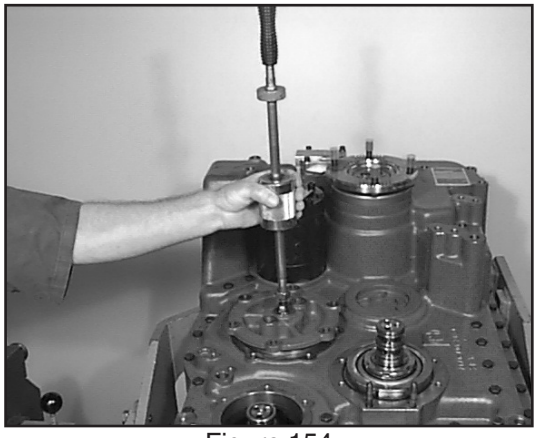


Figure 154

Loosen screw connection and separate housing cover by means of back-off screws (arrows) and lifting device from the gearbox housing.

During the separating procedure, drive out the output shaft by tapping continuously downwards!

(S) Back-off screws	504183
(S) Lifting device	504198
(S) Plastic hammer	504196

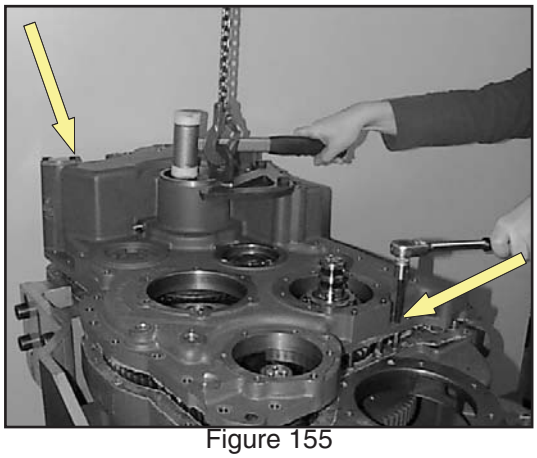


Figure 155

Loosen hex. head screws and remove cover plate.

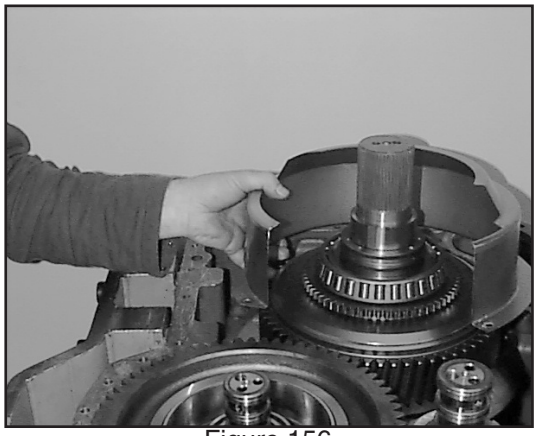


Figure 156

Assembly,
see the section: Manual transmission assembly

Interaxle differential:

Description:

The differential, installed in the output, has the task to transmit different torques on the vehicle axles and to function as intermediate compensation in the driving direction (longitudinal direction of the vehicle).
Due to the existing differential lock, both functions can be put out of service and a rigid con-nection between the axles can be created.

Function:

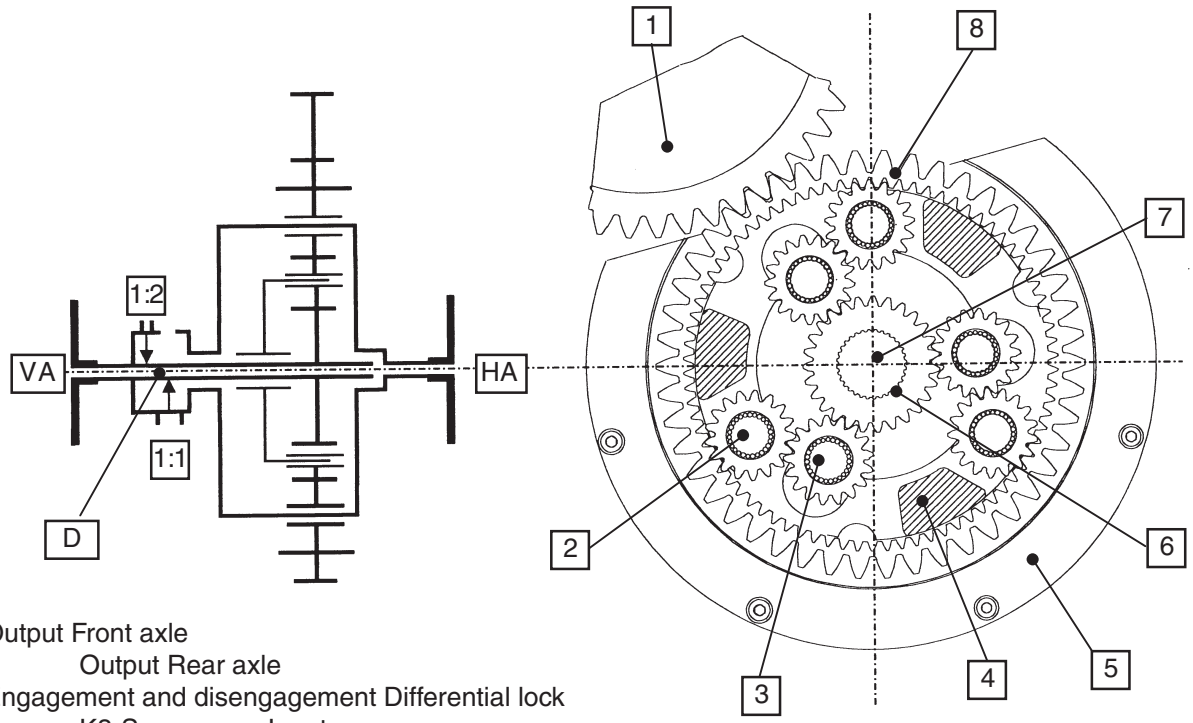
The planetary drive (differential) is designed in such a way that the external internal gear will be driven.

The output is realized via the planet carrier (4) – great lever arm – and via the internal sun gear (6) – small lever arm.
Due to these different lever arms (diameters), a torque splitting of 1 : 2 is given in the actual case as follows:

- Front axle 1/3
- Rear axle 2/3

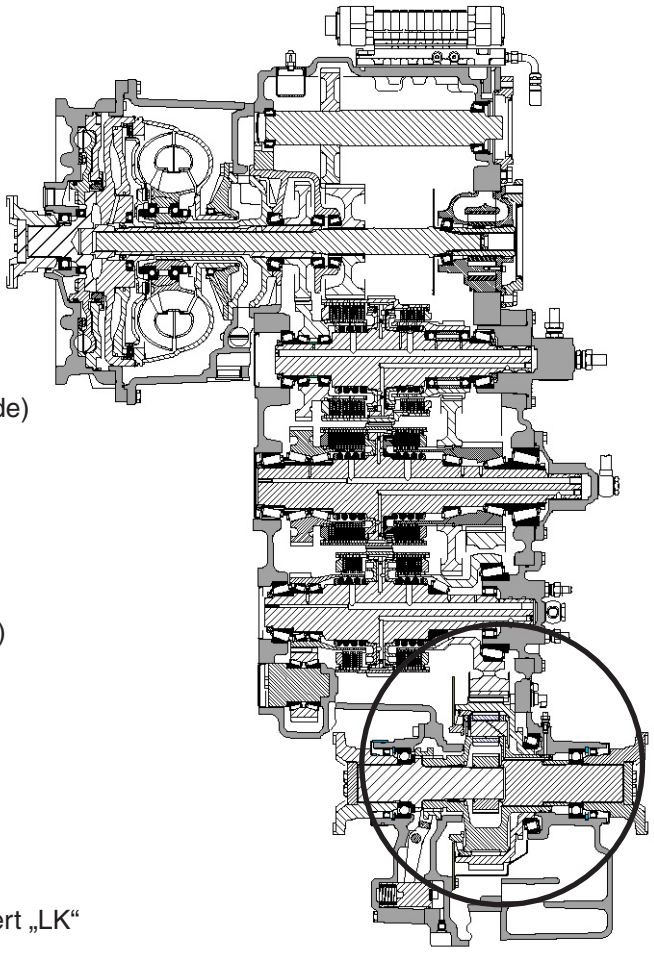
Due to the special arrangement of the planetary gears (2 and 3) - Ravignaux-System – the required inversion takes place within the planetary drive, so that both outputs (planet carrier and sun gear) are running in the same direction of rotation.

If an axle of the vehicle is showing slip, a rigid connection between the vehicle axles can be created by the differential lock.
In this condition, a torque output of 1 : 1 is realized.

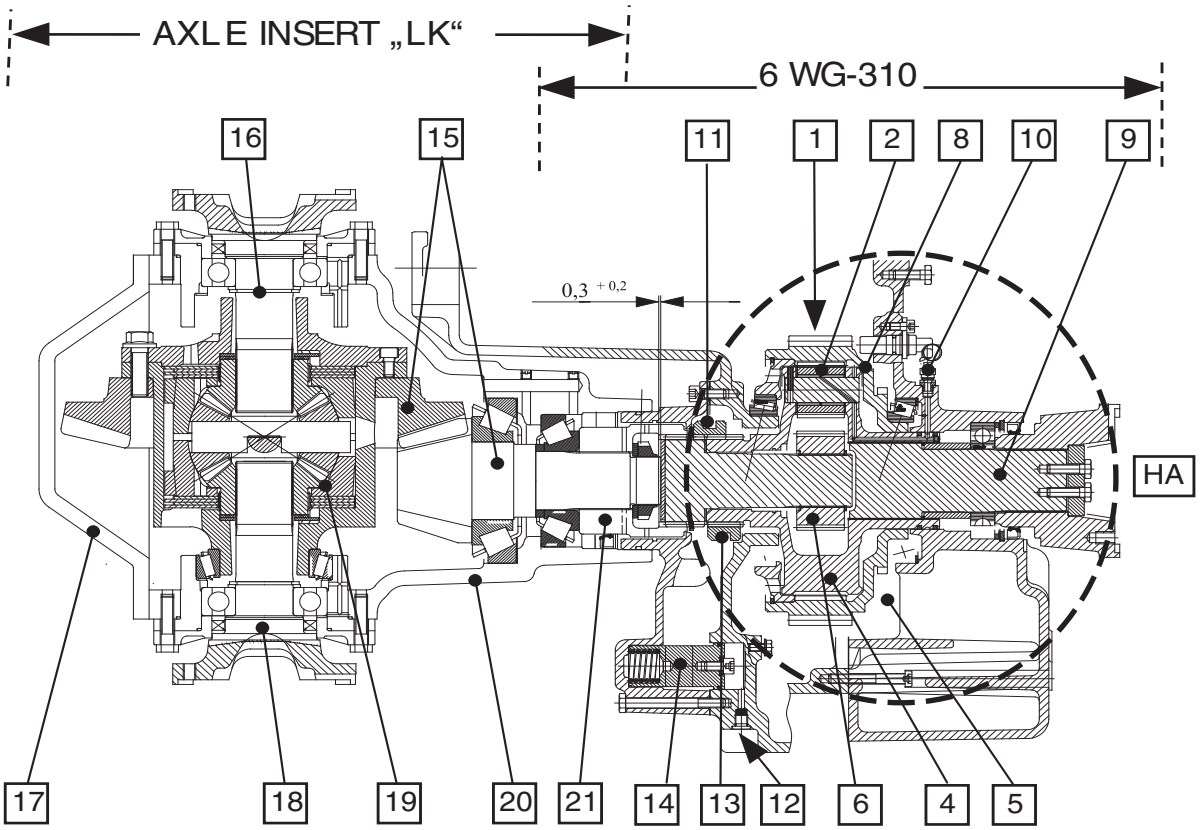


VA = Output Front axle
HA = Output Rear axle
D = Engagement and disengagement Differential lock
1 = K3-Spur gear – Input
2 = Planetary gear (Ravignaux-System outer hole circle))
3 = Planetary gear (Ravignaux-System inner hole circle)
4 = Planet carrier
5 = Screening plate
6 = Sun gear
7 = Output shaft to the Front axle
8 = Internal gear

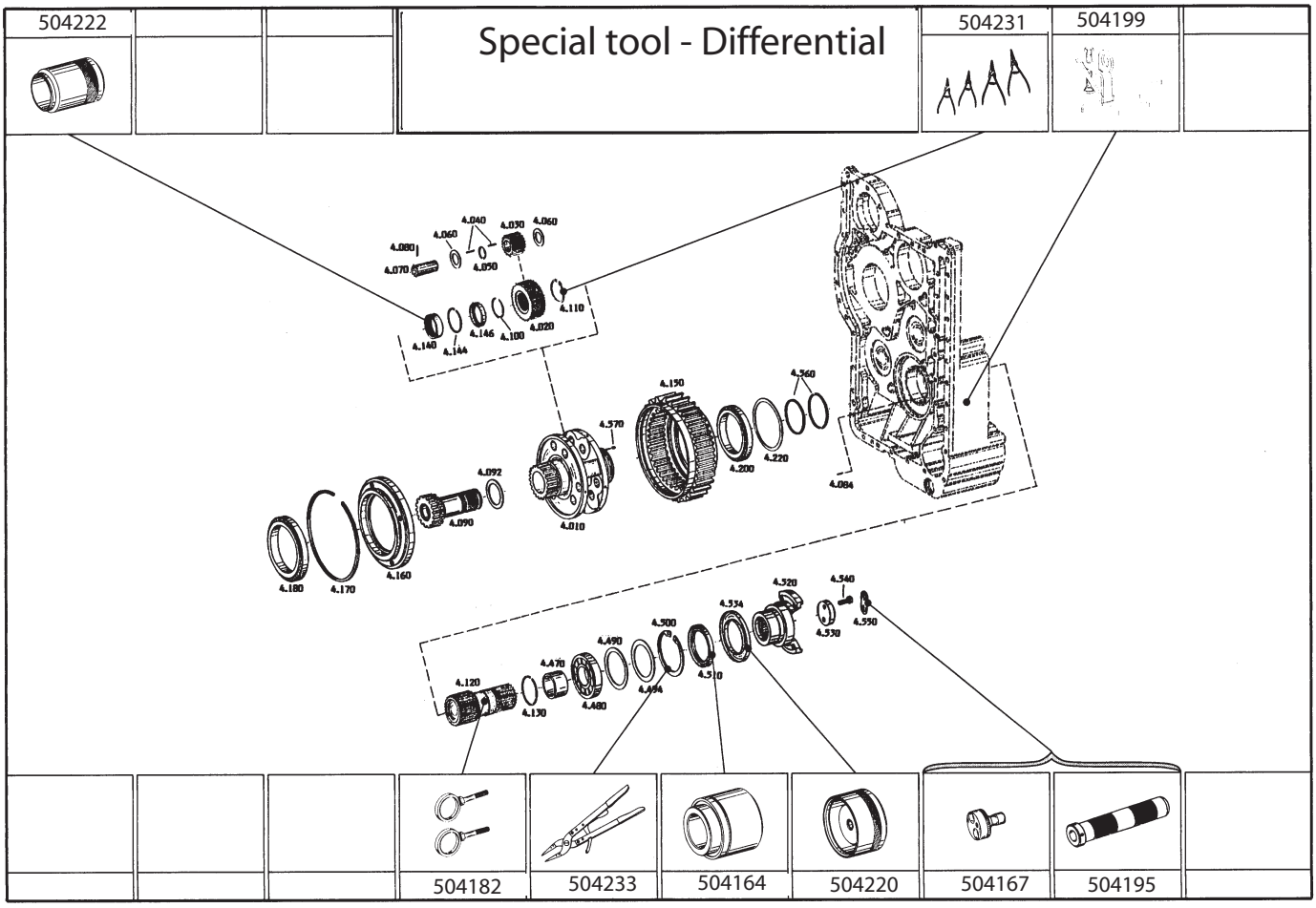
Interaxle differential with mounted Differential carrier „LK“



HA= Output Rear axle
1 = K3-Spur gear – Input
2 = Planetary gear
(Ravignaux-System outer hole circle)
4 = Planet carrier
5 = Screening plate
6 = Sun gear
7 = Output shaft to the Front axle (converter-side)
8 = Internal gear
9 = Output shaft to the Rear axle (rear-side)
10 = Connection lubrication Interaxle differential
11 = Sliding sleeve Differential lock (engaged)
12 = Connection actuation Differential lock (hydraulic or pneumatic)
13 = Sliding sleeve Differential lock (disengaged)
14 = Pneumatic or hydraulic engagement and disengagement of the Differential lock
15 = Bevel gear set
16 = Output front axle - RH
17 = Cover with oil fillter- and oil drain plug
18 = Ouput front axle - LH
19 = Limited – slip differential
20 = Differential housing
21 = Adapter Transmission 6 WG-310 / Axle insert „LK“



Interaxle differential disassembly



Lift differential out of the gearbox by means of lifting device.

(S) Lifting device 504198
(S) Set of eye bolts 504182



Figure 157

Remove plate and disassemble bearing inner race.

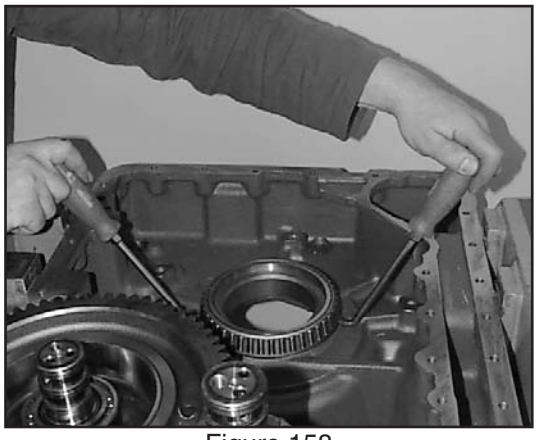


Figure 158

Squeeze out both rectangular rings (arrow) and remove them.

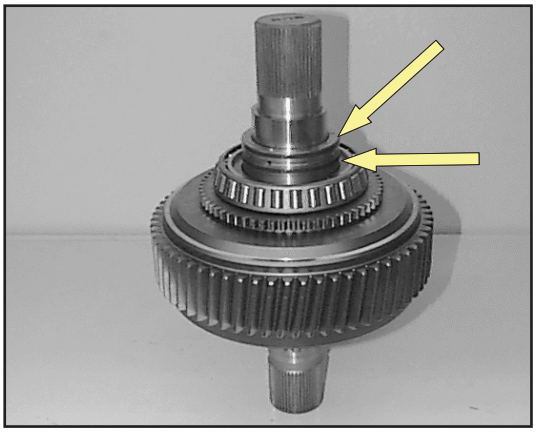


Figure 160

Remove bush.



Figure 161

Squeeze out snap ring and pull output shaft off the planet carrier.

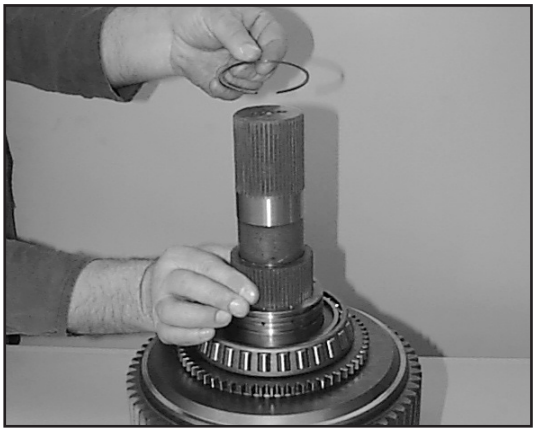


Figure 162

Squeeze out circlip (sun gear fixing).

(S) Set of external pliers 504231



Figure 163

Pull bearing inner race off the internal gear.

(S) Quick-acting grip	504252
or grab sleeve	504247
(S) Basic tool	504246

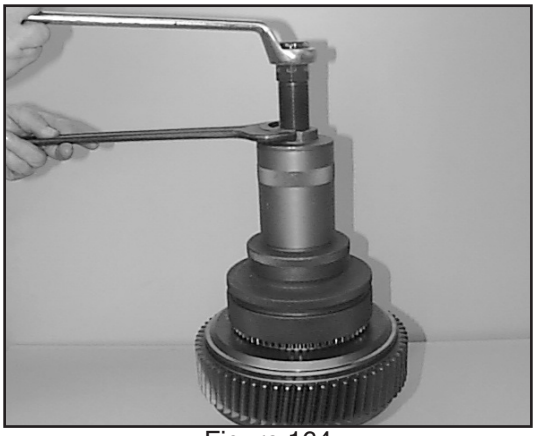


Figure 164

Squeeze out snap ring.

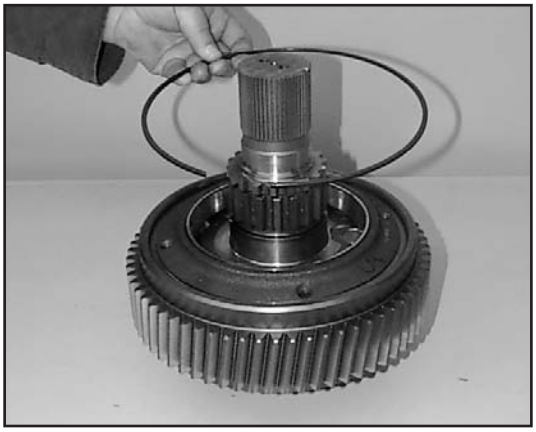


Figure 165

Press internal gear and planet carrier out of the internal gear.

Figure 167 shows the released components!

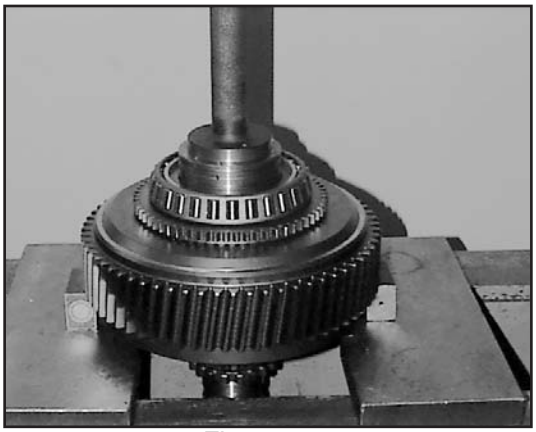


Figure 166

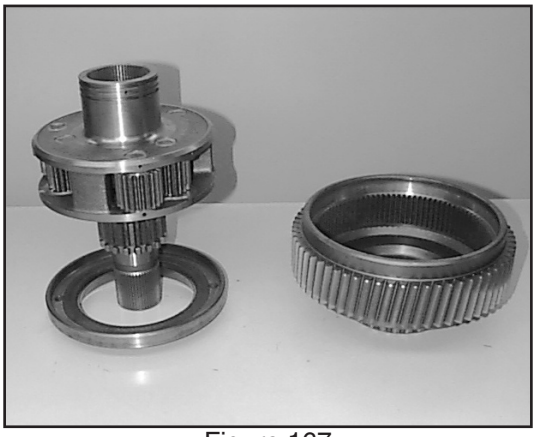


Figure 167

Carefully drive in roll pin (arrow) until contact is obtained.

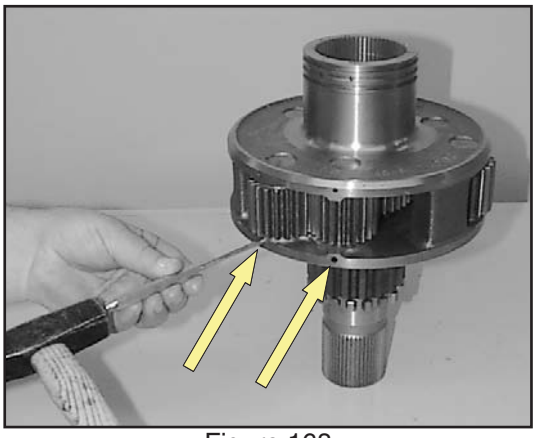


Figure 168

Drive out planet bolt and remove planet gears.

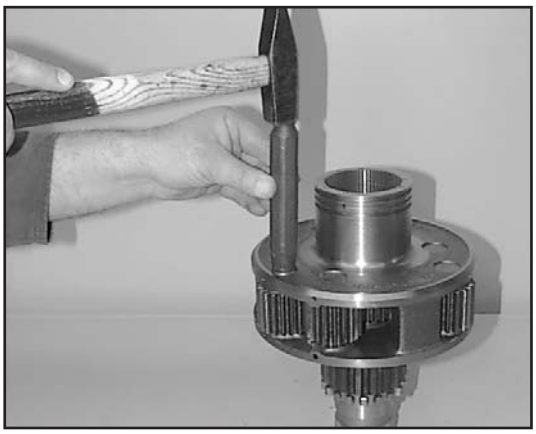


Figure 169

Press output shaft far enough downward until the sun gear can be removed, also see Figure 171!

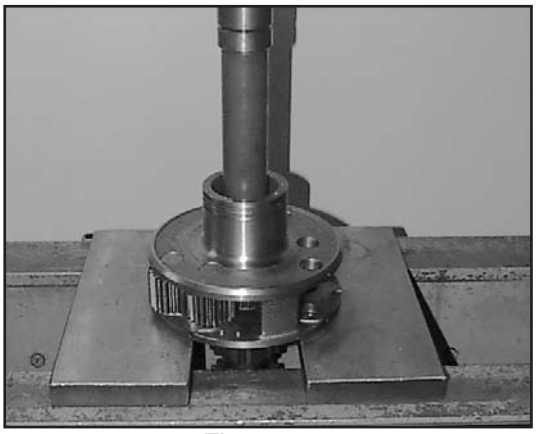


Figure 170

Squeeze out snap ring (arrow) and separate output shaft from planet carrier.

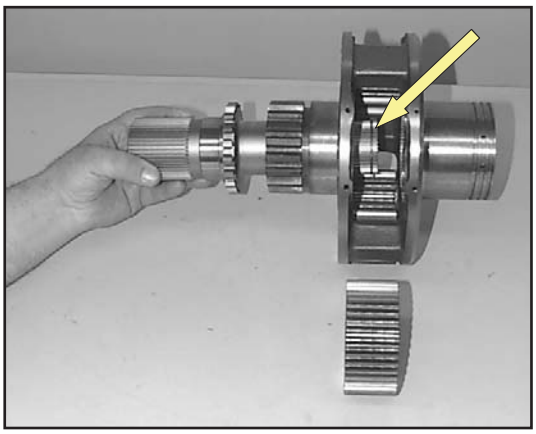


Figure 171

If necessary, pry baffle ring out of the planet carrier bore, squeeze out snap ring (Figure 172) and drive out needle bearing (Figure 173).

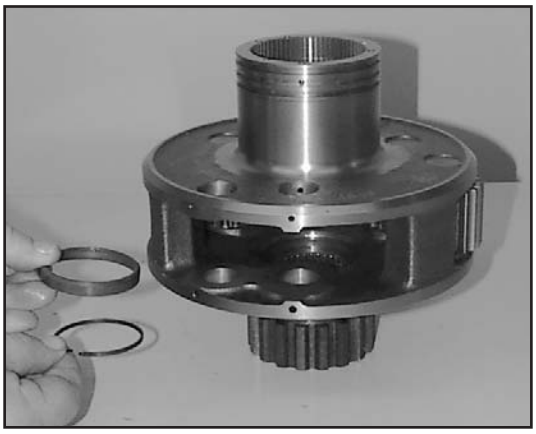


Figure 172

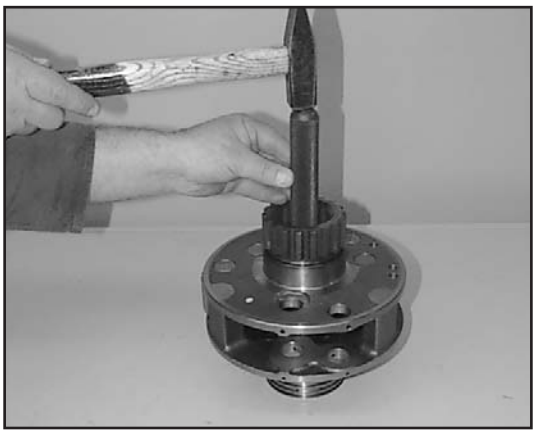
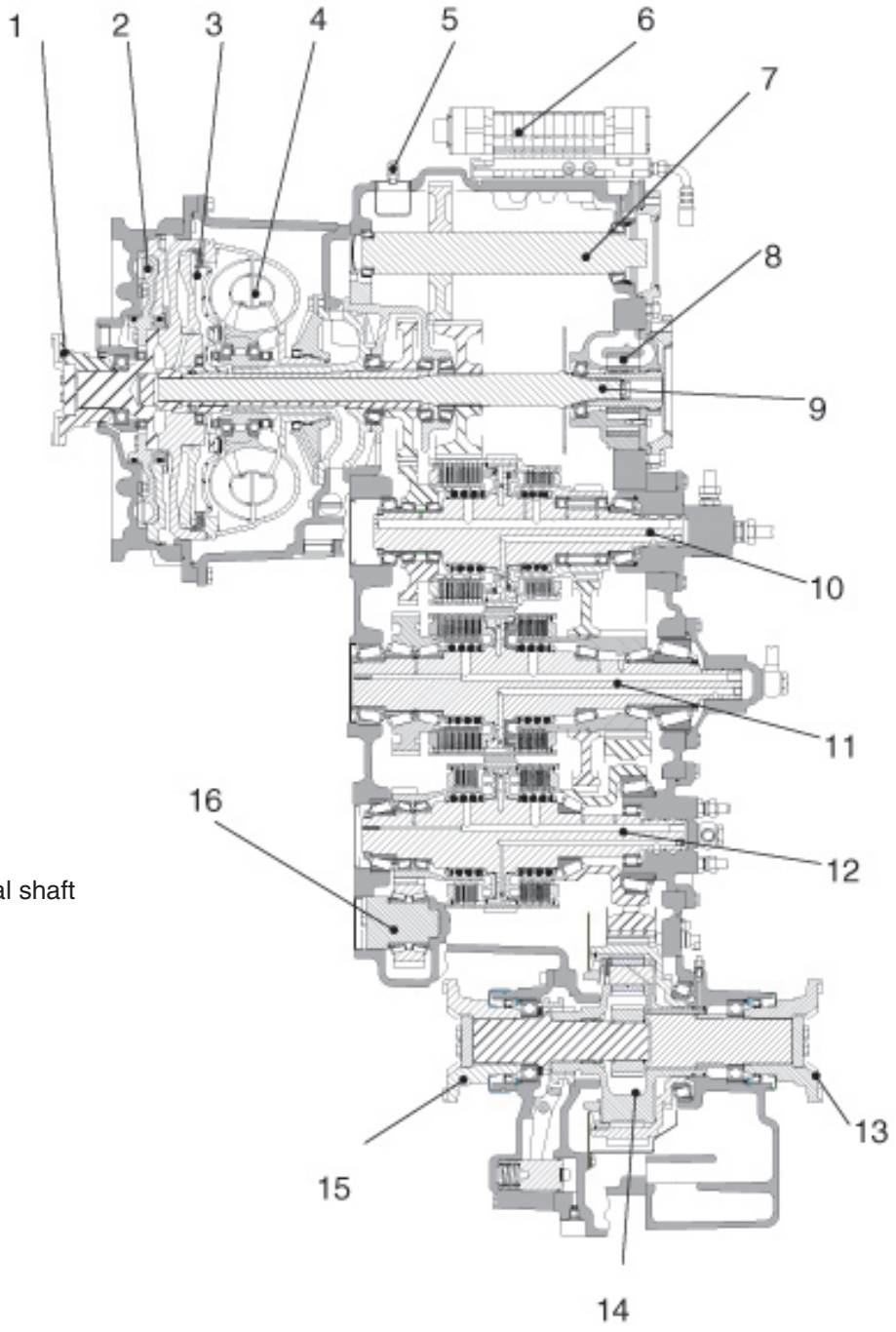


Figure 173

Assembly the interaxle diff, see the section:

Interaxle differential assembly

Clutches, Powershift transmission



1 = Input flange - Drive via universal shaft
2 = Retarder
3 = WK
2 = Converter
5 = Breather
6 = Electrohydraulic control unit
7 = 2nd Power take-off
8 = Transmision pump
9 = 1st Pover take off
10 = Clutck axle "KV/K1"
11 = Clutc axle "KR/K2"
12 = Clutch axle "K4/K3"
13 = Output flange rear side
14 = Interaxle differential
15 = Output flange (converter-side)
16 = Countershaft

Multi-disk clutch

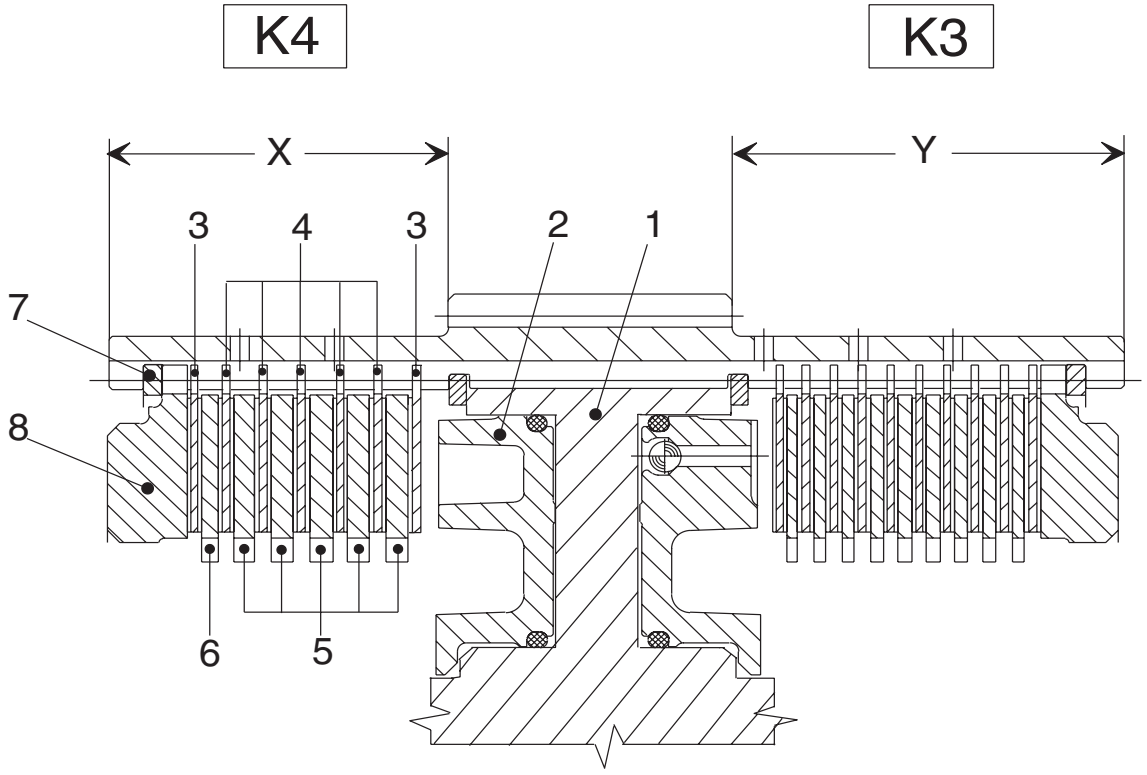
The multi-speed reversing transmission in countershaft design is power shiftable by hydrauli-cally actuated multi-disk clutches.
All gears are constantly meshing and carried on antifriction bearings.

The gear wheels, bearings and clutches are cooled and lubricated with oil.

The 6-speed reversing transmission is equipped with 6 multi-disk clutches. (Figure example)
At the shifting, the actual plate pack is compressed by a piston, movable in
axial direction, which is pressurized with pressure oil.
A compression spring takes over the pushing back of the piston, thus the release of the plate pack.
As to the layout of the transmission as well as the specifications of the closed clutches in the single speeds.

See in chapter 2.3 Disassembly & Assembly for other clutches.

Example of the Multi-disk clutches

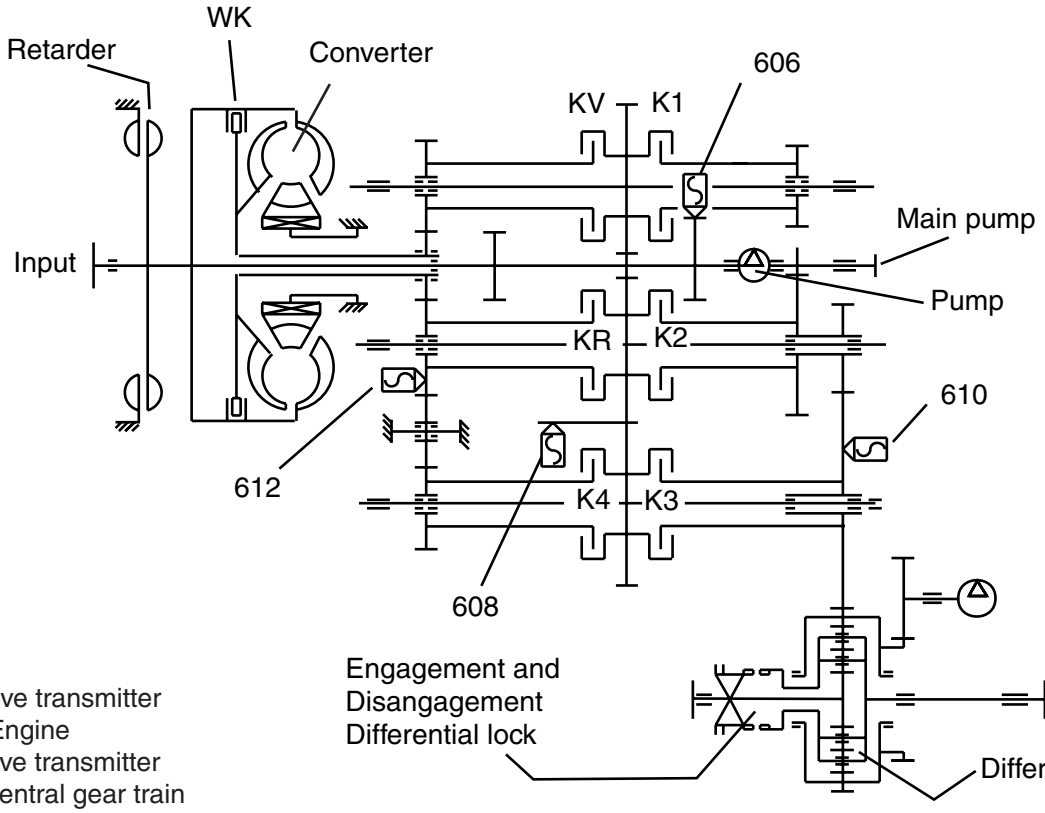


Item.	Designation	Quantity	s (mm)	Remark
1	Plate carrier	1		
2	Piston	1		
3	Outer plate	2	1,85	One-side coated
4	Outer plate	5	2,5	Coated on both sides
5	Inner plate	5	3,5	
6	Inner plate	1	2,5 ... 4,0	Optional
7	Snap ring	1	2,55 ... 3,10	Optional
8	End shim	1		
Number of friction surfaces: 12				
Plate clearance: 2,2 ... 2,4 mm				

Clutch chart

DRIVING DIRECTION	PRESSURE REGULATOR UNDER VOLTAGE							ENGAGED CLUTCHES	
	Speed	Y1	Y2	Y3	Y4	Y5	Y6		
FORWARD	1			●		●		K1	KV
	2		●	●				K4	K1
	3					●	●	KV	K2
	4		●				●	K4	K2
	5				●	●		K3	KV
	6		●		●			K4	K3
REVERSE	1	●		●				KR	K1
	2	●					●	KR	K2
	3	●			●			KR	K3
NEUTRAL									

ENGAGED CLUTCH	KR	K4	K1	K3	KV	K2
POSTITIONS ON VALVE BLOCK	F	E	D	C	B	A
CONSEC. NO. OF MEAS. POINTS	55	60	56	58	53	57



606 = Inductive transmitter
n – Engine
608 = Inductive transmitter
n – Central gear train
610 = Speed sensor
n – Output
612 = Inductive transmitter
n – Turbine

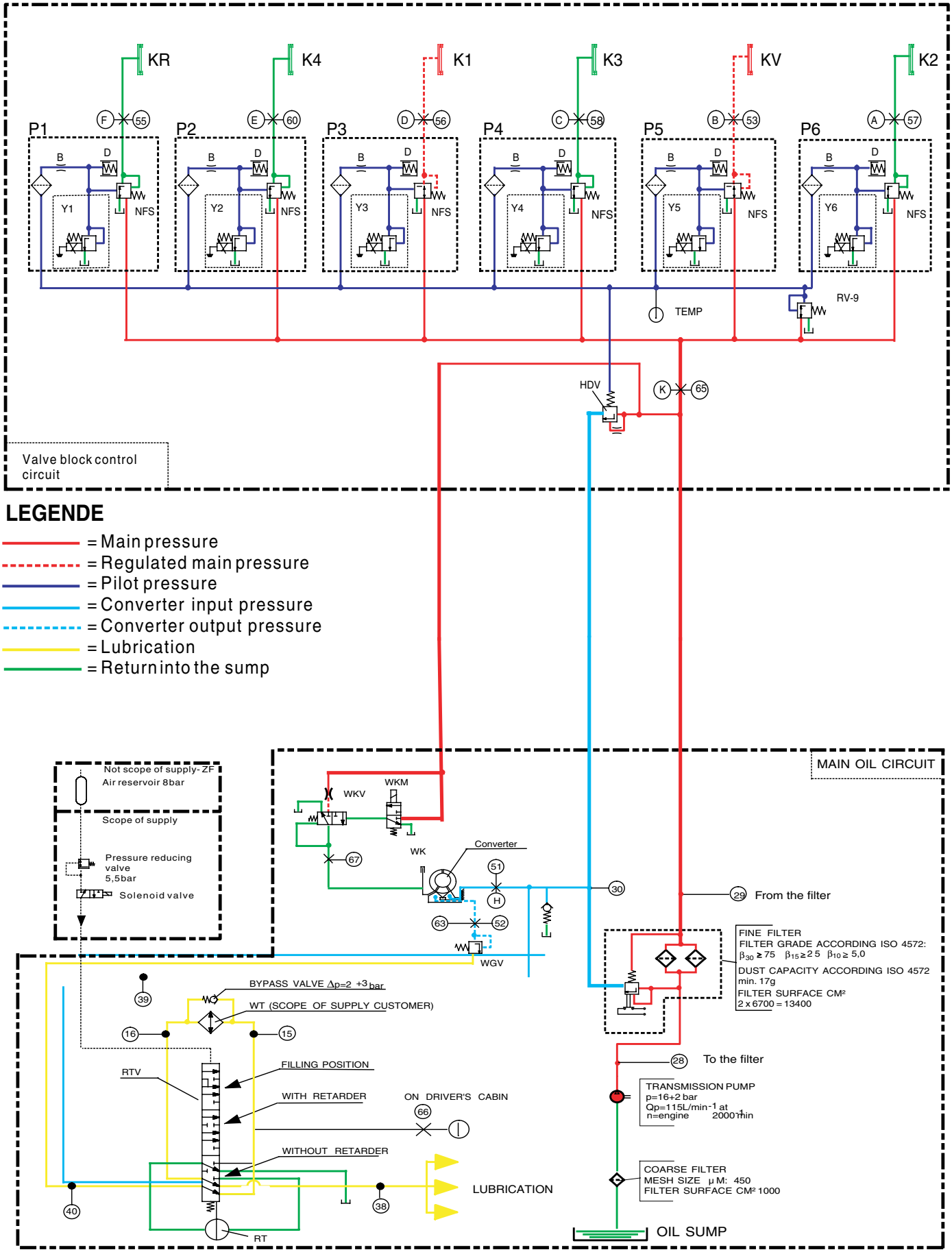
Plate clearanse in the single Multi-disc clutches

Type	K1 (mm)	K2 (mm)	K3 (mm)	K4 (mm)	KV (mm)	KR (mm)
WG-310	2,6 +0,2	2,2 +0,2	2,2 +0,2	2,2 +0,2	2,8 +0,2	2,2 +0,2

No	Measuring point and values
15	To the cooler
16	From the cooler
28	To the ZF-filter
29	From the filter
30	From the filter bypass to the converter
38	From cooler lubrication (via retarder valve)
39	In front of conv. to cooler (via retarder valve)
40	After converter to cooler (via retarder valve)
51	In front of conv. – opening pressure 8,5 bar
52	After converter – opening pressure 5 bar
53	Clutch forward KV 16 + 2 bar
55	Clutch reverse KR 16 + 2 bar
56	Clutch K1 16 + 2 bar
57	Clutch K2 16 + 2 bar
58	Clutch K3 16 + 2 bar
60	Clutch K4 16 + 2 bar
63	Temp. after conv. (short time 120°C)
65	System pressure 16 + 2 bar
66	Temp. after retarder (short time 150°C)
67	LU – control pressure 12 + 2 bar

Denomination of the positions
to Oil circuit diagram, next page.

Oil circuit diagram



Disassemble Multi-disc clutches

Disassemble clutch K4/K3, KR/K2 and KV/K1 by means of lifting device.



At the disassembly of the clutch K4/K3, slightly lift clutch KR/K2 and displace it in arrow direction, see figure on the left!

(S) Set of eye bolts 504182

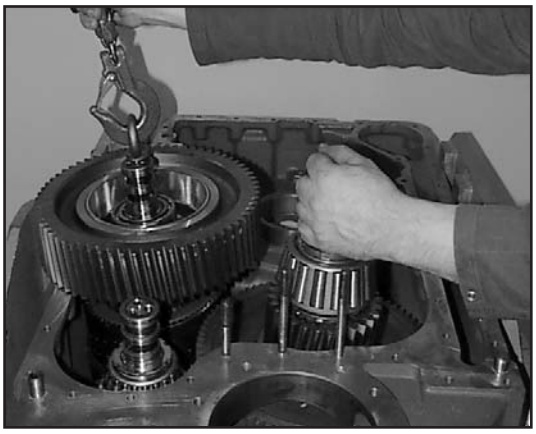


Figure 175

The figure on the left shows the clutches in disassembled condition.



Figure 176

Remove countershaft gear.



Figure 177

Disassemble and dismantle power take-off

Squeeze out circlip and remove shims.

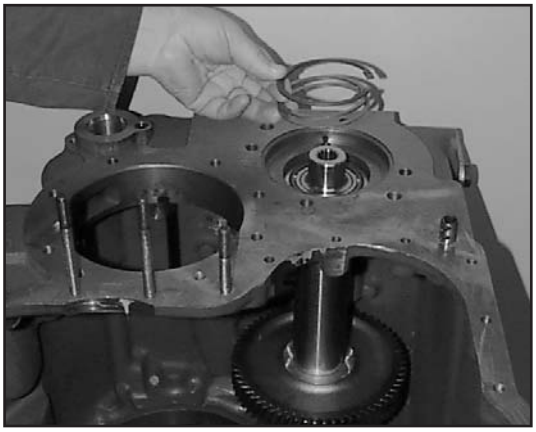


Figure 178

Lift output shaft by means of pry bar until the bearing outer race is free.

(S) Pry bar 504209

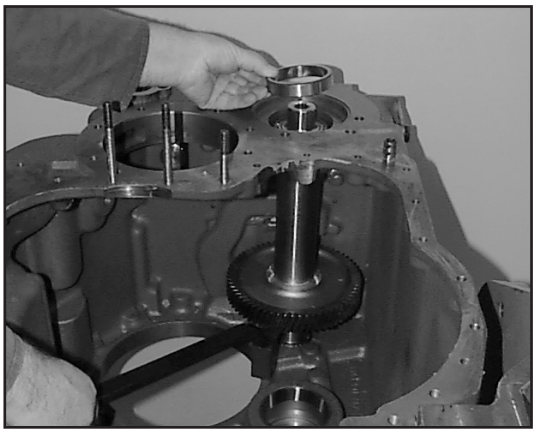


Figure 179

Take output shaft out of the housing.

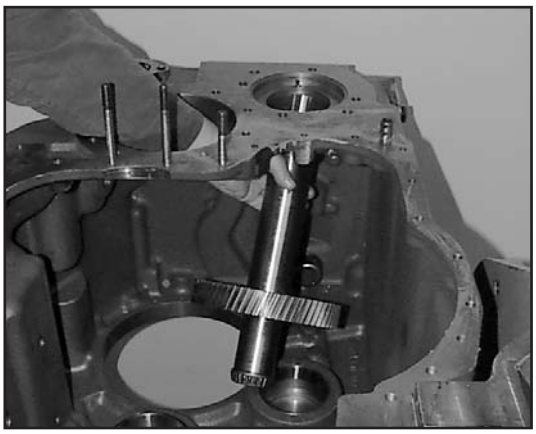


Figure 180

Pull bearing outer race out of the housing bore.

(S) Internal puller 504202
(S) Counter support 504201

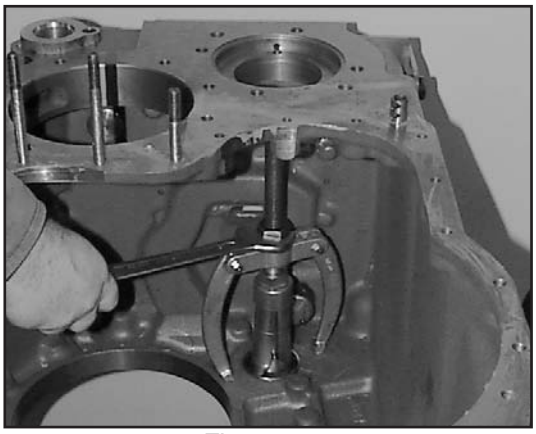


Figure 181

Pull bearing inner race off the shaft (Figure 182).

Press opposite bearing inner race off the shaft.

The separation of shaft and gear is not possible (shrink fit)!

(S) Grab sleeve 504241
(S) Basic tool 504161

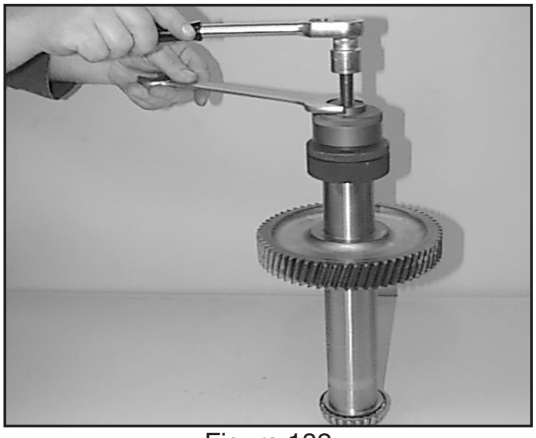
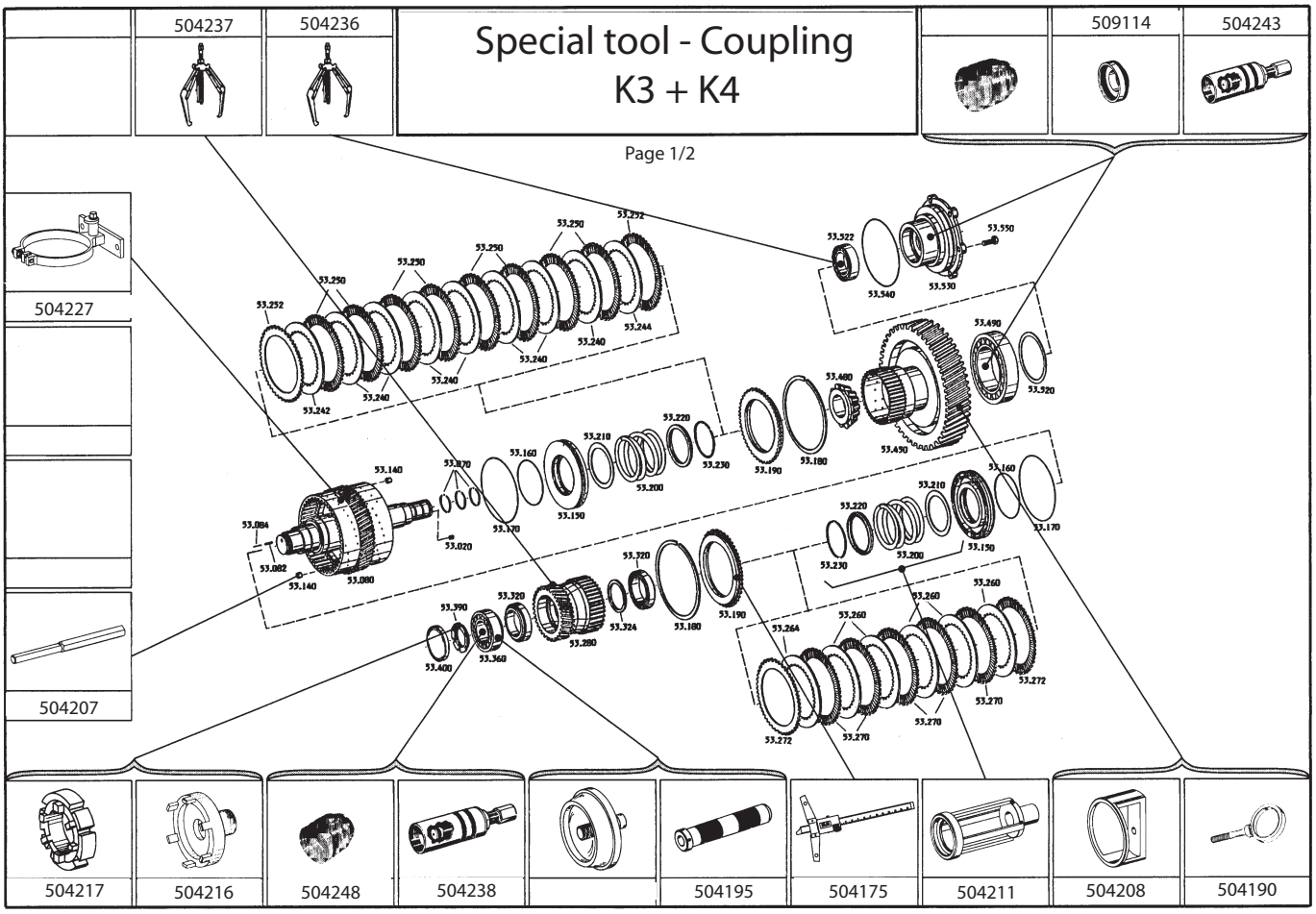


Figure 182

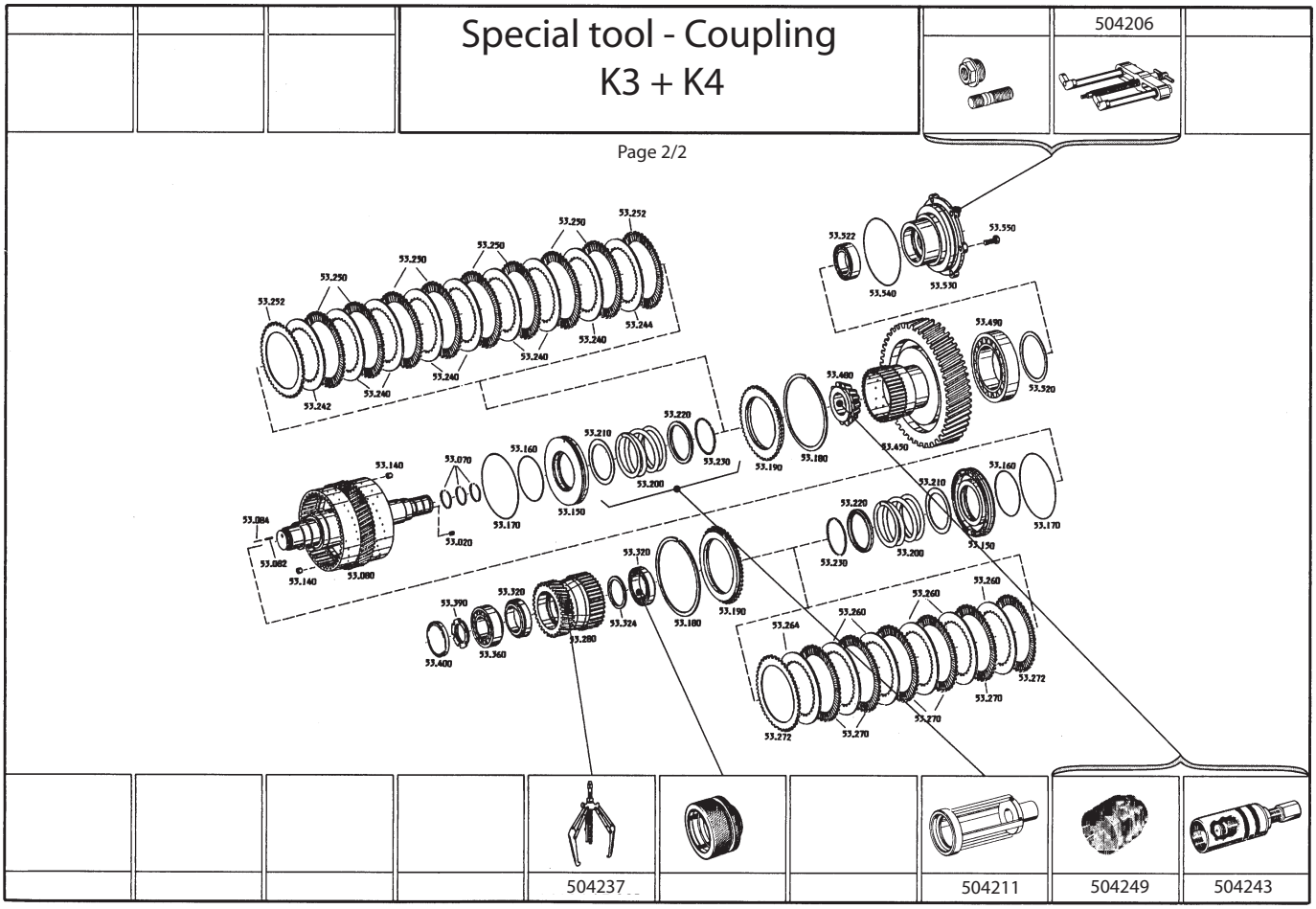
Special tool - Coupling K3 + K4

Page 1/2



Special tool - Coupling K3 + K4

Page 2/2



Dismantle multi-disc clutch – K3/K4

Fasten clutch by means of clamping ring (S) on the assembly car.

(S) Clamping ring 504226
or 504227

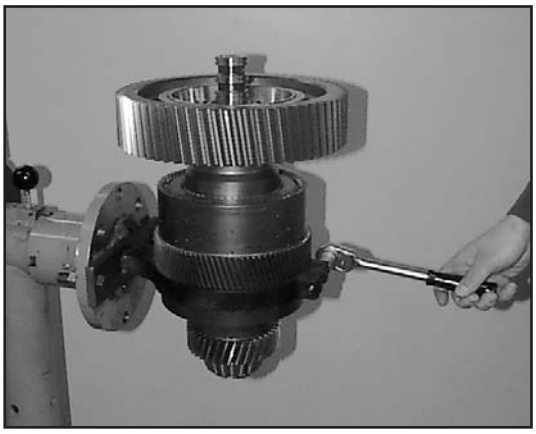


Figure 185

Pull roller bearing off plate carrier.

(S) 3-leg puller 504236

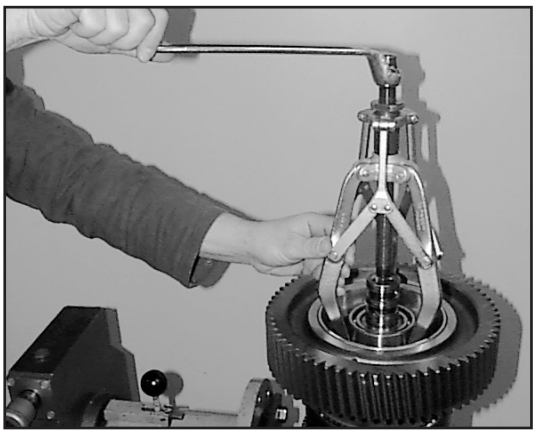


Figure 186

Separate spur gear K3 from plate carrier.

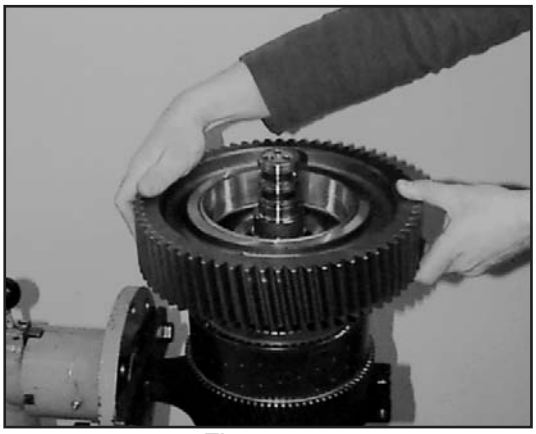


Figure 187

Pull bearing inner race off plate carrier.

(S) Quick-acting grip 504249
(S) Basic tool 504243

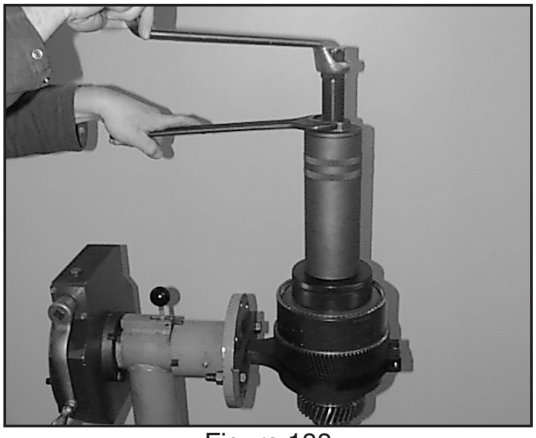


Figure 188

Squeeze snap ring out.

Disassemble end shim and plate pack K3.

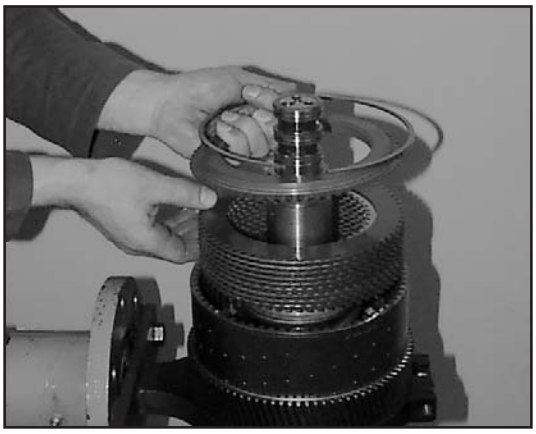


Figure 189

Tilt plate carrier 90°.
Loosen slotted nut.

Slotted nut is secured with Loctite!
To prevent damage to the thread, heat up slotted nut prior to loosen it (abt. 120° C)!

(S) Hook spanner	504217
(S) Hook spanner	504216
(S) Hot-air blower 230 V	504193
(S) Hot-air blower 115 V	504194

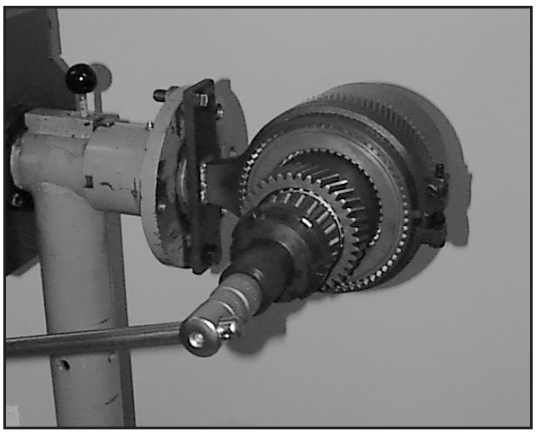


Figure 190

Tilt plate carrier by 90°.

Pull off tapered roller bearing.

(S) Grab sleeve	504248
(S) Grab sleeve	504238

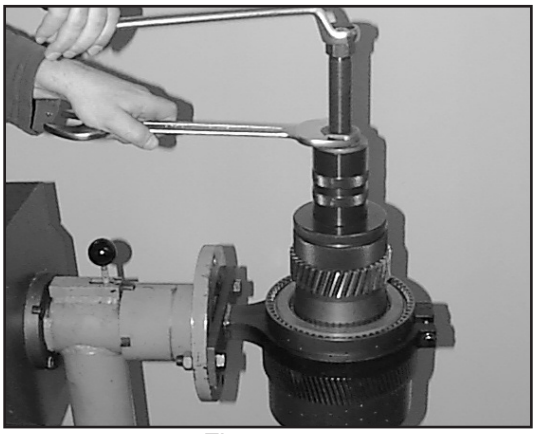


Figure 191

Pull spur gear K4 off plate carrier.

(S) 3-leg puller	504237



Figure 192

Remove adjusting ring.

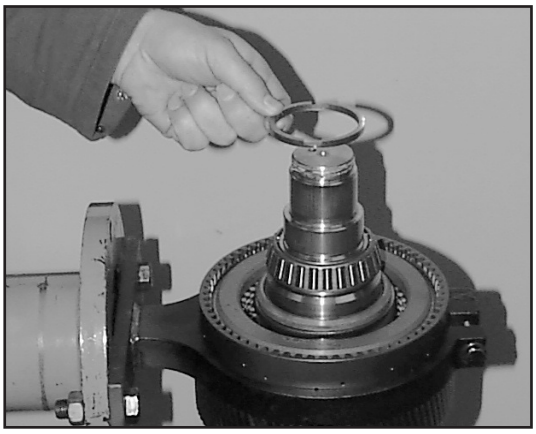


Figure 193

Pull off tapered roller bearing.

(S) 3-leg puller 504236

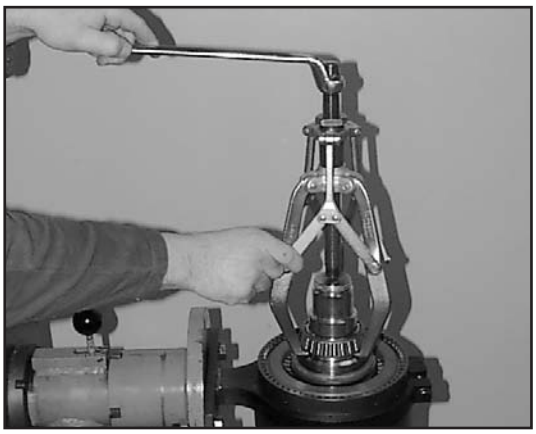


Figure 194

Squeeze out snap ring.

Disassemble end shim and plate pack K4.

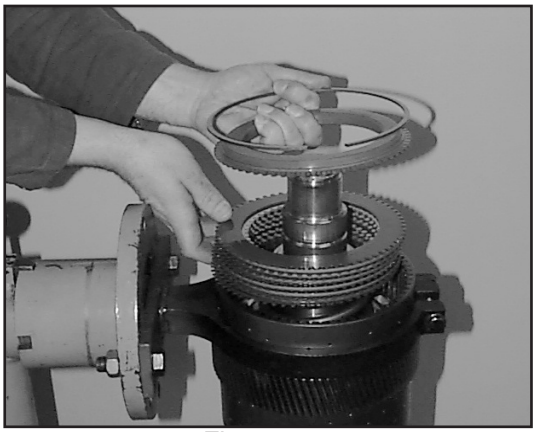


Figure 195

Pre-load compression spring by means of special device (S).
Squeeze out snap ring and remove the released components.

Accordingly disassemble opposite components (K3-side).

(S) Pressure piece 504211

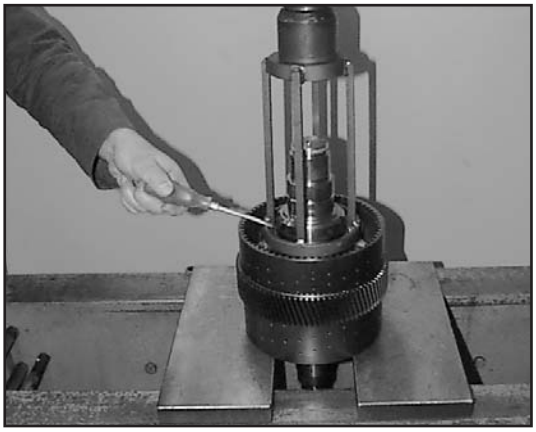


Figure 196

Separate both pistons with compressed air from the plate carrier.

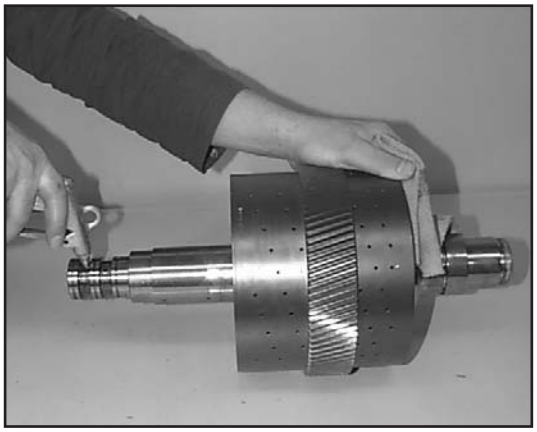
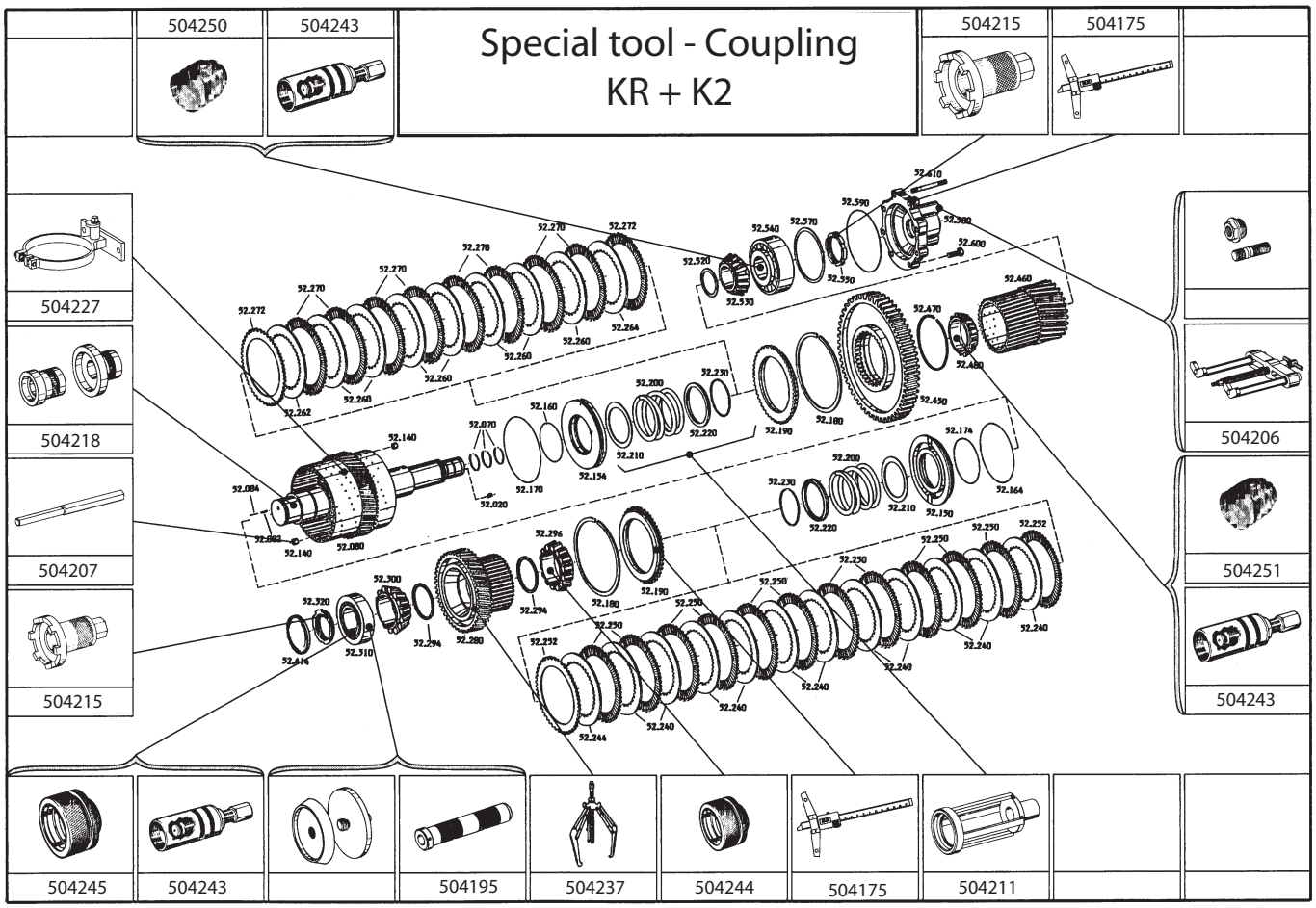


Figure 197

Dismantle multi-disc clutch KR/K2



Fasten clutch by means of clamping ring (arrow) on the assembly car.

(S) Clamping ring 504226
or
(S) Clamping ring 504227

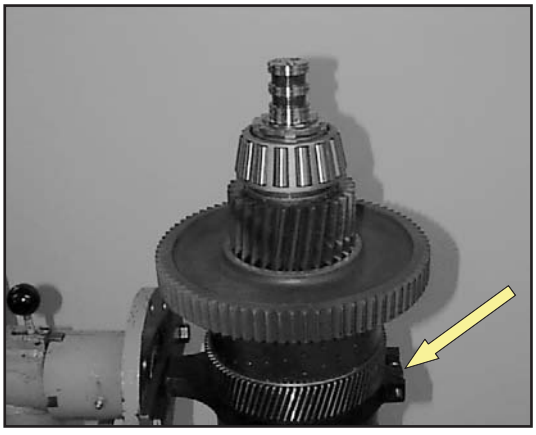


Figure 198

Tilt plate carrier by 90°.

Loosen slotted nut.

Slotted nut is secured with Loctite!
To prevent damage to the thread, heat slotted nut prior to loosen it (abt. 120° C)!

(S) Hook spanner 504215

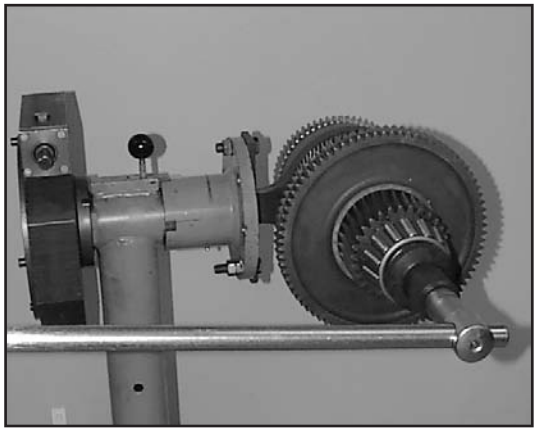


Figure 199

Pull tapered roller bearing off plate carrier.

(S) Grab sleeve 504250
(S) Basic tool 504243

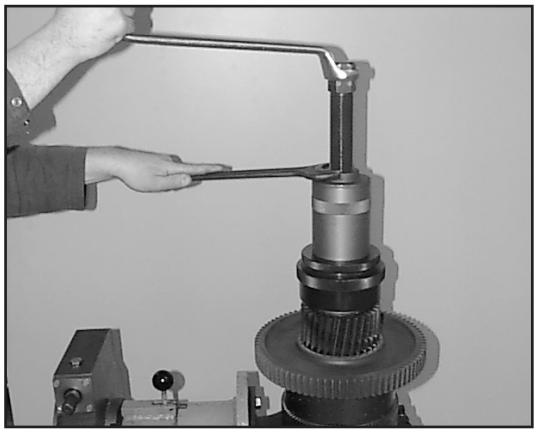


Figure 200

Press spur gear K2 from the plate carrier.

Pay attention to released plate carrier!

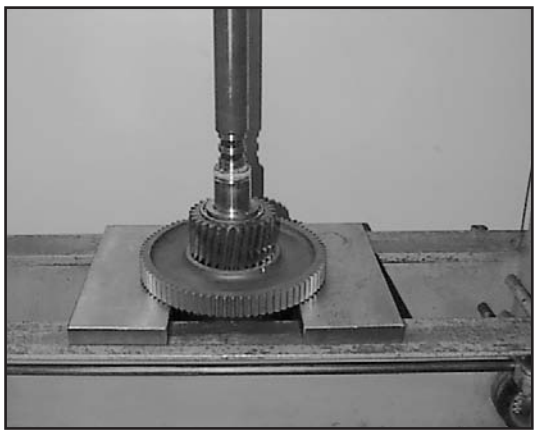


Figure 201

Fix plate carrier by means of clamping ring (S).

Remove shim.

(S) Clamping ring 504226
or 504227

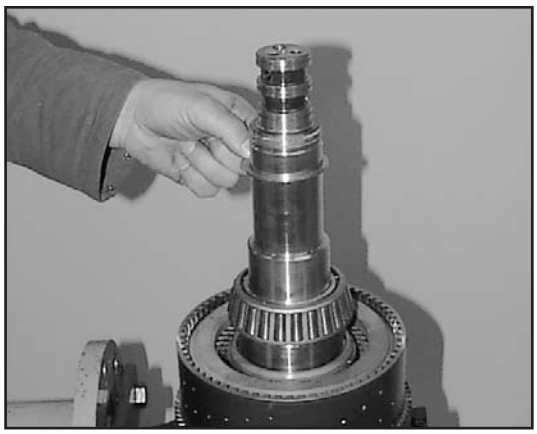


Figure 202

Pull tapered roller bearing off plate carrier.

(S) Grab sleeve 504251
(S) Basic tools 504243

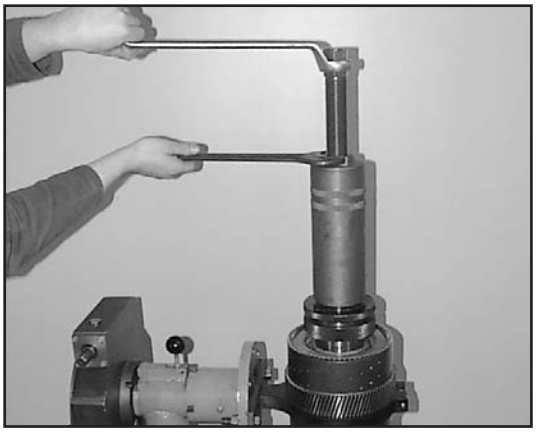


Figure 203

Squeeze snap ring out.

Disassemble end shim and plate pack K2.

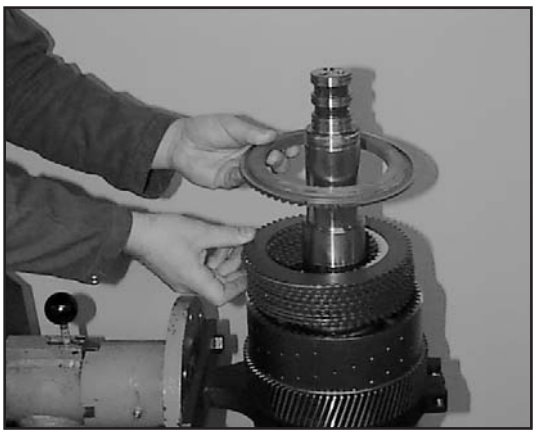


Figure 204

Tilt plate carrier by 90°.

Loosen slotted nut.

Slotted nut is secured with Loctite!
To prevent damage to the thread, heat slotted nut prior to loosen it (abt. 120° C)!

(S) Hook spanner 504215
(S) Hot-air blower 230 V 504193
(S) Hot-air blower 115 V 504194

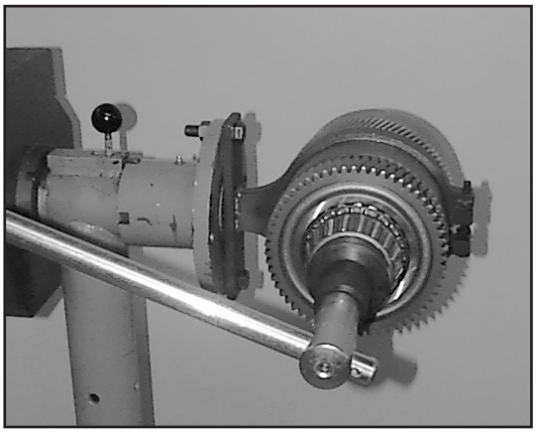


Figure 205

Pull tapered roller bearing from plate carrier.

(S) Grab sleeve 504245
(S) Basic tool 504243

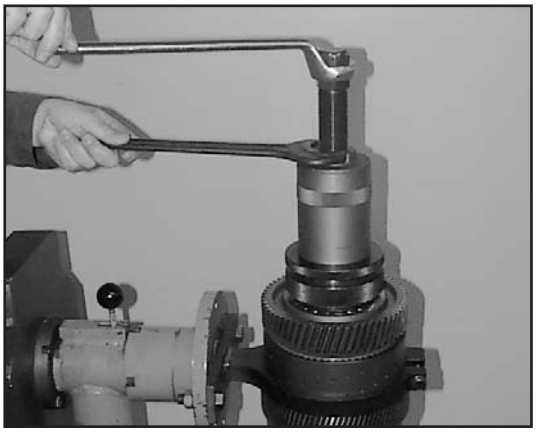


Figure 206

Pull tapered roller bearing from plate carrier.

(S) 3-leg puller 504237

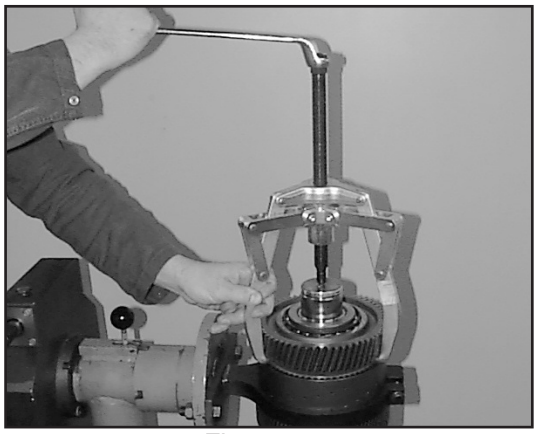


Figure 207

Remove adjusting rings.

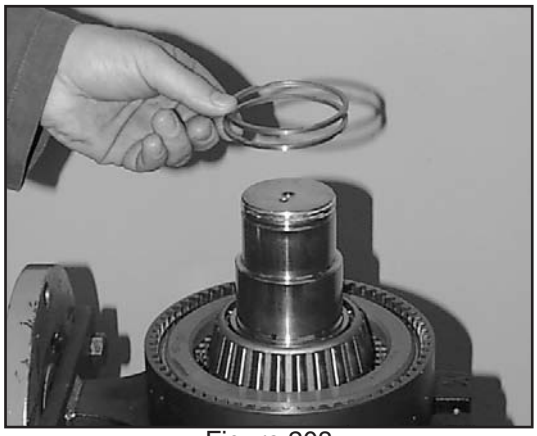


Figure 208

Squeeze out snap ring.

Disassemble end shim and plate pack KR.



Figure 209

Pull tapered roller bearing off plate carrier.

(S) Grab sleeve 504244
(S) Basic tool 504243

Then, disassemble both pistons (as described in Figure 196 and 197).

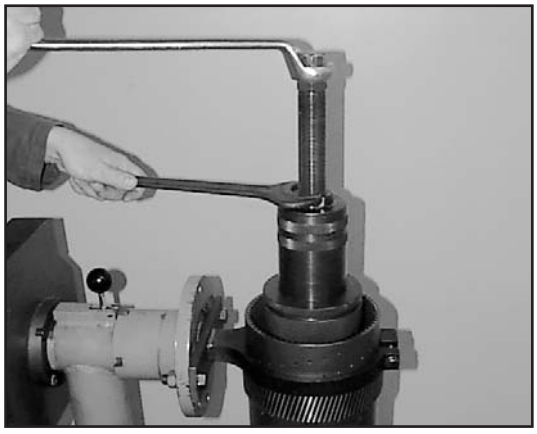
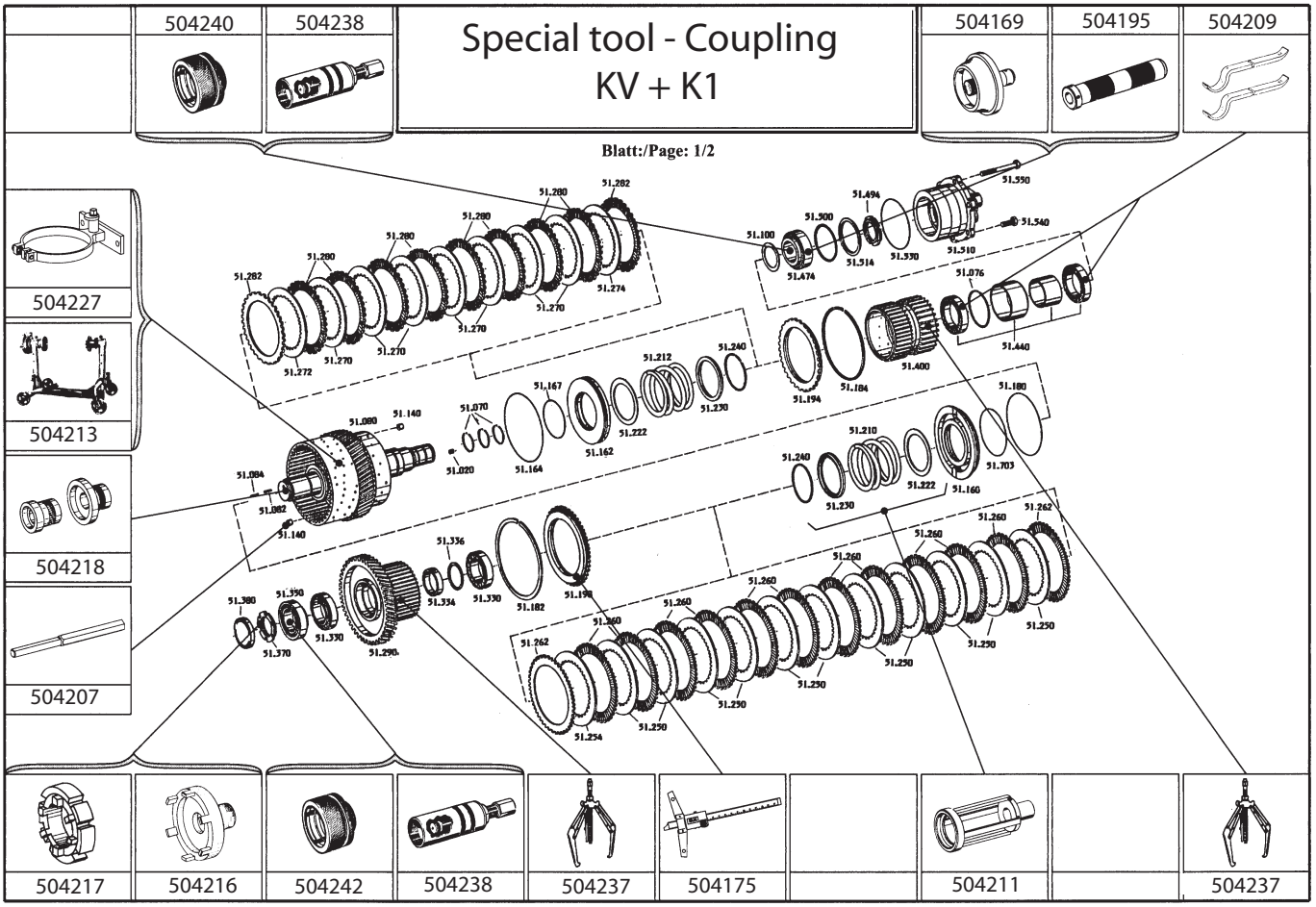


Figure 210

Special tool - Coupling KV + K1

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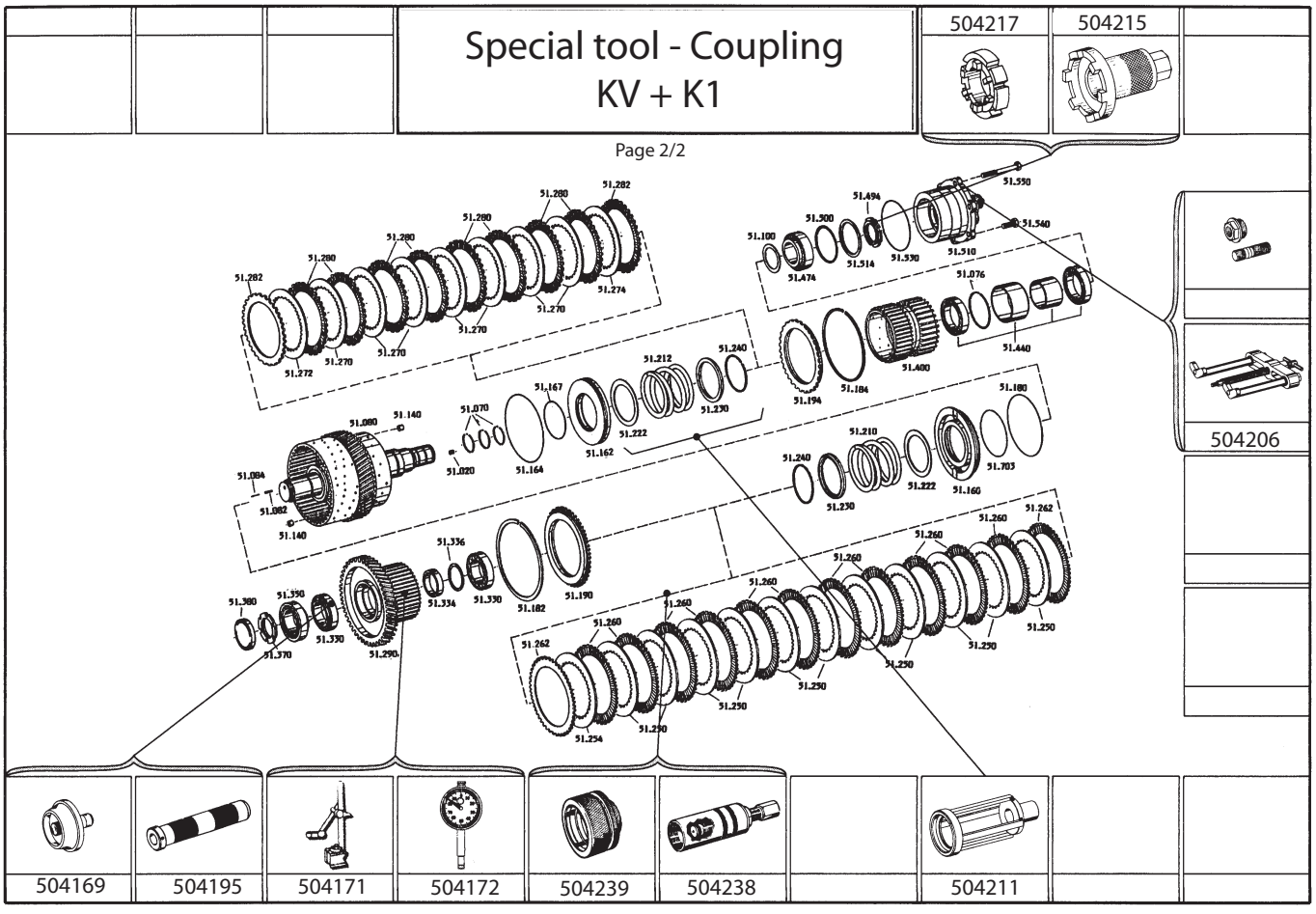
504240 504238 504169 504195 504209

504227 504213 504218 504207

504217 504216 504242 504238 504237 504175 504211 504237

Special tool - Coupling KV + K1

Page 2/2



504217 504215 504206

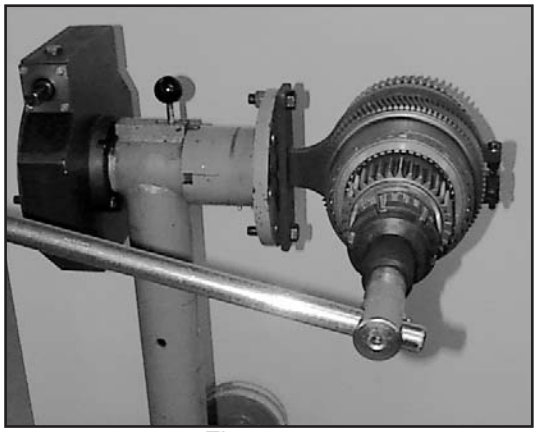
504169 504195 504171 504172 504239 504238 504211

Dismantle multi-disc clutch KV/K1

Fasten clutch by means of clamping ring on the assembly car.
Loosen slotted nut (Figure 211).

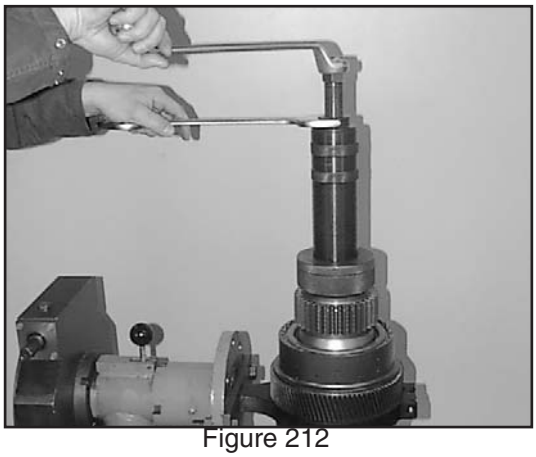
Slotted nut is secured with Loctite!
To prevent damage to the thread, heat the slotted nut prior to loosen it (abt. 120° C)!

(S) Clamping ring	504226	or
	504227	
(S) Hook spanner	504217	
(S) Hook spanner	504215	


Figure 211

Pull tapered roller bearing off plate carrier.

(S) Grab sleeve	504240
(S) Basic tool	504238


Figure 212

Remove disc.

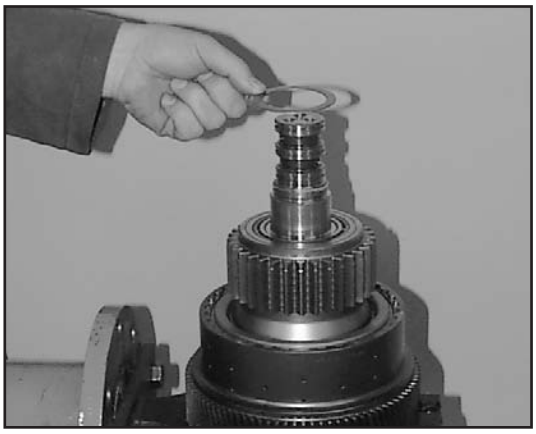


Figure 213

Pull cylindrical gear K1 off plate carrier.

(S) 3-leg puller 504237

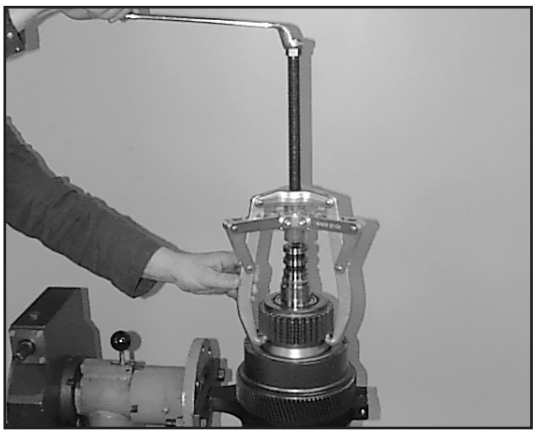


Figure 214

The figure on the left shows the spur gear bearing -K1.

Bearing 1 is available only as sub-assembly.

If the disassembly of the plate pack-side ball bearing (arrow) is necessary – also see Fig. 217 and 218 – the complete bearing must be renewed!

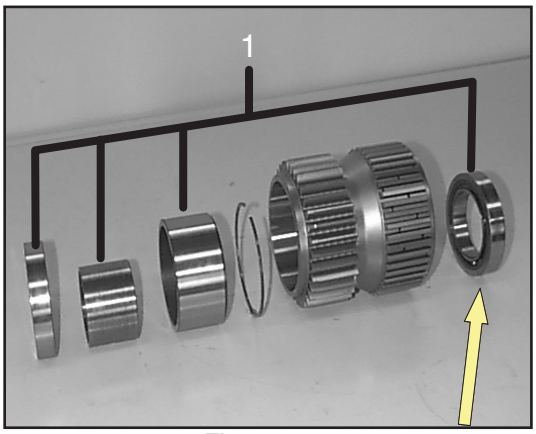


Figure 215

Remove bush.

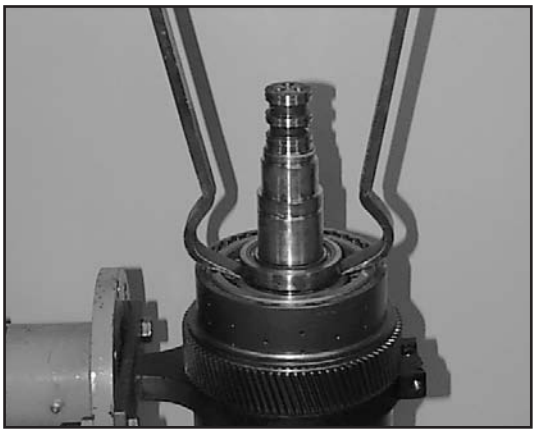


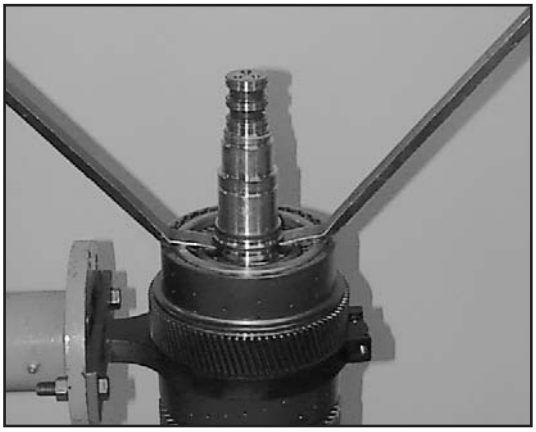
Figure 216

Pull ball bearing from plate carrier (Figure 217 and 218).

Pay attention to the released balls!

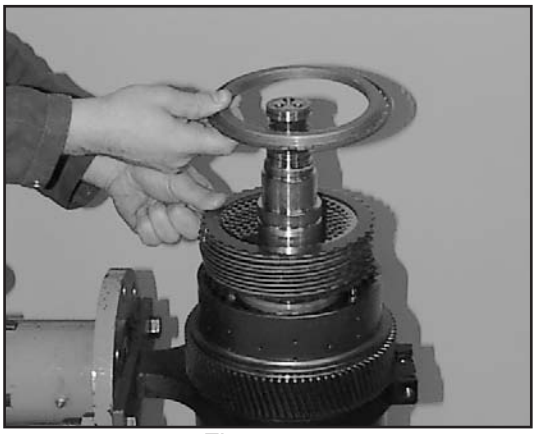
(S) Pry bar 504209


Figure 217


Figure 218

Squeeze out snap ring.

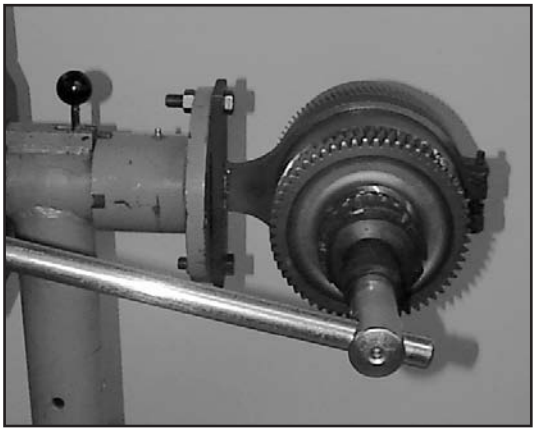
Disassemble end shim and plate pack K1.


Figure 219

Tilt plate carrier by 90°.
Loosen slotted nut.

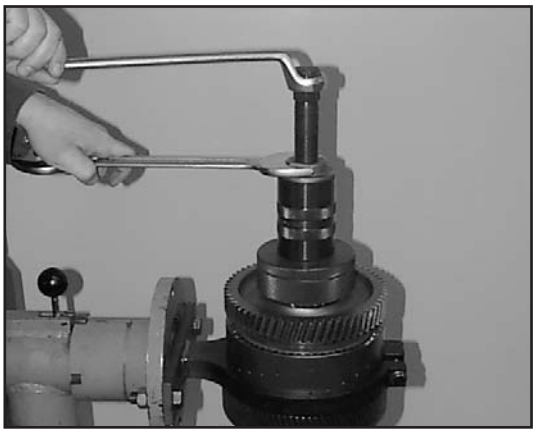
Slotted nut is secured with Loctite!
To prevent damage to the thread, heat slotted nut prior to loosen it (about 120°C).!

(S) Hook spanner 504217
(S) Hook spanner 504216
(S) Hot-air blower 230 V 504193
(S) Hot-air blower 115 V 504194


Figure 220

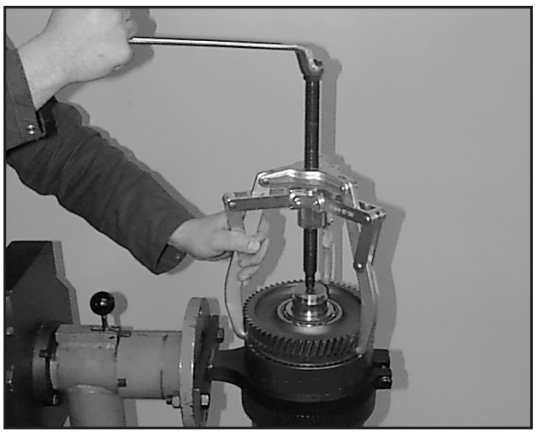
Pull tapered roller bearing off plate carrier.

(S) Grab sleeve 504242
(S) Basic tool 504238

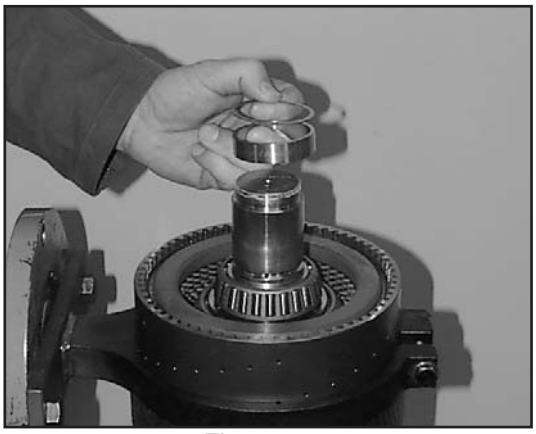

Figure 221

Pull spur gear KV off plate carrier.

(S) 3-leg puller 504237


Figure 222

Remove shim and ring.

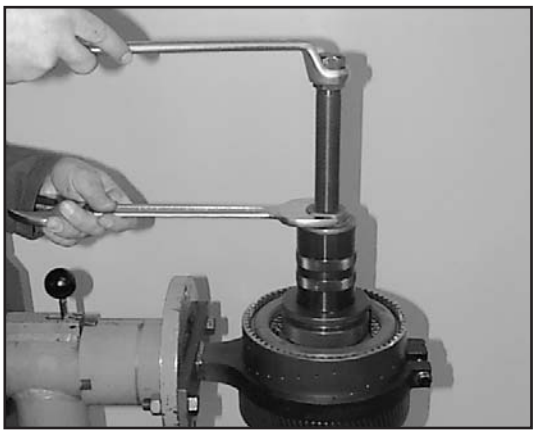

Figure 223

Pull tapered roller bearing off plate carrier (Figure 224).

Squeeze out snap ring.

Disassemble end shim and plate pack KV.
Disassemble both pistons (as described under Figure 196 and 197).

(S) Grab sleeve 504239
(S) Basic tool 504238


Figure 224

Manual transmission assembly

Mount studs (arrows).

Wet thread with Loctite (type-no. 243)!

Depending on the transmission version, differences concerning number and length of the studs are possible.
See in this connection the corresponding Spare Parts List.

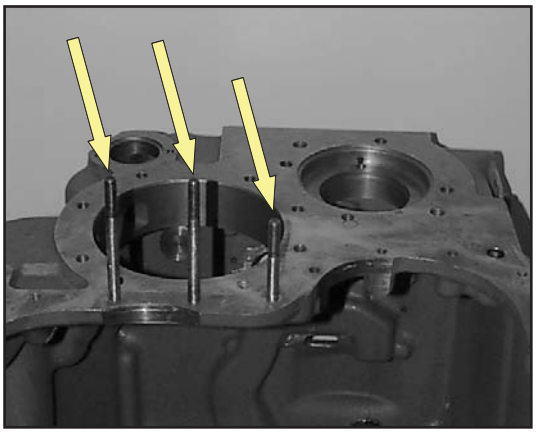


Figure 230

Line up O-ring (arrow).
Insert bush into the housing bore until contact is obtained and fasten it.

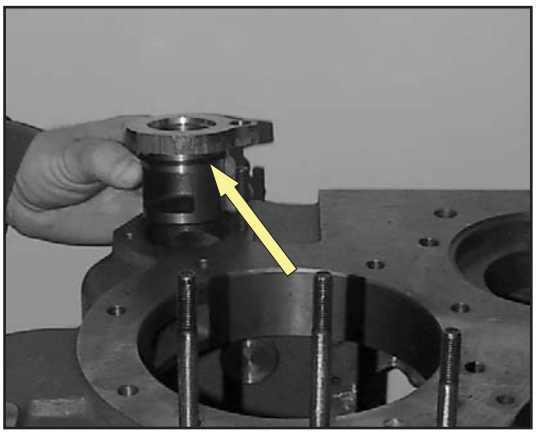


Figure 231

Power take-off

Supercool shaft (about – 80° C), heat up gear (abt. + 120° C) and line it up, or press it against shoulder.

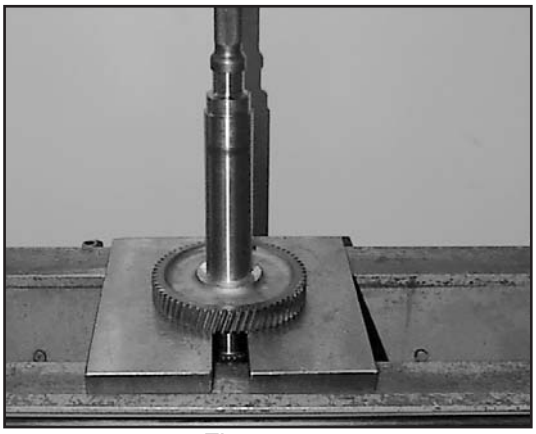


Figure 232

Press bearing inner race against shoulder.
Press opposite bearing inner race against shoulder.

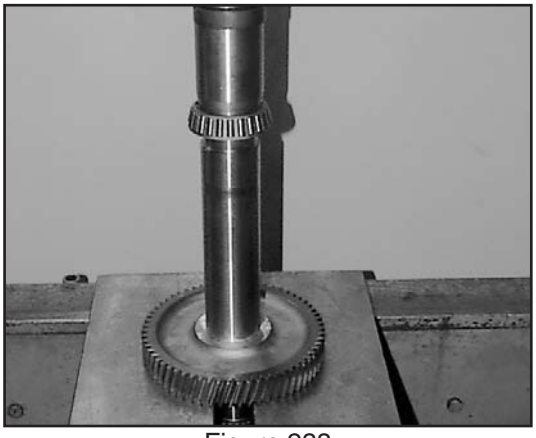


Figure 233

Insert bearing outer race (arrow) into housing bore until contact is obtained.

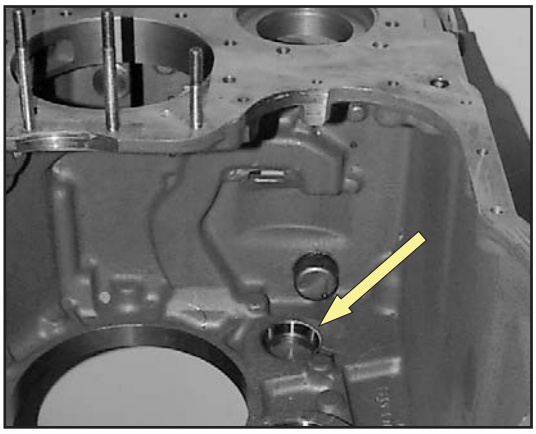


Figure 234

Position pre-assembled pto-shaft in the housing and insert bearing outer race until contact is obtained.

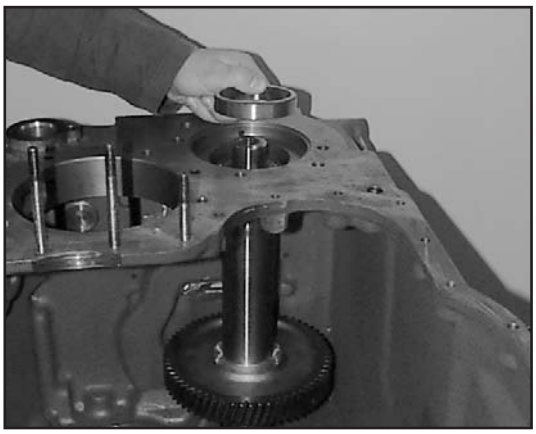


Figure 235

Adjust axial gap – power take-off bearing max. 0,10 mm, using shim(s) and circlip.

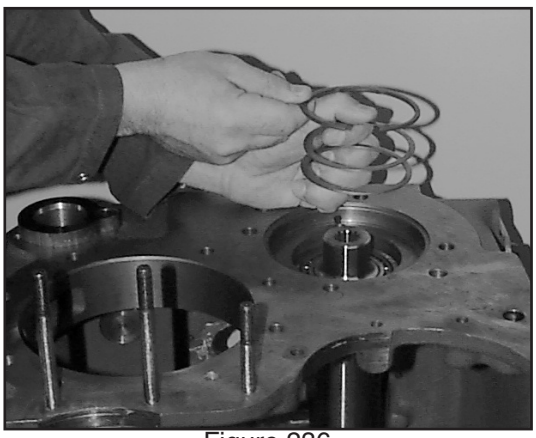


Figure 236

Tilt gearbox housing by 180°.

Insert sealing disc (arrow) with the concave side showing downwards into the housing bore until contact is obtained.

Wet contact surface with Loctite (type-no. 262)!

Do not damage the centric orifice hole Æ 0,8 mm during the installation of the sealing disc!

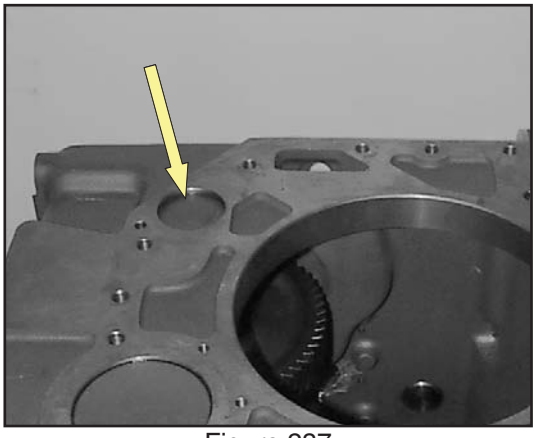


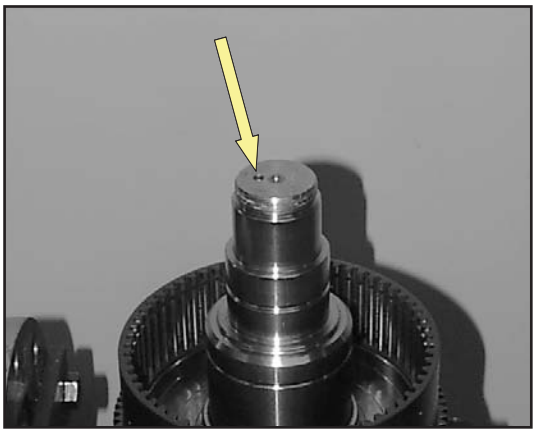
Figure 237

Reassemble multi-disc clutch-K3/K4

Lift plate carrier with the K4-side showing downwards into the clamping ring (S) and fix it.
Now, tilt plate carrier by 180°.

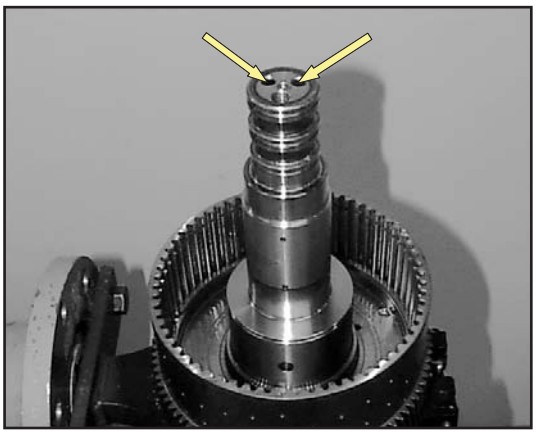
Insert both roll pins (6x24 and 3,5x24 mm) flush into the end face-side bore of the plate carrier, see arrow/Figure 239

(S) Clamping ring	504226
or	504227


Figure 239

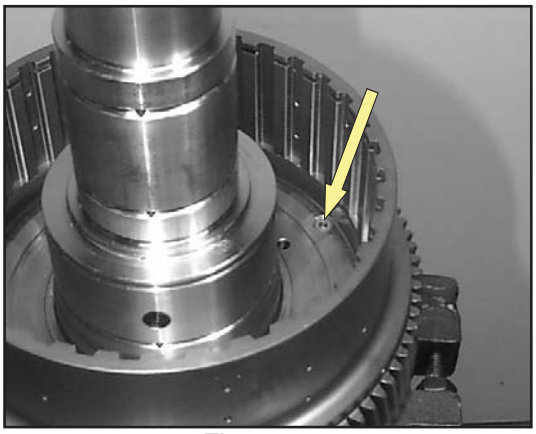
Tilt plate carrier by 180°.

Wet both roll pins (arrows) with Loctite, type-no. 262, and install them.

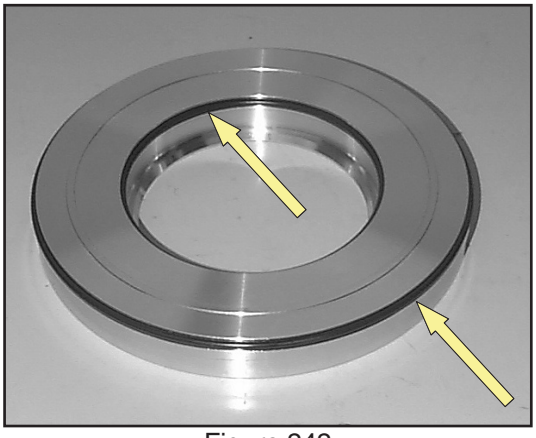

Figure 240

Insert purge valve (arrow) with the chamfer showing downwards.

(S) Settling tool	504207


Figure 241

Insert both O-rings **scrollfree** into the ring grooves of the piston, see arrows!


Figure 242

Oil O-rings and piston bearing surfaces.

Uniformly insert piston K3 until contact is obtained.

Observe the installation position of the piston, see Figure!

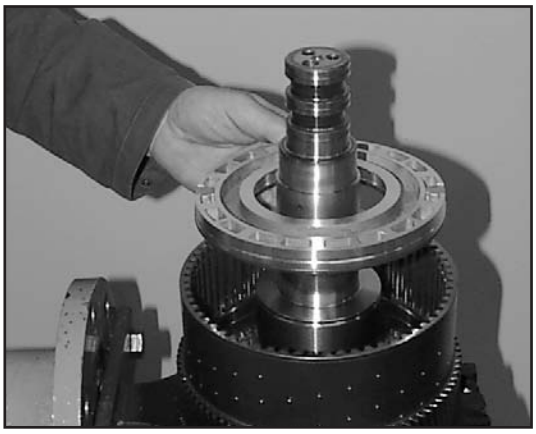


Figure 243

Introduce intermediate washer and compression spring.

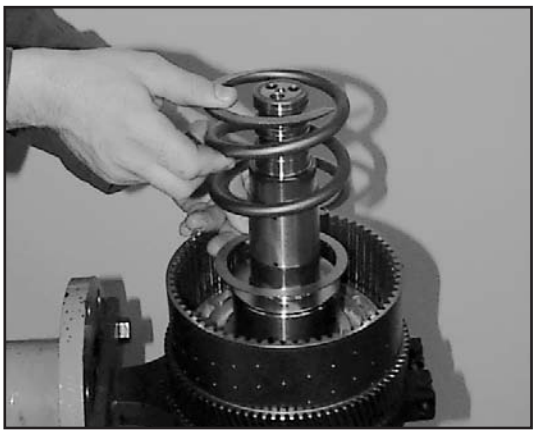


Figure 244

Lay guide ring with the chamfer (arrow) showing upwards over compression spring and line up snap ring.

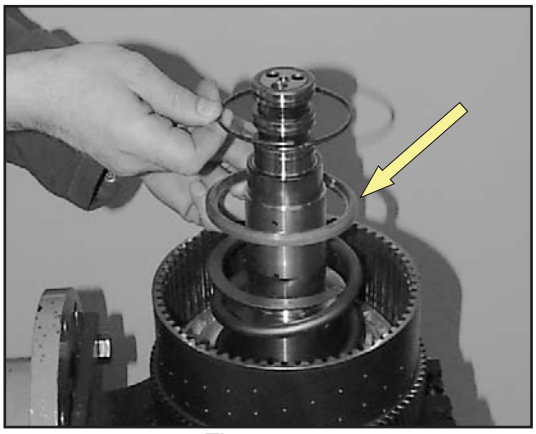


Figure 245

Lift plate carrier out of the clamping ring.

Pre-load compression spring by means of special device (S) and squeeze snap ring into the annular groove of the plate carrier (arrow)

(S) Special device 504211

Analogously install purge valve, spool and compression spring on the opposite side (clutch K4).

Now, lift plate carrier with the K4-side showing downwards into the clamping ring and fix it.

Tilt plate carrier by 180°.

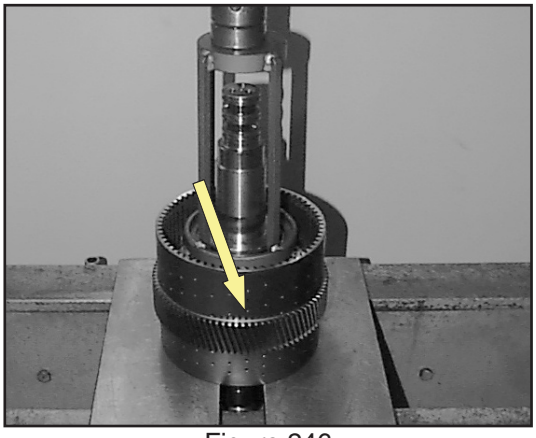


Figure 246

Multi-disc clutch-K4

The following sketch or table show plate stacking and installation position of the components.

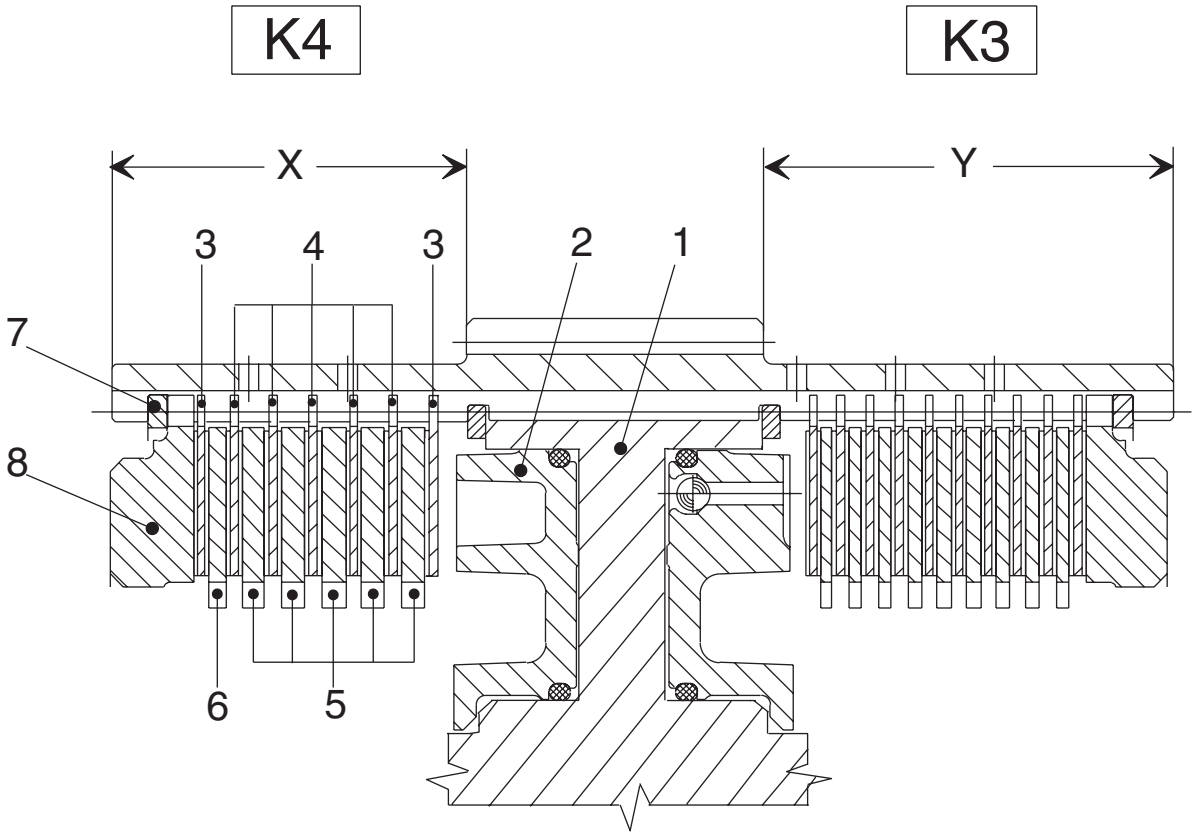


Figure 248

Item.	Designation	Quantity	s (mm)	Remark
1	Plate carrier	1		
2	Piston	1		
3	Outer plate	2	1,85	One-side coated
4	Outer plate	5	2,5	Coated on both sides
5	Inner plate	5	3,5	
6	Inner plate	1	2,5 ... 4,0	Optional
7	Snap ring	1	2,55 ... 3,10	Optional
8	End shim	1		
Number of friction surfaces: 12				
Plate clearance: 2,2 ... 2,4 mm				

Install outer plates Item 3 with the uncoated side facing the piston or the end shim!
The respective clutch side can be recognized by the length of the plate carrier, see sketch!
K4 = Measure X (short plate carrier side)
K3 = Measure Y (long plate carrier side)

Check plate clearance-K4 (Figure 249 ... 251)!

To ensure a correct measuring result, initially install plate pack without oil!

Install plate pack according to the sketch or table (page 3.31 or 3.32).

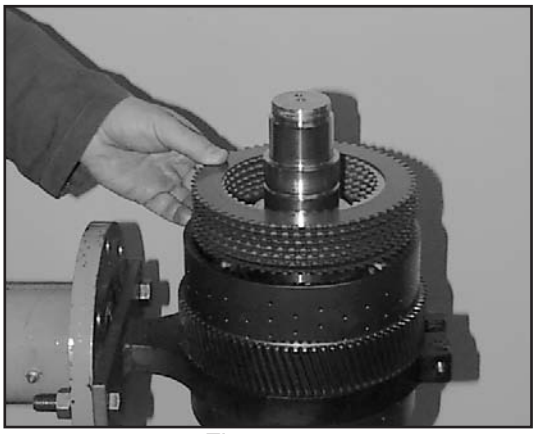


Figure 249

Insert end shim and fix it by means of snap ring.

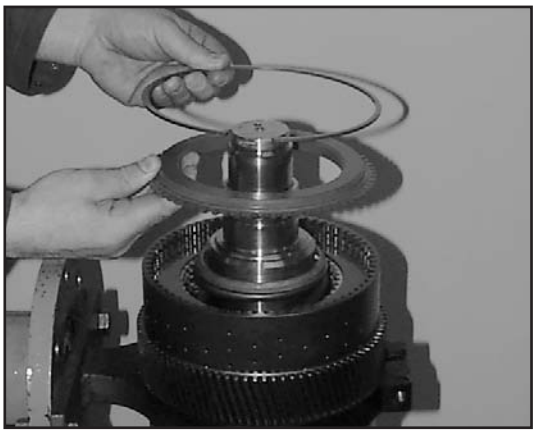


Figure 250

Press on end shim with about 100 N (10 kg) and set dial indicator to „Zero“ (Figure 251).

Now, press end shim against snap ring (upwards) and read plate clearance from dial indicator.

In case of a deviation from the required plate clearance (see table/page 3.31 or 3.32), correct with suitable inner plate Item 6 (optionally s = 2,5 to 4,0 mm) or and snap ring Item 7 (optionally)!

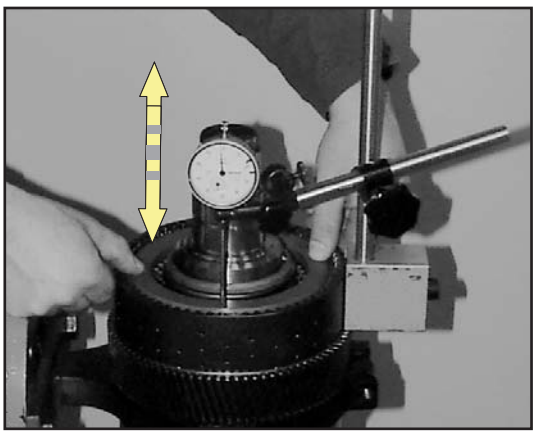


Figure 251

(S) Magnetic stand	504171
(S) Dial indicator	504172

After the performed adjustment of the plate clearance, disassemble plate pack. Oil plates according to ZF-list of lubricants TE-ML 03 and install them again.

Pre-assemble and install spur gear -K4 (Figure 252 ... 257):

The figure on the left shows the components of the spur gear-K4

1 = Bearing inner race
2 = Bearing outer race
3 = Shim (optional, empirical value s = 5,4 mm)
4 = Spur gear

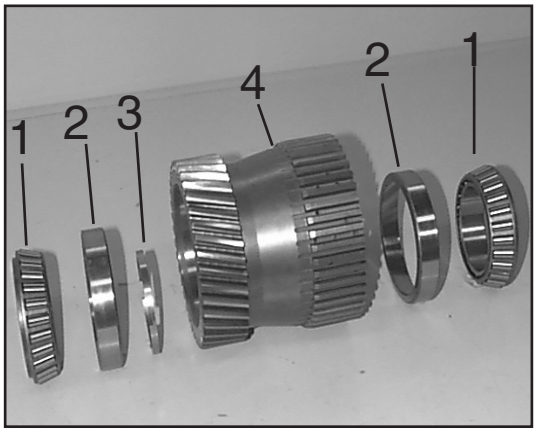


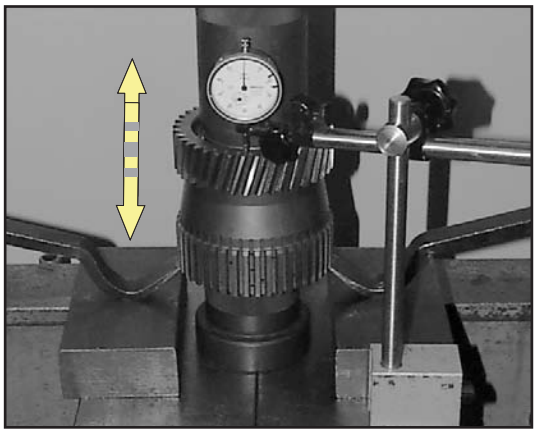
Figure 252

Check axial gap – spur gear bearing 0,0 ... 0,05 mm!

Install components according to Figure 252.
Pre-load tapered roller bearing with about 50.000 N (5 To.) and determine axial gap with dial indicator

In case of deviations from the required axial gap, correct with suitable shim (Item. 3/Figure 252)!

(S) Pry bar	504209
(S) dial indicator	504172
(S) Magnetic stand	504171


Figure 253

Heat bearing inner race and line it up until contact is obtained.


Figure 254

Line up the determined shim (see Figure 252 and 253) with the oil groove showing upwards.


Figure 255

Introduce spur gear until all inner plates are accommodated.

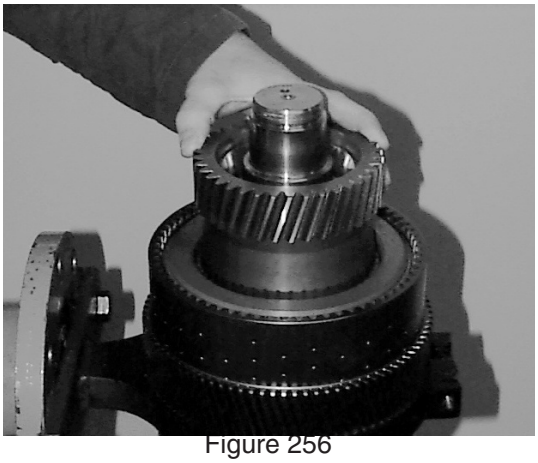


Figure 256

Heat up bearing inner race (spur gear bearing) and position it until contact is obtained

Use protective gloves!



Figure 257

Heat bearing inner race (clutch support) and line it up until contact is obtained

Use protective gloves!



Figure 258

Multi-disc clutch-K3

The following sketch or table show plate stacking and installation position of the components!

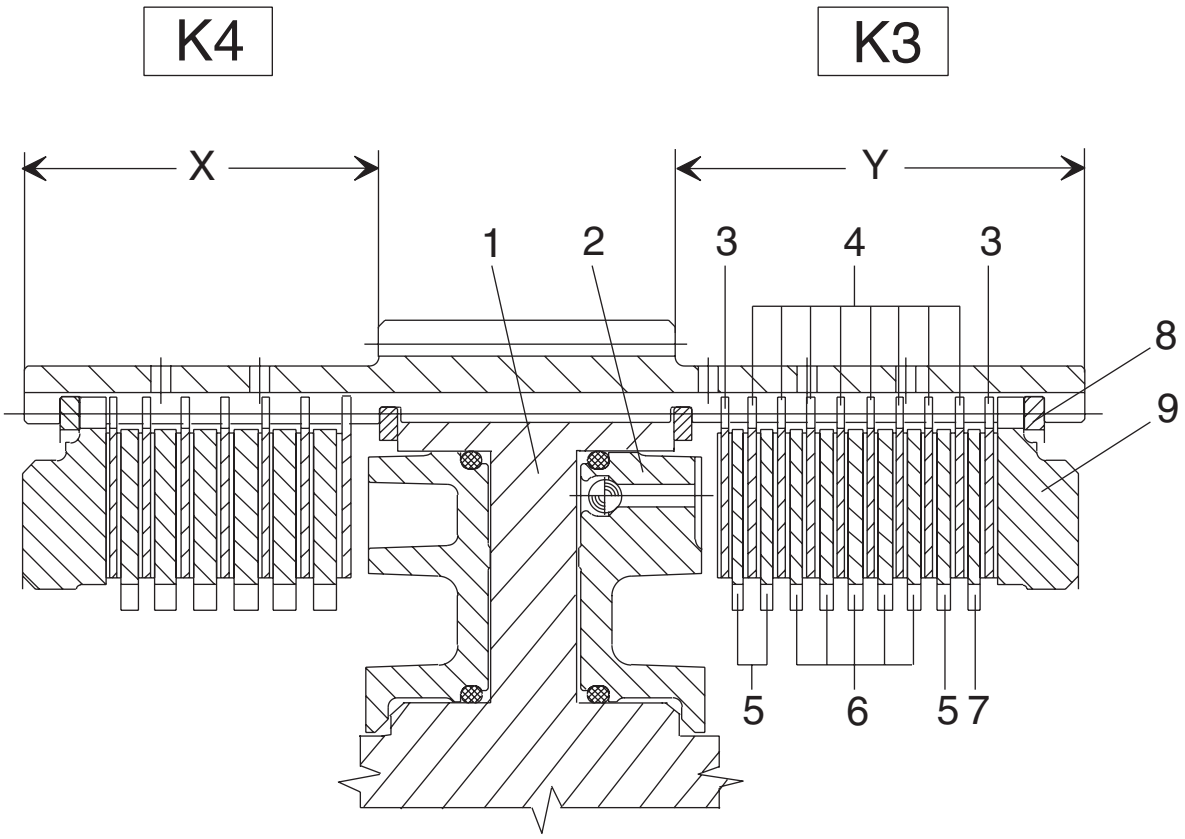


Figure 259

Item.	Designation	Quantity	s (mm)	Remark
1	Plate carrier	1		
2	Piston	1		
3	Outer plate	2	1,85	One-,side coated
4	Outer plate	8	2,5	Coated on both sides
5	Inner plate	3	2,5	
6	Inner plate	5	3,0	
7	Inner plate	1	2,5 ... 4,0	Optional
8	Snap ring	1	2,55 ... 3,10	Optional
9	End shims	1		
Number of friction surfaces: 18				
Plate clearance: 2,6 ... 2,8 mm				

Outer plates Item 3 with the uncoated side facing the piston or the end shim!
The respective clutch side can be recognized by the length of the plate carrier, see sketch!
K3 = Measure Y (long plate carrier side)
K4 = Measure X (short plate carrier side)

Check plate clearance-K3 (Figure 261 ... 263) !

To ensure a correct measuring result, initially install plates without oil!

Install plate pack according to the sketch or table (page 3.36 or 3.37).

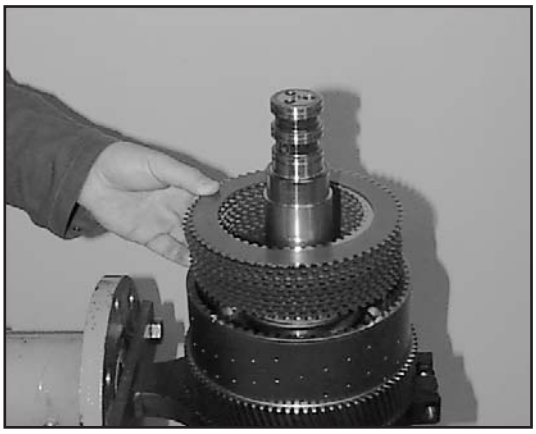


Figure 261

Introduce end shim and fix it by means of snap ring

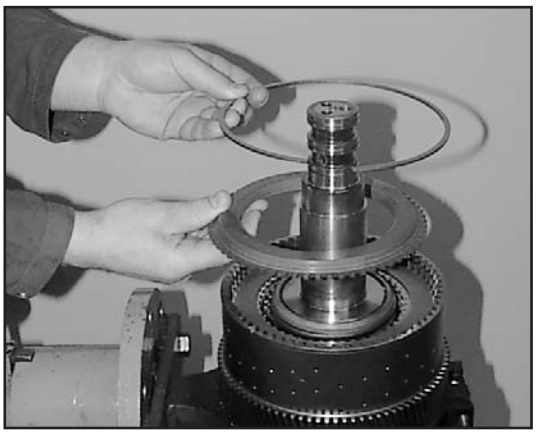


Figure 262

Press on end shim on with about 100 N (10 kg) and set dial indicator to „Zero“.
Now, press end shim against snap ring (upwards) and read plate clearance from dial indicator.

In case of deviations from the required plate clearance (see table/page 3.36 or 3.37),correct with suitable inner plate (optionally s = 2,5 ... 4,0 mm) or and snap ring (optionally)!

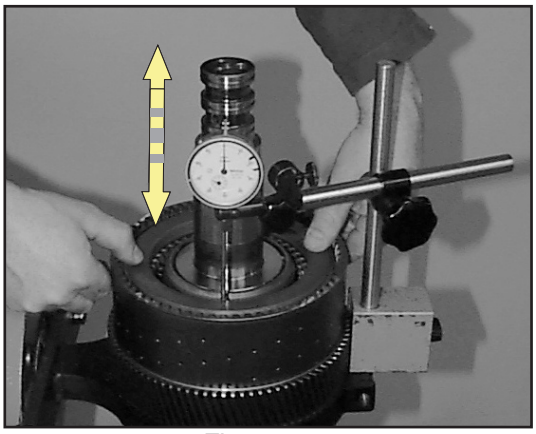


Figure 263

(S) Magnetic stand	504171
(S) Dial indicator	504172

After the performed adjustment of the plate clearance, disassemble plate pack. Oil plates according to ZF-list of lubricants TE-ML 03 and install them again.

Heat up bearing inner race and line it up until contact is obtained.



Use protective gloves!

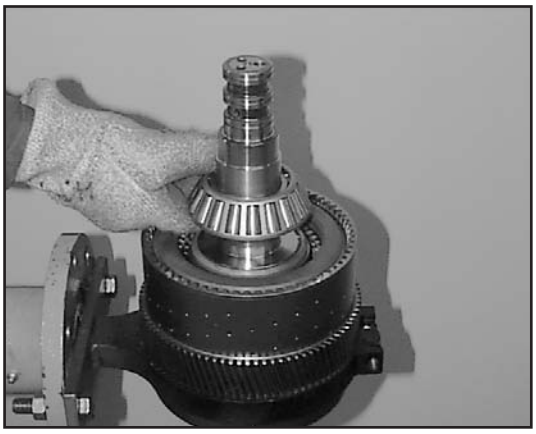


Figure 264

Lift plate carrier out of the clamping ring (S).

To ensure the exact contact of the components, pre-load the bearing with 100 000 N (10 To.) .



Support at the lower as well as at the upper bearing inner race!

Use pressure pieces (S)!

(S) Pressure piece 504218

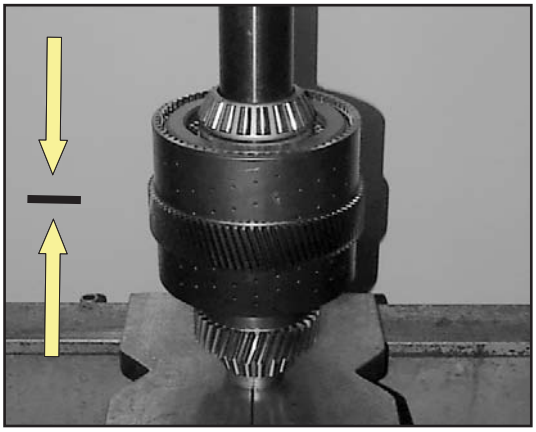


Figure 265

Lift plate carrier with the K-4 side showing downwards into clamping ring (S) and fix it.

Tilt plate carrier by 90°.

Wet thread nut with Loctite (type-no. 262) and install slotted nut (Figure 266).



Install slotted nut with the collar (60 mm dia.) facing the bearing inner race!

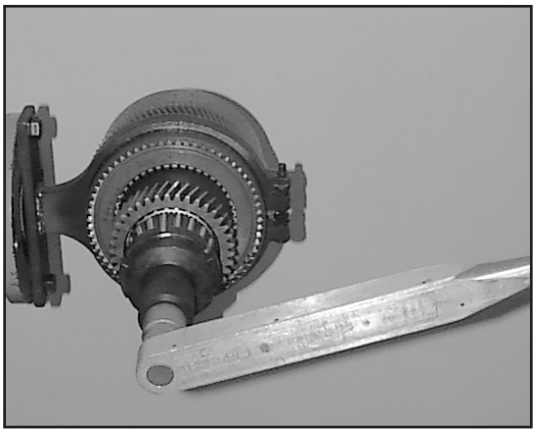


Figure 266

(S) Clamping ring 504226
or 504227
(S) Hook spanner 504217
(S) Hook spanner 504216

Insert bearing outer race into spur gear K3 until contact is obtained.

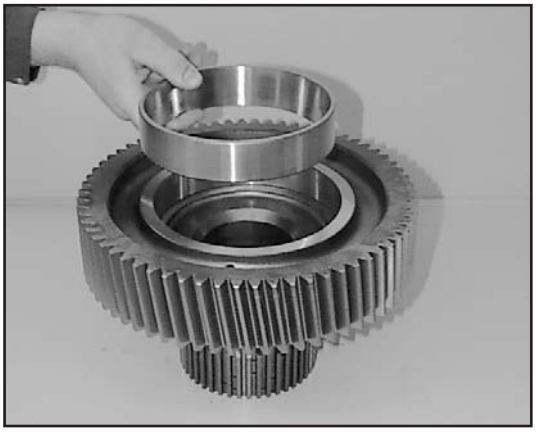


Figure 267

Introduce spur gear until all inner plates are accommodated.

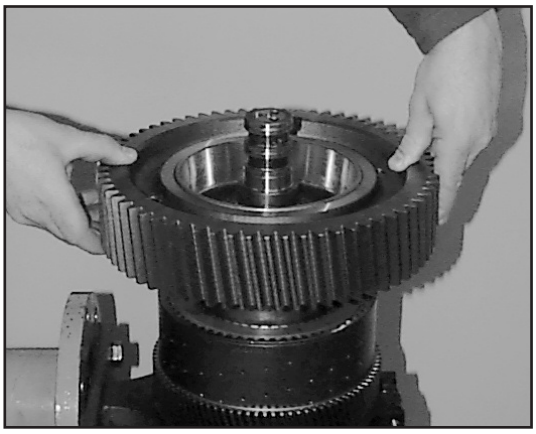


Figure 268

Heat roller bearing and position it until contact is obtained.



Figure 269

Use protective gloves!

Introduce bearing inner race.

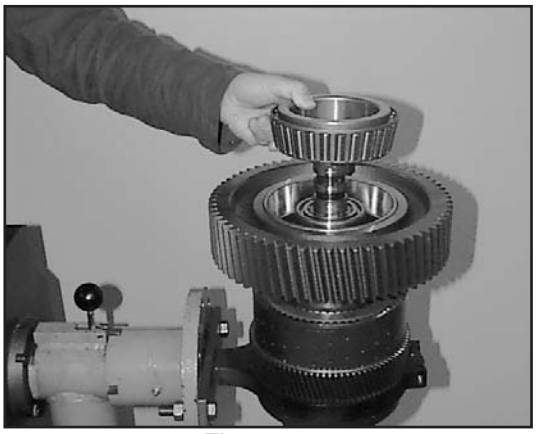


Figure 270

Check function of clutches K3 and K4 by means of compressed air.

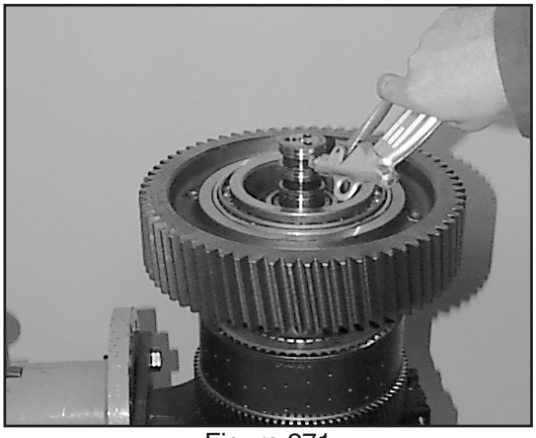


Figure 271

With correctly installed components, closing or opening of the clutches is clearly audible.

Squeeze in and engage rectangular rings (3x, see arrows).

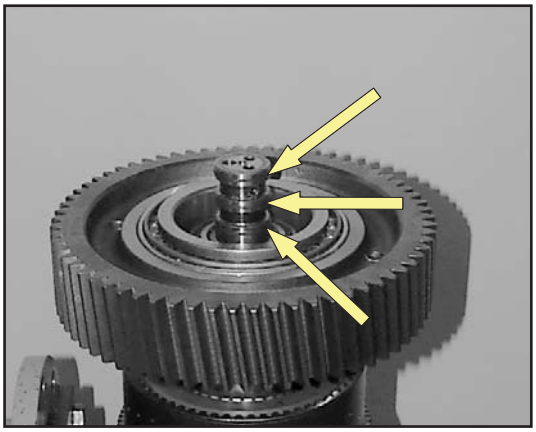


Figure 272

Reassemble multi-disc clutch-KR/K2

Lift plate carrier with the KR-side showing downward into clamping ring and fix it.

Tilt plate carrier 180°.

Insert both roll pins (6x24 and 3,5x24 mm) flush into the spur gear side bore of the plate carrier (arrow).

(S) Clamping ring	504226
or	504227

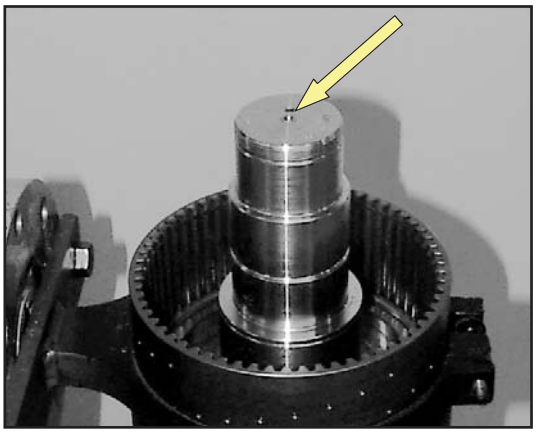


Figure 275

Tilt plate carrier by 180°.

Wet both set screws (arrows) with Loctite, type-no. 262 and install them

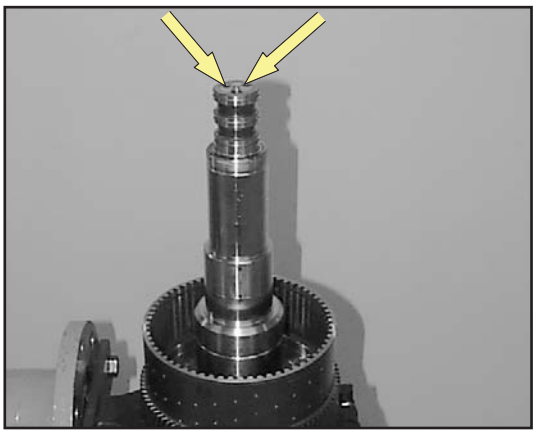


Figure 276

Insert purge valve (arrow) flush with the chamfer showing downwards.

(S) Settling tool	504207

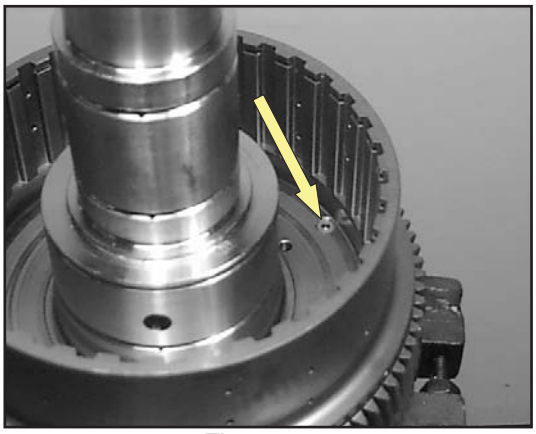


Figure 277

Lay both O-rings **scrollfree** into the ring grooves of the piston, see arrows!

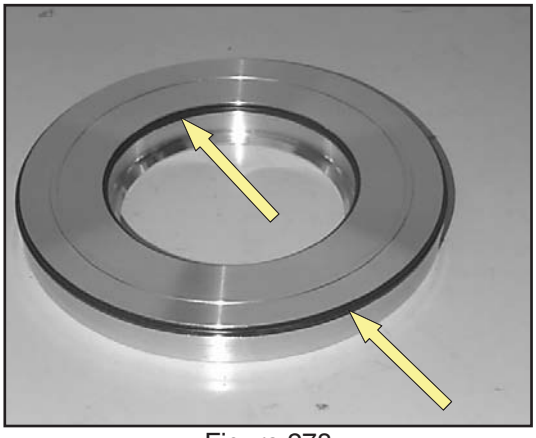


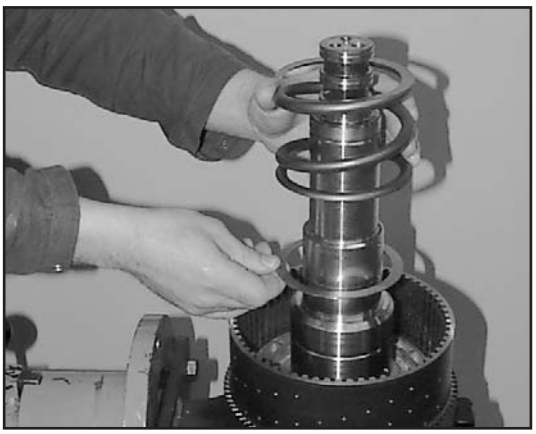
Figure 278

Oil O-rings and piston bearing surfaces.
Uniformly insert K2-piston until contact is obtained.

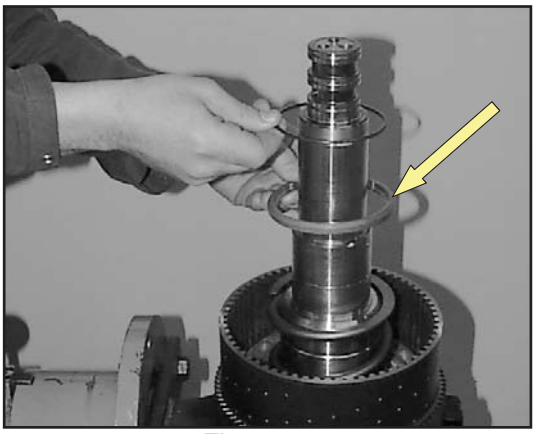
Pay attention to the installation position of the piston, see figure!


Figure 279

Introduce intermediate plate and compression spring.


Figure 280

Lay guide ring with the chamfer (arrow) showing upwards over the compression spring and line up snap ring.


Figure 281

Lift plate carrier out of the clamping ring (S).

Pre-load compression spring by means of special device (S) and squeeze snap ring into the annular groove of the plate carrier (arrow), see Figure 282!

(S) Pressure piece 504211

Analogously install purge valve, piston and compression spring on the opposite side (KR-clutch) (see Figure 277-282)!

Now, lift plate carrier with the KR-side showing downwards into the clamping ring (S) and fix it.

Tilt plate carrier by 180°.


Figure 282

Multi-disc clutch-KR

Multi-disc clutch-KR

The following sketch or table show plate stacking and installation position of the components!

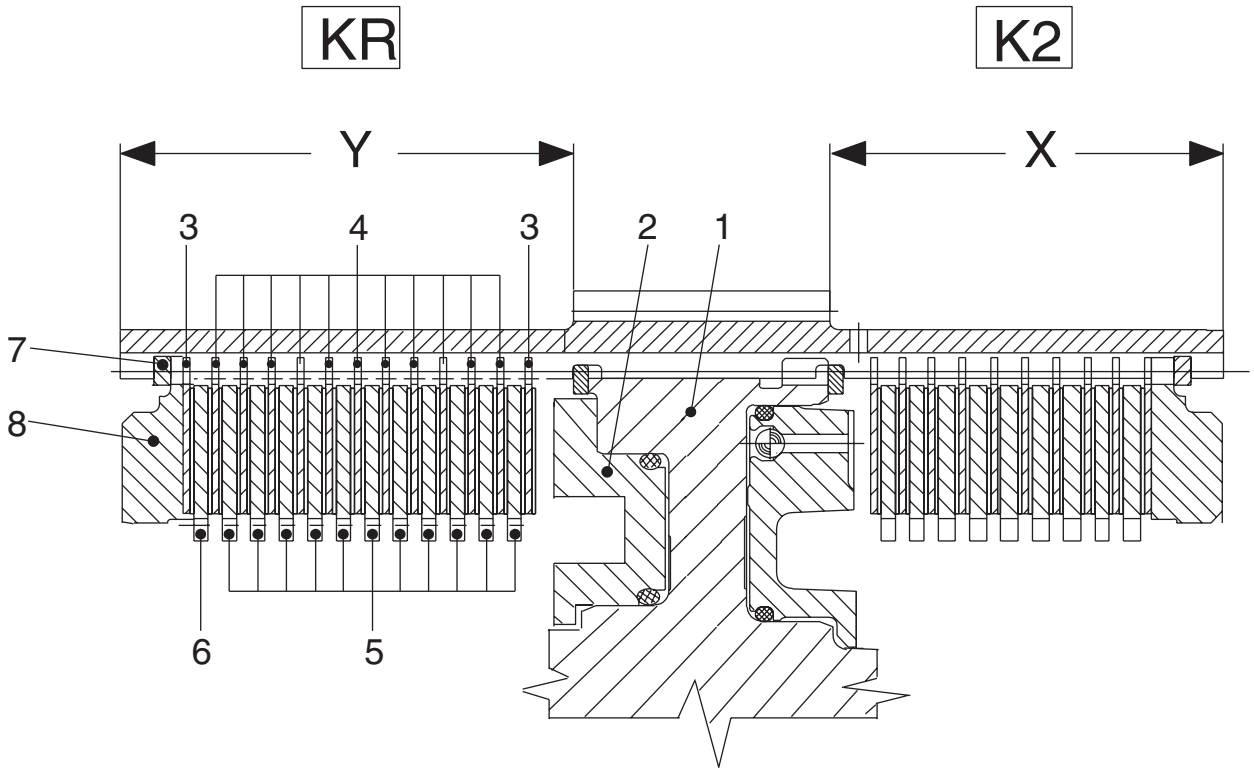


Figure 283

Item.	Designation	Quantity	s (mm)	Remark
1	Plate carrier	1		
2	Piston	1		
3	Outer plate	2	1,85	One-side coated
4	Outer plate	11	2,5	Coated on both sides
5	Inner plate	11	2,5	
6	Inner plate	1	2,5 ... 4,0	Optionally
7	Snap ring	1	2,55 ... 3,1	Optional
8	End shim	1		
Number of friction surfaces: 24				
Plate clearance: 2,8... 3,0 mm				

Install outer plates Item 3 with the uncoated side showing towards the piston or end shim.
The respective clutch side can be recognised by the length of the plate carrier, see sketch.
KR = Measure Y (long plate carrier side)
K2 = Measure X (short plate carrier side)

Check plate clearance-KR (Figure 285 ... 287) !

To ensure a correct measuring result, initially install plate pack without oil!

Install plate pack according to the sketch or table

(Figure 283).

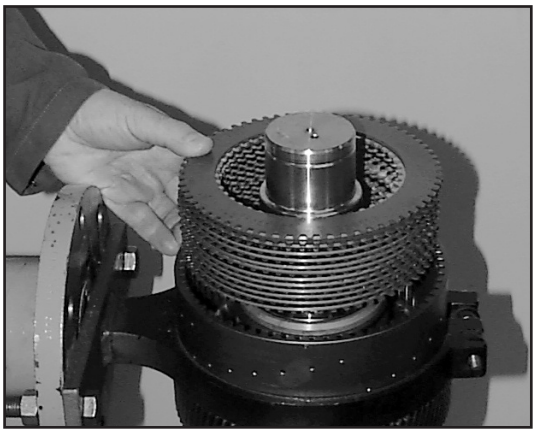


Figure 285

Insert end shim and fix it by means of snap ring.

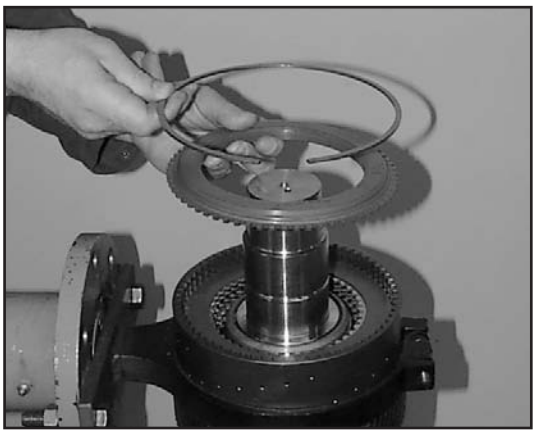


Figure 286

Press on end shim with about 100 N (10 kg) and set dial indicator to „Zero“.
Now, press end shim against snap ring (upwards) and read plate clearance from the dial indicator.

In case of deviations from the required plate clearance correct with suitable inner plate (optionally 2,5 to 4,0 mm) or and snap ring Item 7 (optionally).

(S) Magnetic stand	504171
(S) dial indicator	504172

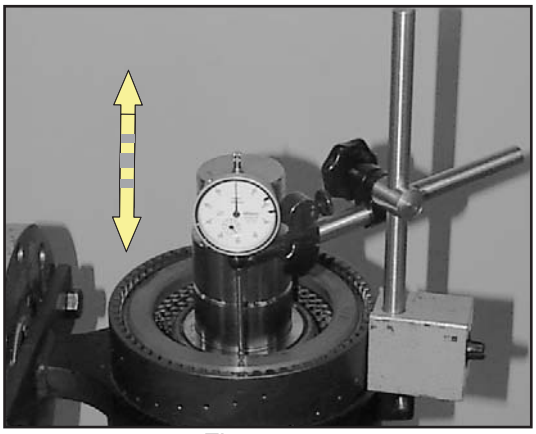


Figure 287

After the adjustment of the plate clearance, disassemble plate pack. Oil plates according to ZF-list of lubricants TE-ML 03 and install them again.

Pre-assemble and install spur gear KR (Figure 288 ... 296):

The figure on the left shows the components of the spur gear KR.

1 = Bearing inner race
2 = Shims , s = 3,0 and s = 3,10 mm
(Σ = 6,10 mm/empirical value)
3 = Spur gear
4 = Bearing inner race

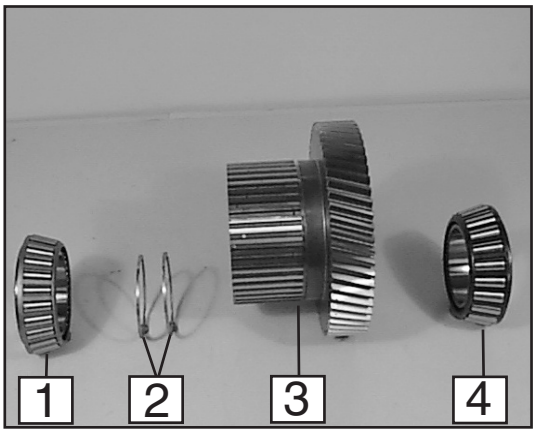


Figure 288

Check axial gap – spur gear support 0,0 ... 0,05 mm!

Place spur gear over the bearing inner race.

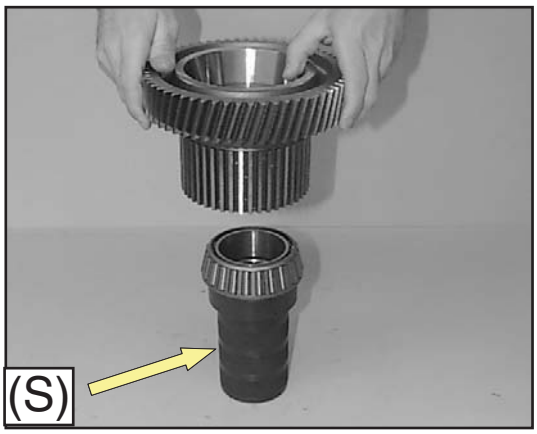


Figure 289

Introduce shims (2 units / s = 3,0 and s = 3,10 mm) .


Figure 290

Mount bearing inner race


Figure 291

Pre-load tapered roller bearing with about 50 000 N (5 t) and determine axial gap by means of dial indicator.

In case of deviations from the required axial gap, correct with suitable shims (Item. 2/Figure 288)!

(S) Pry bar	504209
(S) Dial indicator	504172
(s) Magnetic stand	504171

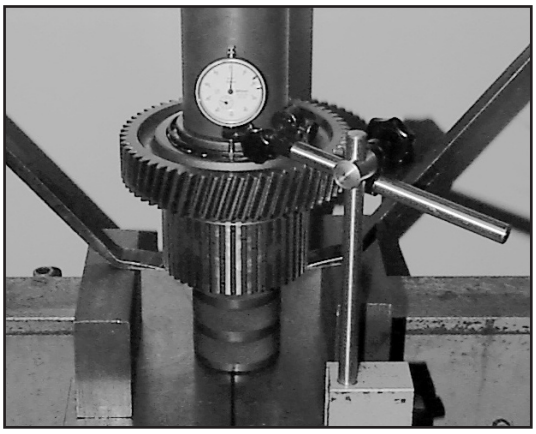


Figure 292

Heat bearing inner race and position it until contact is obtained.

Use protective gloves!

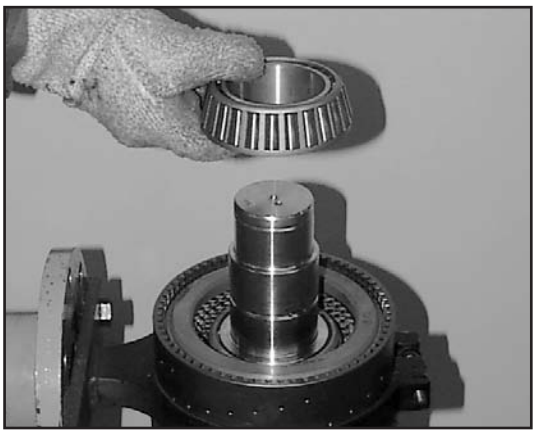


Figure 293

Introduce spur gear until all inner plates are accommodated

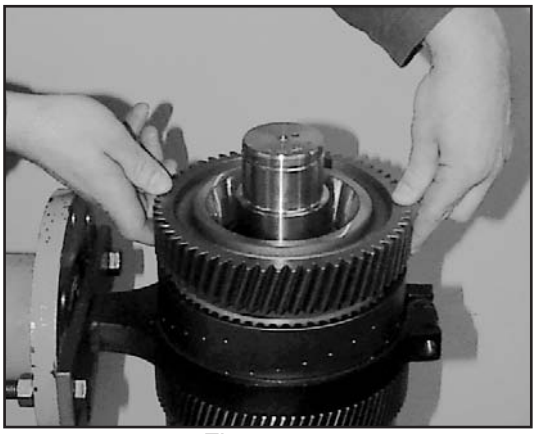


Figure 294

Introduce determined shims (see Figure 289 to 292).



Figure 295

Heat up bearing inner race (spur gear support) and position it until contact is obtained.

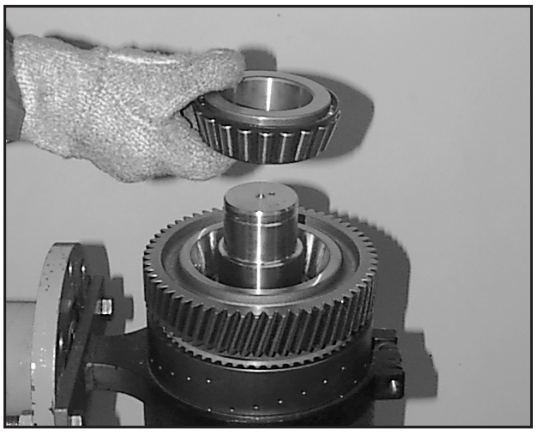


Figure 296

Use protective gloves!

Heat bearing inner race (clutch support)and position it until contact is obtained.

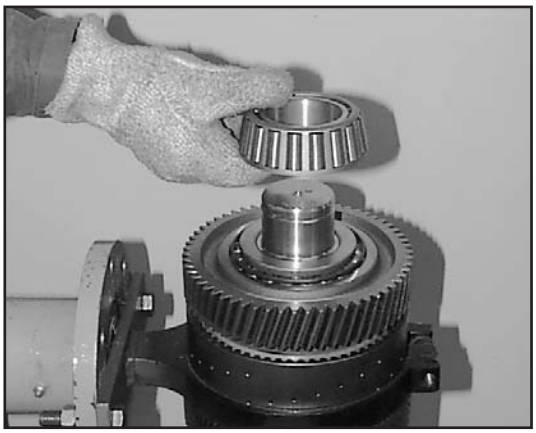


Figure 297

Use protective gloves!

Multi-disc clutch-K2

The following sketch or table show plate stacking and installation position of the components!

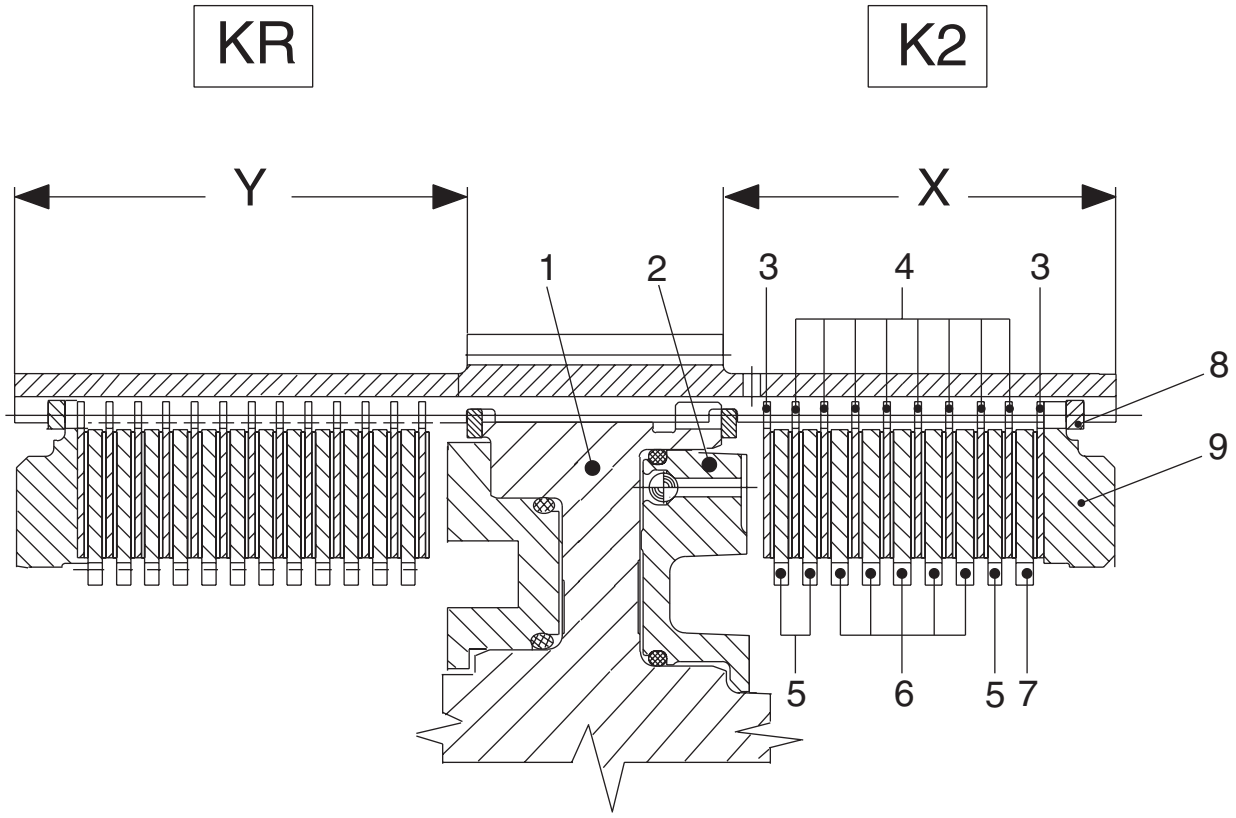


Figure 299

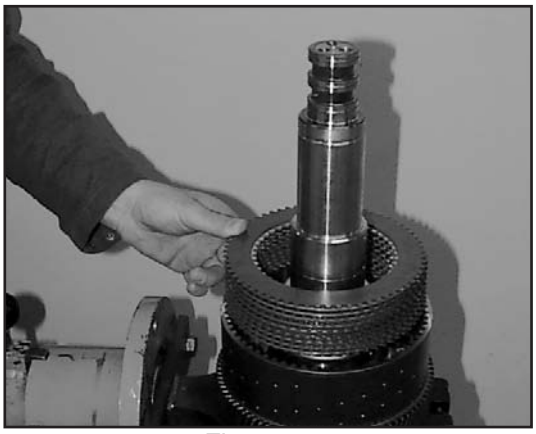
Item.	Designation	Quantity	s (mm)	Remark
1	Plate carrier	1		
2	Piston	1		
3	Outer plate	2	1,85	One-side coated
4	Outer plate	8	2,5	Coated on both sides
5	Inner plate	3	2,5	
6	Inner plate	5	3,0	
7	Inner plate	1	2,5 ... 4,0	Optional
8	Snap ring	1	2,55 ... 3,10	Optional
9	End shim	1		
Number of friction surfaces: 18				
Plate clearance: 2,6 ... 2,8 mm				

Install outer plates Item 3 with the uncoated side showing towards the piston or end shim.
The respective clutch side can be recognized by the length of the plate carrier, see sketch
K2 = Measure X (short plate carrier side)
KR = Measure Y (long plate carrier side)

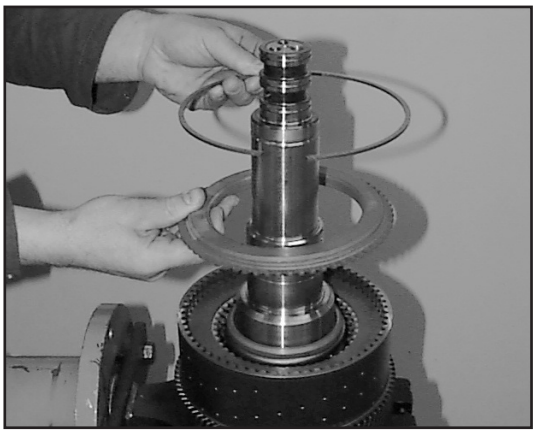
Check plate clearance-K2 (Figure 300 ... 302)

To ensure a correct measuring result, initially install plates without oil!

Install plate pack according to the sketch or table
See Fig 299 and 308.


Figure 300

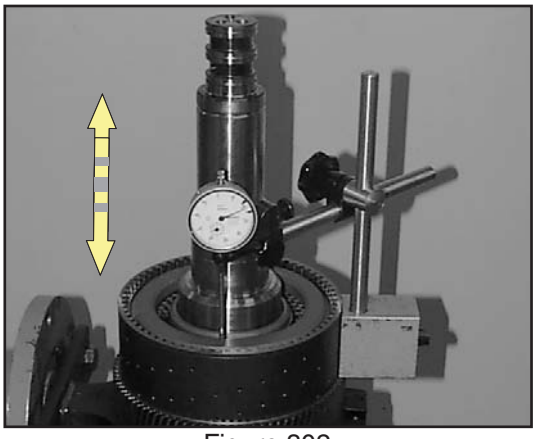
Insert end shim and fix it by means of snap ring.


Figure 301

Press on end shim with about 100 N (10 kg) and set dial indicator to „Zero“.
Now, press end shim against snap ring (upwards) and read plate clearance from dial indicator.

In case of deviations from the required plate clearance (see table/page 3.50 or 3.51), correct with a suitable inner plate (optionally s = 2,5 ... 4,0 mm) or and snap ring (optionally)!

(S) Dial indicator	504172
(S) Magnetic stand	504171


Figure 302

After the performed adjustment of the plate clearance, disassemble plate pack, oil plates according to ZF-list of lubricants TE-ML 03 and install them again!

Pre-assemble and install spur gear K2 (Figure 303 ... 312):

Supercool gear wheel 1 (abt. -80 °C) and heat up gear wheel 2 (abt. 120 °C).
Squeeze snap ring (arrow), pre-load it and join both parts together with a hydraulic press until the snap ring is engaged in the annular groove of gear wheel 2.

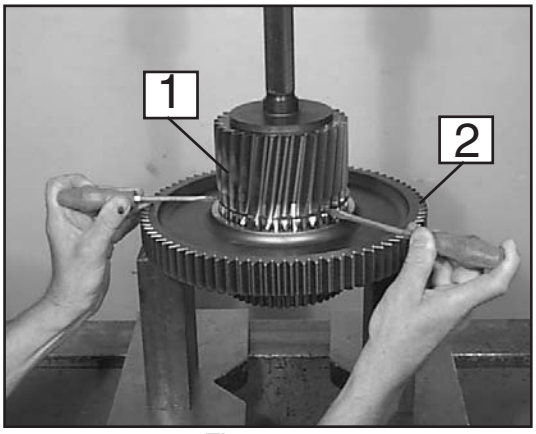


Figure 303

Adjust axial clearance – spur gear support 0,05 ... 0.15 mm (Figure 304 ... Calculation example “C “)

The figure on the left shows the components of the spur gear support.

1 = Bearing inner race
2 = Shim (optional)
3 = Spur gear compl.
4 = Bearing inner race

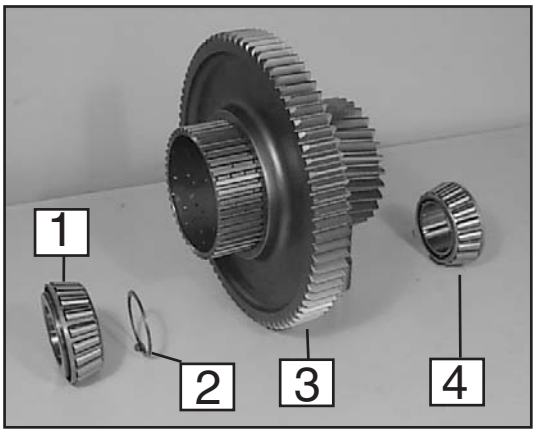
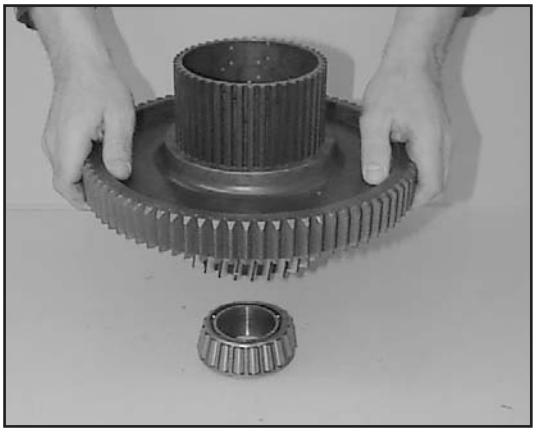
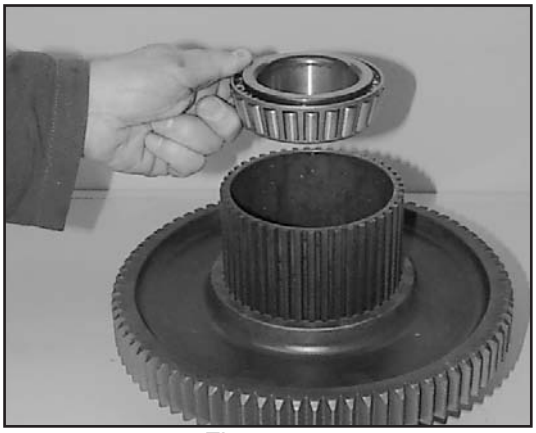


Figure 304

Place spur gear over the bearing inner race.


Figure 305

Introduce bearing inner race.


Figure 306

Determine measure I (bearing measure).

Measure I e.g. ..... 76,27 mm

(S) Digital depth gauge 504175

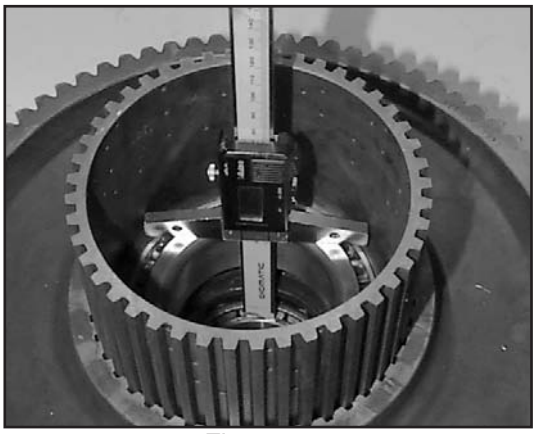


Figure 307

Determine measure II (shaft measure).

Measure II e.g.. ..... 74,14 mm

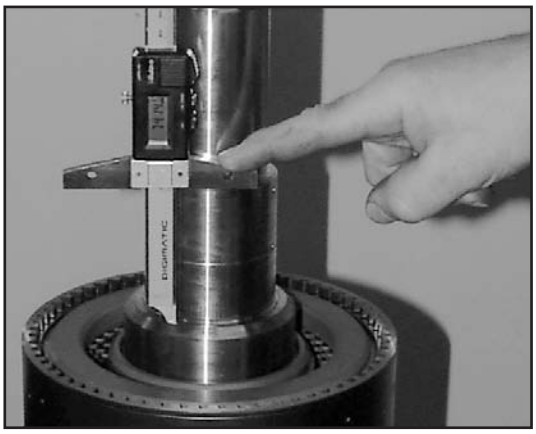


Figure 308

CALUCALTION EXAMPLE “C“:

Measure I e.g.:.		76,27 mm
Measure II e.g..	–	74,14 mm
Difference.	=	2,13 mm
Axial gap e.g.	+	0,07 mm
Gives shim s		2,20 mm

Heat up bearing inner race and line it up until contact is obtained.

Use protective gloves!

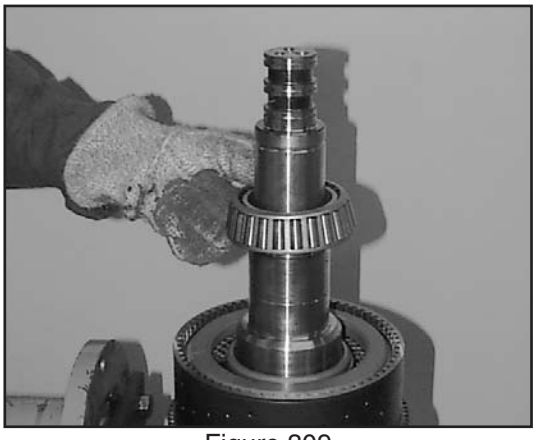


Figure 309

Line up spur gear until all inner plates are accommodated.

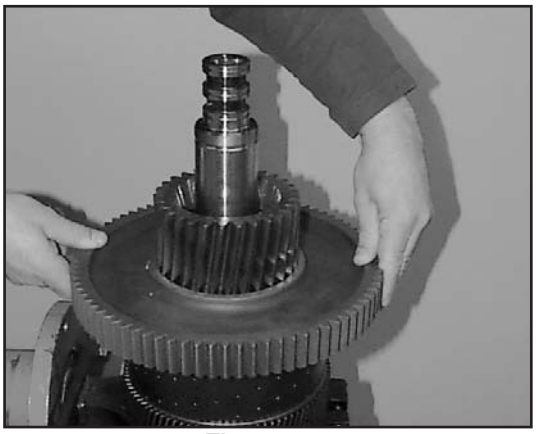


Figure 310

Line up shim e.g. s = 2.20 mm (see calculation example/ page 3.50).



Figure 211

Heat up bearing inner race (spur gear support) and line it up until contact is obtained.

Use protective gloves!

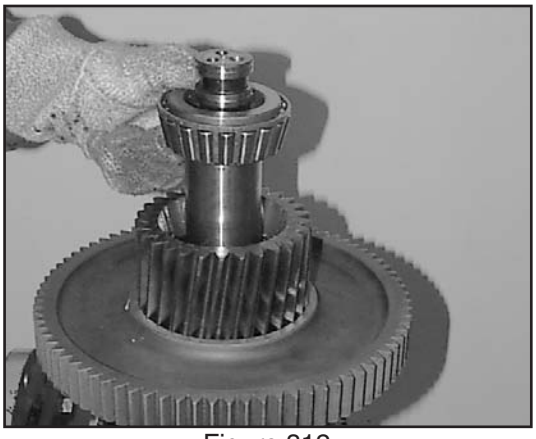


Figure 312

Heat up bearing inner race (clutch support) and bring it into contact.

Use protective gloves!

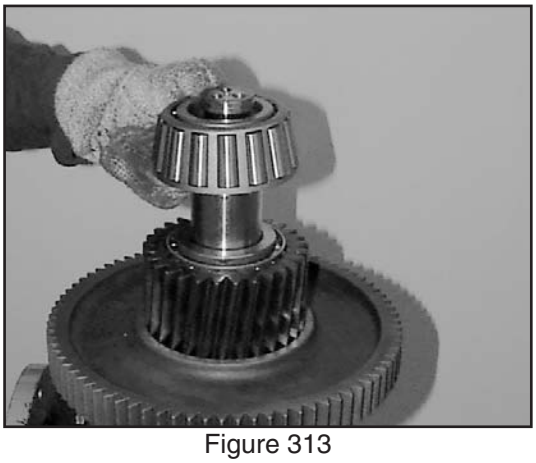


Figure 313

Lift plate carrier off the clamping ring (S).

To ensure the exact contact of the components, pre-load bearing with 100 000 N (10 t) (Figure 314).

Support at the lower as well as the upper bearing race!

Use pressure piece (S)!

(S) Pressure pieces 504218

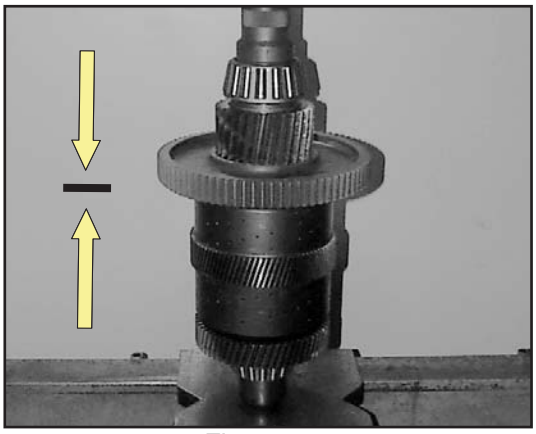


Figure 314

Lift plate carrier into clamping ring (S) and fix it.
Tilt clutch 90°.

K2-side:
Wet thread of the slotted nut with Loctite (type-no. 262) and mount it (Figure 315).

Install slotted nut with the chamfer facing the bearing inner race!

Torque limit ..... = 800 Nm

(S) Clamping ring 504226
Or 504227
(S) Hook spanner 504215

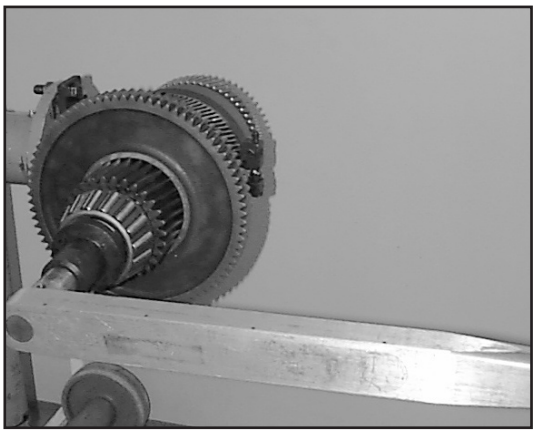


Figure 315

KR-side:
Wet thread of the slotted nut with Loctite (type-no. 262) and mount it.

Install slotted nut with the collar (Ø 76 mm) facing the bearing inner race!

Torque limit ..... = 800 Nm

(S) Hook spanner 504215

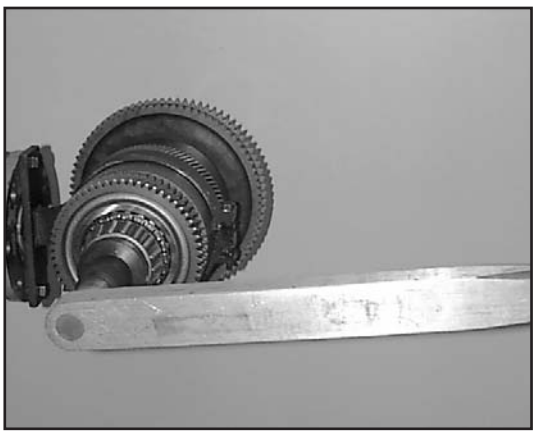


Figure 316

Check functioning of clutches-K3 and K4 with compressed air (Figure 317).

At correctly installed components, engaging and disengaging of the clutch is clearly audible!

Squeeze in and engage rectangular ring (3x, see arrow).

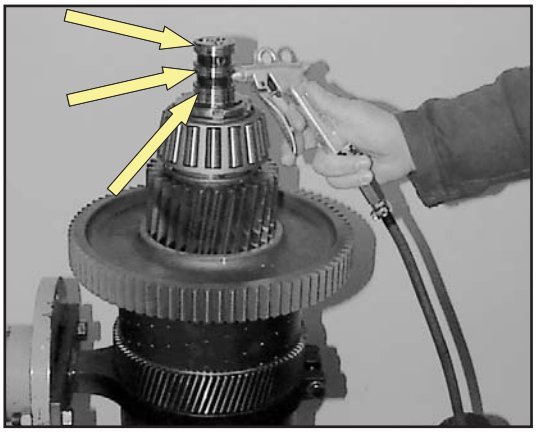


Figure 317

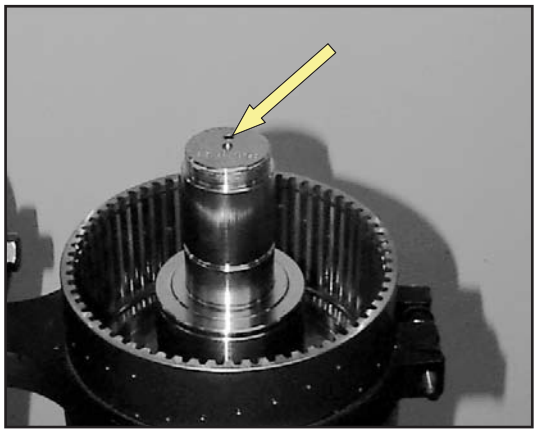
Assemble multi-disc clutch-KV/K1

Lift plate carrier with the KV-side showing downwards into clamping ring (S) and fix it.

Tilt plate carrier by 180°.

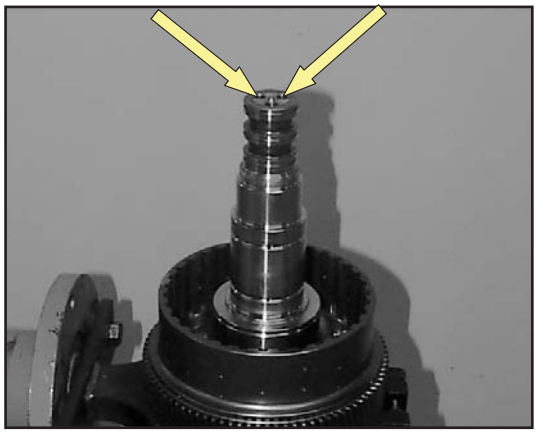
Insert both roll pins (6x24 and 3,5x24 mm) flush into the face bore of the plate carrier (arrow).

(S) Clamping ring 504226
or 504227


Figure 320

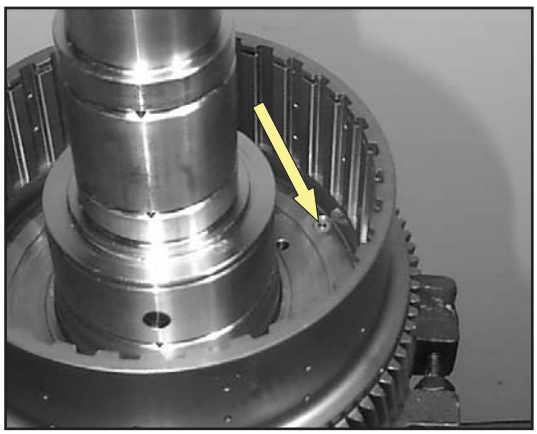
Tilt plate carrier by 180°.

Wet both set screws (arrows) with Loctite, type-no. 262 and mount it.

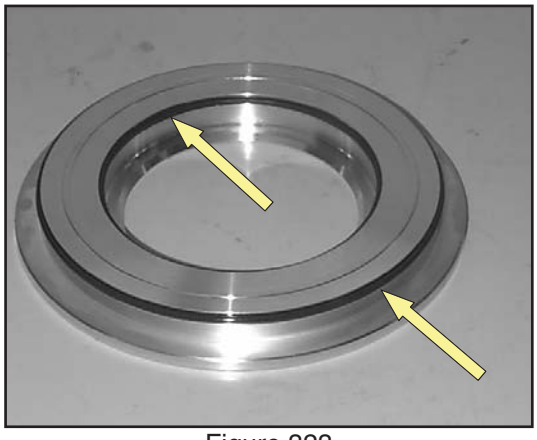

Figure 321

Drive in purge valve (arrow) flush, with the chamfer showing downwards.

(S) Settling tool 504207


Figure 322

Lay both O-rings **scrollfree** into the ring grooves of the piston.!


Figure 323

Oil O-rings and piston bearing surfaces.

Uniformly insert K1-piston until contact is obtained.

Pay attention to the installation position of the piston, see figure!

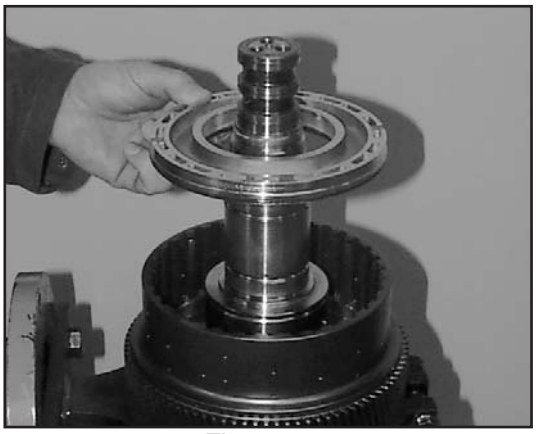


Figure 324

Introduce intermediate washer and compression spring

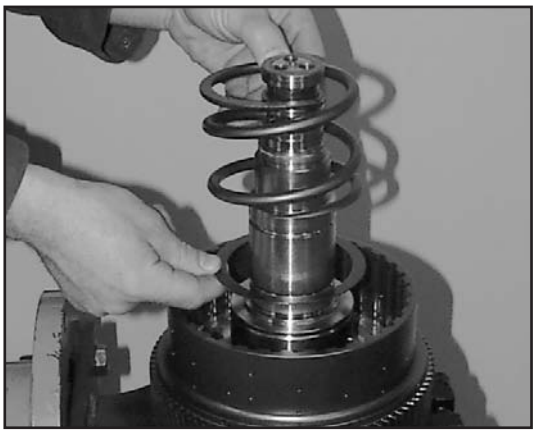


Figure 325

Lay guide ring with the chamfer (arrow) showing upwards over the compression spring and line up snap ring..

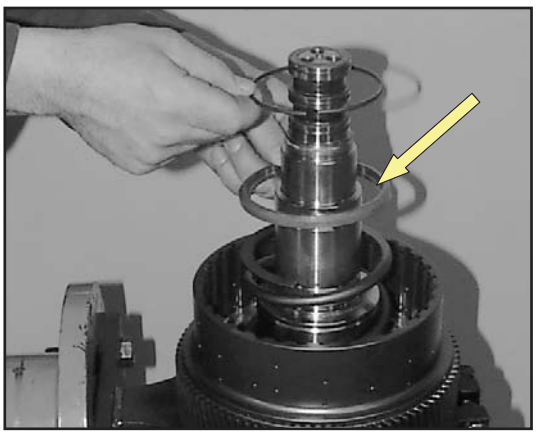


Figure 326

Lift plate carrier off the clamping ring.
Pre load compression spring by means of special device (S) and squeeze snap ring into the annular groove of the plate carrier (arrow).
See Figure 327!

Accordingly install purge valve, spool and compression spring on the opposite side (KV-clutch).
Now, lift plate carrier with the KV-side showing downwards into the clamping ring and fix it.

Tilt plate carrier 180°.

(S) Pressure piece 504211

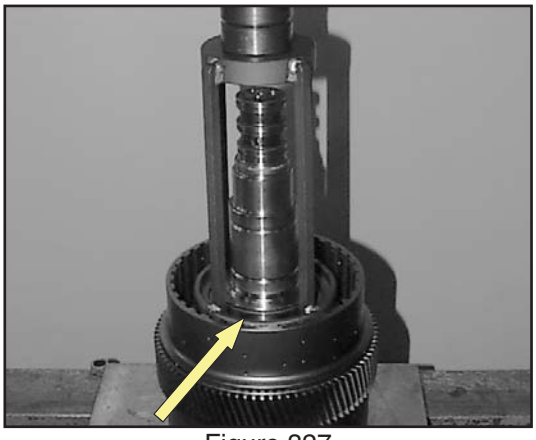


Figure 327

Clutch-KV

The following sketch or table show plate equipment and installation position of the components.!

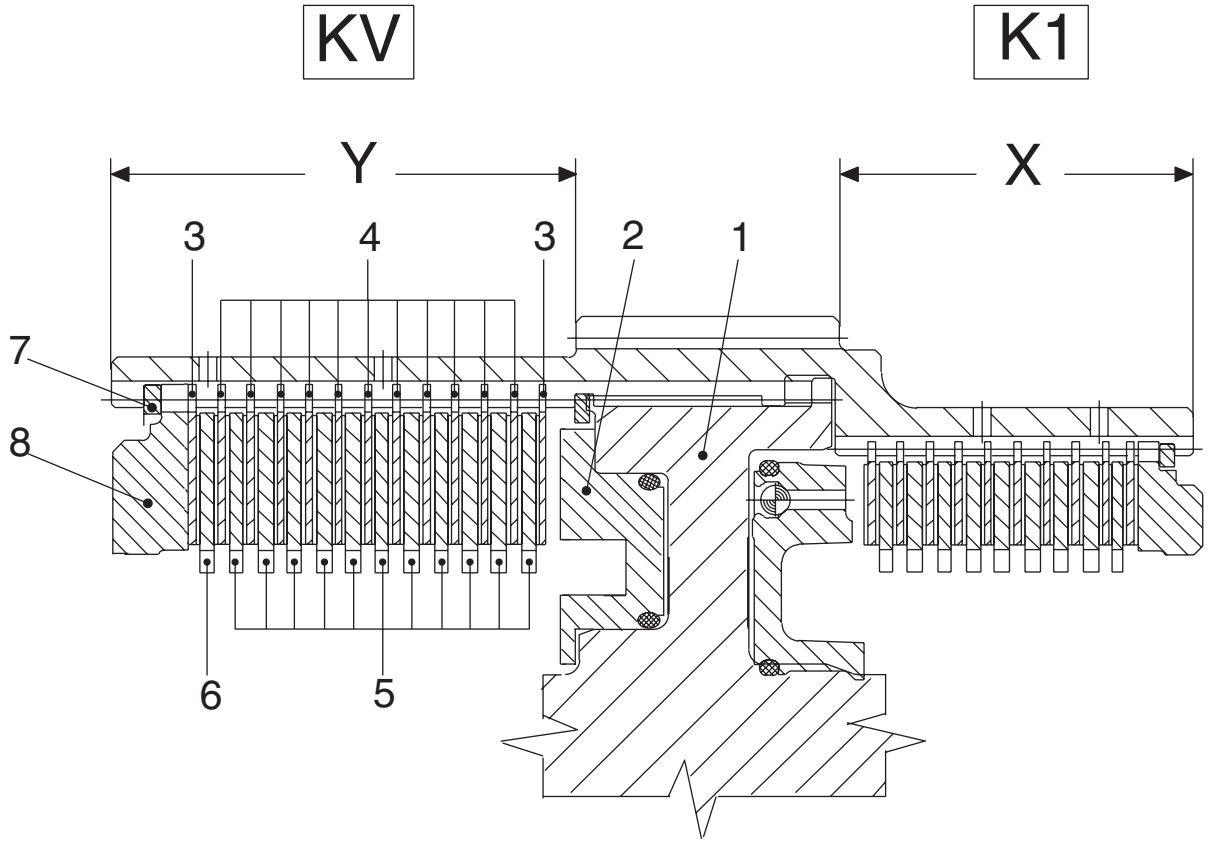


Figure 328

Item	Designation	Quantity	s (mm)	Remark
1	Plate carrier	1		
2	Piston	1		
3	Outer plate	2	1,85	One-side coated
4	Outer plate	11	2,5	Coated on both sides
5	Inner plate	11	2,5	
6	Inner plate	1	2,5 ... 4,0	Optional
7	Snap ring	1	2,55 ... 3,1	Optional
8	End shim	1		
Number of friction surfaces: 24				
Plate clearance: 2,8... 3,0 mm				

Install outer plates Item 3 with the uncoated side facing the piston or the end shim!
The respective clutch side an be recognized by the length or the Ø. Of the plate carrier, see sketch!
KV = Measure Y (long plate carrier side or great Ø)
K1 = Measure X (short plate carrier or small Ø)

Check plate clearance-KV (Figure 330 ... 332) !

To ensure a correct measuring result, initially install plate pack without oil!

Install plate pack according to the sketch or table (previous page)

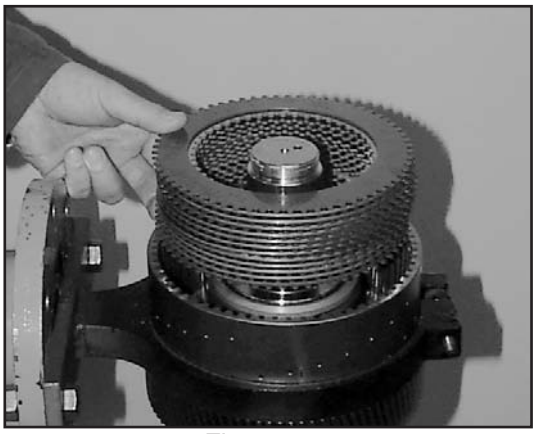


Figure 330

Introduce end shim and fix it by means of snap ring..

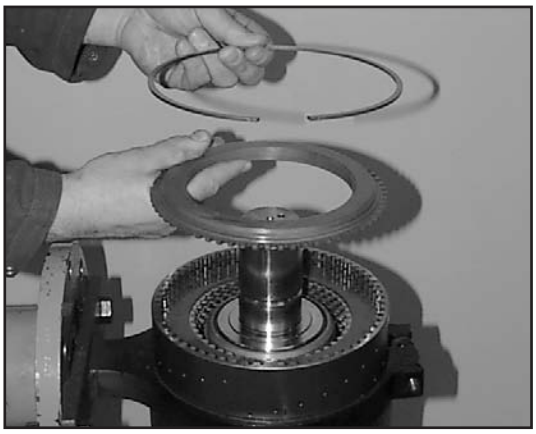


Figure 331

Press end shim on with about 100 N (10 kg) and set dial indicator to „Zero“.

In case of deviations from the required plate clearance (see table/page 3.59 or 3.60), correct with suitable inner plate (optionally s = 2,5 ... 4,0 mm) or and snap ring (optionally)!

(S) Magnetic stand	504171
(S) Dial indicator	504172

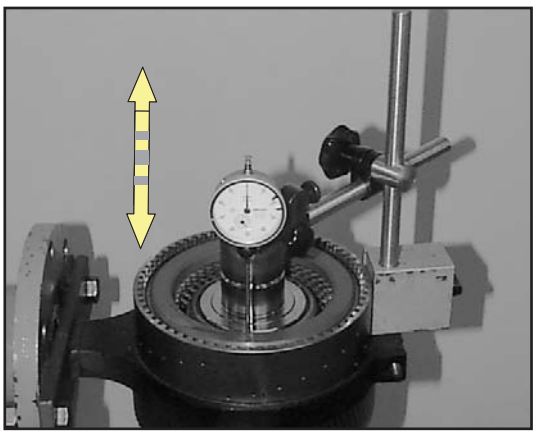


Figure 332

After the performed adjustment of the plate clearance, dismantle plate pack and oil plates as per ZF-list of lubricants TE-ML 03 and mount them again.

Pre-assemble and install spur gear-KV (Figure 335 ... 343):

The figure on the left shows the components of spur gear KV.

1 = Bearing inner race
2 = Bearing outer race
3 = Ring
4 = Shim(s) optionally, empirical value s = 1,7 mm
5 = Spur gear

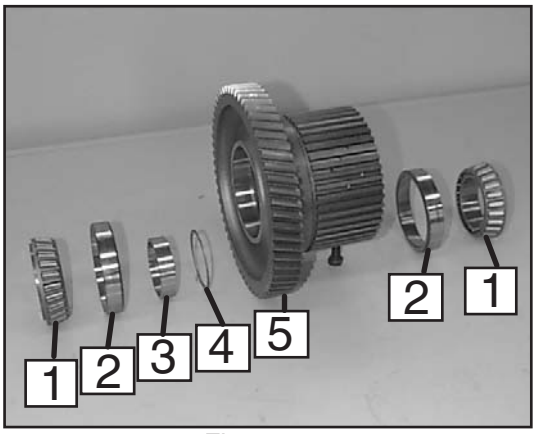


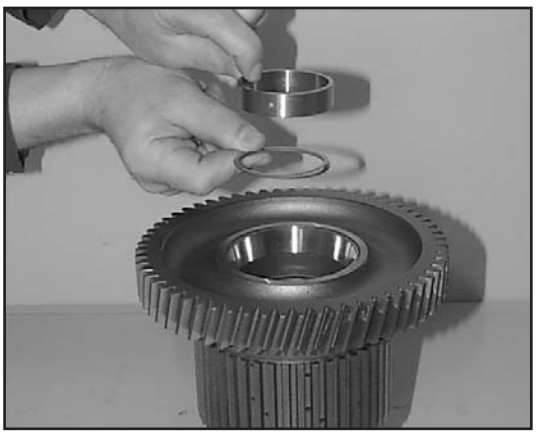
Figure 335

Check axial gap – spur gear support 0,0 ... 0,05 mm!

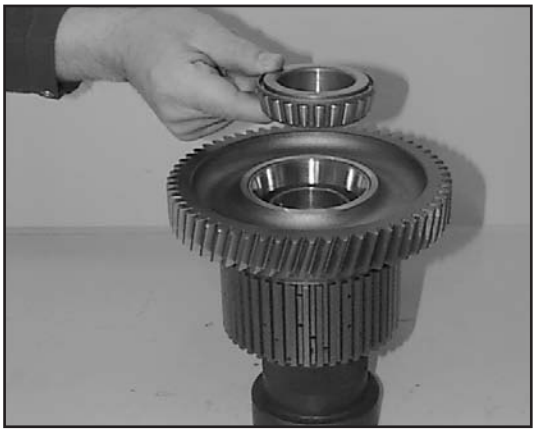
Install both bearing outer races (2) and place spur gear over the bearing inner race


Figure 336

Introduce shim(s) 4 and ring 3.


Figure 337

Install bearing inner race.


Figure 338

Pre-load tapered roller bearing with about 50 000 N (5 t) and determine axial gap with the dial indicator

In case of deviations from the required axial gap, correct with suitable shim (Item 4/Figure 335)!

(S) Pry bar	504209
(S) Magnetic stand	504171
(S) Dial indicator	504172

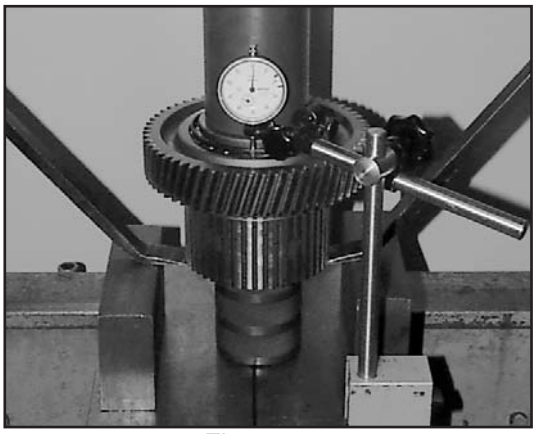


Figure 339

Heat up bearing inner race and position it until contact is obtained.

Use protective gloves!

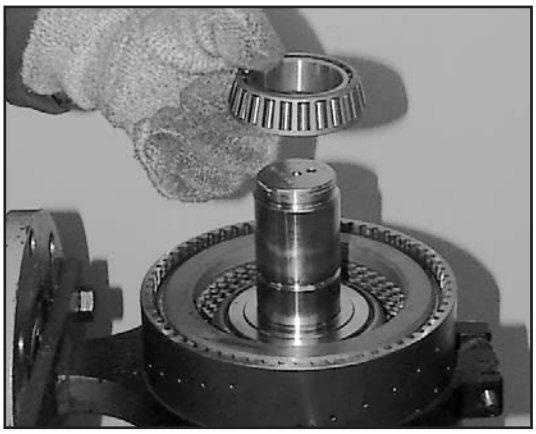


Figure 340

Introduce determined shim (Figure 335 ... 339) and ring 3.

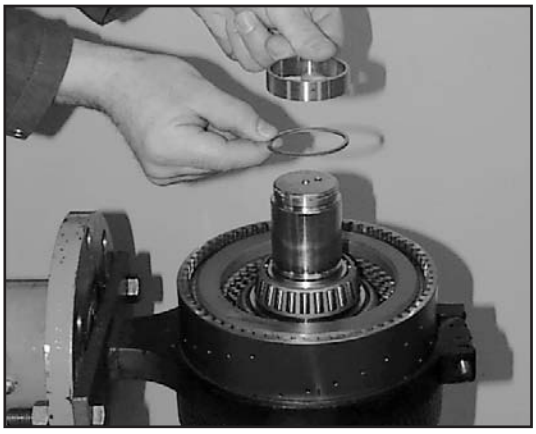


Figure 341

Introduce spur gear until all inner plates are accommodated.

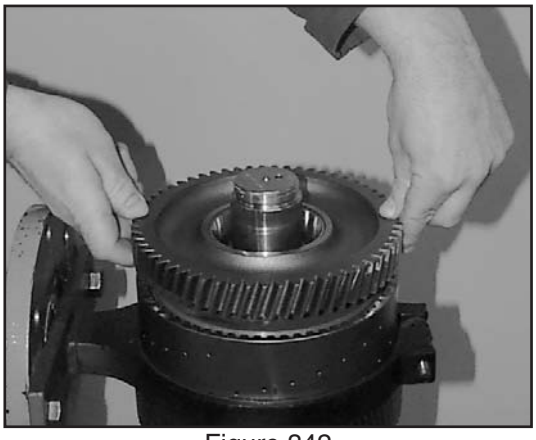


Figure 342

Heat up bearing inner race (spur gear support) and bring it into contact.



Use protective gloves!

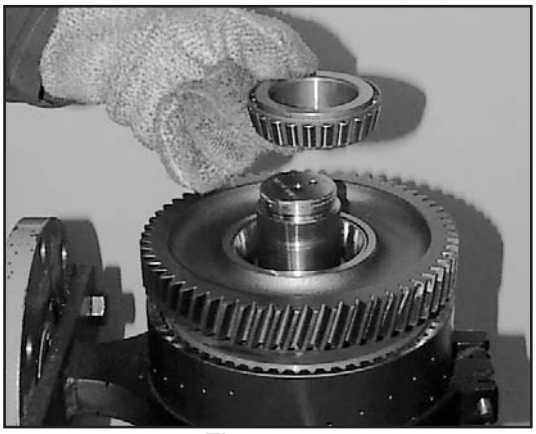


Figure 343

Heat up bearing inner race (clutch support) and bring it into contact.



Use protective gloves!

Tilt plate carrier by 180°.

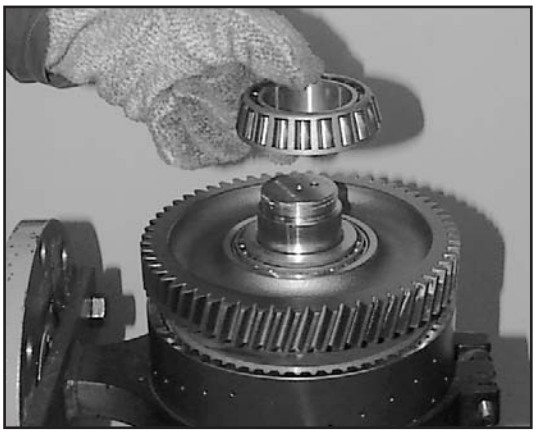


Figure 344

Multi-disc clutch-K1

The following sketch or table show plate stacking and installation position of the components!

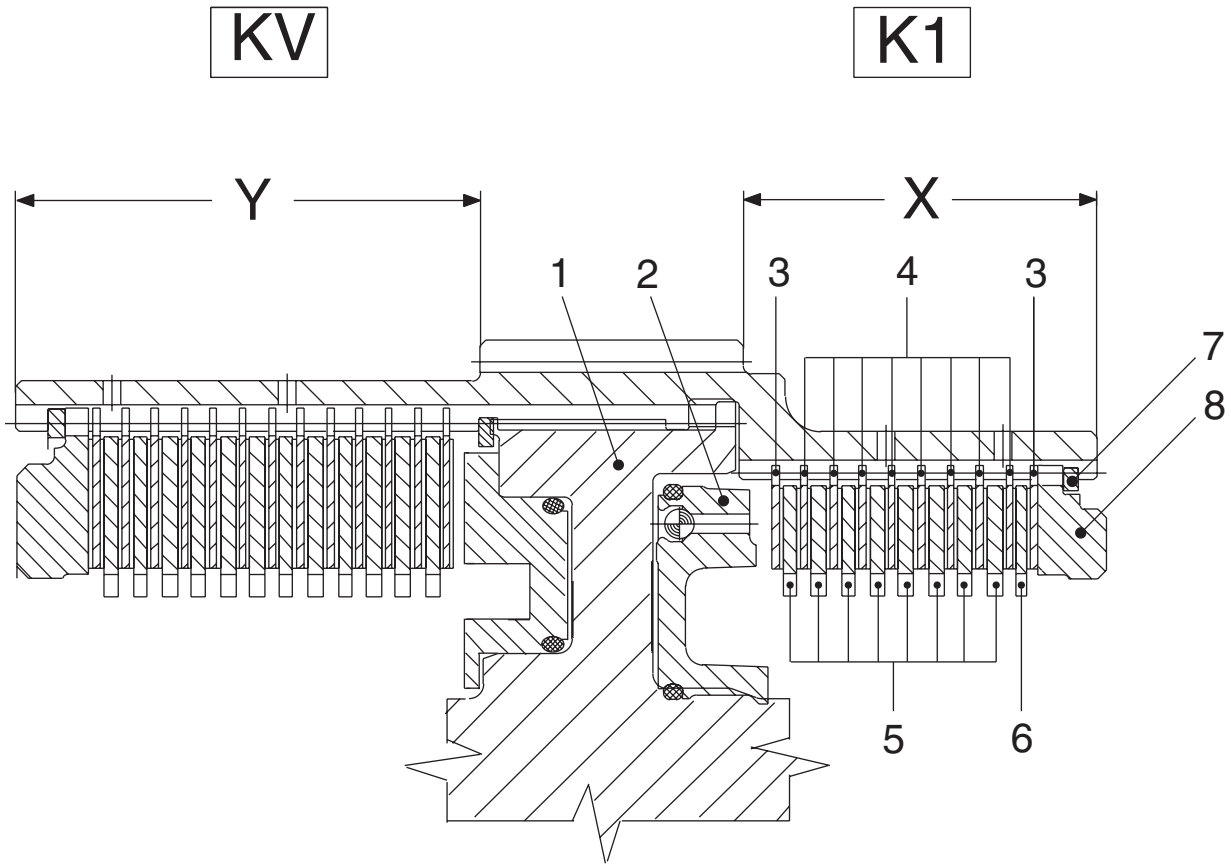


Figure 348

Item	Designation	Number	s (mm)	Remark
1	Plate carrier	1		
2	Piston	1		
3	Outer plate	2	1,85	One-side coated
4	Outer plate	8	2,5	Coated on both sides
5	Inner plate	8	2,5	
6	Inner plate	1	2,5 ... 3,5	Optional
7	Snap ring	1	2,1 ... 2,5	Optional
8	End shim	1		
Number of friction surfaces: 18				
Plate clearance: 2,6... 2,8 mm				

Install outer plate Item 3 with the uncoated side facing the piston or the end shim!
The respective clutch side can be recognized by the length or the Æ of the plate carrier, see sketch!
K1 = Measure X (short plate carrier side or small Ø)
KV = Measure Y (long plate carrier side or great Ø)

Check plate clearance -K1 (Figure 350 ... 352) !

To ensure a correct measuring result, initially install plate pack without oil!

Install plate pack according to sketch or table (page 3.65 or 3.66).

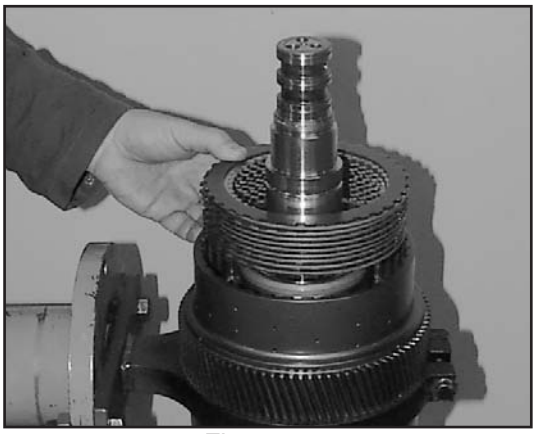


Figure 350

Introduce end shim and fix it by means of snap ring.

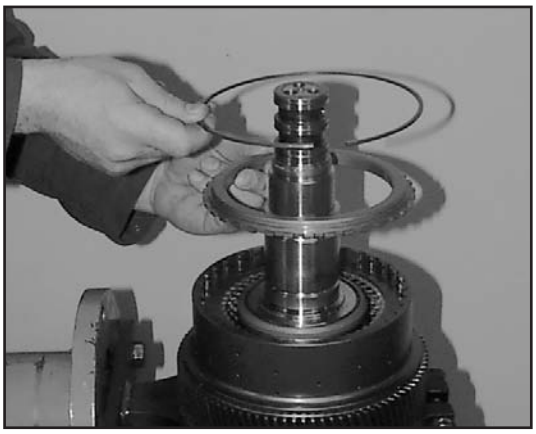


Figure 351

Press on end shim with about 100 N (10 kg) and set dial indicator to „Zero“.

Now, press end shim against snap ring (upwards) and read plate clearance from dial indicator.

In case of deviations from the required plate clearance (see table/page 3.65 or 3.66),correct with suitable inner plate (optionally 2,5 ... 3,5 mm) or and snap ring (optionally).

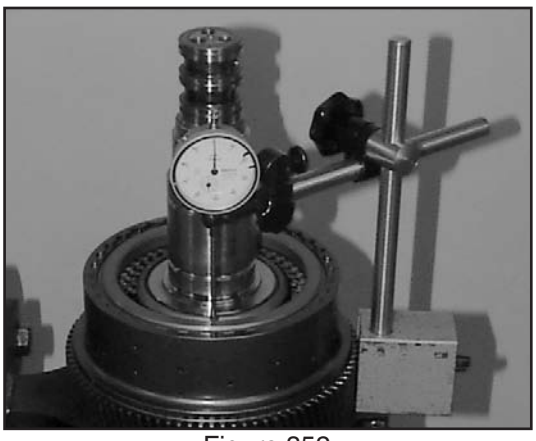


Figure 352

(S) Magnetic stand	504171
(S) Dial indicator	504172

After the performed adjustment of the plate clearance, dismantle plate pack, oil plates as per ZF-list of lubricants TE-ML 03 and mount it again!

Pre-assemble and install spur gearK1 (Figure 353 ... 360):

The figure on the left shows the components of spur gear K1.

1 = Ball bearing (compl.)
2 = Snap ring
3 = Spur gear

Prior to the installation of the components, radially align plate pack by means of spur gear and center it, see Figure 354!

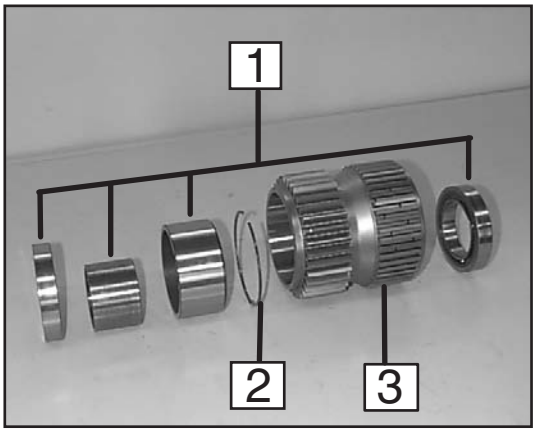
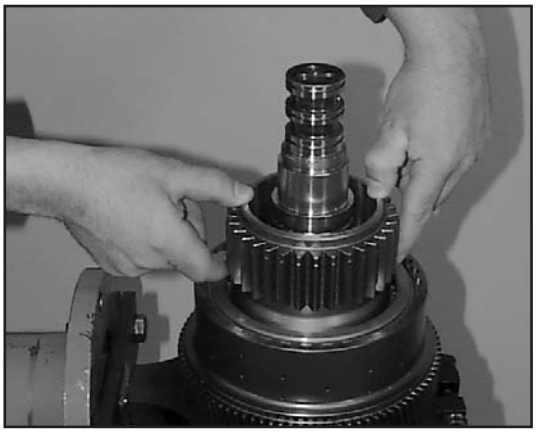
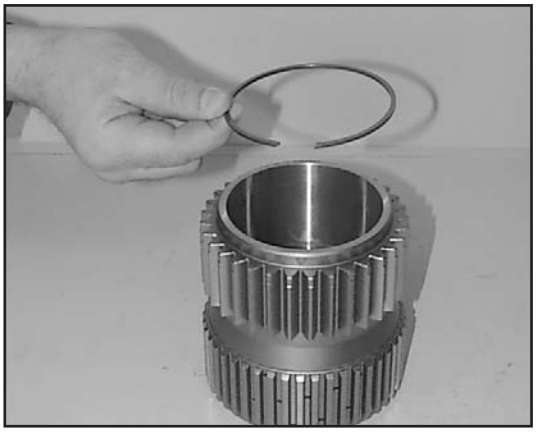


Figure 353

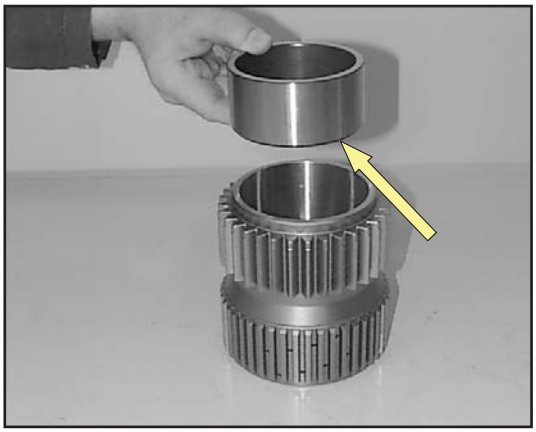
Install snap ring.


Figure 354

Install snap ring.

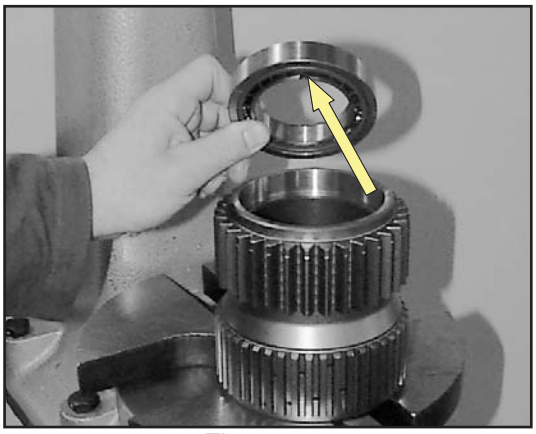

Figure 355

Introduce bush with the end face-side collar (arrow) facing the snap ring.


Figure 356

Press in ball bearing until contact is obtained.

Install ball bearing with the lubricating groove (arrow) showing downwards!
Apply pressing-in tool only to the bearing outer race!


Figure 357

Heat up second ball bearing and introduce it until contact is obtained.

The lubricating groove (arrow) must show upwards!

Use protective gloves!

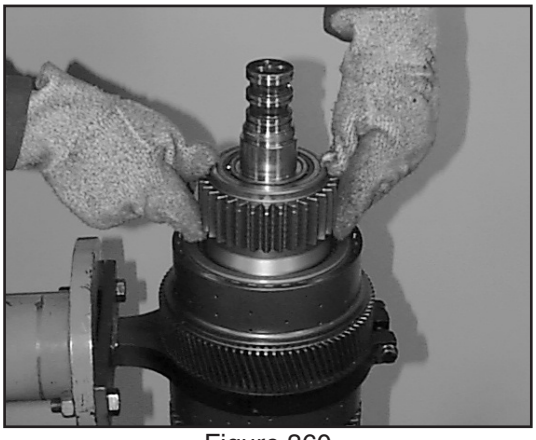

Figure 358

Line up bush.


Figure 359

Heat up spur gear about to 120° C and introduce it until all inner plates are accommodated.

Use protective gloves!


Figure 360

Line up shim s = 1,2 mm.

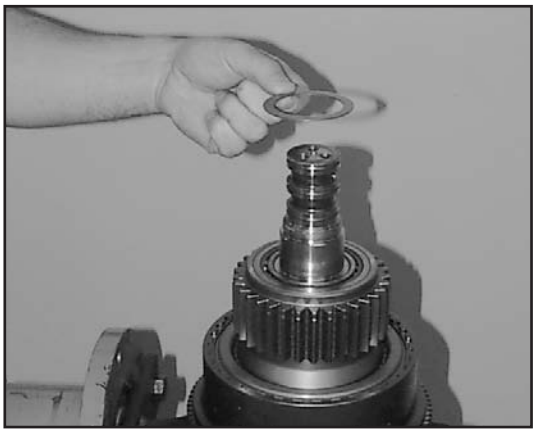


Figure 361

Heat bearing inner race and line it up until contact is obtained.

Use protective gloves!

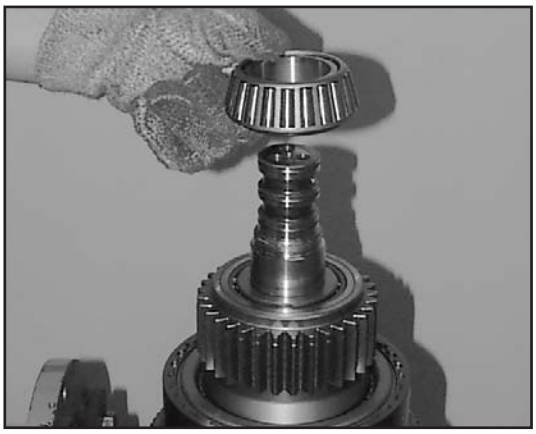


Figure 362

Lift plate carrier off the clamping ring (S)
To ensure the exact contact of the components, pre-load bearing with 100 000 N (10 t) (Figure 363).

Support at the lower as well as the upper bearing inner race!
Use pressure pieces (S)!

(S) Pressure pieces 504218

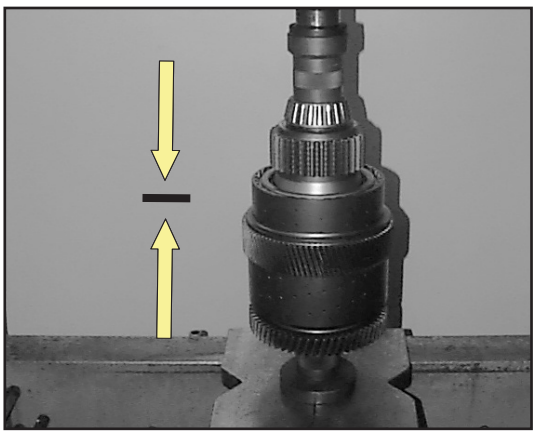


Figure 363

Lift plate carrier into clamping ring (S), fix it and tilt by 90°.

Wet thread of the slotted nut with Loctite, type-no. 262 and mount slotted nut.

Install slotted nut with the collar facing the bearing inner race!

Torque limit ..... = 550 Nm

Install opposite slotted nut (KV-side) accordingly.

(S) Hook spanner 504217
(S) Hook spanner 504215

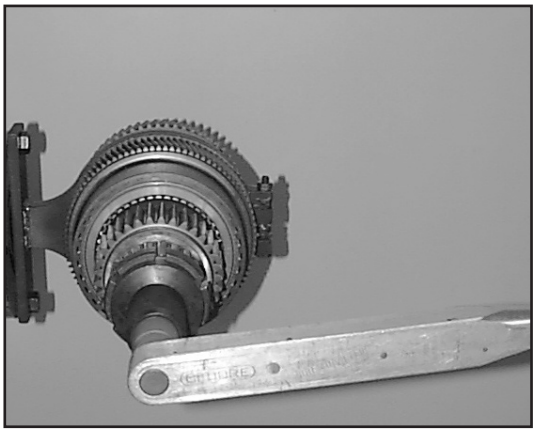


Figure 364

Check functioning of the clutches -KV and -K1 by means of compressed air!

At correctly installed components, closing or opening of the clutches is clearly audible.



Figure 365

Squeeze in and engage rectangular rings (3x, see arrows).

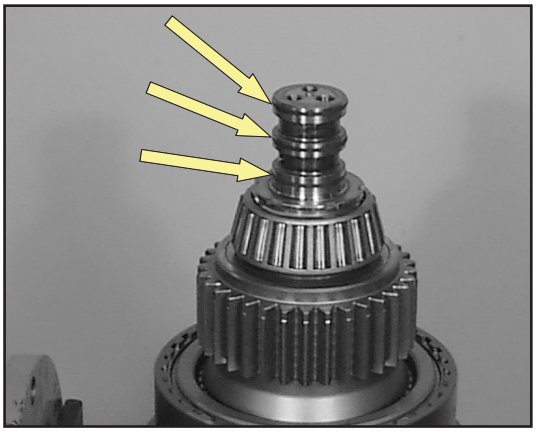


Figure 366

3.2.5 Install countershaft gear and multi-disc clutches

Adjust axial gap of the countershaft gear bearing = 0,00 ... 0,05 mm (Figure 367 ... 371):

The figure on the left shows the components of the countershaft gear bearing.

1 = Bearing inner race (2x)
2 = Adjusting ring e.g.. s = 7,95 mm
3 = Countershaft gear

Adjusting ring s = 7,95 mm, empirical value!

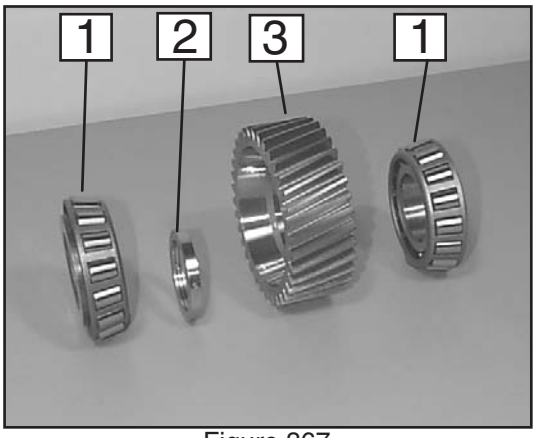


Figure 367

Pile up lower bearing inner race, adjusting ring (e.g. s = 7,95 mm) and upper bearing inner race.

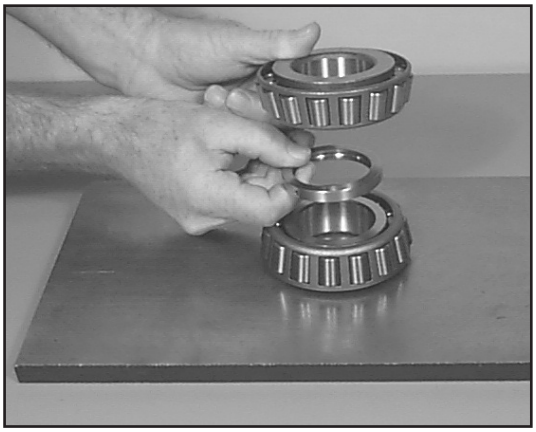


Figure 368

Determine measure I.

Measure I e.g.. ..... 61,85 mm

(S) Digital depth gauge 504175

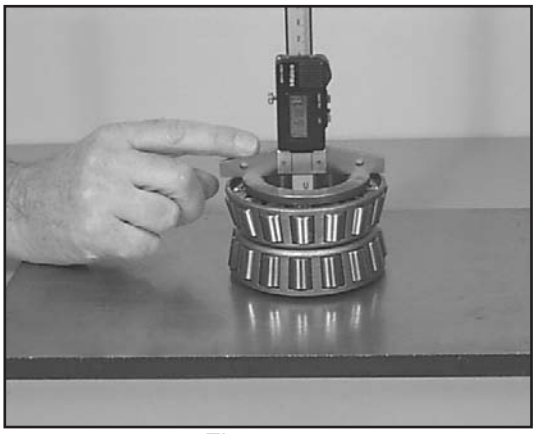


Figure 369

Position countershaft gear over lower bearing inner race and place upper bearing inner race on top.

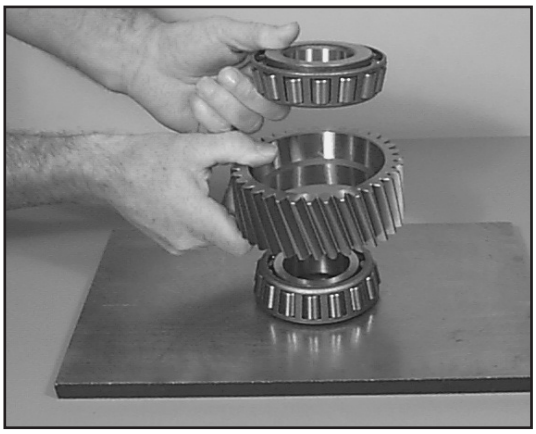


Figure 370

Repeatedly rotate countershaft gear to ensure centering of the components
Determine measure II (total height without adjusting ring) .

Measure II e.g. ..... 61,82 mm

CALCULATION EXAMPLE:
Measure I ..... 61,85 mm
Measure II ..... – 61,82 mm
Difference = Axial gap 0,03 mm

Measure I must be larger than measure II!
In case of deviations from the required axial gap, correct with suitable shim!

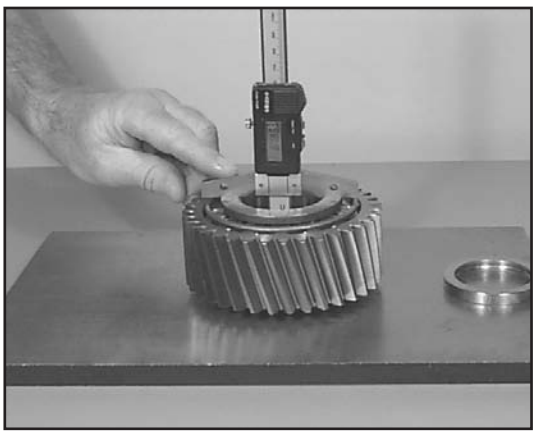


Figure 371

Install components according to Figure 367 and position countershaft gear inside the housing.

The assembly of the countershaft axle can be performed only after the installation of the clutches!

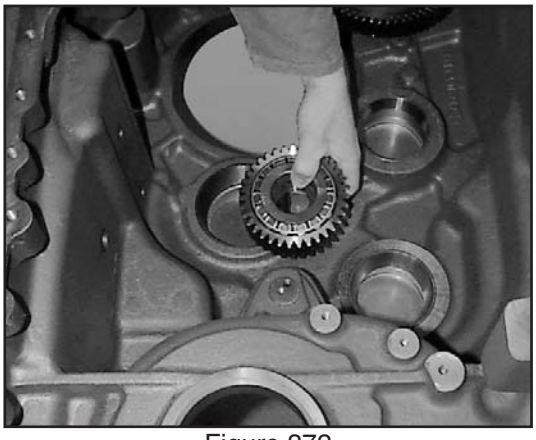


Figure 372

Insert bearing outer races-KV/K1, -KR/K2 and -K3/K4 into the housing bores until contact is obtained, see arrows.

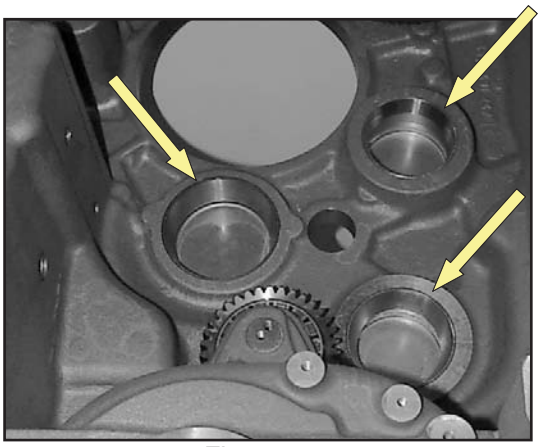


Figure 373

Position clutchKV/K1 by means of lifting device.

(S) Set of eye bolts 504182

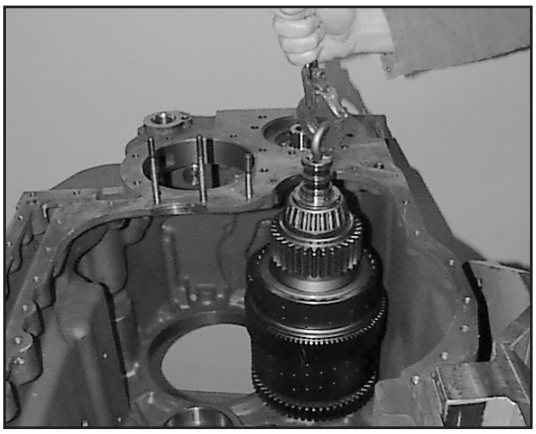


Figure 374

Position clutch-KR/K2.



Figure 375

Check again installation position of countershaft gear (arrow) and correct, if necessary.

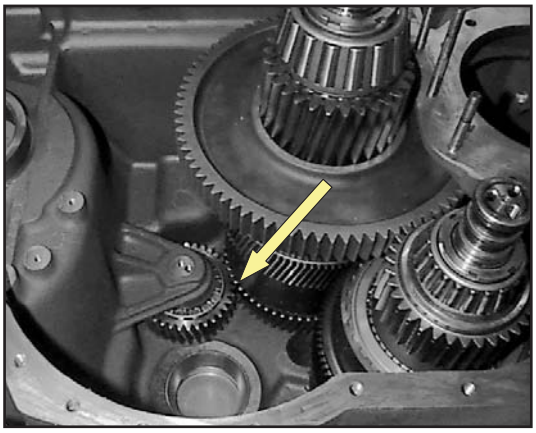


Figure 376

Axially fix spur gear K3 by means of special device and eye bolt (arrow)-

The spur gear fixing prevents the plates from slipping off when lifting the clutch into position.

(S) Assembly device	504208
(S) Eye bolt	504190

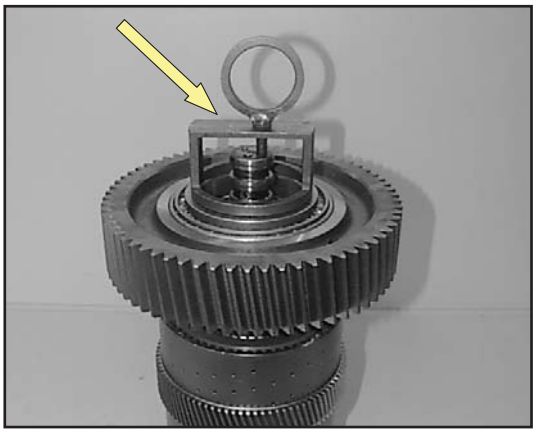


Figure 377

Slightly lift clutch KR/K2, shift it into the direction of the arrow and position clutch K3/K4.

Now, remove special device again.

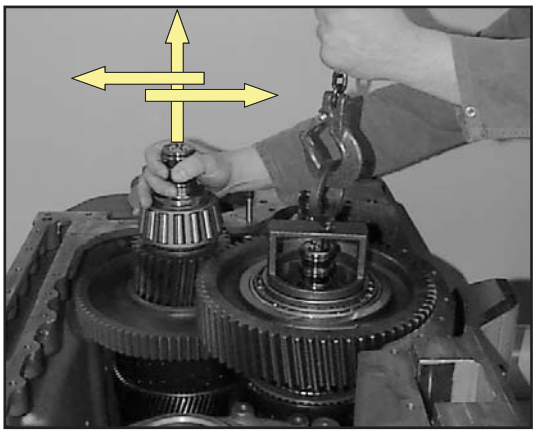
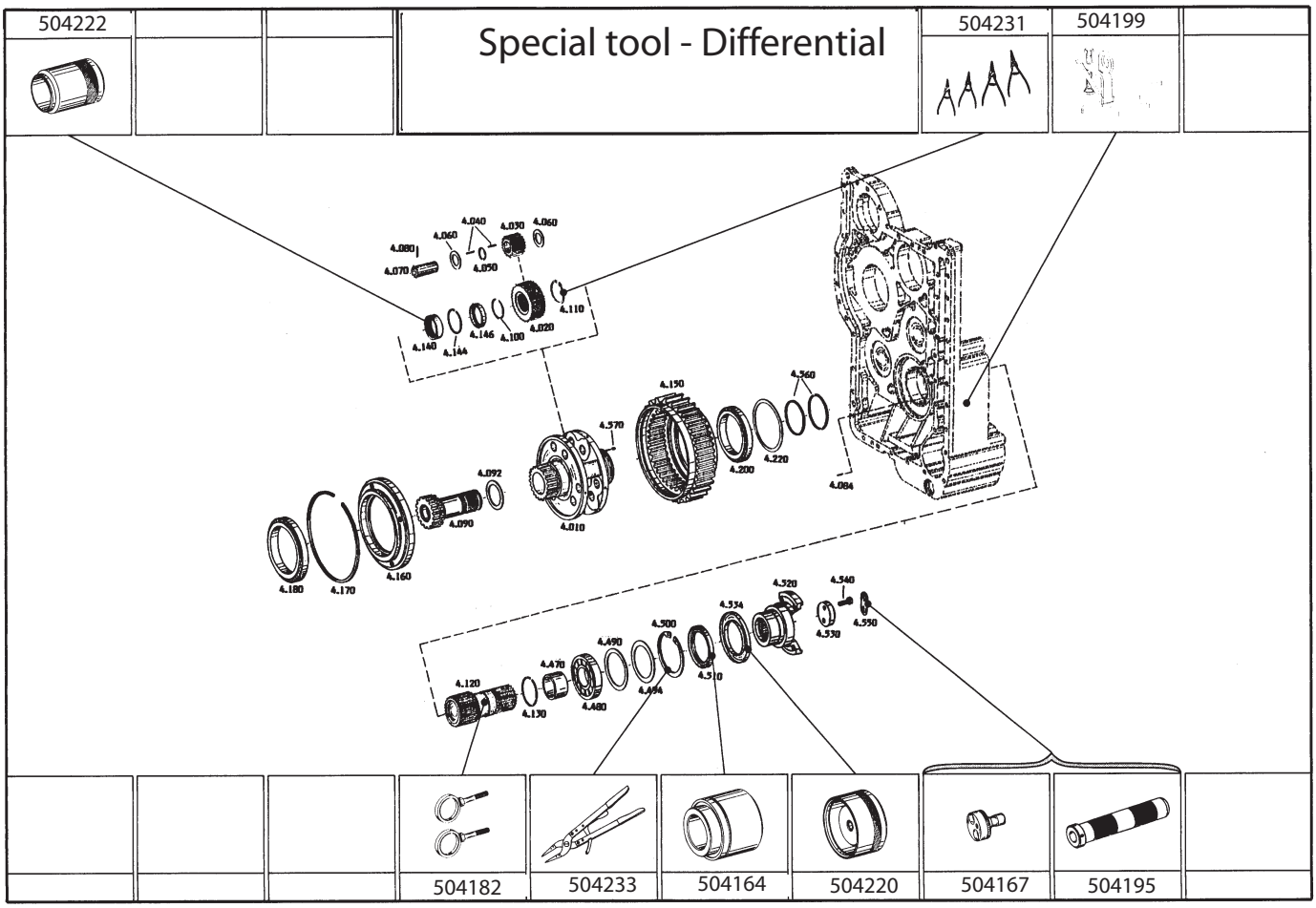


Figure 378

Interaxle differential assembly



Close bores (6x , arrows) by means of set screws.

Insert set screws with Loctite (type-no. 243)!

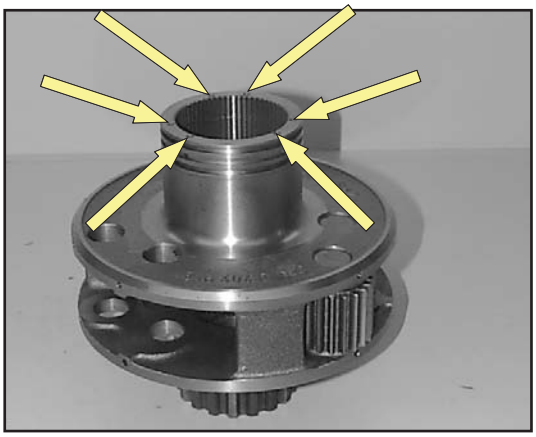


Figure 380

Press needle sleeve with the reinforced lining facing the pressing-in tool until contact is obtained and fix it by means of snap ring.

(S) Pressing-in sleeve 504222

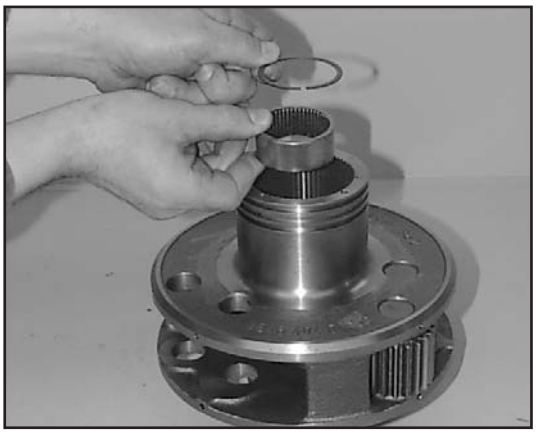


Figure 381

Press ring in with the great Æ showing downwards until contact is obtained.

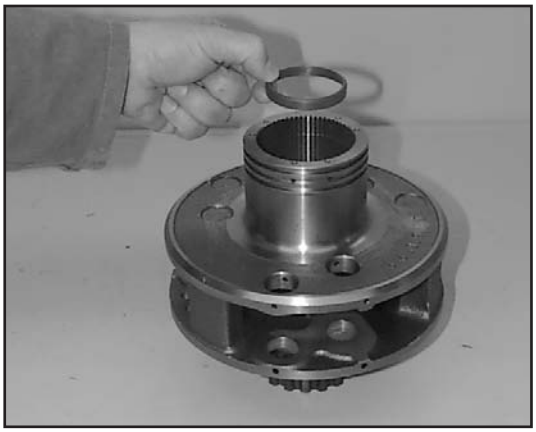


Figure 382

Introduce output shaft and install snap ring (arrow).

Position sun gear with the stepped plane surface facing the snap ring and introduce output shaft until the snap ring snaps into position.

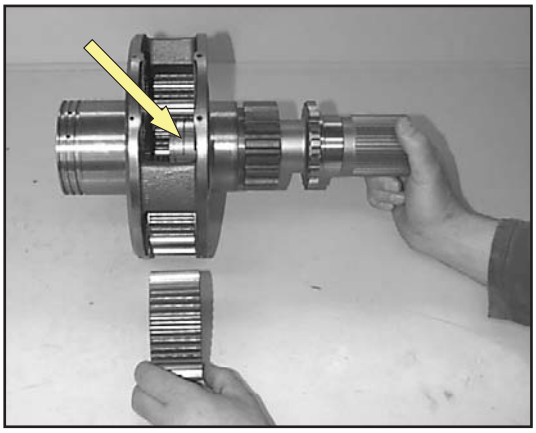


Figure 383

Fix sun gear by means of circlip.

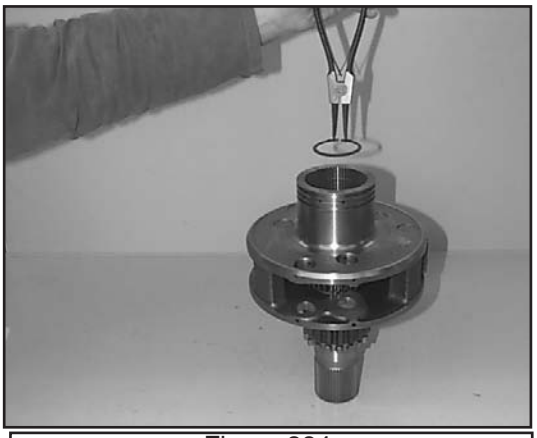


Figure 384

The figure on the left show the components of the planetary gear.

1 = Thrust washer
2 = Needle rollers (30 units)
3 = Disc
4 = Planetary shaft
5 = Planetary gear

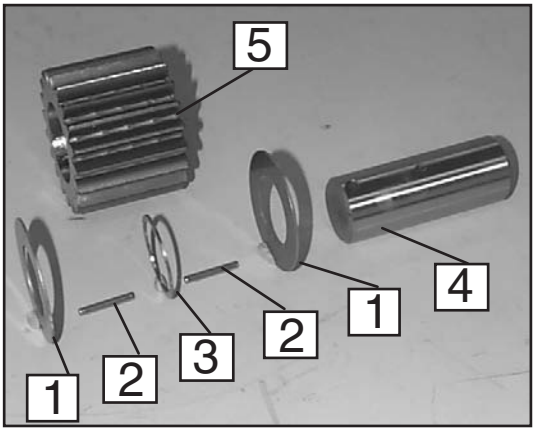


Figure 385

Install components 1 to 3.

As assembly aid, use grease!
Renew needle rolls only by sets!

Position planetary gear, centrically align and fix it by means of planetary shaft.

Observe the installation position of the planetary shaft – central oil bore (arrow) showing ahead!

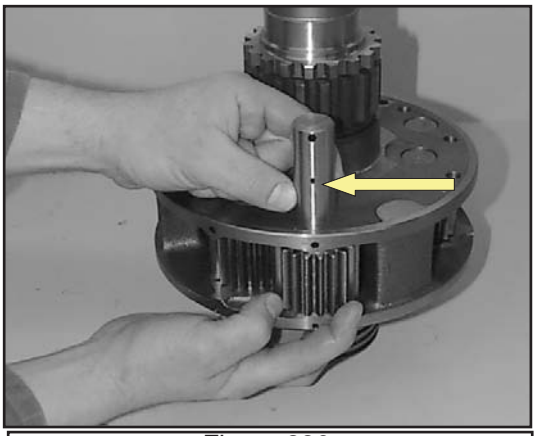


Figure 386

Fix planetary shaft by means of roll pin.

Accordingly install remaining planetary gears.

Drive in roll pins up to the shaft center, see arrow!

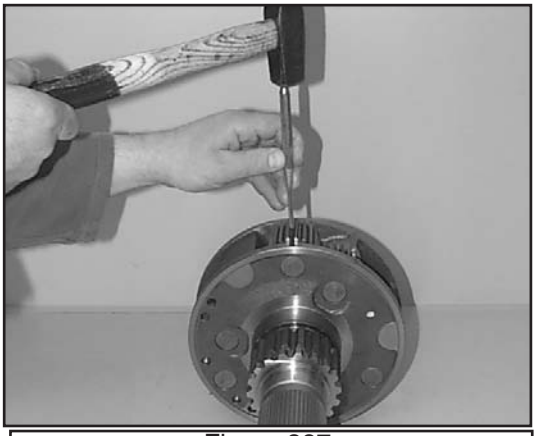


Figure 387

Insert planet carrier into the internal gear.

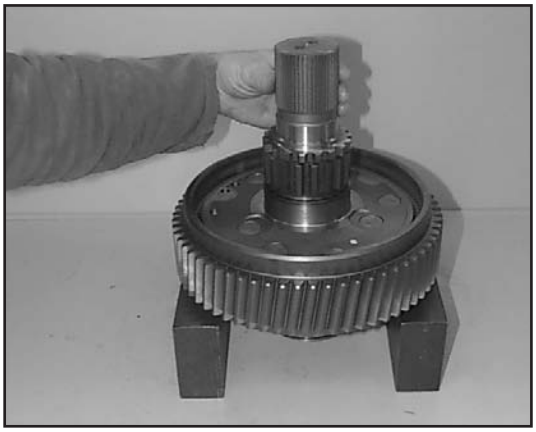


Figure 388

Insert bearing outer race (arrow) into the internal gear carrier until contact is obtained.

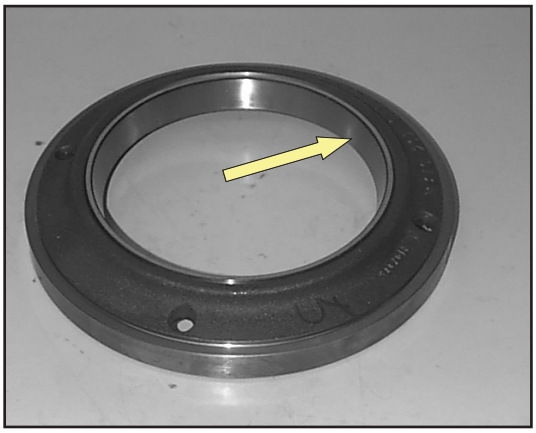


Figure 389

Supercool internal gear until contact is obtained.

Use protective gloves!

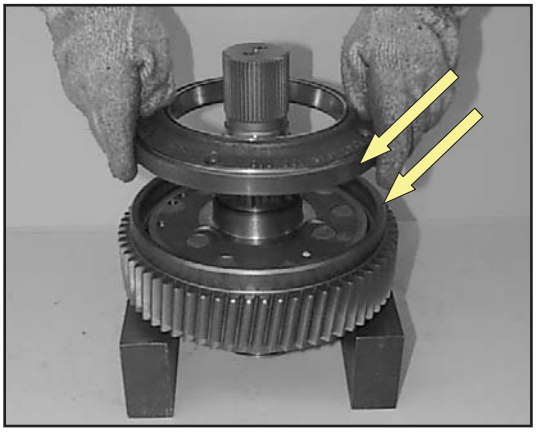


Figure 390

Fix internal gear carrier by means of snap ring.

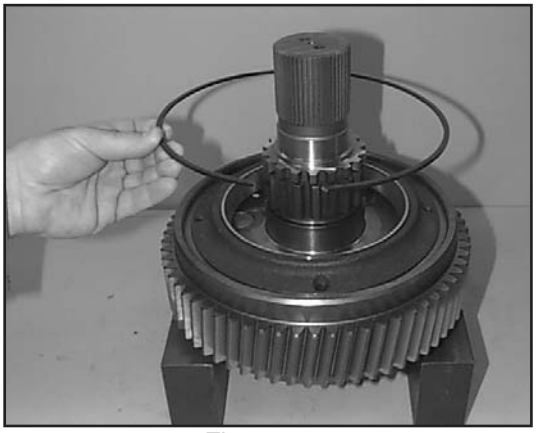


Figure 391

Heat up bearing inner race until contact is obtained.



Use protective gloves!

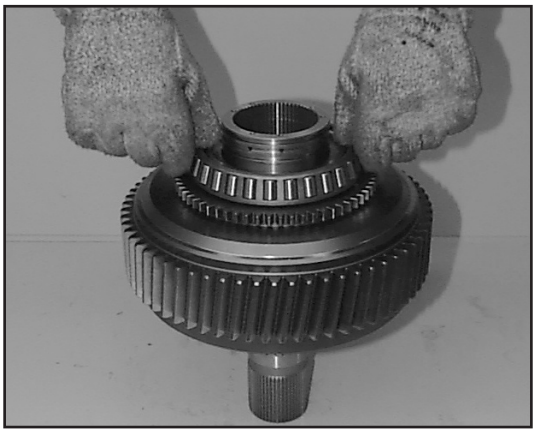


Figure 392

Introduce output shaft.

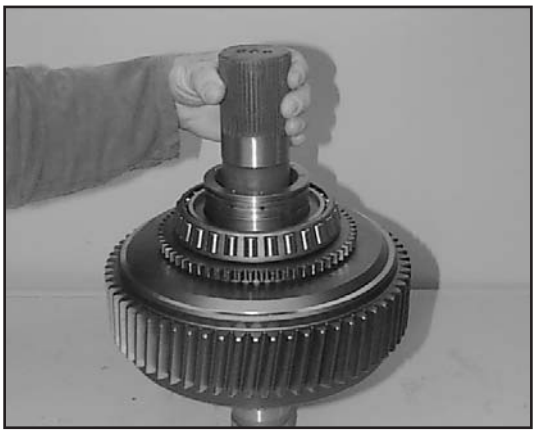


Figure 393

Fix output shaft by means of snap ring (arrow).

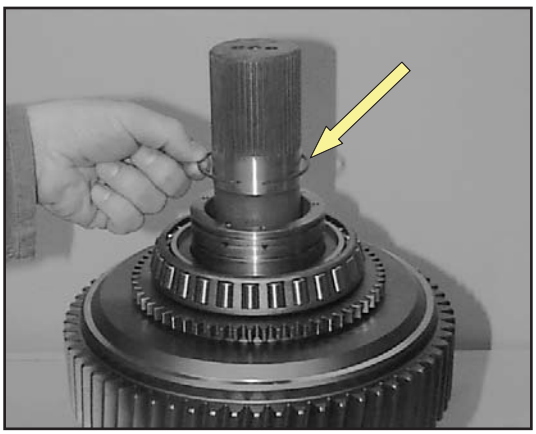


Figure 394

Squeeze in and engage both rectangular rings (arrows).

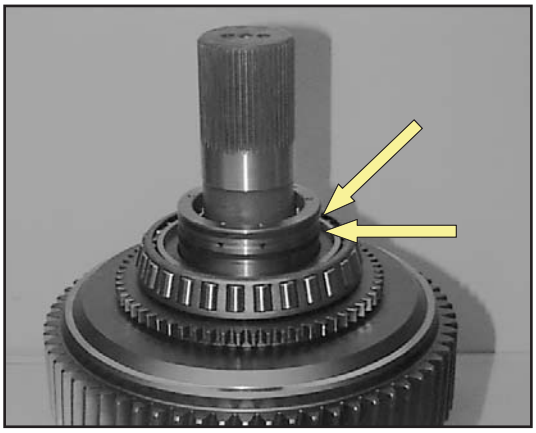


Figure 395

Line up bush (arrow).

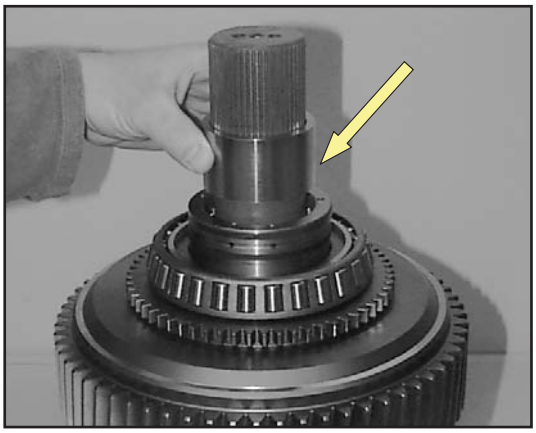


Figure 396

Heat up bearing inner race until contact is obtained.

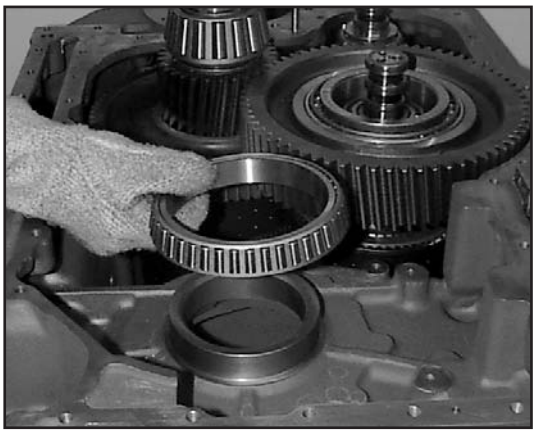


Figure 397

Use protective gloves!

Insert plate.

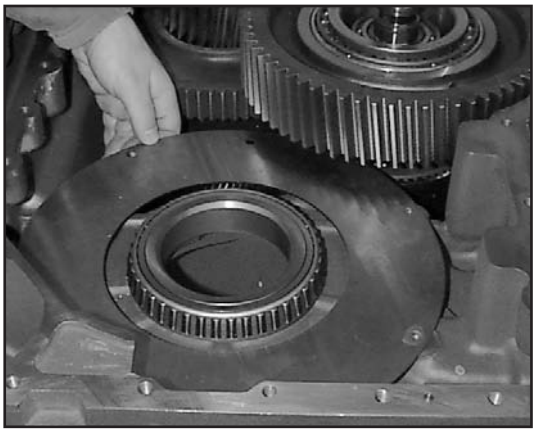


Figure 398

Lift differential into housing by means of lifting device.

(S) Set of eye bolts 504182

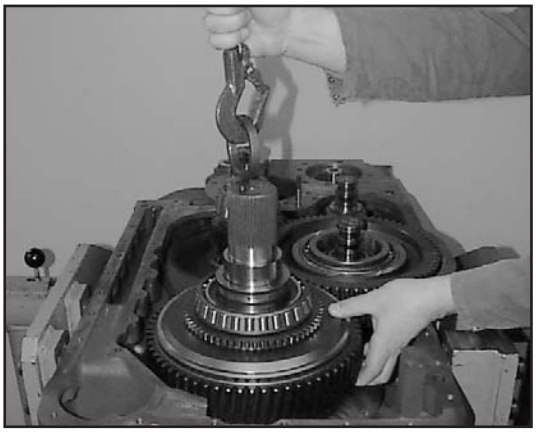
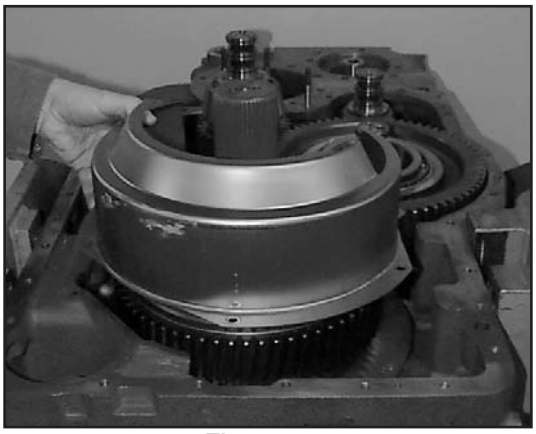


Figure 399

Position upper oil baffle and fasten both oil baffles by means of hex. head screws (5x) and hex. nut (1x).

Mount flat washers!
Secure hex. head screw with Loctite (type-no. 243)!

Torque limit (M8/8.8) ..... = 23 Nm


Figure 400

Pre-assemble housing cover

(version with intermediate axle differential) and mount it.

Mount components.

1 = Sealing cover (use Loctite, type-no. 262)
2 = Connection piece (mount new sealing ring)
3 = Cover plate (mount new gasket)
4 = Sealing cover (use Loctite type-no. 262)

Depending on the transmission version, differences regarding components and their installation position are possible!
See respective spare parts list!

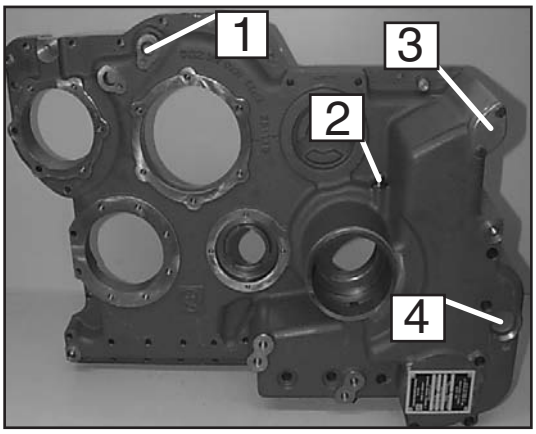


Figure 401

Drive in roll pin (2x8 mm) flush-mounted, see arrow 1!

Provide screw plug with an O-ring and install it, see arrow 2.

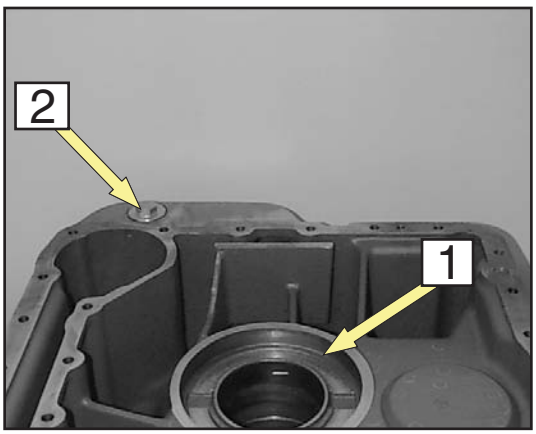
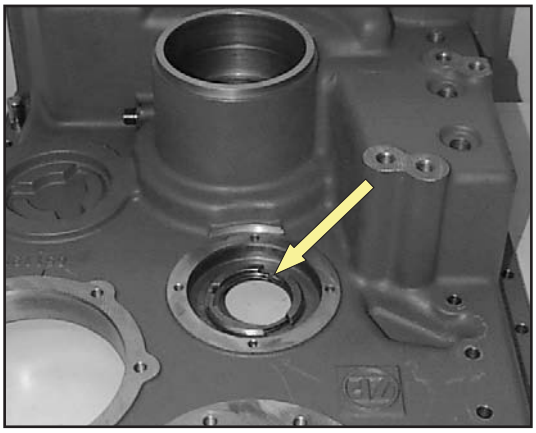


Figure 402

Squeeze both snap rings (arrow) into the recess.


Figure 403

Expand the two snap rings.
Introduce ball bearing with the annular groove showing upwards until the upper snap ring is engaged in the groove of the ball bearing.

(S) Clamping pliers 504730



Figure 404

Insert gear wheel until contact is obtained.

(S) Mallet 504196

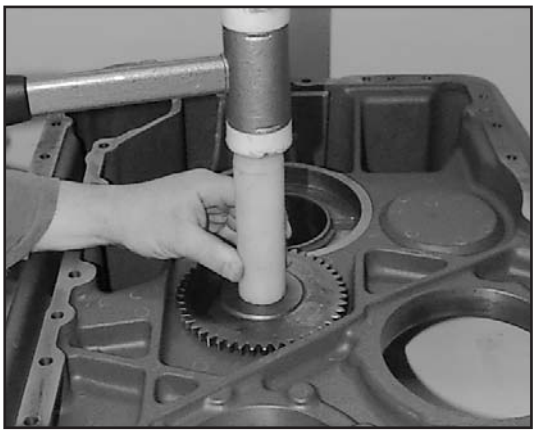


Figure 405

Fix gear wheel by means of circlip.

(S) Set of external pliers 504231



Figure 406

Adjust bearing pre-load of differential bearing 0,0 ... 0,1 mm (Figure 407 ... 409):

Determine measure I, from the mounting face to the locating face of the bearing outer race.

Measure I e.g.. ..... 66,36 mm

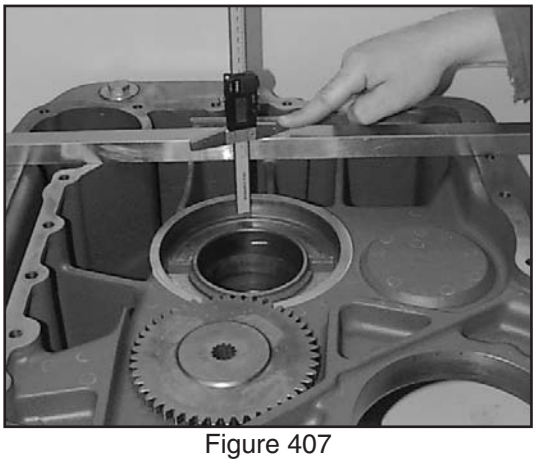


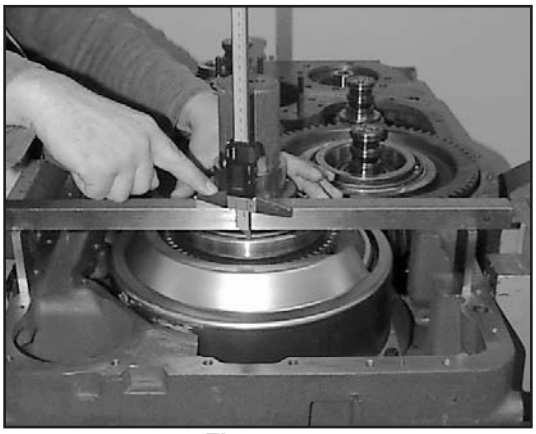
Figure 407

Mount bearing outer race.
Uniformly press on bearing outer race and determine measure II from bearing outer race to mounting face.

Measure II e.g.. ..... 64,00 mm

Take several measuring points and determine average value!

(S) Straight edge 504170
(S) Digital-depth gauge 504175


Figure 408

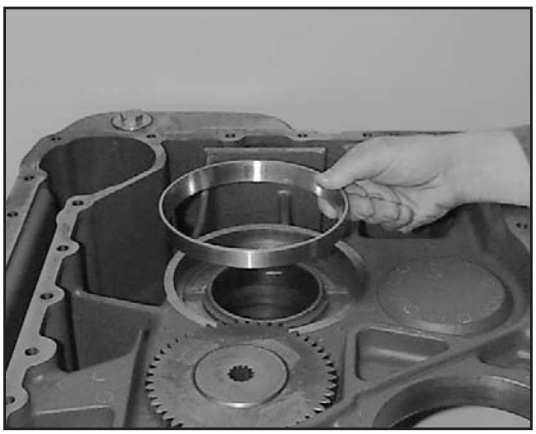
CALCULATION EXAMPLE “E“:

Measure I e.g.		66,36 mm
Measure II e.g.	–	64,00 mm
Difference		2,36 mm
Required bearing pre-load e.g.	+	0,04 mm
Gives shim e.g. s	**=**	**2,40 mm**

Insert shim.


Figure 409

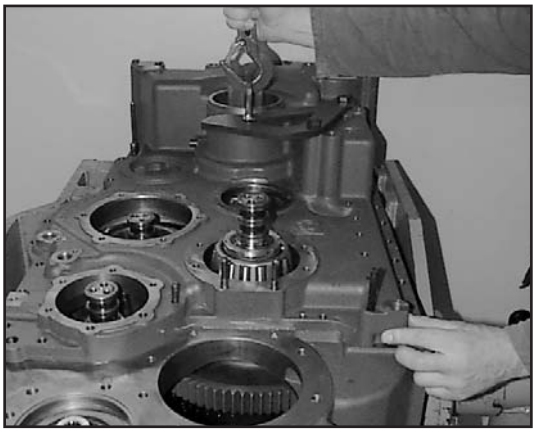
Install bearing outer race.


Figure 410

Apply sealing compound (Loctite, type-no. 574) to mounting face.

Install two adjusting screws and position housing cover on gear-box housing until contact is obtained, use lifting device.

(S) Adjusting screws 504184
(S) Lifting device 504199


Figure 411

Insert both cylindrical pins (arrow 1 and 2) until contact is obtained.

Fasten housing cover by means of screw connection.

Drive in roll pin (arrow 3) flush-mounted.

Torque limit (M10/8.8) ..... = 46 Nm

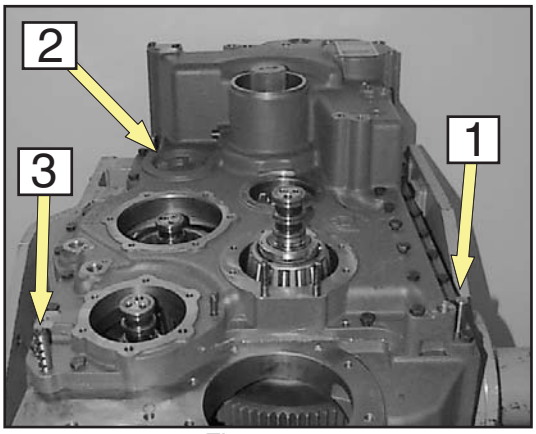
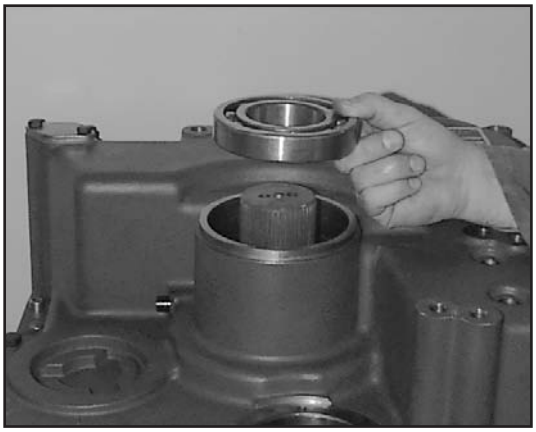
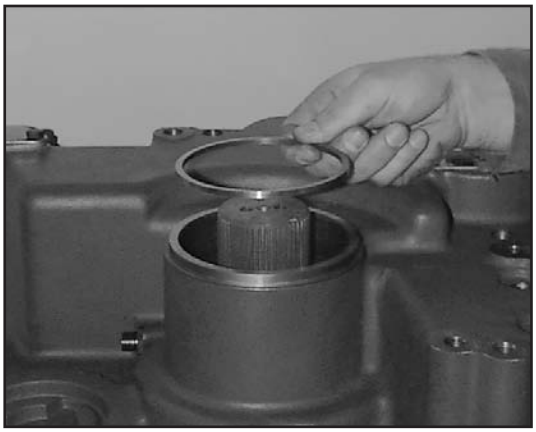


Figure 412

Insert ball bearing until contact is obtained.

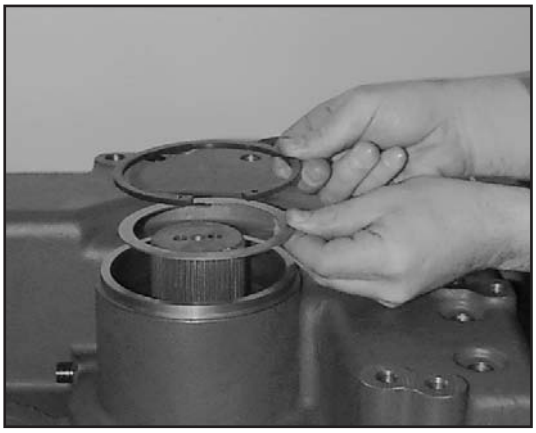

Figure 413

Introduce shim s = 4,0 mm .


Figure 415

Fix ball bearing without gap by means of shim and circlip.

(S) Clamping pliers 504233

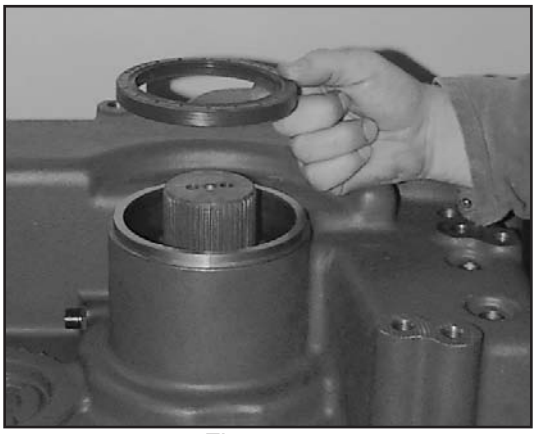

Figure 416

Install shaft seal with the sealing lip facing the oil chamber.

When using the specified driver (S), the exact installation position is obtained!
Grease sealing lip!

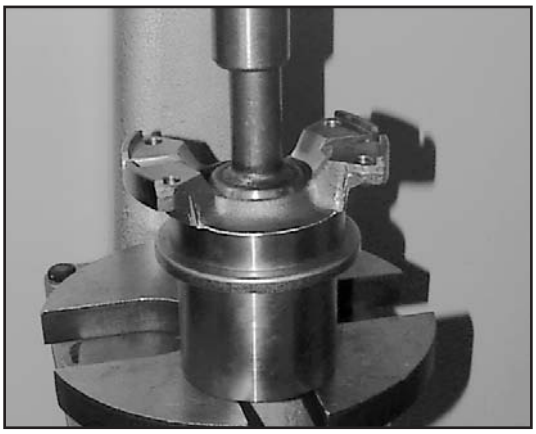
(S) Driver 504164

Depending on the version, different shaft sealing rings can be necessary!
Outer diameter rubber-coated – wet with spirit!
Outer diameter metallic – wet with sealing compound (Loctite, type-no. 574)!


Figure 417

Press on screening plate until contact is obtained.

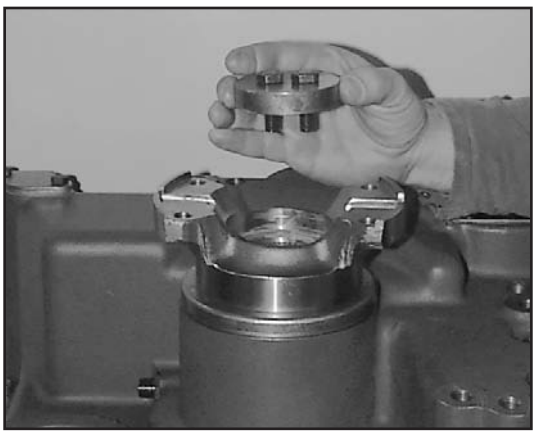
(S) Pressure piece 504223


Figure 418

Line up output flange.

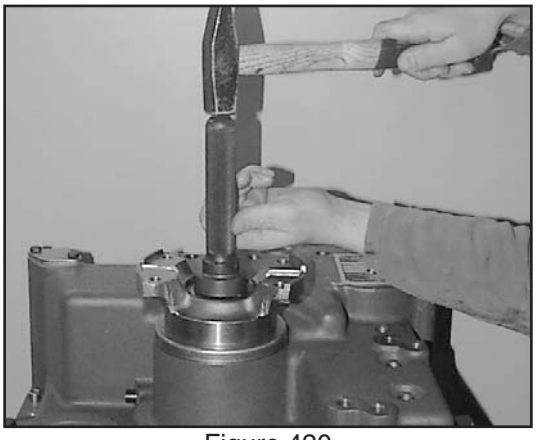
Wet contact face of the shim with sealing compound (Loctite, type-no. 574) and fasten output flange with hex. head screws..

Torque limit (M10/8.8) .....= 46 Nm


Figure 419

Fix hex. head screws by means of lock plate.

(S) Driver 504167
(S) Handle 504195


Figure 420

Adjust bearing pre-load of the clutches

Adjust bearing pre-load of the clutch -K3/K4= 0,00 ... 0,05 mm (Figure 420 ... 422):

Insert bearing inner race into the outer race.

Housing dimensions:
Uniformly press on bearing inner race and determine measure I from the mounting face to bearing inner race.

Measure I e.g. ..... 43,85 mm

Take several measuring points and determine average value!

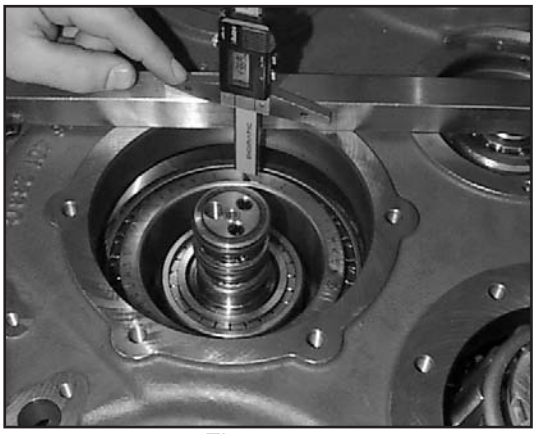


Figure 421

Cover dimension:
Determine measure II, from the mounting face to the contact/bearing inner race.

Measure II e.g. ..... 42,15 mm

(S) Straightedge	504170
(S) Digital depth gauge	504175
(S) Gauge blocks	504174

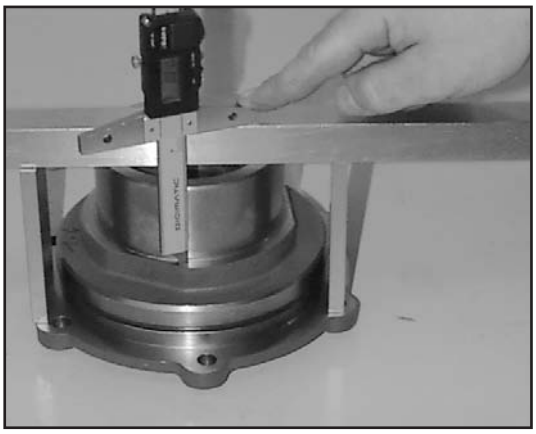


Figure 422

CALCULATION EXAMPLE " F ":

Measure I e.g.		43,85 mm
Measure II e.g.	–	42,15 mm
Difference	=	1,67 mm
Bearing pre-load e.g.....	+	0,03 mm
Gives shim(s) s	**=**	**1,70 mm**

Line up the shim.

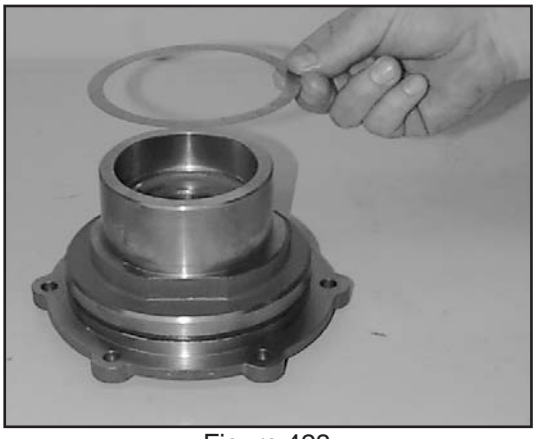


Figure 423

Heat up bearing inner race and bring it into contact.

Use protective gloves!



Figure 424

Mount O-ring (arrow) and grease it.
Heat up inner diameter of the bearing cover (bearing seat).



Figure 425

Grease rectangular rings (3 x ,arrows) and centrically align them.

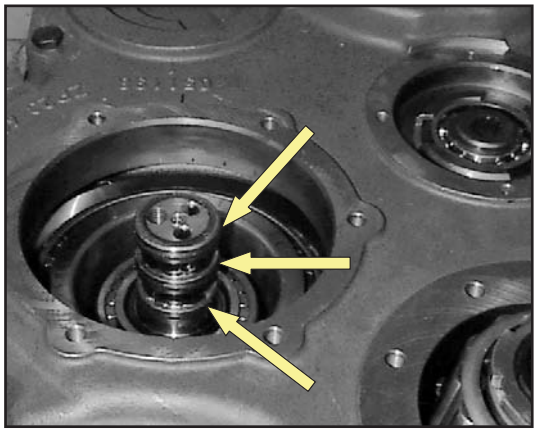


Figure 426

Install two adjusting screws.
Line up bearing cover by means of hex. head screws and uniformly tighten them until contact is obtained.

Torque limit (M10/8.8) .....= 46 Nm

Observe the radial installation position, see marking (arrows)!

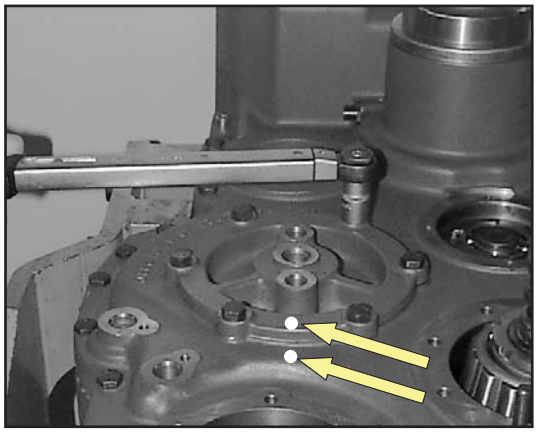


Figure 427

Adjust bearing pre-load of clutch KR/K2 = 0,00 ... 0,05 mm (Figure 427 ... 430):

Insert bearing outer race until contact is obtained.

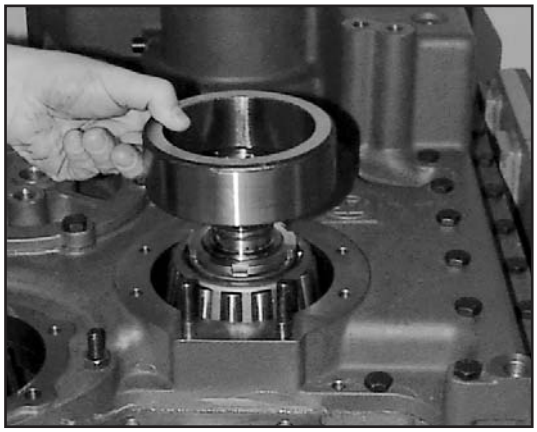
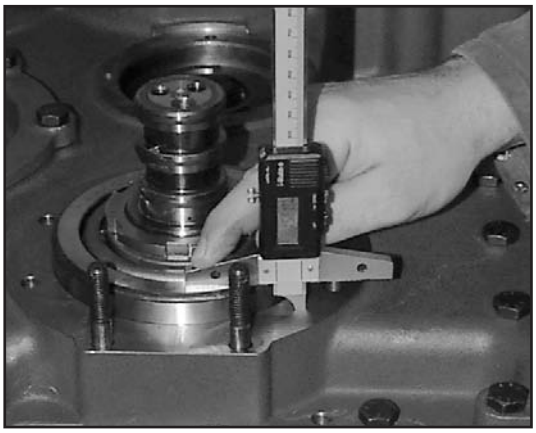


Figure 428

Housing dimension:
Determine measure I from bearing outer race to mounting face.

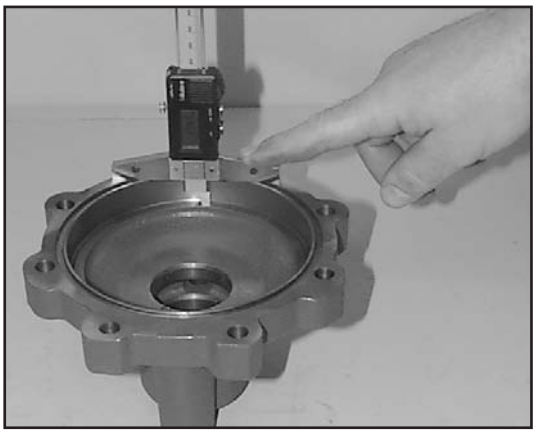
Measure I e.g. ..... 15,68 mm


Figure 429

Cover dimension:
Determine measure II from contact/bearing outer race to mounting face

Measure II e.g.. ..... 17,46 mm

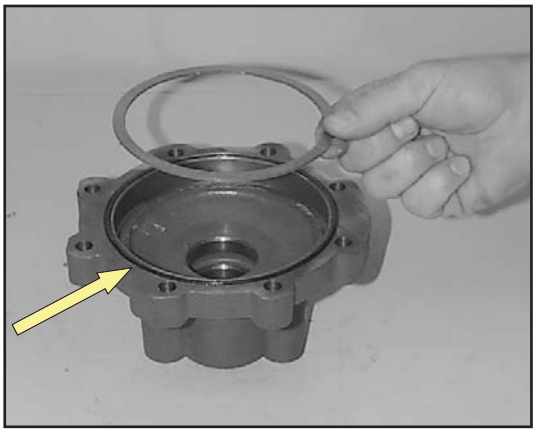
(S) Digital depth gauge 504170


Figure 430

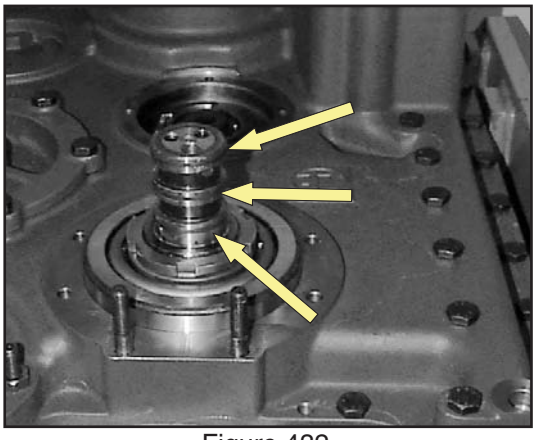
CALCULATION EXAMPLE " G ":

Measure II e.g.		17,46 mm
Measure I e.g.	–	15,68 mm
Difference.....	=	1,78 mm
Bearing pre-load e.g.	+	0,02 mm
Gives shim(s) s	**=**	**1,80 mm**

Make shim adhere with assembly grease in the cover.
Install O-ring (arrow).


Figure 431

Grease rectangular rings (arrows) and centrically align them.


Figure 432

Uniformly pull bearing cover until contact is obtained

Torque limit (M10/8.8) ..... = 46 Nm

Observe the radial installation position, see marking (arrows).

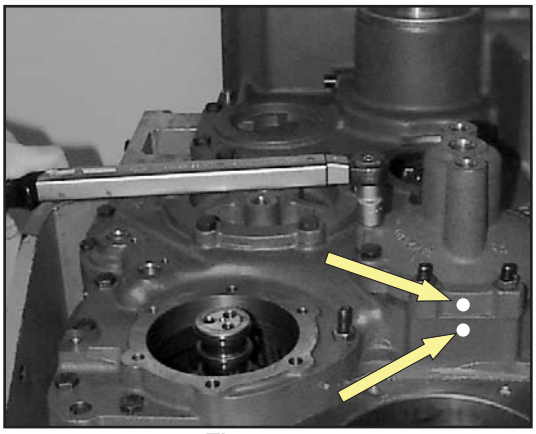


Figure 433

Adjust bearing pre-load of clutch-KV/K1 = 0,00 ... 0,05 mm (Figure 433 ... 436):

Lay bearing outer race over bearing inner race.

Housing dimension:
Uniformly press on bearing outer race and determine measure I from mounting face to bearing outer race.

Measure I e.g. ..... 52,67 mm

Take several measuring points and determine the average value!

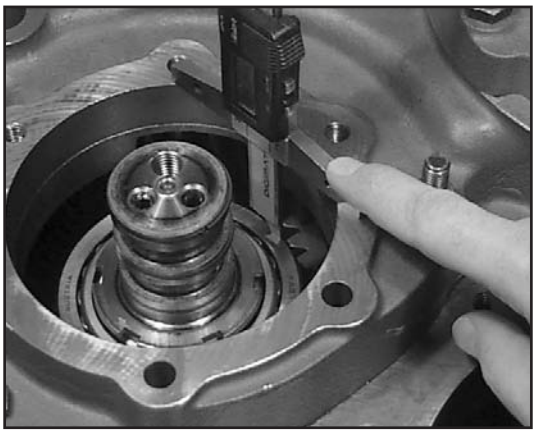


Figure 434

Insert ring with the chamfer showing downwards into the bearing cover.



Figure 435

Cover measure:
Determine measure II from mounting face to ring.

Measure II e.g. ..... 50,75 mm

(S) Digital depth gauge 504175

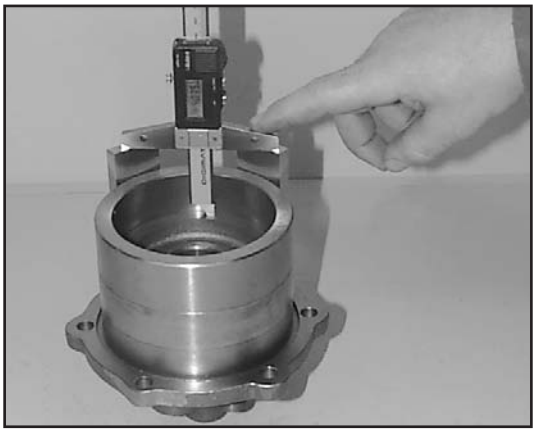


Figure 436

CALCULATION EXAMPLE " H ":

Measure I e.g..		52,67 mm
Measure II e.g.	–	50,75 mm
Difference	=	1,92 mm
Bearing pre-load e.g.	+	0,03 mm
Gives shim(s) s	**=**	**1,95 mm**

Insert shim.



Figure 437

Insert bearing outer race until contact is obtained.

Line up O-ring (arrow).

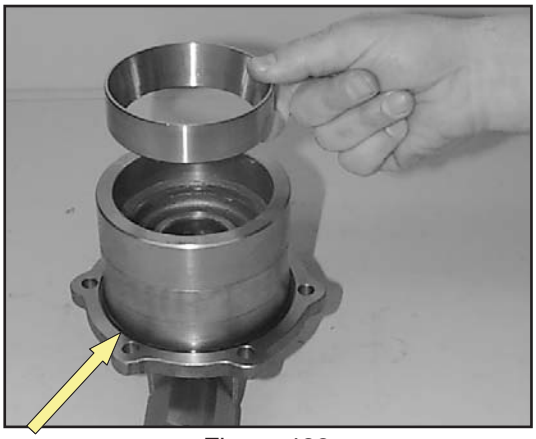


Figure 438

Grease rectangular rings (arrows) and centrically align them.

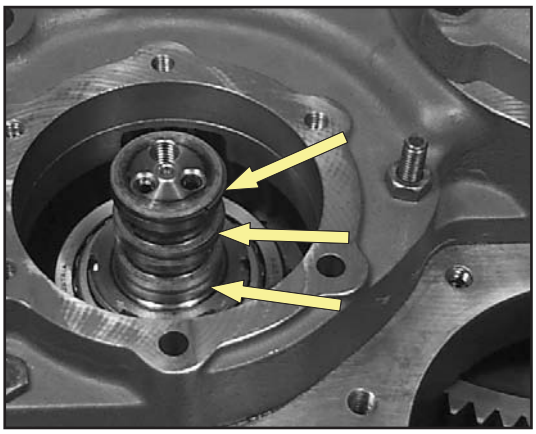


Figure 439

Insert bearing cover until contact is obtained and fasten it by means of hex. head screws.

Torque limit (M10/8.8) ..... M_A = 46 Nm

Pay attention to radial installation position, see marking (arrows)!

(S) Plastic mallet 504196

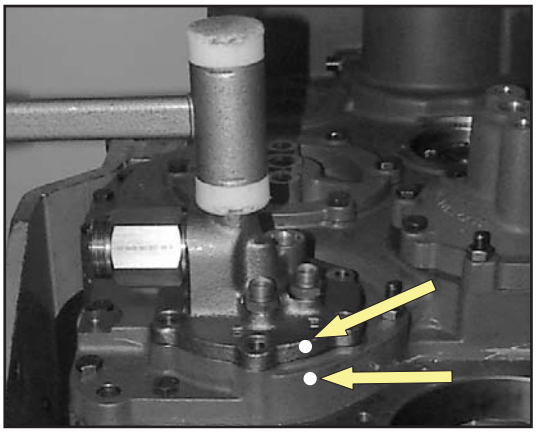


Figure 440

Tilt transmission housing.



Figure 441

Install countershaft axle

Centrically align countershaft gear and install adjusting screw

(S) Adjusting screw 504187

Supercool pin and insert it until contact is obtained.



Figure 442

Use protective gloves!

Remove adjusting screw and fix bolt by means of hex. head screw.

Torque limit (M10/8.8) .....= 46 Nm

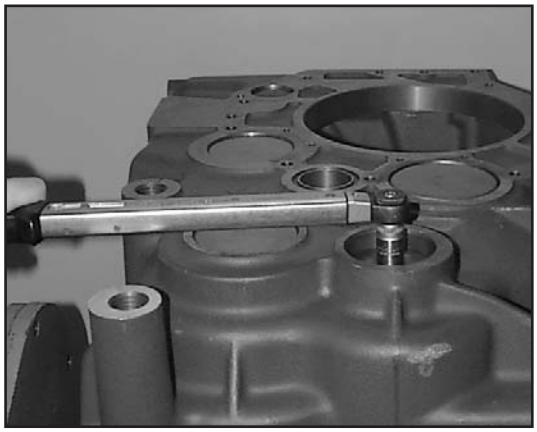


Figure 443

Wet thread of hex. head screw with Loctite (type-no. 243)!

Drive sealing covers (arrows) with the concave side showing downwards flush-mounted into the housing face.

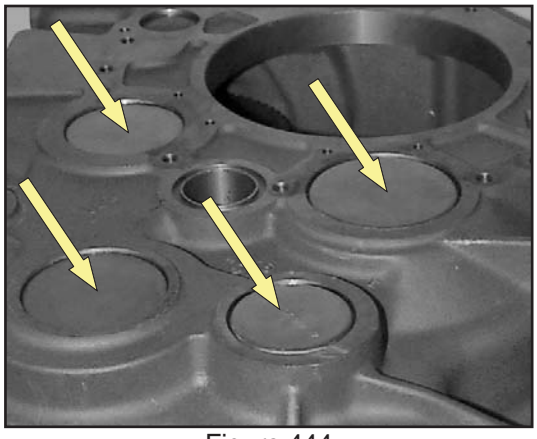
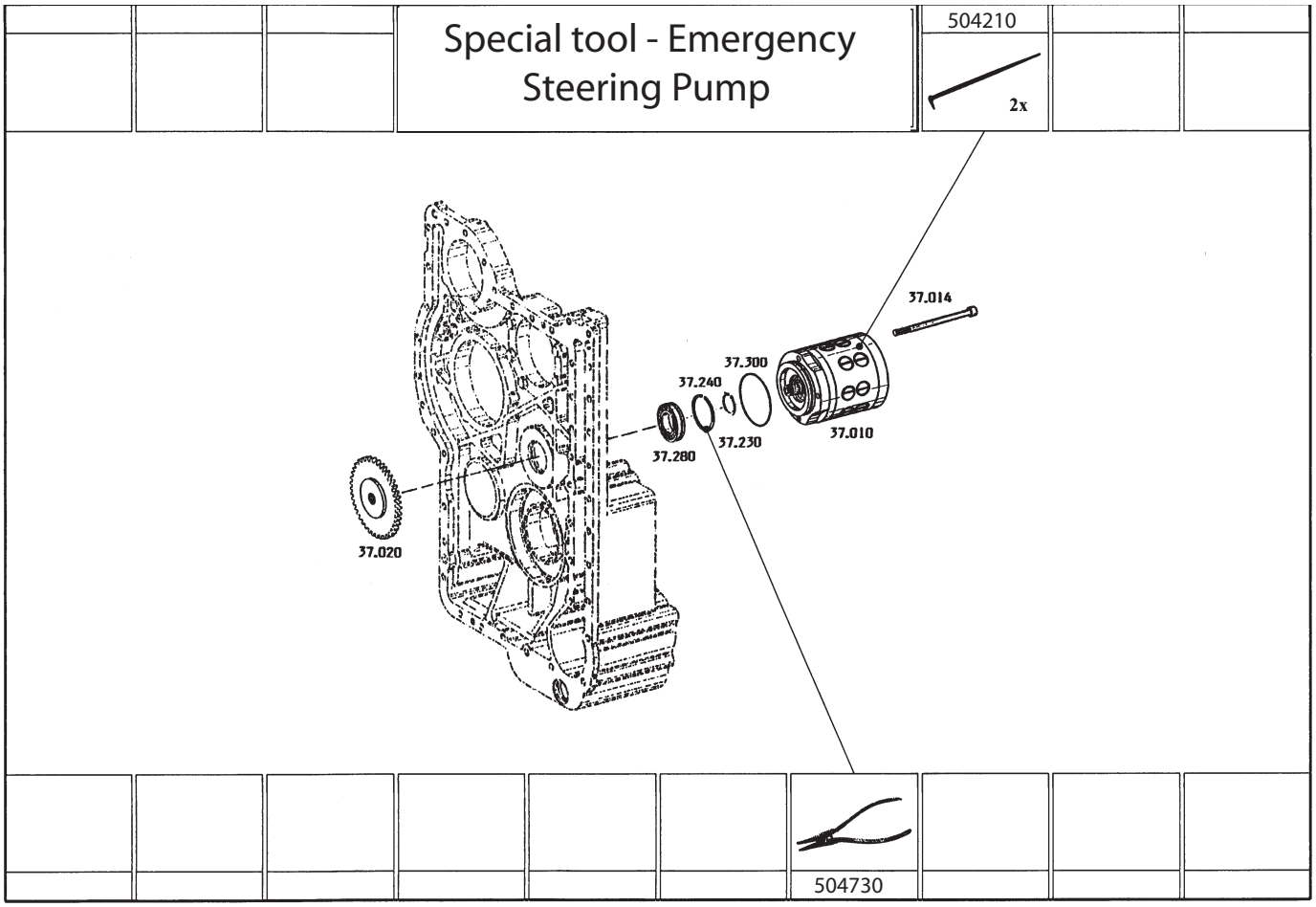


Figure 444

Wet contact face with Loctite (type-no. 262)!

Install emergency steering pump



Tilt gearbox housing 180°.

Insert O-ring (arrow) into the annular groove and grease it.

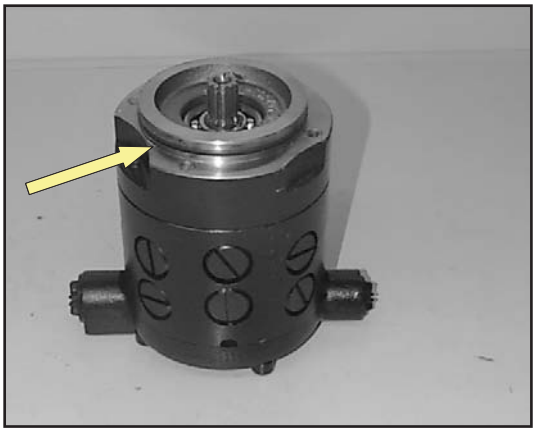


Figure 445

Introduce emergency steering pump until contact is obtained and fasten it by means of hex. head screws.

Torque limit (M8/8.8) ..... M_A = 23 Nm

Observe the installation position, see markings!
Wet thread of the hex. head screws with Loctite (type-no. 262)!

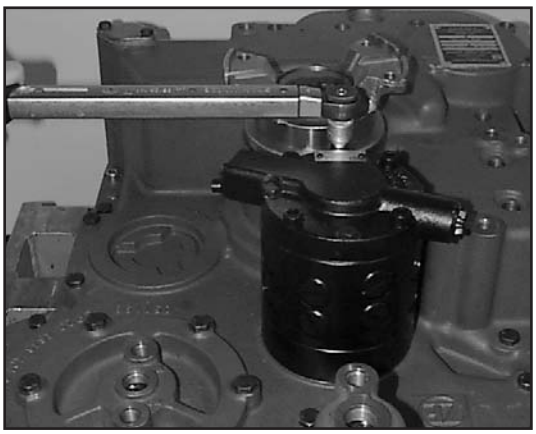
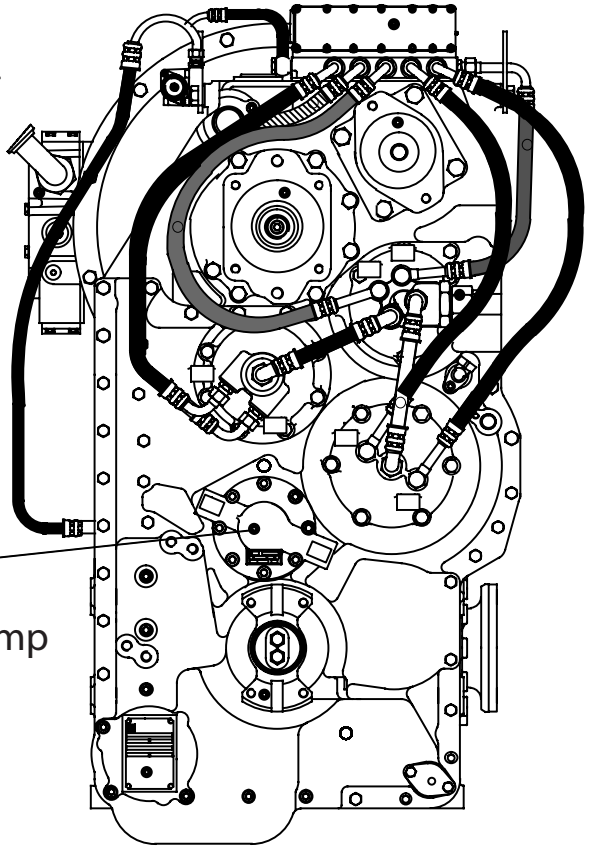


Figure 446

Transmission
view from rear



The emergency steering pump is a part of the hydraulic system.
Further about the emergency steering pump, see in the
Chapter 5 Hydraulic system

Transmission control. The pump

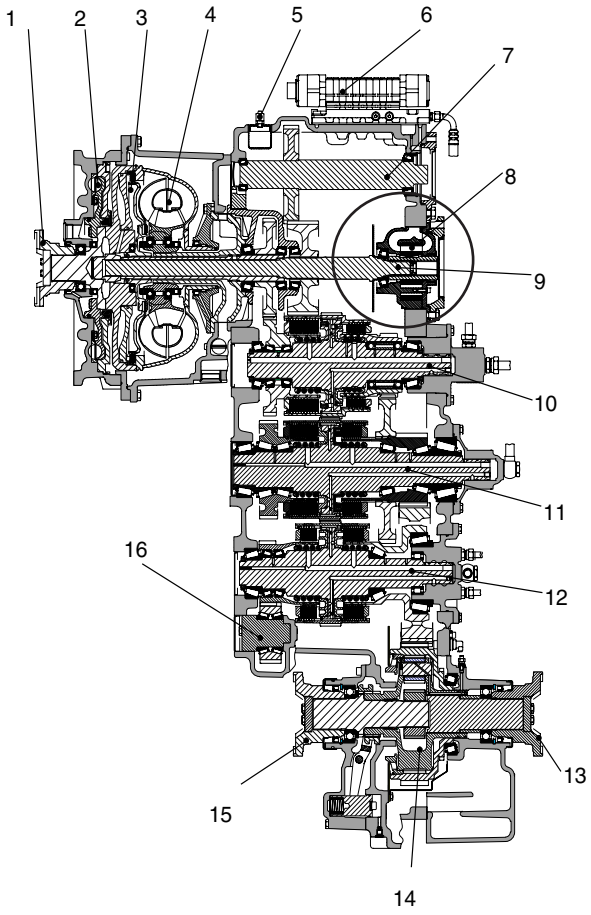
See: (in this chapter)
- Electro hydr. shift control valve, cross section
- Clutch chart
- Oil circuit diagram

The transmission pump, necessary for the oil supply of the converter, and for the transmission control, is located in the transmission on the engine-dependent input shaft. See figure item 8.

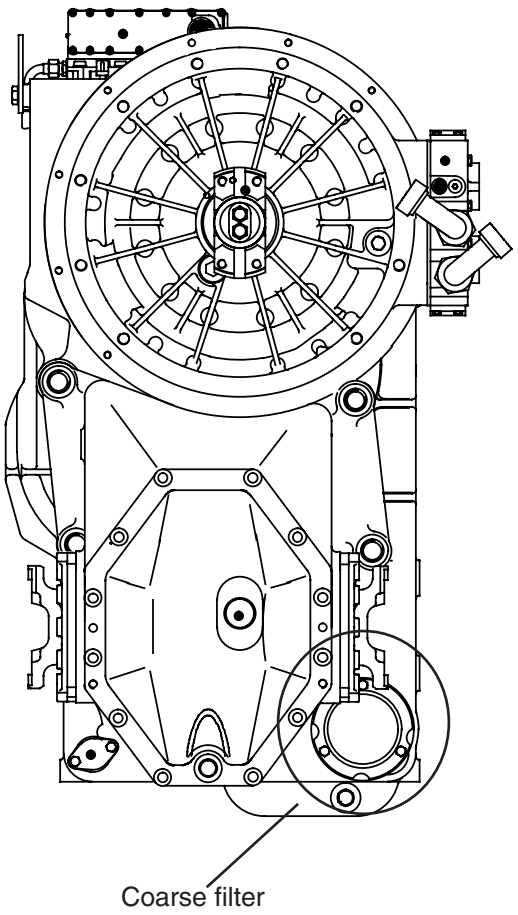
The feed rate of the pump is:
Q = 115 l /min, at nEngine = 2000 min^{-1}.

This pump is sucking the oil via the **coarse filter** out of the oil sump and delivers it via the **Fine filter** – the filter is fitted externally from the transmission – to the main pressure valve.

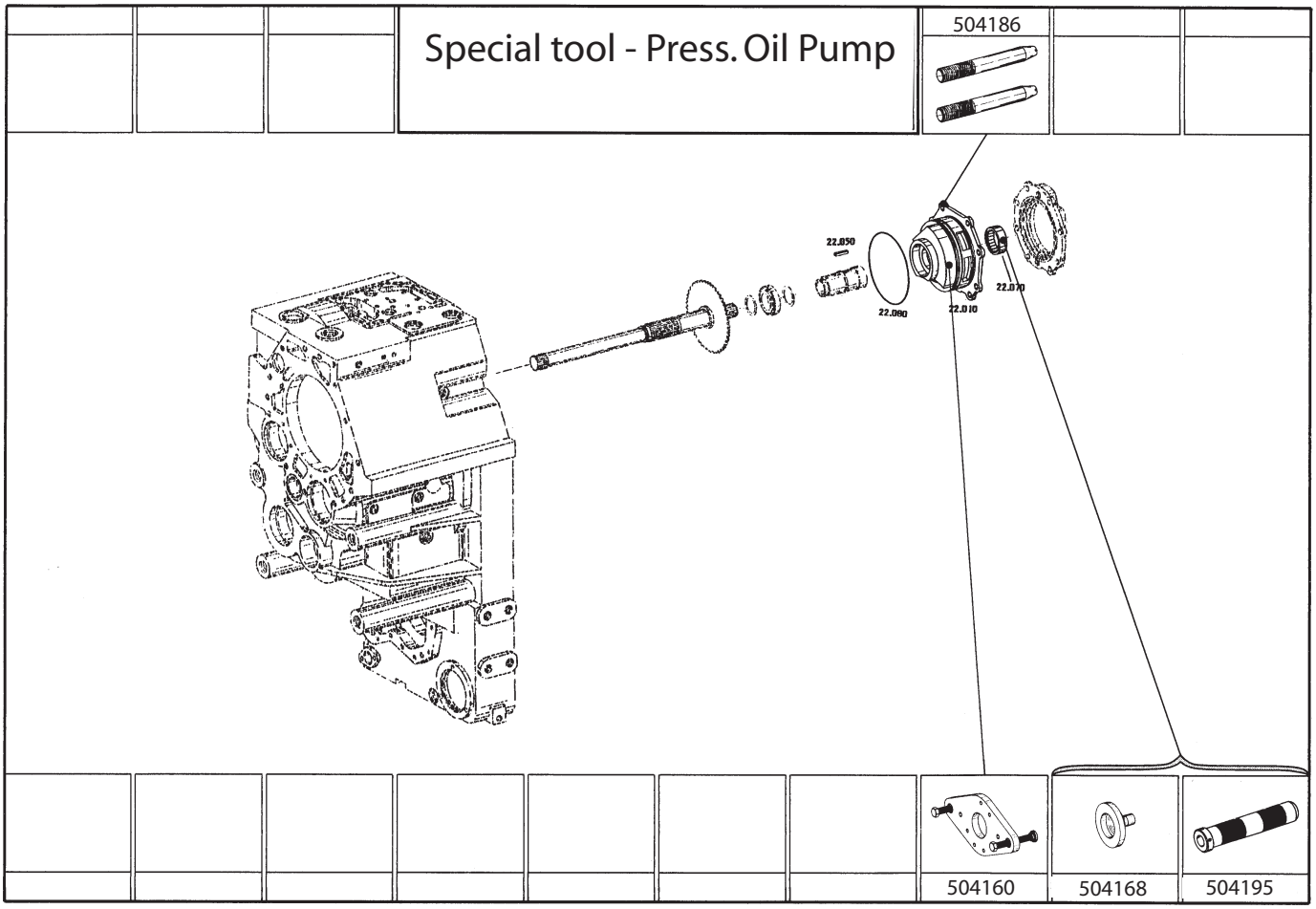
If because of contamination, resp. damage, the through-flow through the Fine filter is not ensured, the oil will be directly conducted via a filter differential pressure valve (bypass valve .p =5,7 bar) to the lubrication.
In this case, an error indication is shown in cab on the Display.



Transmission view from front



Special tool - Press. Oil Pump



Hydraulic pump

Press needle sleeve (arrow) with the reinforced shell facing the pressing-in tool until contact is obtained.

(S) Pressing-in tool 504168

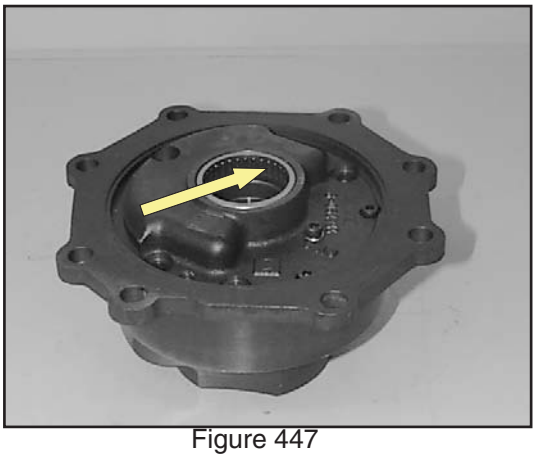


Figure 447

Insert disc s = 1,3 mm and position bearing outer race until contact is obtained.



Figure 448

Install O-ring (arrow) and grease it.

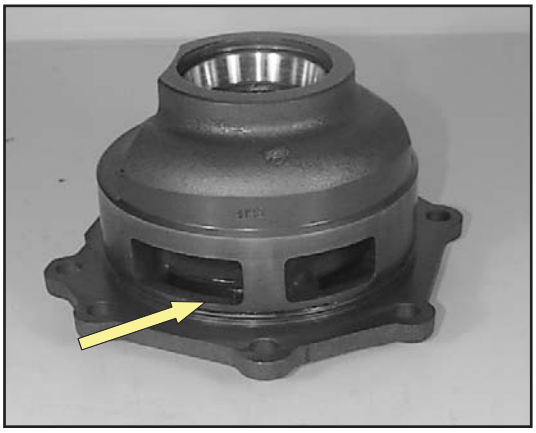


Figure 449

Supercool pump to about - 80° C.

Install two adjusting screws and introduce pump until contact is obtained.

Observe radial installation position!

Use protective gloves!

(S) Adjusting screws 504186

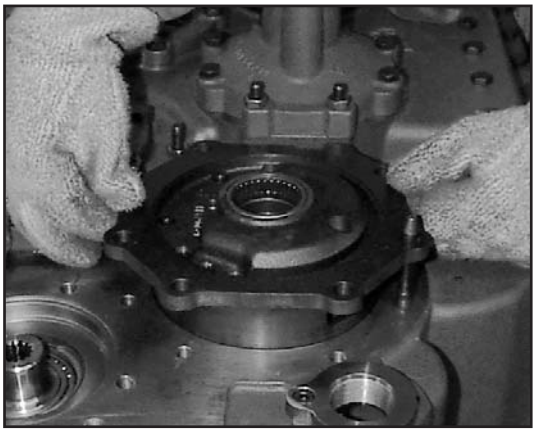


Figure 450

Install O-ring (arrow) and mount pump flange.

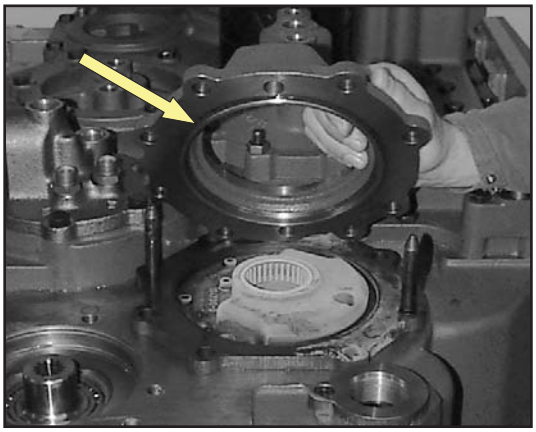


Figure 451

Fasten pump flange or pump by means of hex. head bolts.

Torque limit (M12/8.8) ..... M_A = 79 Nm

Wet thread of the two hex. head screws (position see arrows) with Loctite, type-no. 243 (through holes)!

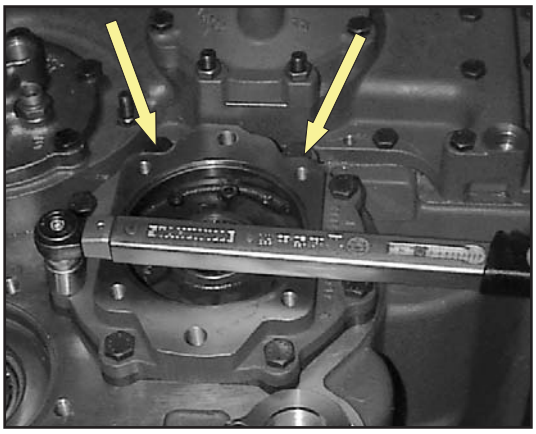


Figure 452

Insert O-ring (arrow) into the annular groove and grease it.
Fasten pump flange (power take-off) with hex. head screws.

Torque limit (M14/8.8) ..... M_A = 125 Nm

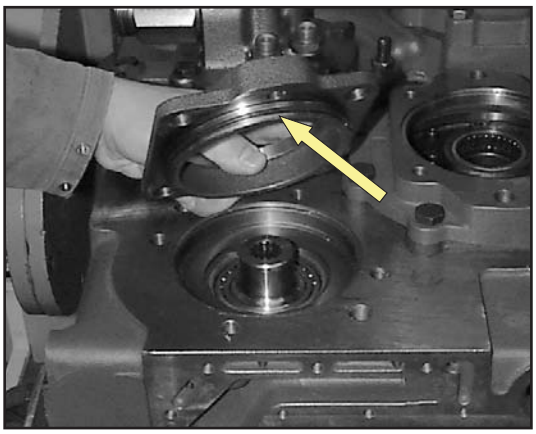
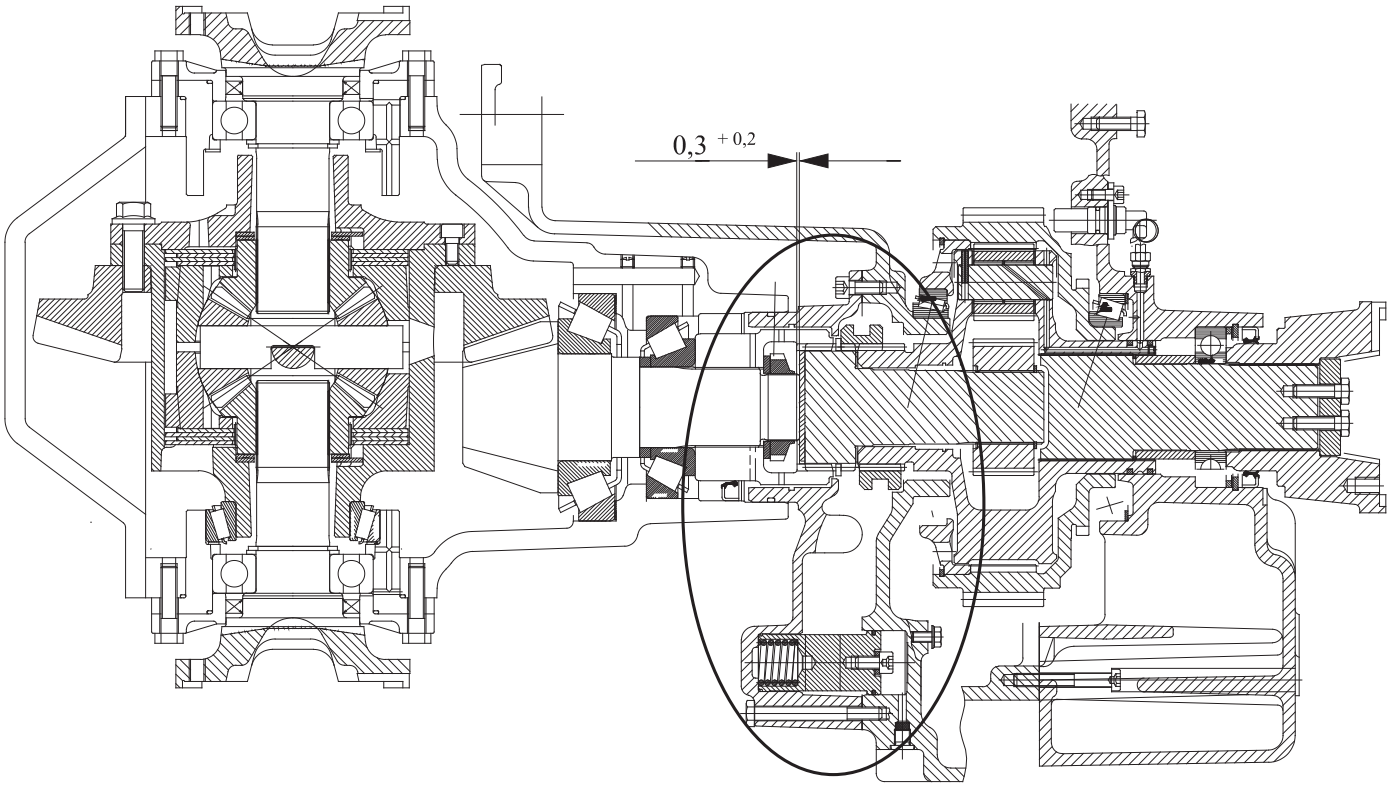


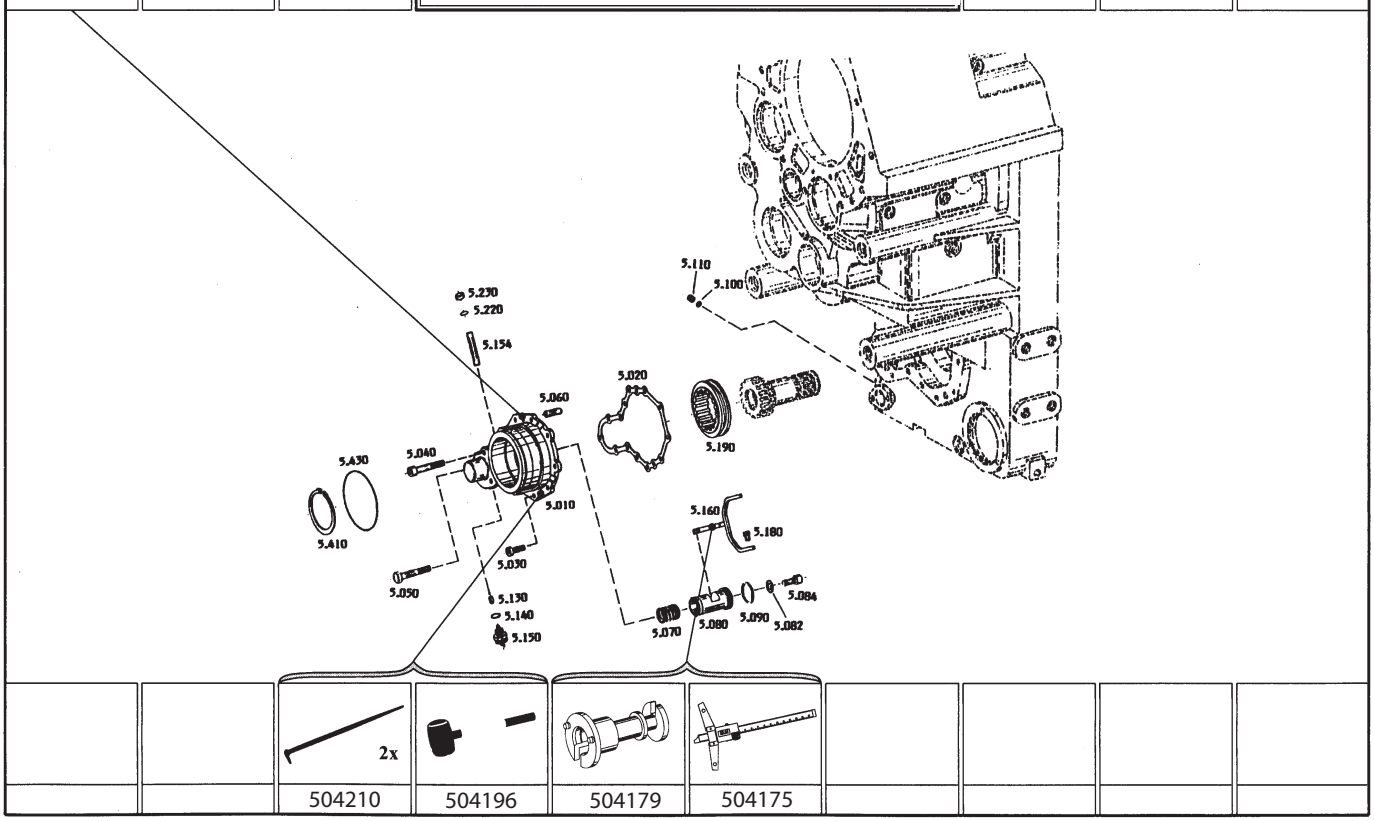
Figure 453

Axle disconnection – version with intermediate



504184

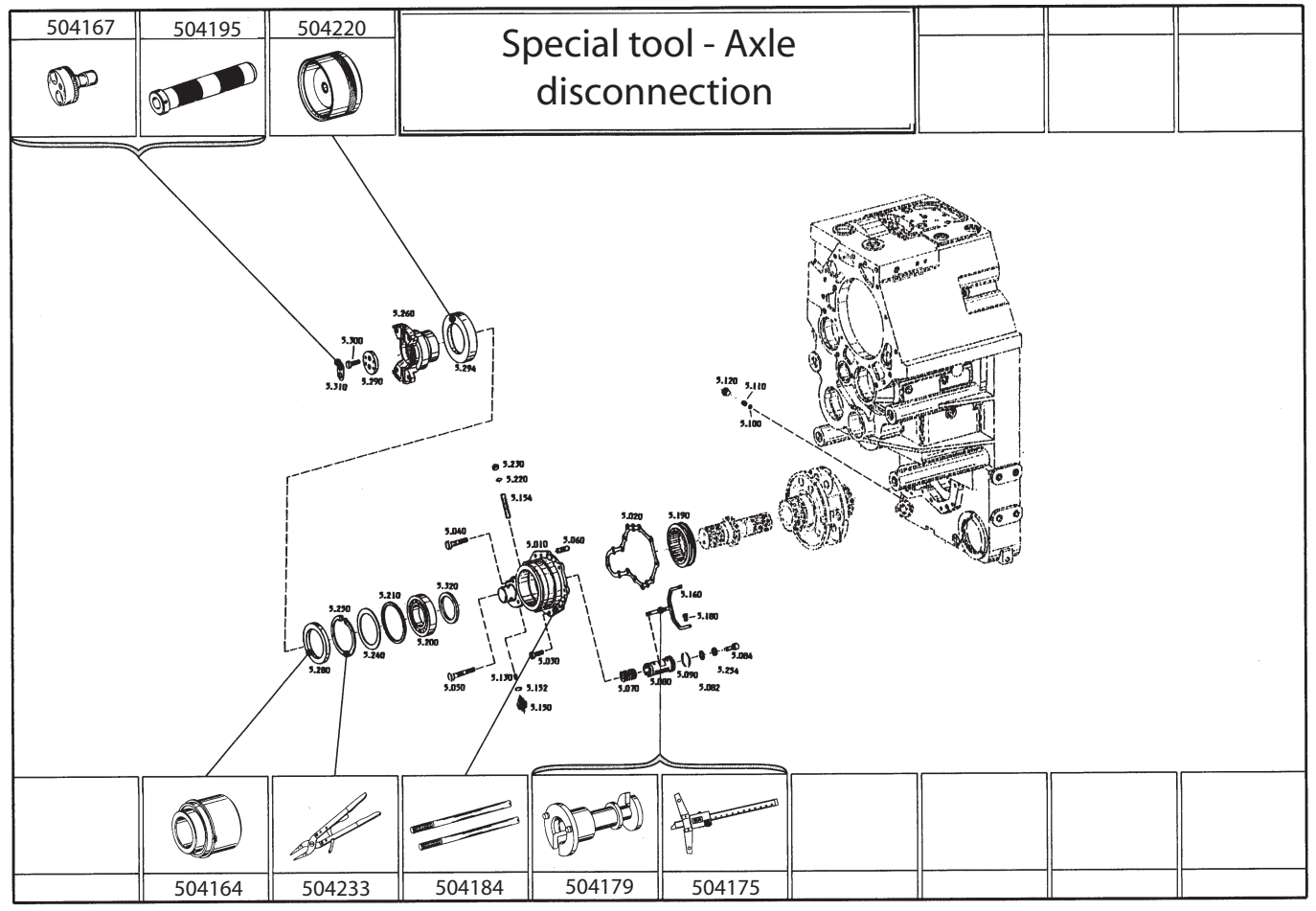
Special tool - Axle disconnection



504210	504196	504179	504175
2x			

504167 504195 504220

Special tool - Axle disconnection



504164	504233	504184	504179	504175

Insert ball bearing until contact is obtained.

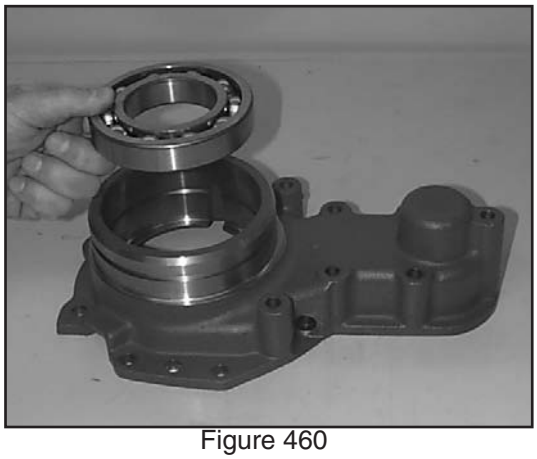


Figure 460

Adjust ball bearing by means of disc s = 4,0 mm, shim (optionally) and circlip without gap.

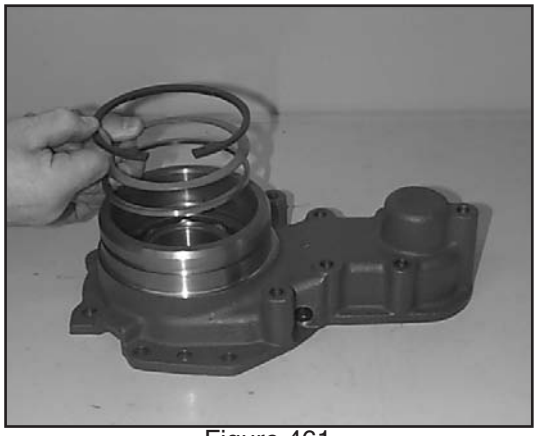


Figure 461

Position compression spring, piston and shift fork.

Stop screw as well as rectangular ring will be installed later!

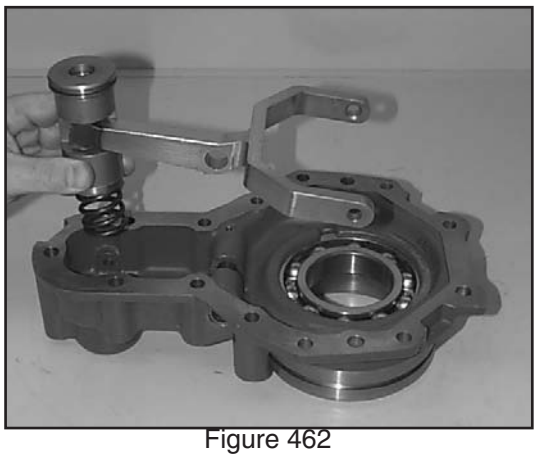


Figure 462

Introduce pin until contact is obtained and fix it by means of circlip.
Now, close bore with cover.

Observe the installation position of the pin – thread for extraction is showing outwards.
Wet contact face of the cover with Loctite (type-no. 262)!

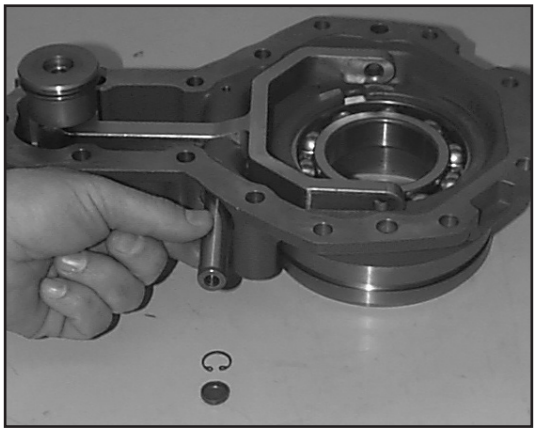


Figure 463

Insert disc with chamfer (arrow) showing upwards

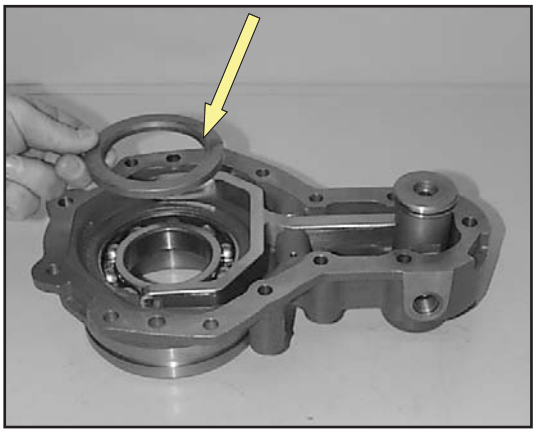


Figure 464

Pre-load compression spring, install sliding blocks and sliding sleeve.

Observe the installation position of the slid-sleeve – the large chamfer at the outer diameter showing downwards!

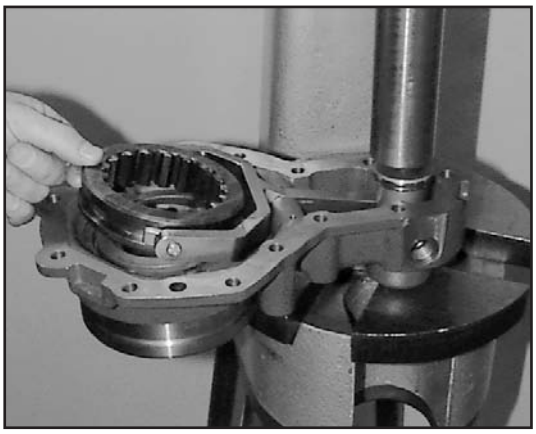


Figure 465

Adjust shifting travel by means of measuring device (S) (Figure 466 ... 470):

Insert stop screw into the measuring device.

(S) Measuring device 504179

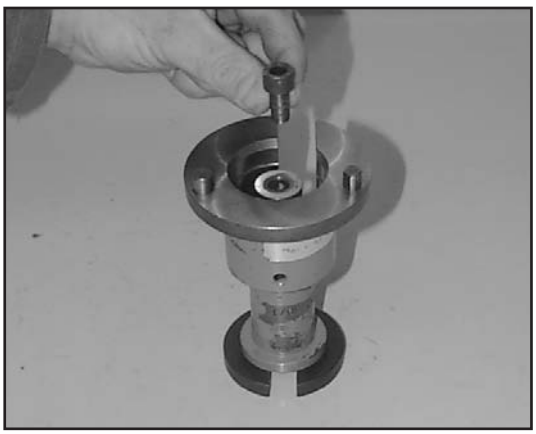


Figure 466

Line up measuring device and position it on the mounting face until contact is obtained.

(S) Measuring device 504179

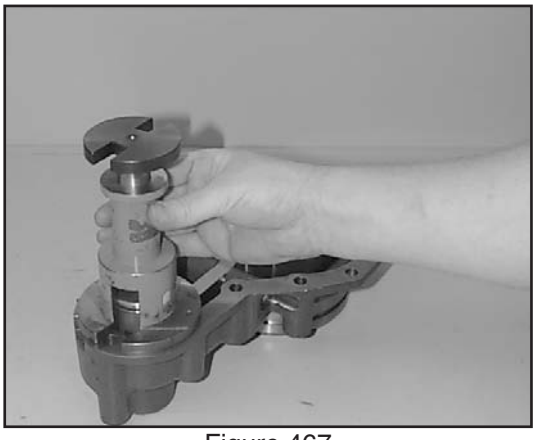


Figure 467

Determine measure I, see figure on the left!

Measure I e.g. ..... 32,90 mm

(S) Digital depth gauge 504175

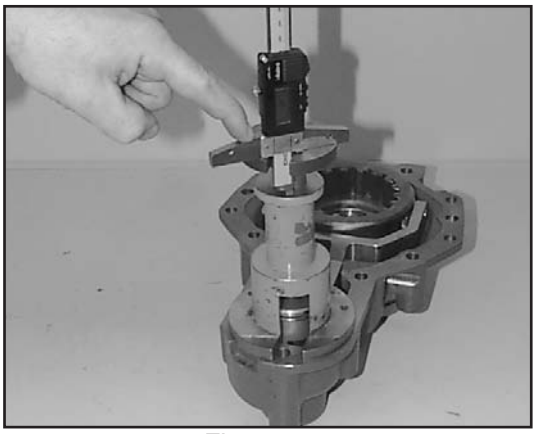


Figure 468

Mount flat gasket and determine measure II from mounting face to bore root (stop face/socket head screw).

Measure II e.g.. ..... 34,50 mm

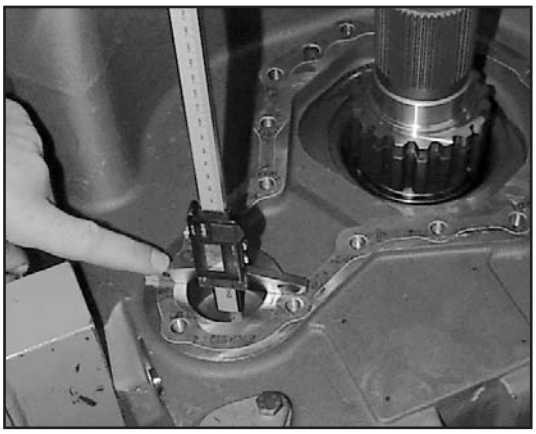


Figure 469

CALCULATION EXAMPLE " I ":

Measure II e.g.		34,50 mm
Measure I e.g.	–	32,90 mm
Difference	=	1,60 mm
Adjusting measure	+	1,00 mm
Gives him(s) s	**=**	**2,60 mm**

Adjusting measure = 1,0 mm, gives the required shifting travel!

Line up shim(s) e.g.. s = 2,6 mm (arrow) and mount socket head screw.

Wet thread of the socket head screw with Loctite (type-no. 243)!

Torque limit (M10/8.8) ..... M_A = 46 Nm

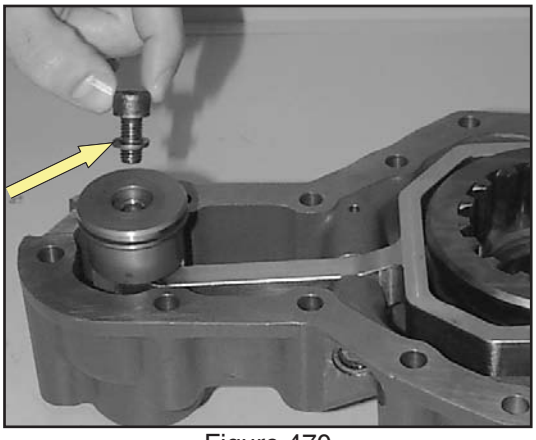


Figure 470

Introduce rectangular ring (VITON) into the annular groove of the piston (arrow) and oil it.

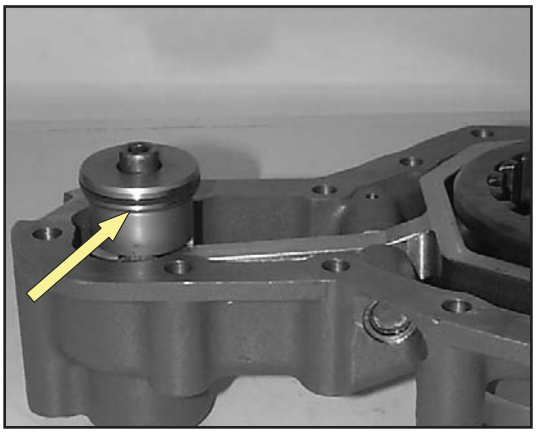


Figure 471

Mount switch.

1 = Lock
2 = Sealing ring (s = 1,5 mm)
3 = Switch

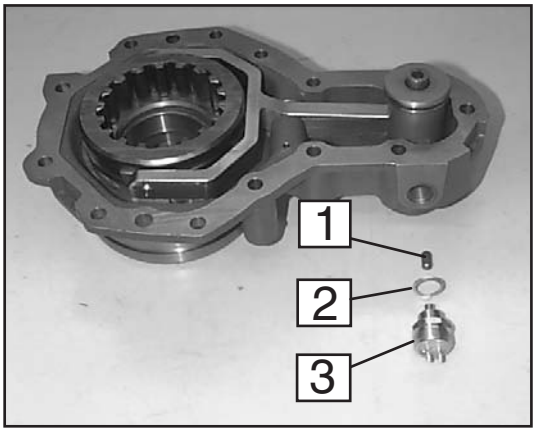


Figure 472

Install two adjusting screws and mount flat gasket.

Heat up ball bearing, carefully introduce axle disconnection device and uniformly position it against shoulder using hex. head screws and socket head screws.

(S) Adjusting screws 504184

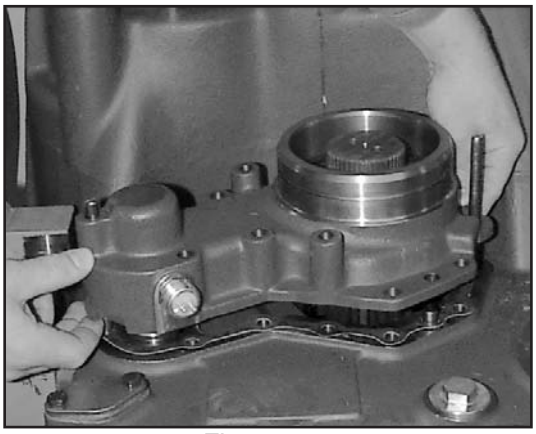


Figure 473

Insert both socket head screws (arrows) until contact is obtained.

Tighten hex. head screws and socket head screws.

Torque limit (M10/8.8) ..... M_A = 46 Nm

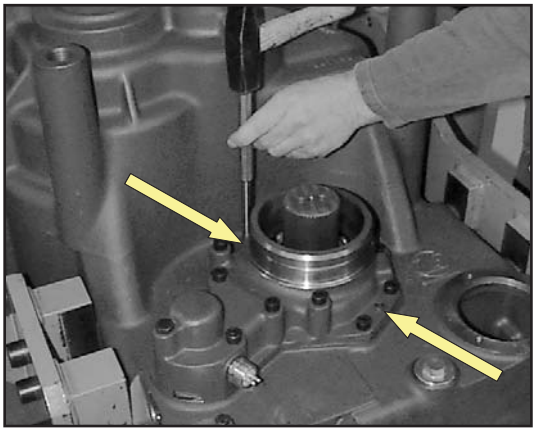


Figure 474

Insert perforated plate (1) and filter insert (2) into the housing bore (arrow/Figure 476).

Close bore with a plug up to the assembly of the hydraulic oil feed (3).

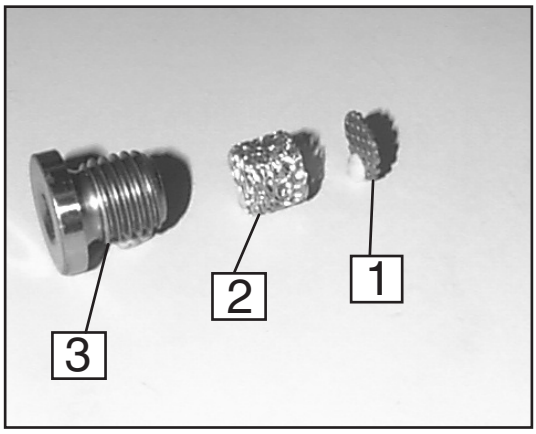
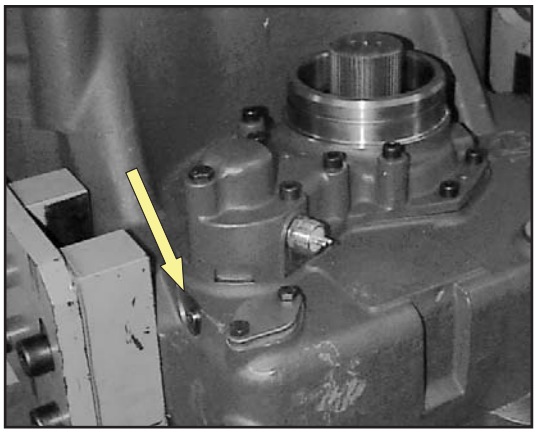


Figure 475


Figure 476

Install shaft seal (arrow) with the sealing lip facing the oil chamber.

When using the prescribed driver (S) the exact installation position is obtained!
Grease sealing lip!

(S) Driver 504164

Depending on the version, different shaft seals may be used.
Outer diameter rubber-coated – wet with spirit!
Outer diameter metallic – wet with sealing agent (Loctite, type-no. 574)!

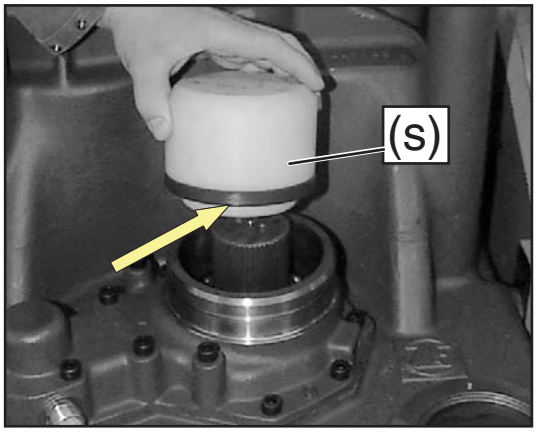
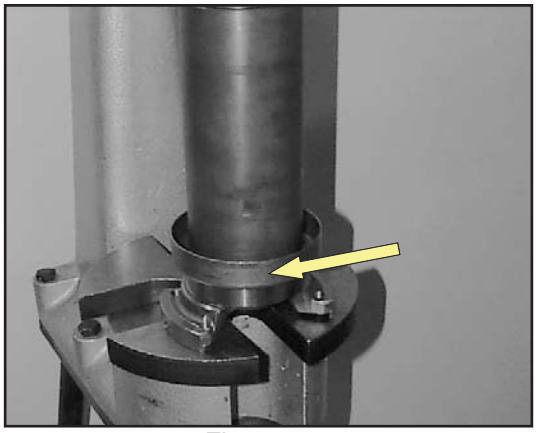


Figure 477

Press on screening plate (arrow) until contact is obtained.

(S) Pressure piece 504220


Figure 478

Line up output flange.

Wet contact surface of the disc with sealing compound (Loctite, type-no. 574) and fasten output flange with hex. head screws.

Torque limit (M10/8.8) ..... M_A = 46 Nm

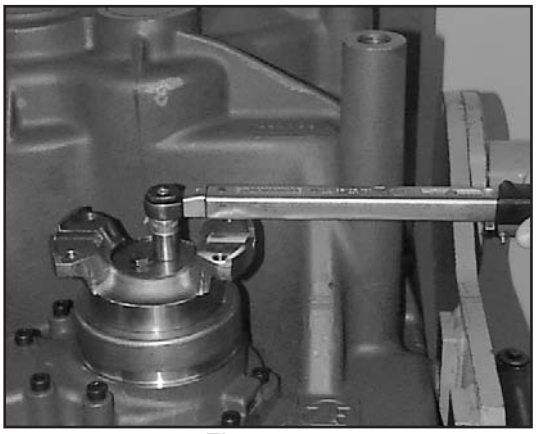


Figure 479

Fix hex. head screws by means of lock plate.

(S) Driver	504167
(S) Handle	504195

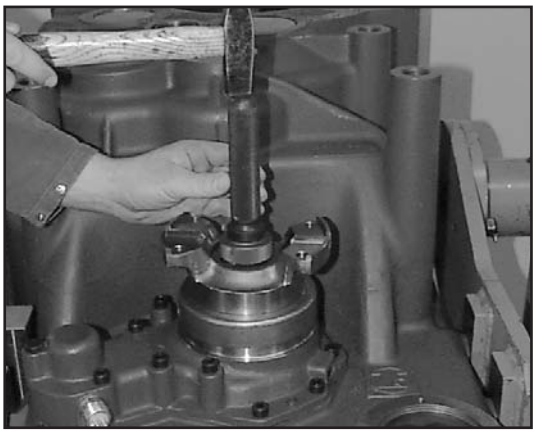


Figure 480

Filter

Introduce filter (compl.) into the housing bore.

Oil sealing ring (arrow)!

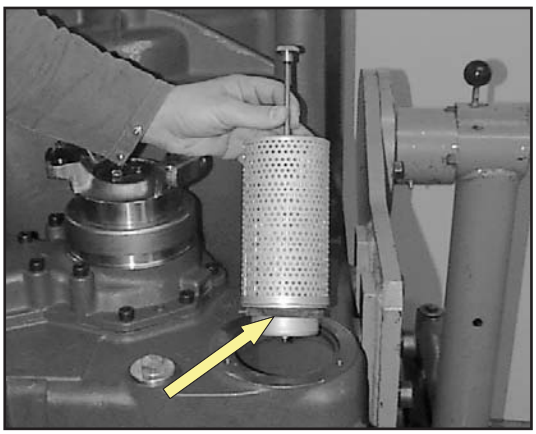


Figure 481

Fasten cover by means of hex. head screws (mount flat washers)

Install new O-ring (arrow)!

Torque limit (M8/8.8) ..... M_A = 23 Nm

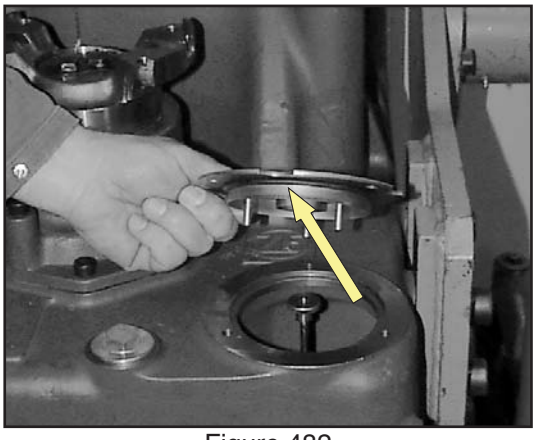


Figure 482

Provide screw plugs (1 and 2) with new O-ring and install them.

Mount gasket and fasten cover plate (3) by means of hex. head screws.

Torque limit (screw plug) ..... M_A = 140 Nm
Torque limit (M8/8.8) ..... M_A = 23 Nm

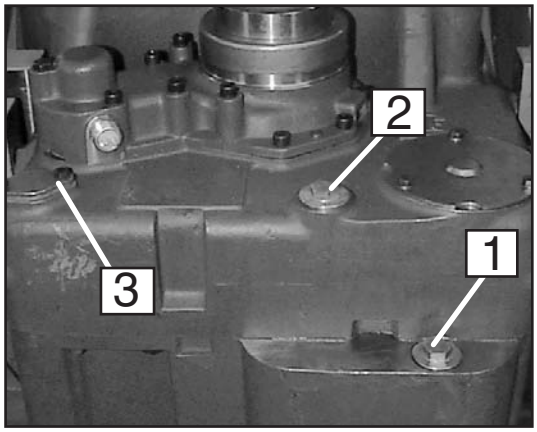
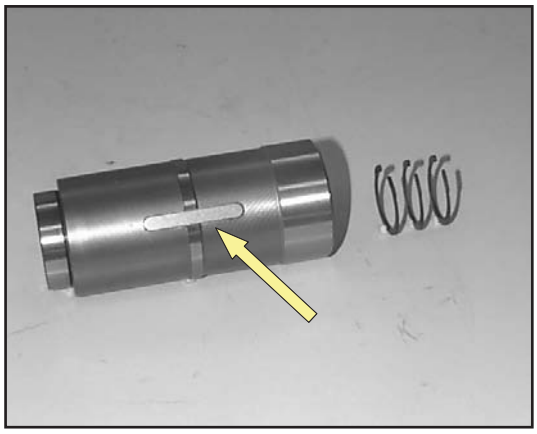


Figure 483

Input shaft (power take-off – pump)

Tilt gearbox housing by 180°.

Squeeze V-rings (3x) into the recess of the driver (internal splines).
Install fitting key (arrow).


Figure 484

Adjust gap dimension = 0,50 mm (Driver/input shaft (Figure 485 ... 489):

1 = Driver
2 = Input shaft

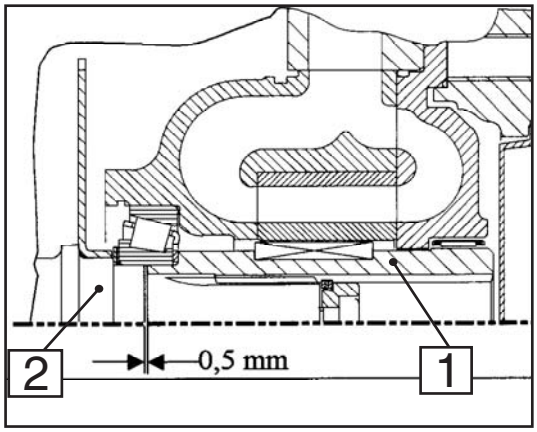


Figure 485

Line up disc s = 1,90 mm and position bearing inner race until contact is obtained.


Figure 486

Determine measure I from bearing inner race to end face/driver

Measure I e.g. ..... 9,64 mm

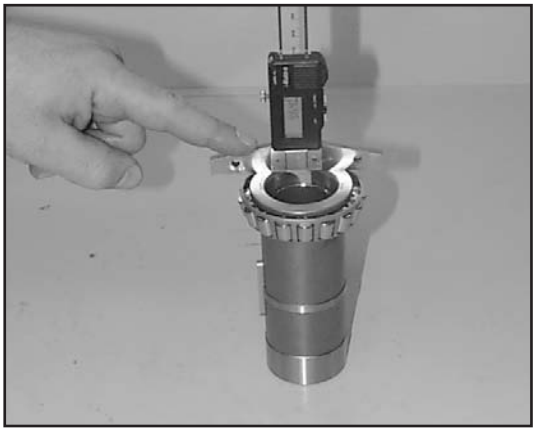


Figure 487

Determine measure II (A – B).

Measure II e.g.. ..... 10,64 mm

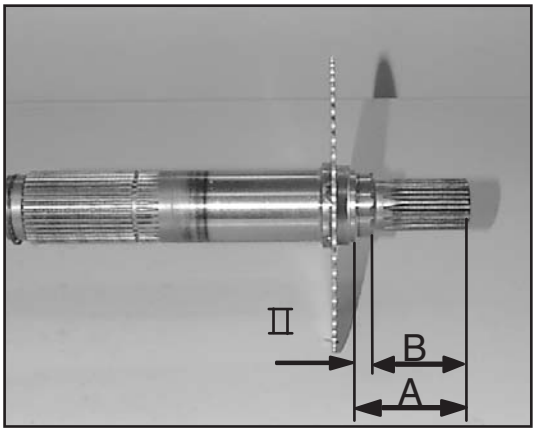


Figure 488

CALCULATION EXAMPLE " J ".

Measure II		10,64 mm
Measure I	–	9,64 mm
Difference	=	1,00 mm
Required gap dimension	+	0,50 mm
Gives shim(s) s	**=**	**1,50 mm**

Line up shim(s).

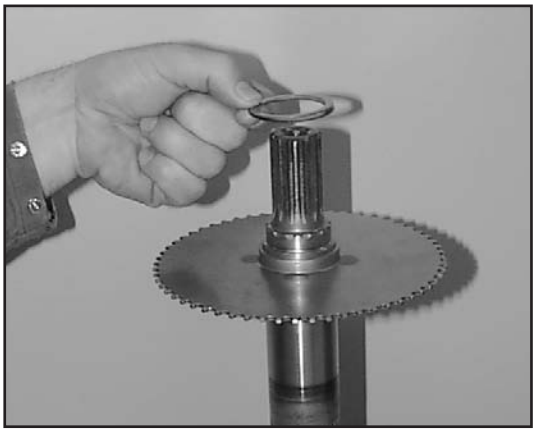


Figure 489

Position driver against shoulder and fix it by means of clamping disc and socket head screw.

Torque limit (M10/8.8, DIN 6912) ..... M_A = 32 Nm

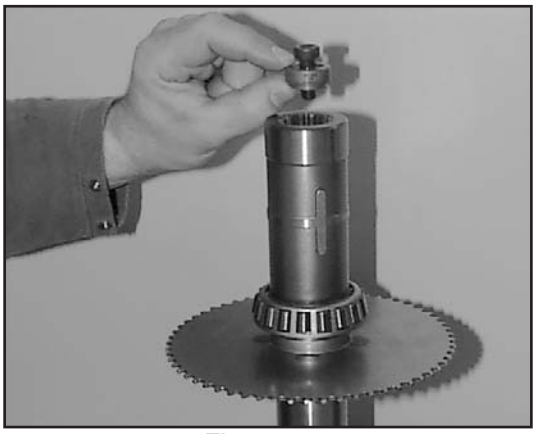


Figure 490

Press on bearing inner race until contact is obtained.

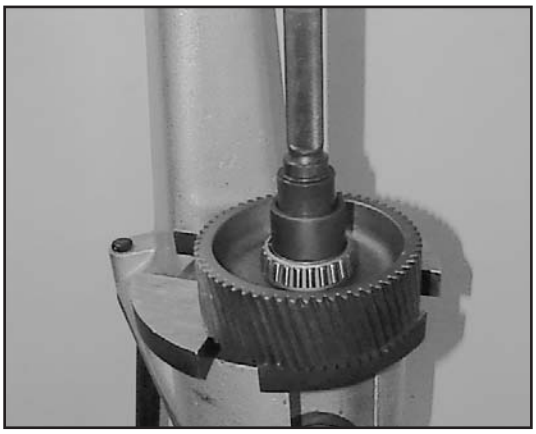


Figure 491

Squeeze in circlip (arrow) and line up drive gear.

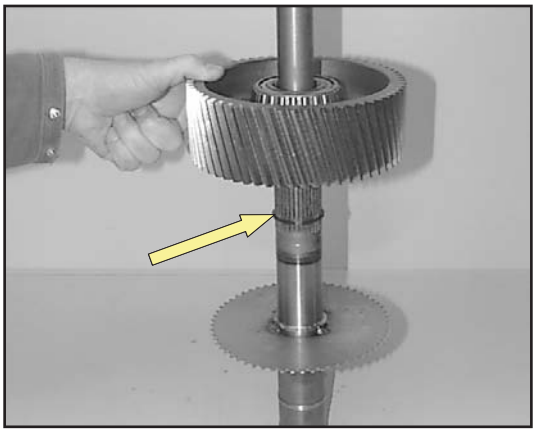


Figure 492

Squeeze in rectangular ring (arrow) and engage it.

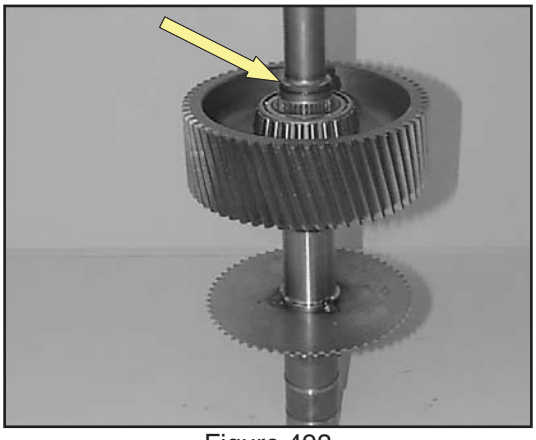


Figure 493

Introduce pre-assembled input shaft until contact is obtained.

Ensure overlapping of the fitting key with the fitting key groove.

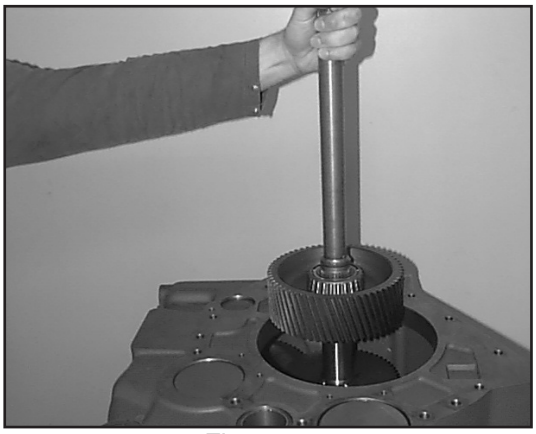


Figure 494

Adjust axial gap of the input shaft bearing = 0,0 ... 0,05 mm (Figure 495 ... 497):

Mount flat gasket.
Mount bearing outer race, uniformly press it on and determine measure I from the mounting face (gasket) to the bearing outer race.

Measure I e.g. ..... 128,50 mm

Take several measuring points to determine the average value!

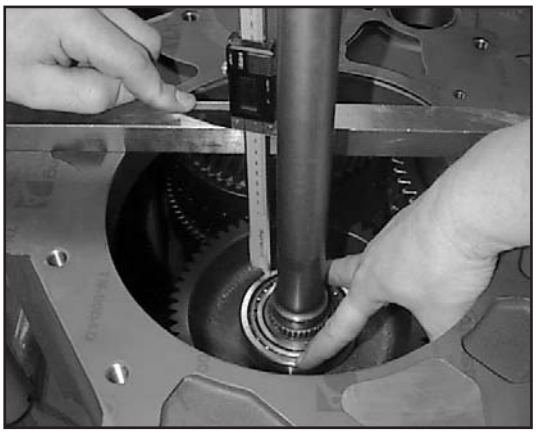


Figure 495

Determine measure II from mounting face/converter bell to locating face/bearing outer race

Measure II e.g. ..... 127,46 mm

(S) Straightedge 504170
(S) Gauge blocks 504176

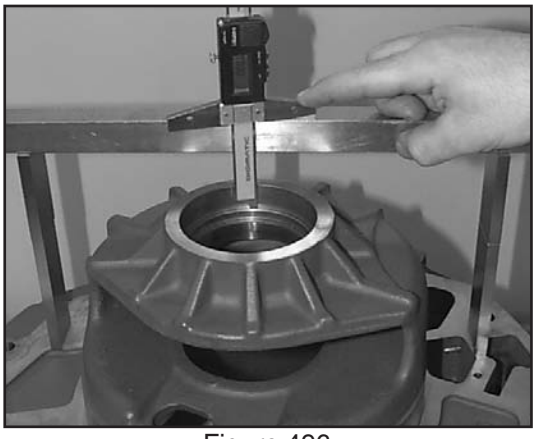


Figure 496

CALCULATION EXAMPLE " K ":

Measure I e.g.		128,50 mm
Measure II e.g.	–	127,46 mm
Difference		1,04 mm
Axial gap e.g.	–	0,04 mm
Gives shim s	**=**	**1,00 mm**

Insert shim and position bearing outer race until contact is obtained.

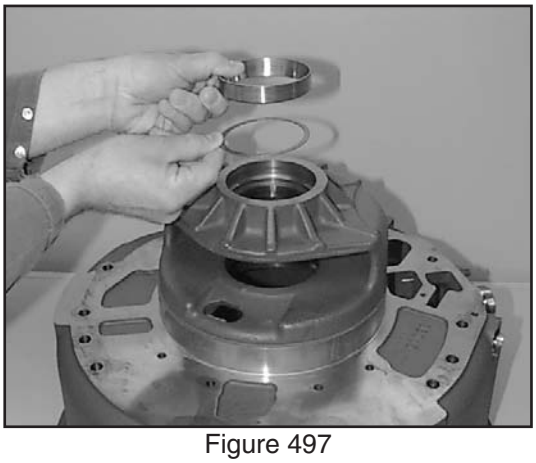
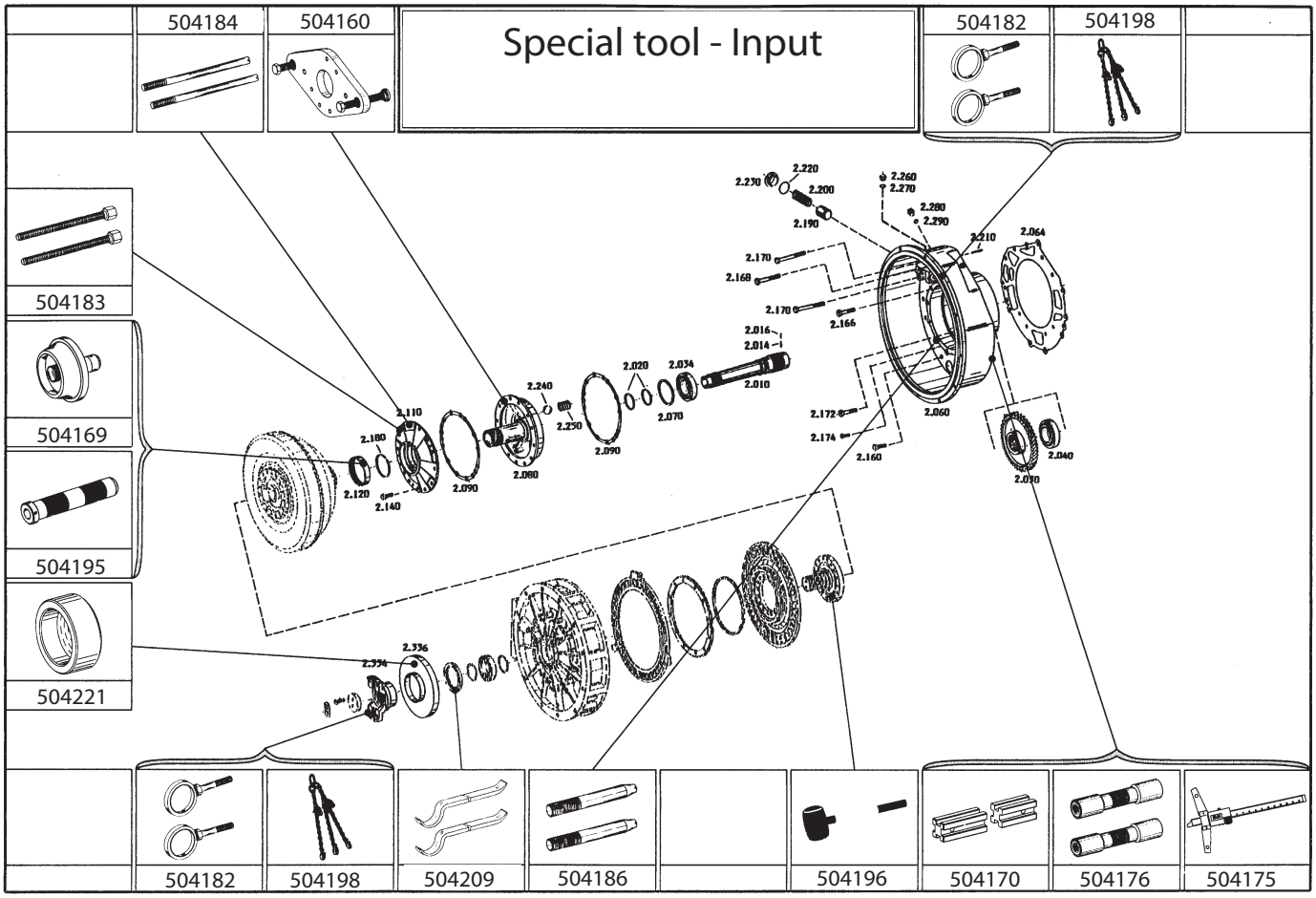
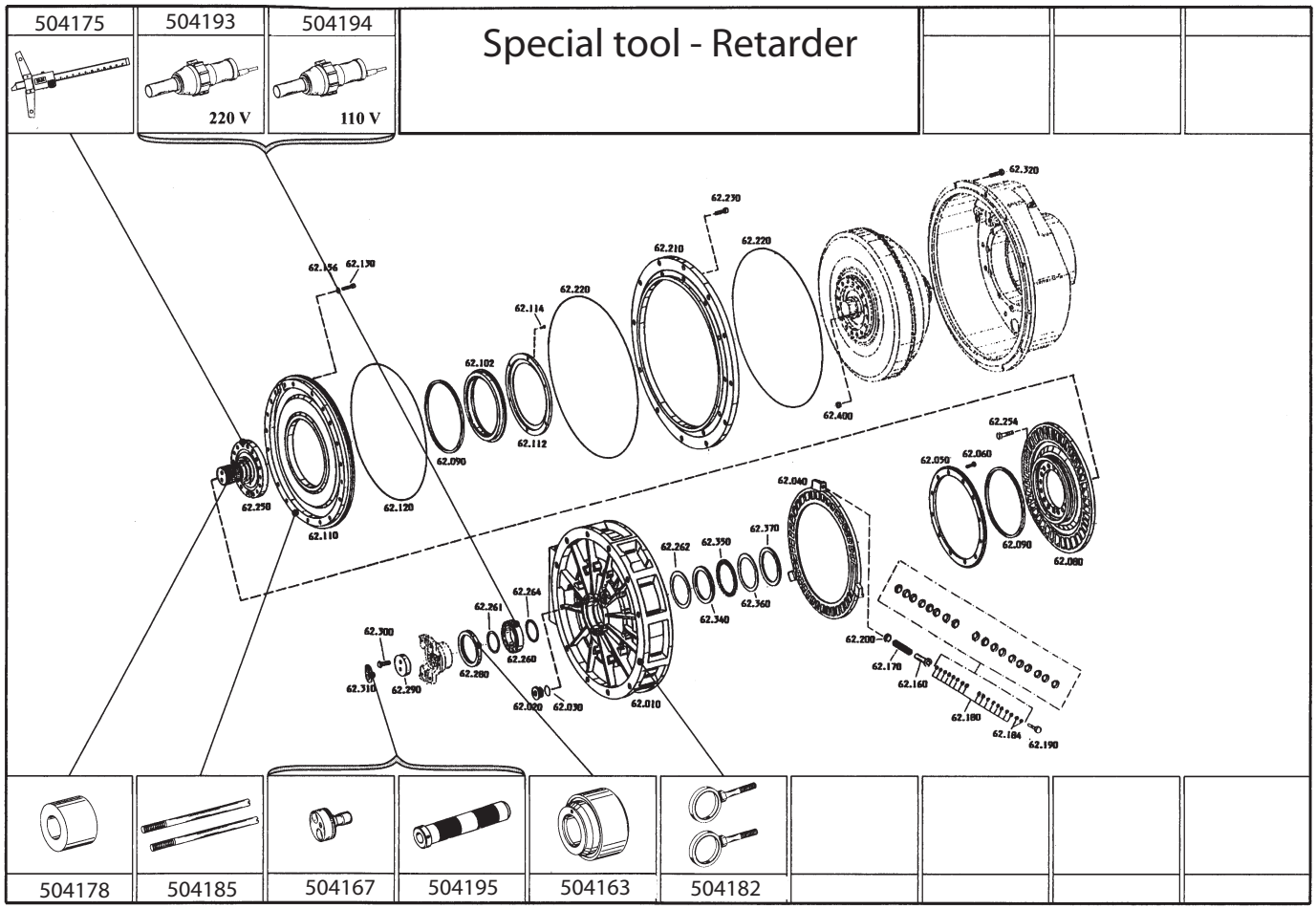


Figure 497

Input converter bell





Insert bearing outer race into housing bore until contact is obtained and install bearing inner race, see arrow!

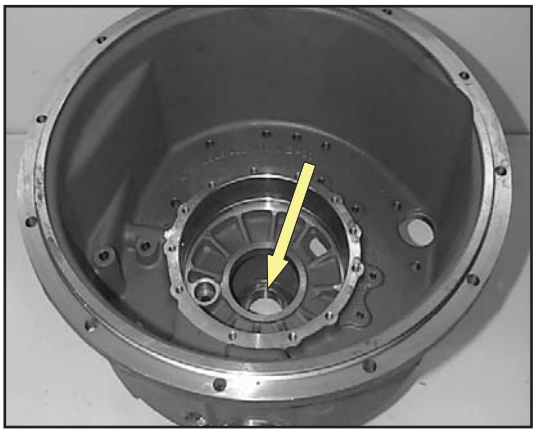


Figure 498

Laterally introduce spur gear (arrow) with the long collar showing upwards and bring it into position.

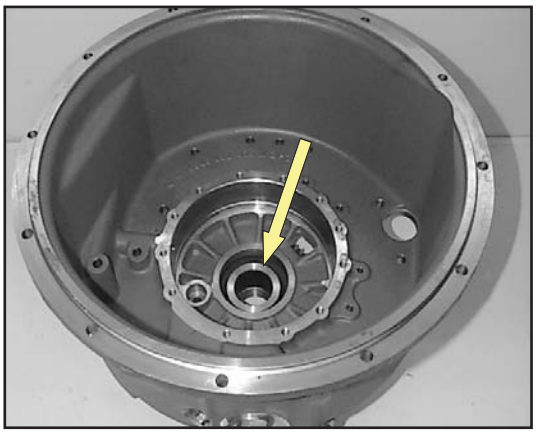


Figure 499

Insert both roll pins (Æ 2,5 and Æ 1,5 mm) flush-mounted into the bore (arrow) of the input shaft.

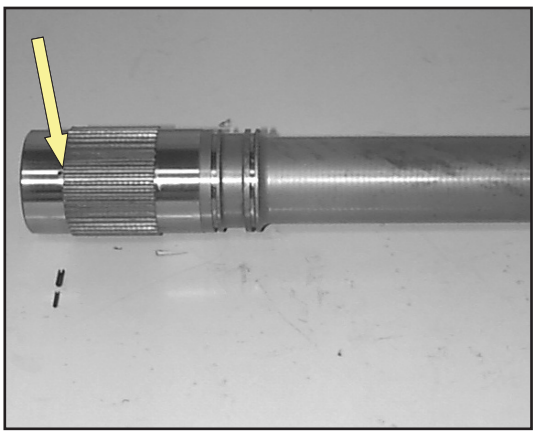


Figure 500

Supercool the input shaft and introduce it until contact is obtained.

Use protective gloves!

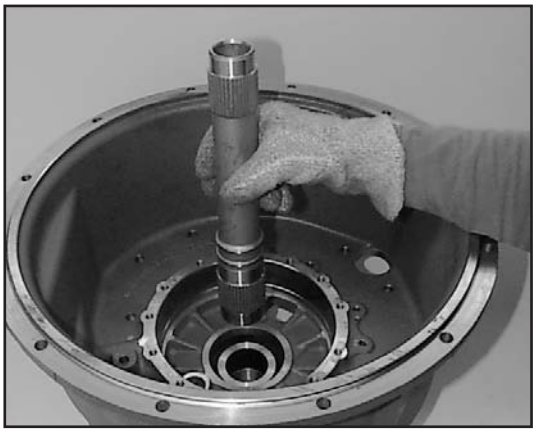


Figure 501

Heat up bearing inner race and line it up until contact is obtained.

Use protective gloves!



Figure 502

Position bearing outer race against shoulder.

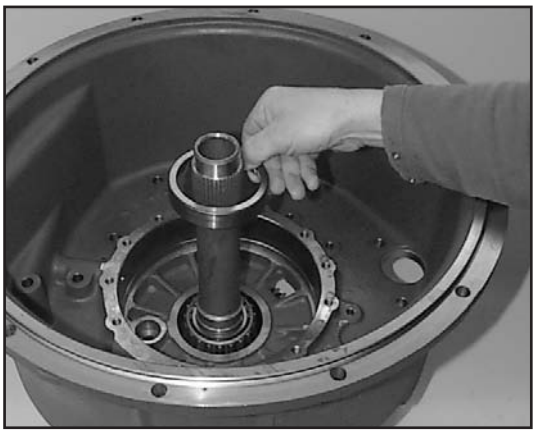


Figure 503

Adjust axial gap of the drive gear bearing = 0,03 ... 0,07 mm (Figure 504 ... Calculation example):

Determine measure I from mounting face to bearing outer race.

Measure I e.g.. ..... 59,60 mm

(S) Straightedge 504180
(S) Digital depth gauge 504175

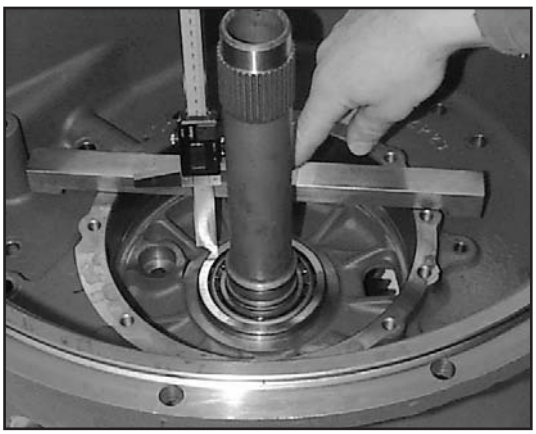


Figure 504

Mount gasket (arrow) and determine measure II from mounting face to locating face of bearing outer race.
Measure II e.g.. ..... 58,50 mm

CALCULATION EXAMPLE " L ":

Measure I		59,60 mm
Measure II	–	58,50 mm
Difference	=	1,10 mm
Axial gap (0,03 ... 0,07) e.g.	–	0,05 mm
Gives shim s	**=**	**1,05 mm**

Installation of the shim, see Figure 508 !

(S) Gauge blocks 504174
(S) Straightedge 504180

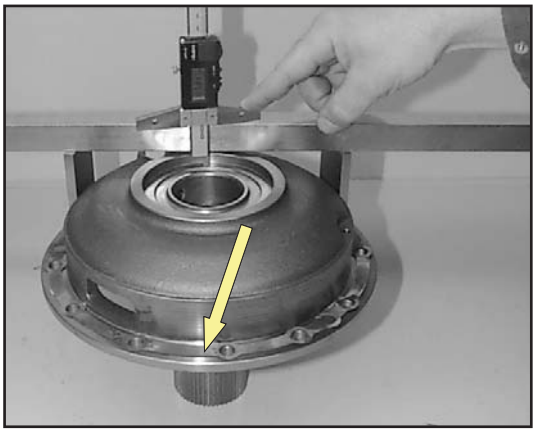


Figure 505

Insert needle sleeve (arrow) with the reinforced shell facing the pressing-in tool until contact is obtained.

(S) Driver 504169
(S) Handle 504195

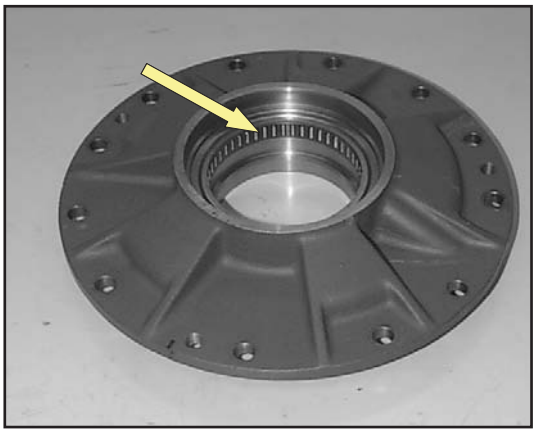


Figure 506

Install two adjusting screws and mount gasket (arrow 1).

Install converter safety valve (disc, compression spring and ball), see arrow 2.
Squeeze both rectangular rings into the annular grooves of the input shaft and engage them (arrow 3).

Now, grease rectangular rings and centrically align them.

(S) Adjusting screws 504184

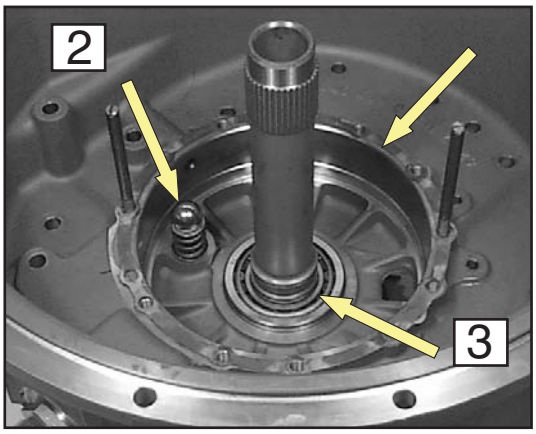


Figure 507

1

Supercool oil feed flange (about - 80° C) and make shim s = 1,05 mm (see calculation example page 3.99) adhere in the bearing bore using assembly grease.

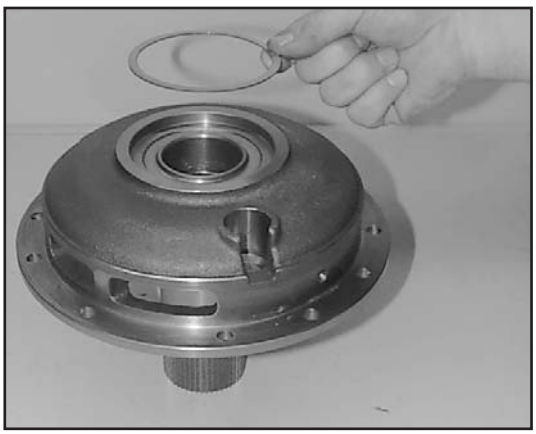


Figure 508

Introduce supercooled oil feed flange until contact is obtained.

Observe the radial installation position!

Use protective gloves!

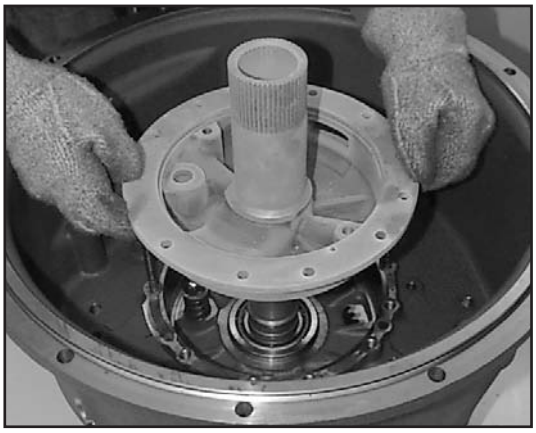


Figure 509

Mount flat gasket (arrow) and install bearing cover

Observe radial installation position!

Torque limit (M10/8.8) ..... M_A = 46 Nm

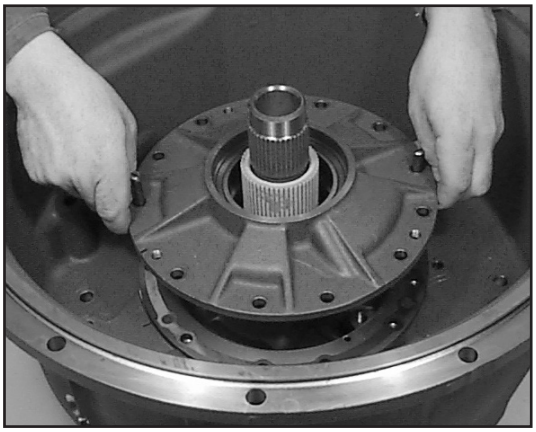


Figure 510

Wet thread of the screw-in sleeves (1 and 2) with Loctite type-no. 262 and install the two screw-in sleeves

Provide screw plug (3 and 4) with new O-rings and install them.

Torque limit (10x1) ..... M_A = 25 Nm
Torque limit (M14x1,5) ..... M_A = 35 Nm

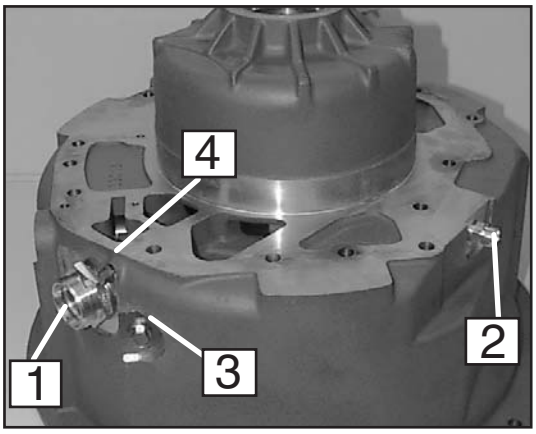


Figure 511

Converter pressure back-up valve (Figure 512 and 513):

Drive in roll pin (6 x 50 mm) until contact is obtained.

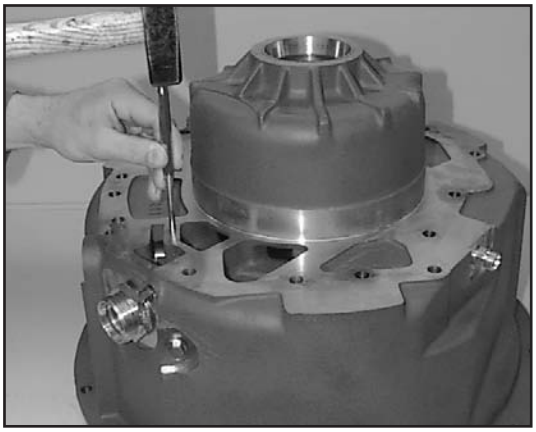


Figure 512

Introduce piston and compression spring.

Provide screw plug with new O-ring and install it.

Torque limit ..... M_A = 130 Nm

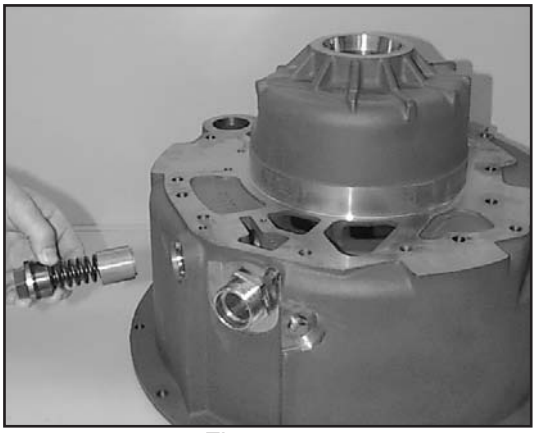


Figure 513

Remove input shaft and heat housing bore (about 120° C).

Perform the following steps (Figure 515 ... 517) in direct chronological order!

(S) Preheating sleeve 504229
(S) Hot-air blower 220V 504193
(S) Hot-air blower 110 V 504194

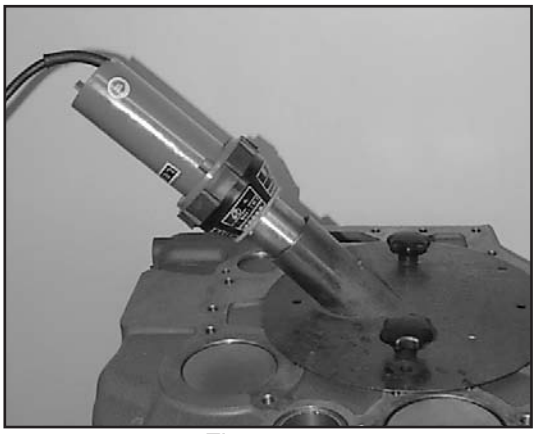


Figure 514

Grease rectangular ring (arrow) and centrically align it.
Introduce input shaft until contact is obtained.

Ensure overlapping of the fitting key with the fitting key groove.

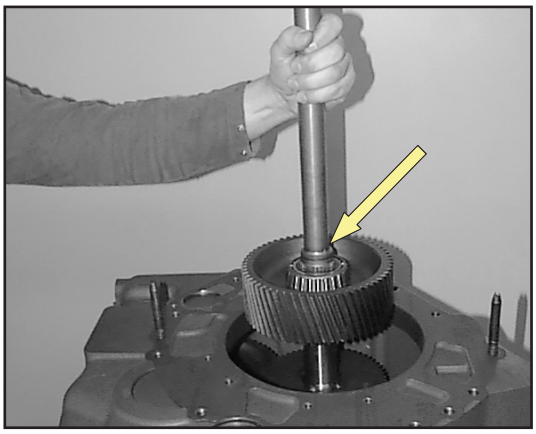


Figure 515

Install two adjusting screws and mount flat gasket (arrow 1).

Insert O-ring (arrow 2) into the annular groove.

(S) Adjusting screws 504186

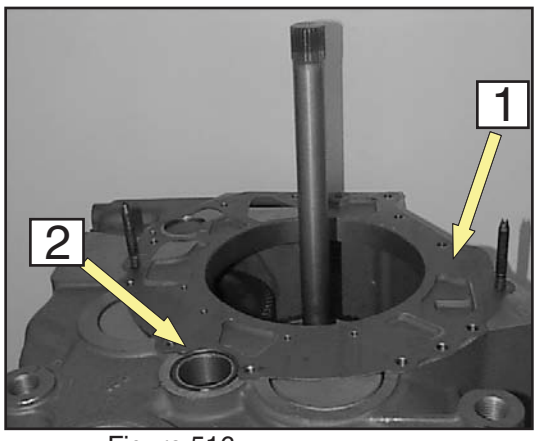


Figure 516

Introduce converter bell by means of lifting device until contact is obtained.

Slight rotary movements of the input shaft facilitate introducing.
Protect the splines against damage!
Pay attention to the radial installation position.

(S) Lifting device 504198
(S) Set of eye bolts 504182

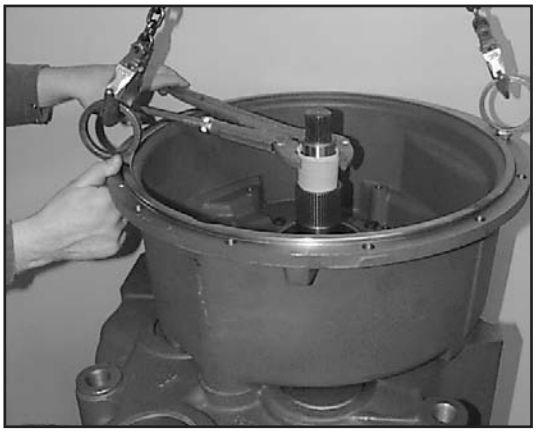


Figure 517

Fasten converter bell by means of hex. head screws.

Torque limit (M8/10.9) ..... M_A = 34 Nm
Torque limit (M12/10.9) ..... M_A = 115 Nm

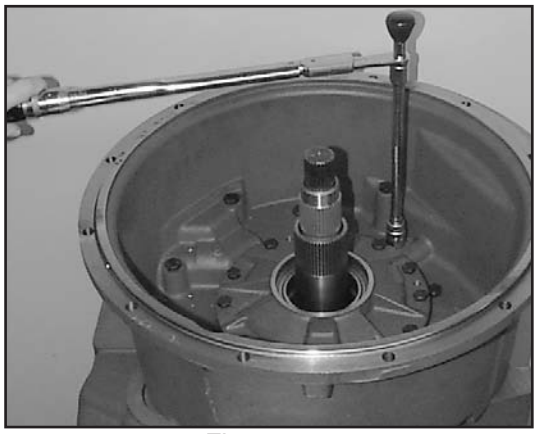


Figure 518

Insert O-ring (arrow) into the annular groove of the converter bell.

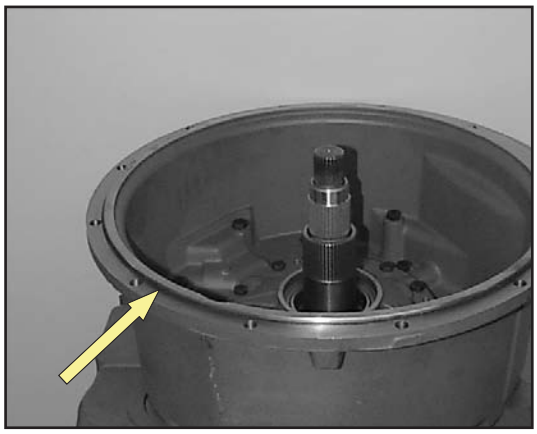


Figure 519

Grease rectangular ring (arrow) and centrically align it.

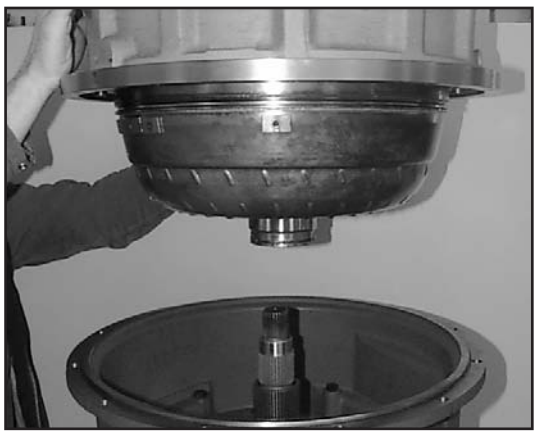


Figure 520

Introduce retarder along with converter against shoulder, using lifting device and fasten it by means of hex. head screws

Pay attention to the radial installation position!
Binding are the specifications of the vehicle manufacturer resp. The marking applied upon disassembly.

(S) Lifting device	504198
(S) Set of eye bolts	504182

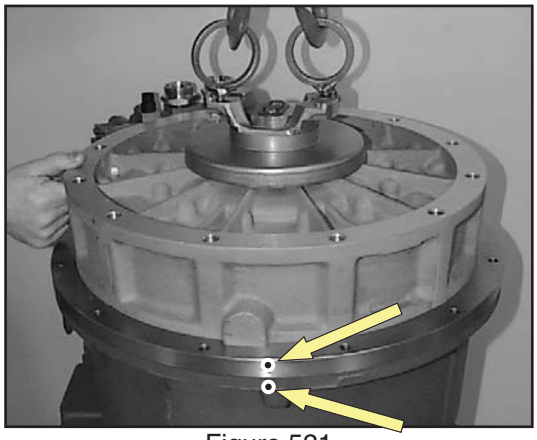


Figure 521

Tilt gear 90°.

Insert pot flush-mounted to the housing face.

Wet sealing surface with Loctite (type-no. 262)!



Figure 522

Install breather (arrow).

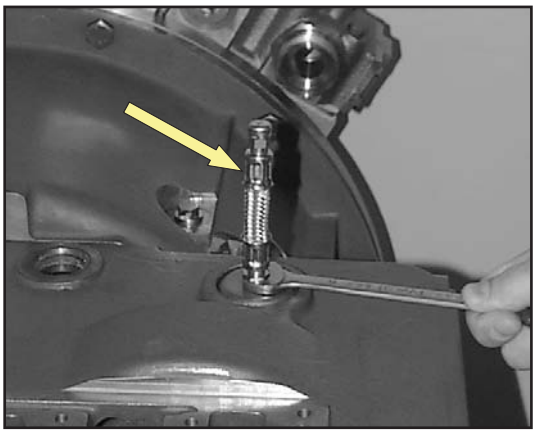


Figure 523

Provide screw plug (arrow 1) with new O-ring and install it.
Mount both retaining plates (arrow 2).

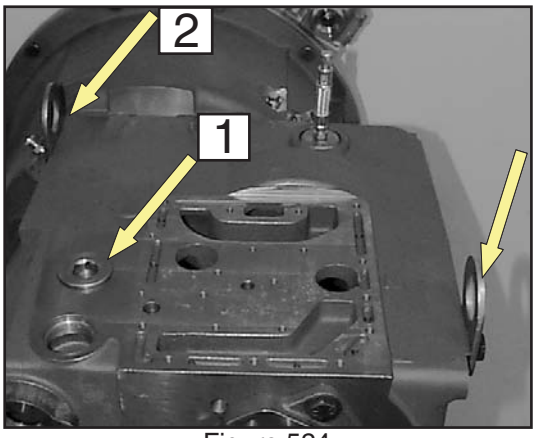


Figure 524

2

Mount hydraulic control unit (HSG-94),
see page 1.09 ... 1.12 !

Install all oil lines.

The line routing is different depending on the design!
Here, pay attention to the perspective illustration in the respective spare parts list

Inductive transmitters and speed sensor

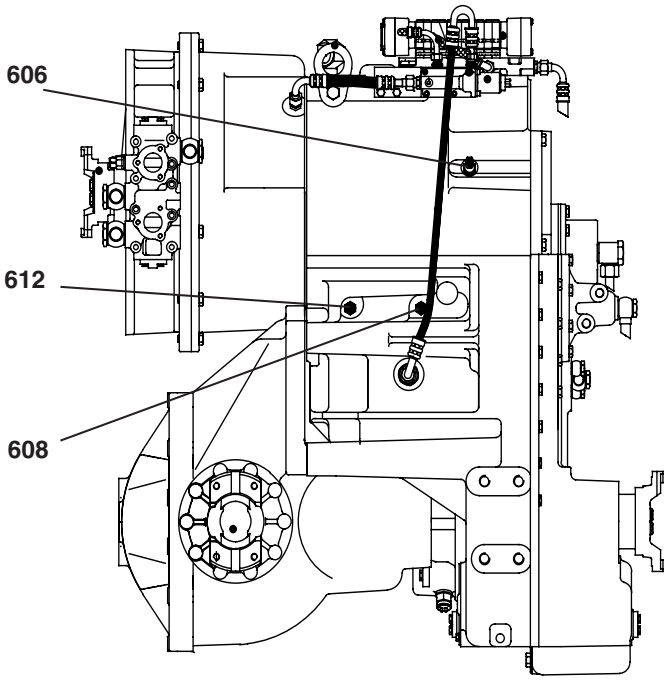
Assembly and settings

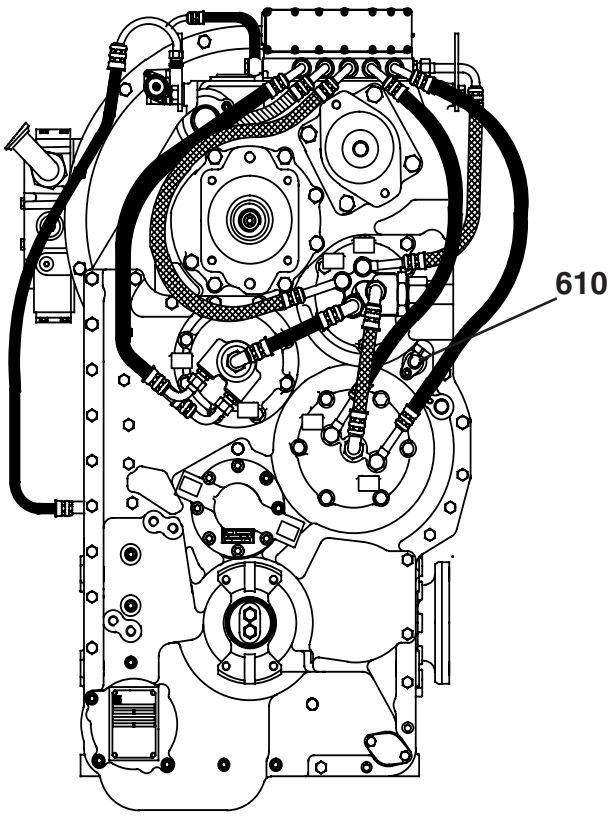
The following sketches show the installation position of the individual inductive transmitters and the speed sensor.

606 : Inductive transmitter n – Engine and
608 : Inductive transmitter n – Central gear train: Resistance
= 1050 Ω ± 10% at 20° C

610 : Speed (Hall) sensor n – Output: Working range
= 2 Hz to 5 Khz Supply voltage: 24 V

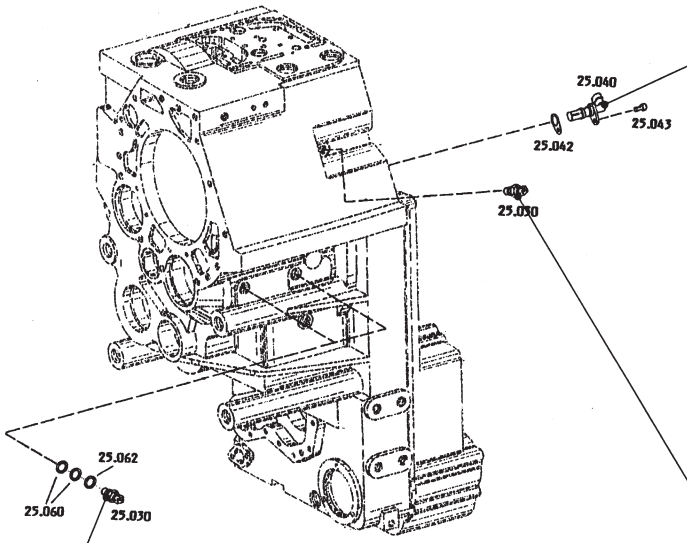
612 : Inductive transmitter n – Turbine: Resistance
= 1050 Ω ± 10% at 20 °C





Special tool - Ind. Transmitter

504175



504177 504175 504177 504175

The following figures describe the assembly or setting of the inductive transmitter n-engine (606)! The assembly of the inductive transmitter n-turbine (612) and n – central gear train (608) must be accordingly carried out!

Pay attention to different setting dimension „X“:
Induct. transmitter n-engine(606) X =0,5 $^{+0,3}$ mm
Induct. transmitter n-turbine(612) X =0,5 $^{+0,3}$ mm
Induct. transmitter n-centr.gear train
(608) X = 0,3 ± 0,1 mm

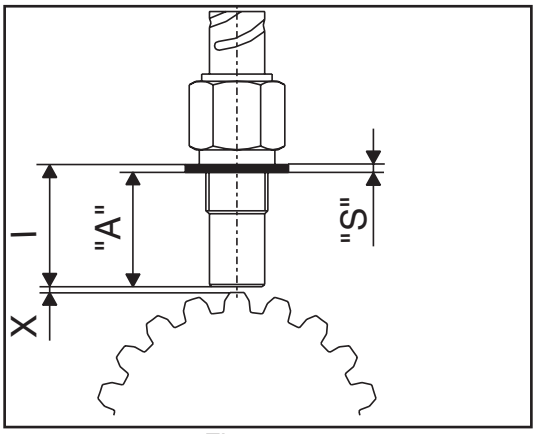


Figure 530

Set measure X by means of adjusting disc (n) (Figure 531 ... 536):

Determine measure I from the contact face to the screw-in face on the inductive transmitter.

Measure I e.g. ..... 30,00 mm

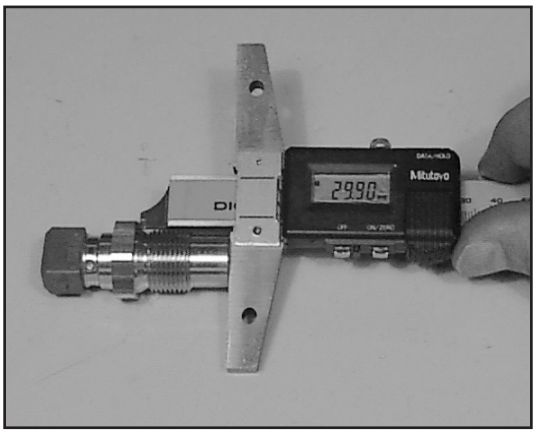
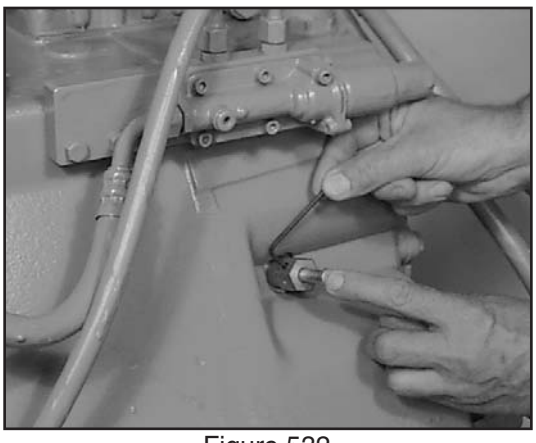


Figure 531

Radially rotate counting disc until one tooth tip is central to the inductive transmitter bore.

Screw in plug gauge until contact is obtained.
Position anvil on tooth tip until contact is obtained and lock it by means of set screw (Figure 532 and 533).

(S) Plug gauge 504177


Figure 532

(S) Plug gauge 504177

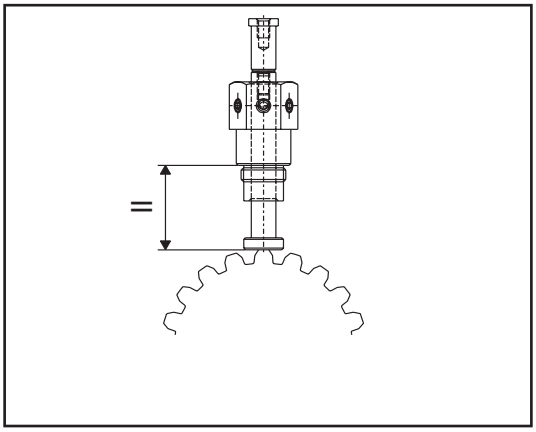


Figure 533

Screw out plug gauge and determine measure II
(also see Figure 533).

Measure II e.g. ..... 30,10 mm

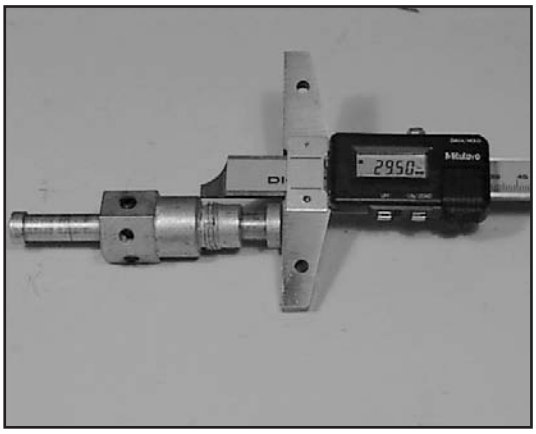


Figure 534

CALCULATION EXAMPLE " M_1 ":

Measure II e.g.		30,10 mm
Measure X (0,5 $^{+0,3}$ mm) ..... e.g..	–	0,60 mm
Gives installation measure A	**=**	**29,50 mm**

CALCULATION EXAMPLE " M_2 ":

Measure I e.g.		30,00 mm
Installation measure A e.g.	–	29,50 mm
Gives adjusting disc(s) s	**=**	**0,50 mm**

Line up suitable adjusting disc(s) and wet thread (arrow) with (type-no. 574).

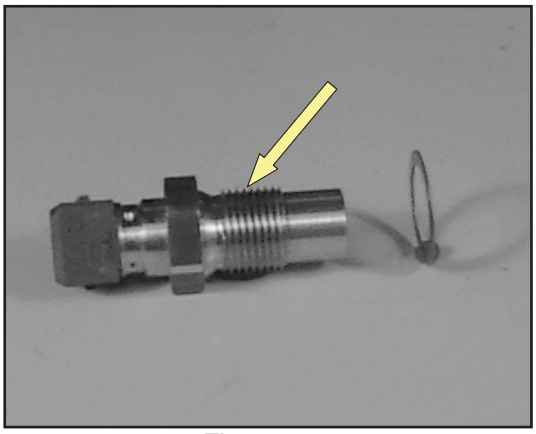


Figure 535

Install inductive transmitter n - engine (14), see arrow !

Torque limit ..... M_A = 30 Nm

Accordingly set and install inductive transmitter n-turbine (6)and n-central gear train (39)!
Pay attention to different setting measures!
Installation position of the single inductive

(See also chapter 2.2 ,Testing & Adjusting)

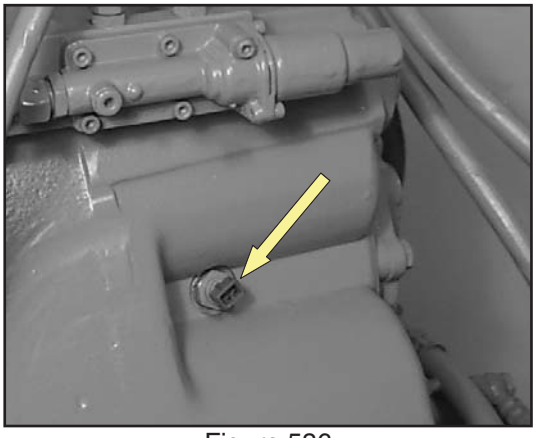


Figure 536

Install speed sensor n-output (31), Figure 540 ... 545:

Setting measure X = 1,0 $^{+0,5}$ mm

See also chapter 2.2 ,Testing & Adjusting

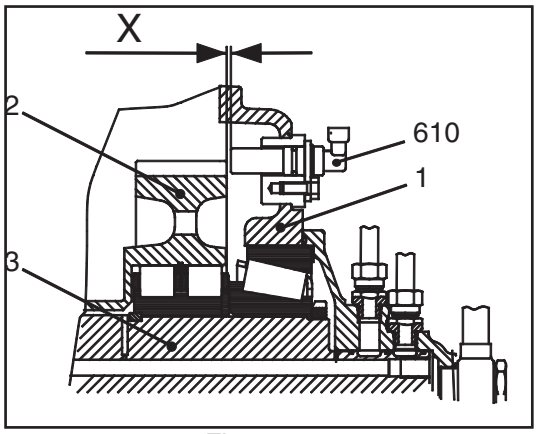


Figure 540

The figure on the left shows the speed sensor (Hall sensor)

1 = Speed sensor
2 = O-ring
3 = Setting plate(s)

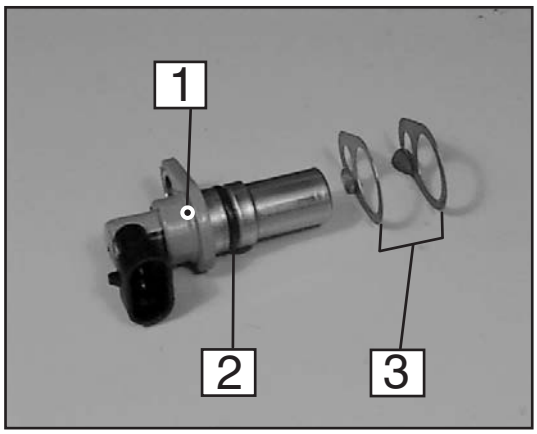
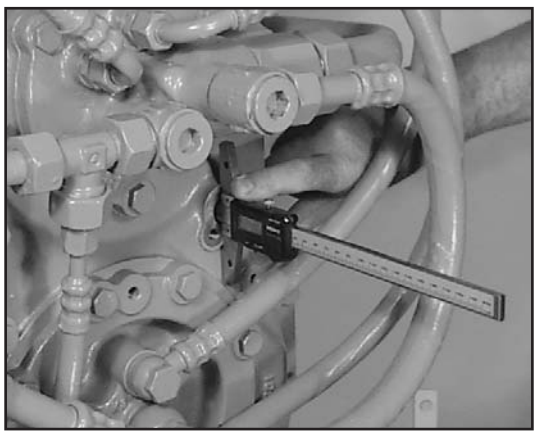


Figure 541

Determine measure I from the housing face to the spur gear K3.

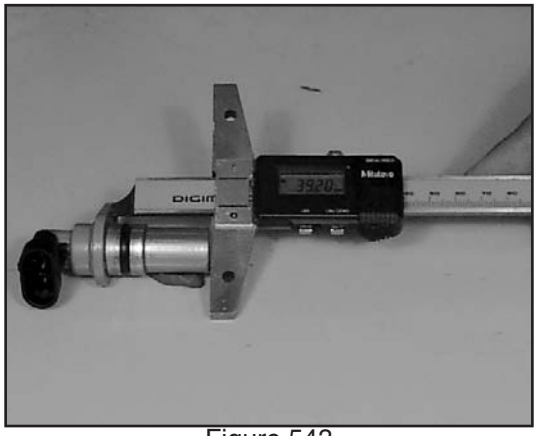
Measure I e.g.. ..... 39.20 mm


Figure 542

Determine measure II from the contact face to the mounting face.

Measure II e.g. ..... 39,00 mm

(S) Digital-depth gauge 504175


Figure 543

CALCULATION EXAMPLE " N_1 ":

Measure I e.g..		39,20 mm
Measure X (1,0 $^{+0,5}$ mm) e.g.	–	1,20 mm
Gives installation measure	**=**	**38,00 mm**

CALCULATION EXAMPLE " N_2 "

Measure II e.g.		39,00 mm
Installation measure	–	38,00 mm
Gives setting plate(s) ..... s	**=**	**1,00 mm**



Figure 544

Line up setting plate(s) (2x, s= 0,5mm) and grease O-ring.

Fasten speed sensor by means of socket head screw

Torque limit (M8/8.8) ..... M_A = 23 Nm

Installation position of the speed sensor, also see
see: chapter 2.2 Testing & Adjusting

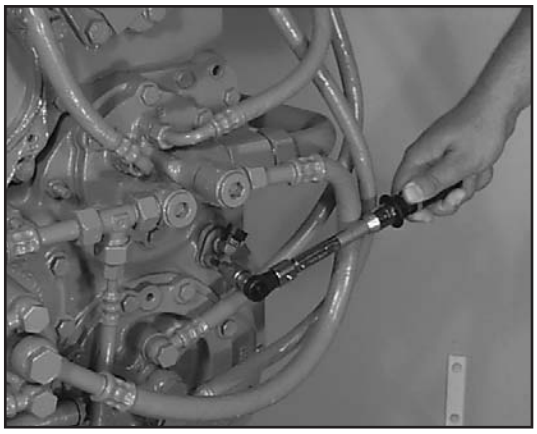
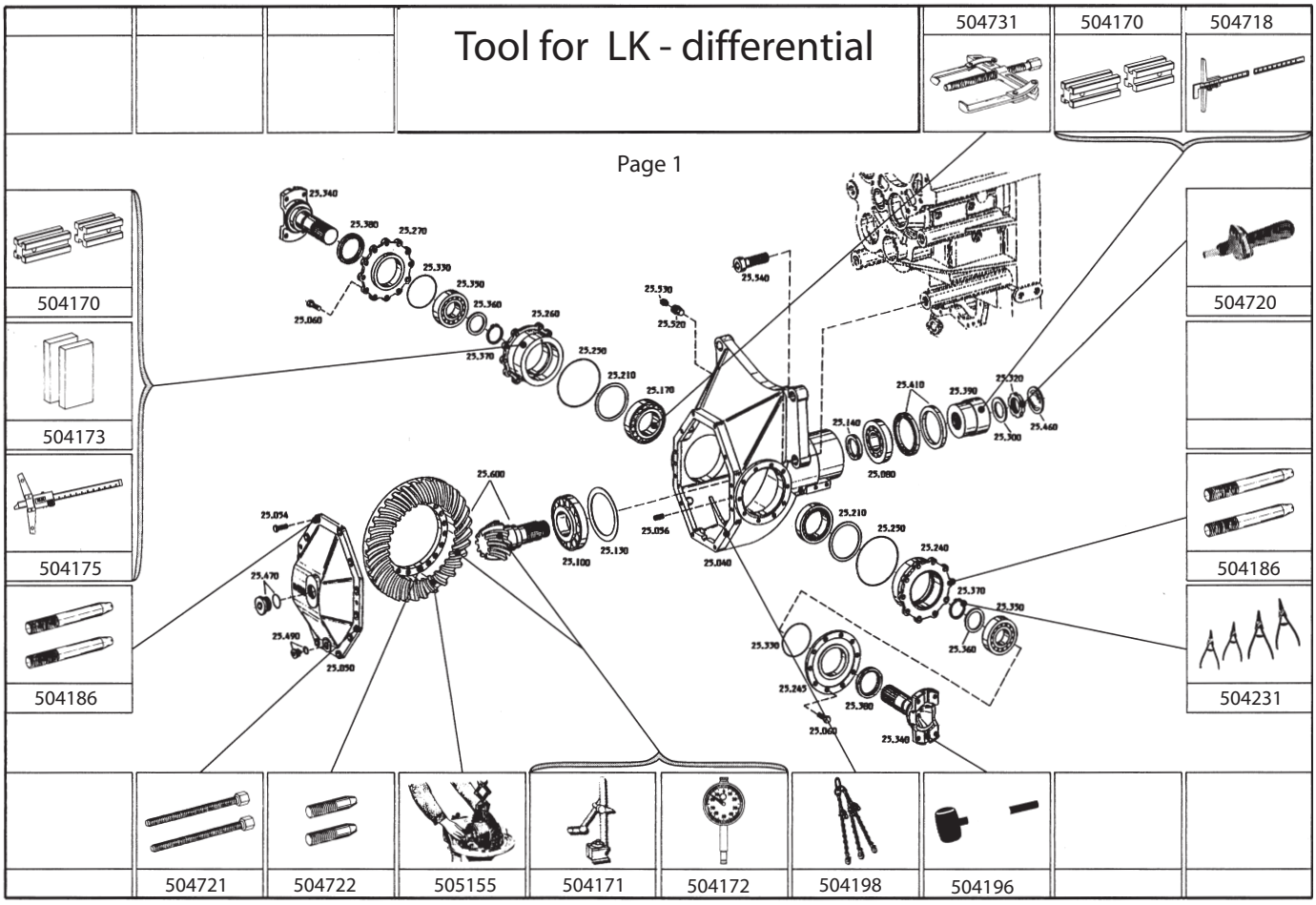


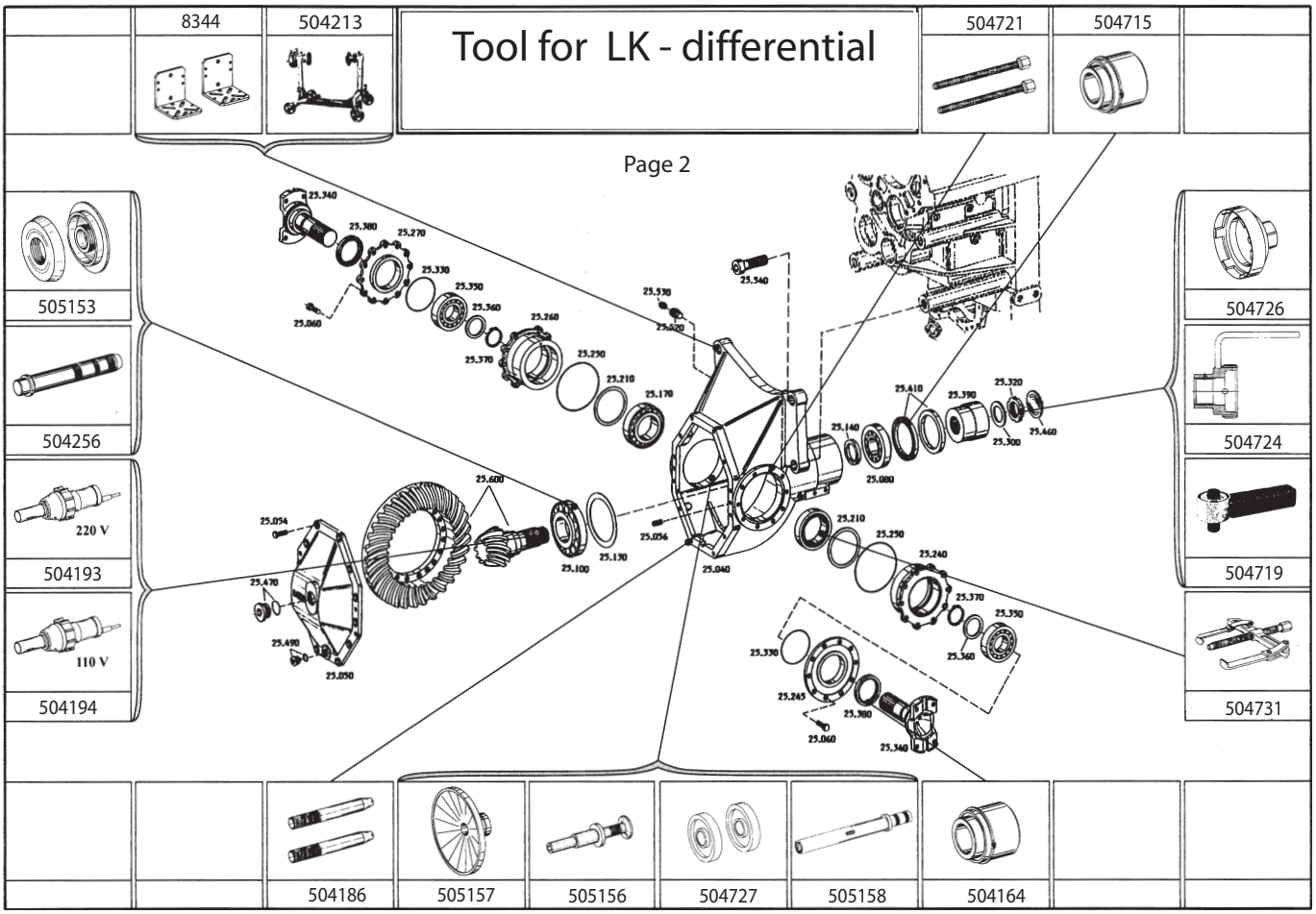
Figure 545

Prior to starting up the transmission, fill in oil according to the Operating Instructions!

Differential Carrier „LK“

Tools





Disasembly

Version: with Limited-slip differential DL-2400
(45% Interlock value)

Fasten transmission on the assembly car.

(S) Assembly car	504213
(S) Clamping bracket	504214

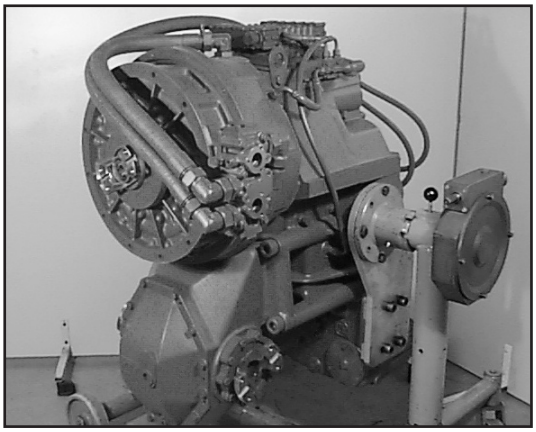


Figure 550

Loosen screw plug (Arrow) and drain oil.

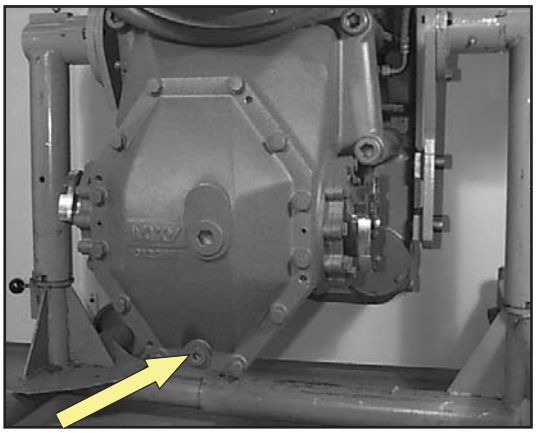


Figure 551

Remove oil line.

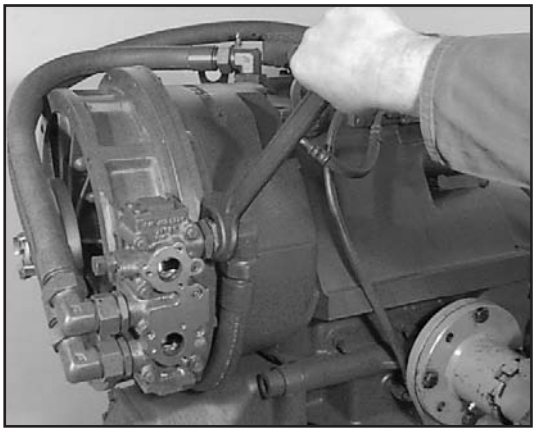


Figure 552

Loosen screw connection (Transmission/LK-drive).

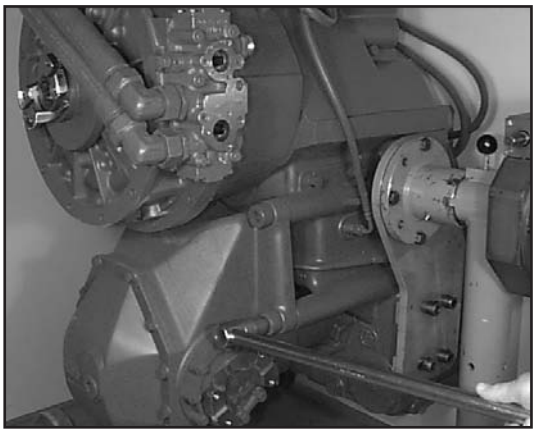


Figure 553

Tilt transmission 90°.

Separate differential carrier from gearbox housing, using lifting device.

(S) Lifting chain 3-rope 504198

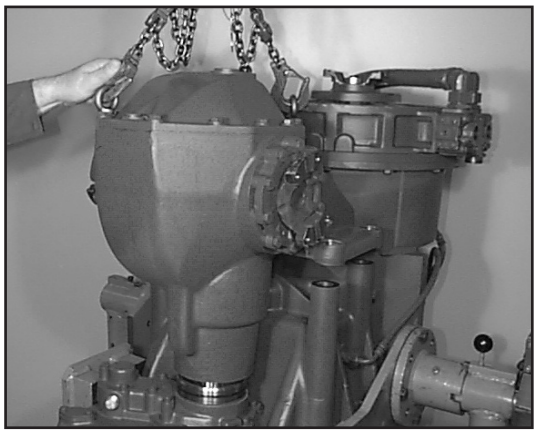


Figure 554

Remove shim.



Figure 555

Fasten differential carrier on the assembly car.
Loosen hex. head screws and separate cover by means of back-off screws from the housing.

(S) Support 8344
(S) Back-off screws 504721

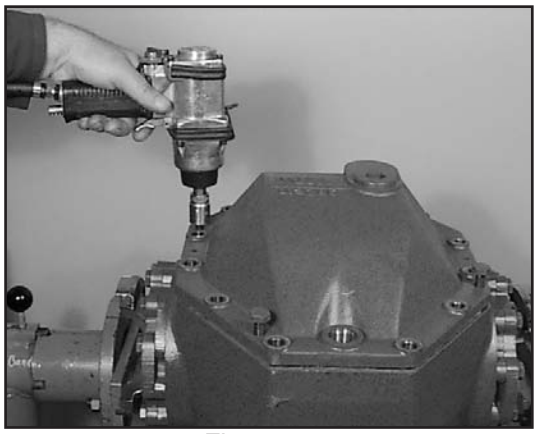


Figure 556

Mark radial installation position of the seal retainer as well as of the bearing cover to the axle drive housing.

The LH resp. RH seal retainer as well as the bearing cover are different; mark the components with <u>one</u> resp. <u>two</u> punch marks!

Now, loosen hex. head screws.

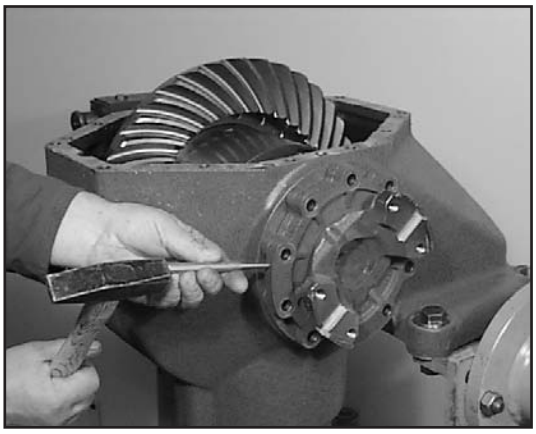


Figure 557

Locate differential by means of lifting device and separate the flange shaft along with bearing cover from the housing.

Disassemble the opposite flange shaft accordingly.

Pay attention to the Note of Figure 557 !

(S) Lifting device 505155

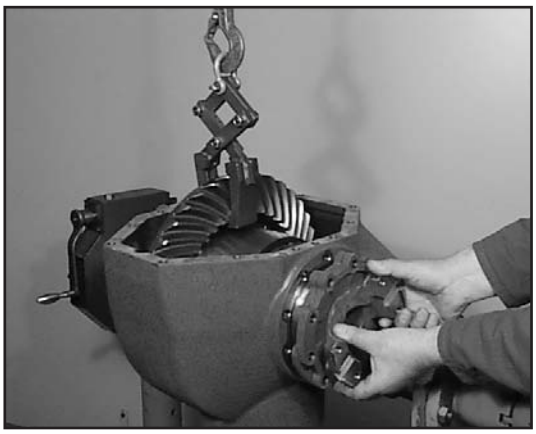


Figure 558

Lift the differential out of the housing, using lifting device.

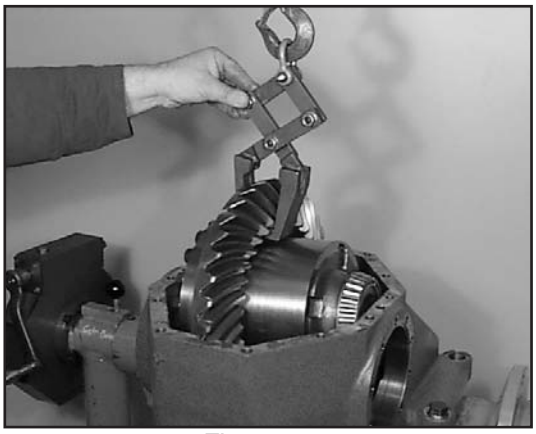


Figure 559

Separate bearing outer race and shim from bearing cover.



Figure 560

Separate flange shaft and seal retainer from bearing cover.

(S) Plastic mallet 504196

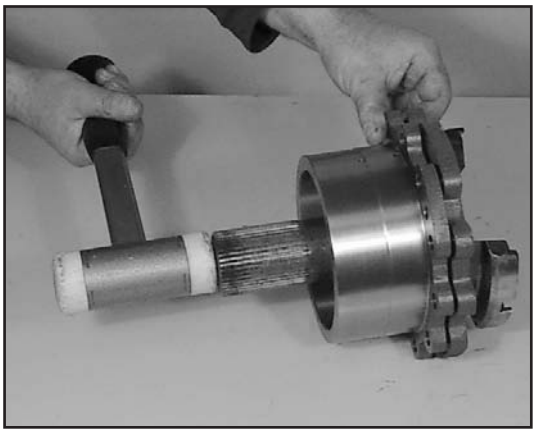


Figure 561

Squeeze circlip out and remove shim.

(S) Set of external pliers 504231

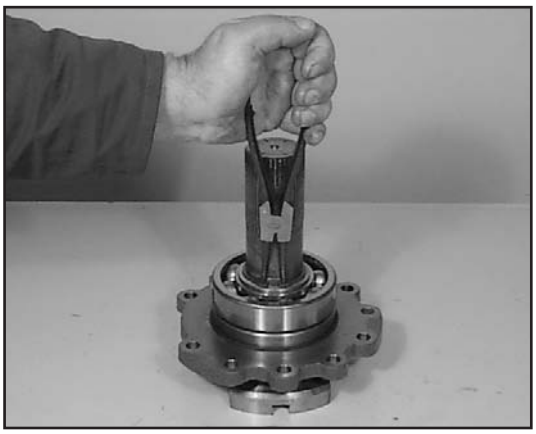


Figure 562

Press flange shaft out of the ball bearing.

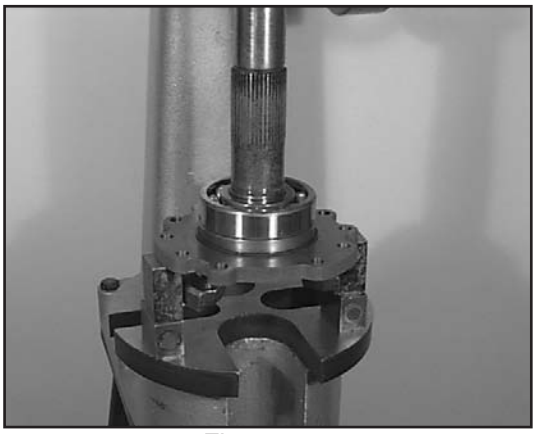


Figure 563

Pull bearing inner race from differential housing.

Disassemble the opposite bearing inner race accordingly.

(S) Two-leg puller 504731

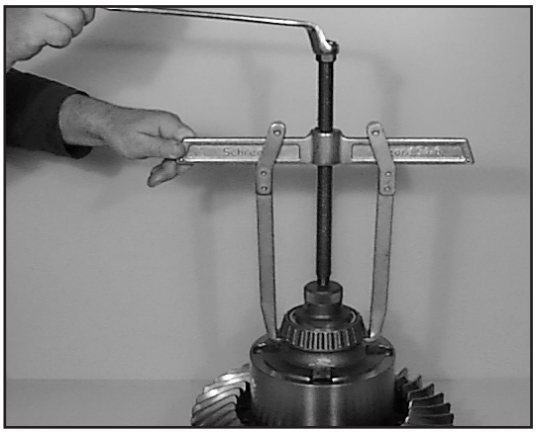


Figure 564

Loosen locking screws.

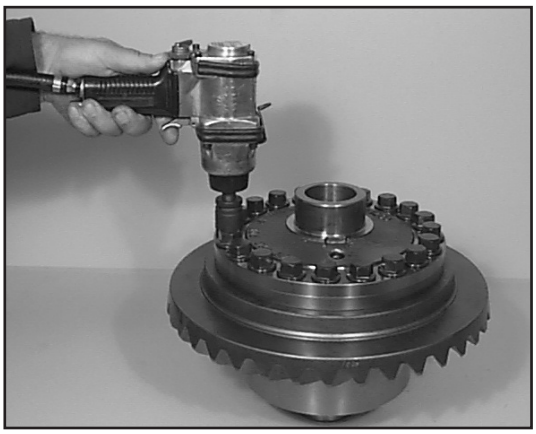


Figure 565

Loosen both socket head screws.

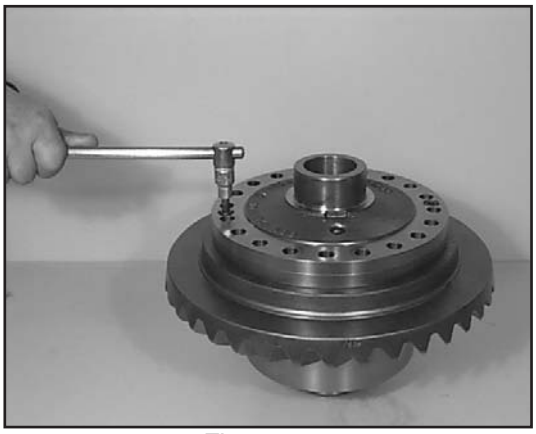


Figure 566

Separate crown wheel from differential housing, using back-off screws.

(S) Back-off screws 505154

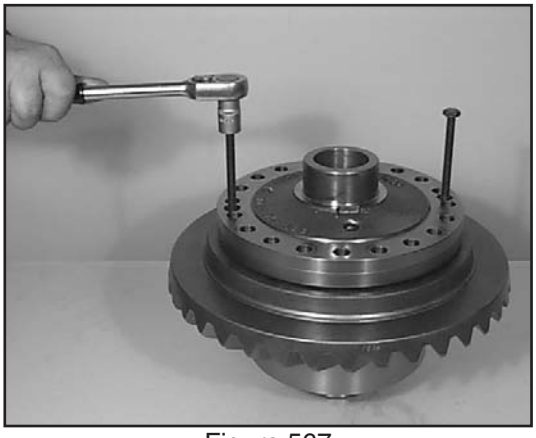


Figure 567

Demount housing cover and disassemble components.

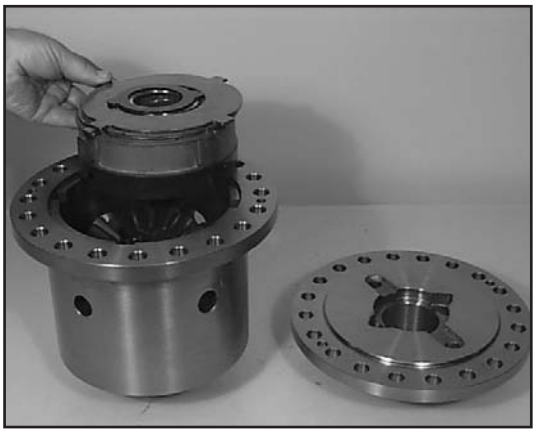


Figure 568

Heat slotted nut (about 120° C).

Slotted nut is secured with Loctite !

(S) Hot-air blower 230 V	504193
(S) Hot-air blower 115 V	504194



Figure 569

Loosen slotted nut and remove disk.

(S) Hook spanner	504726
(S) Counter support	504724
(S) Power amplifier	504719

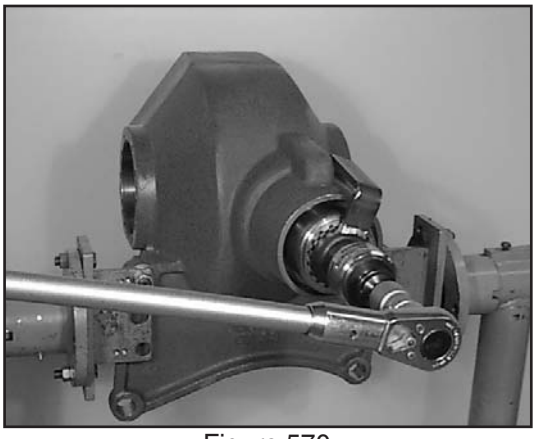


Figure 570

Pull clutch sleeve from drive pinion.

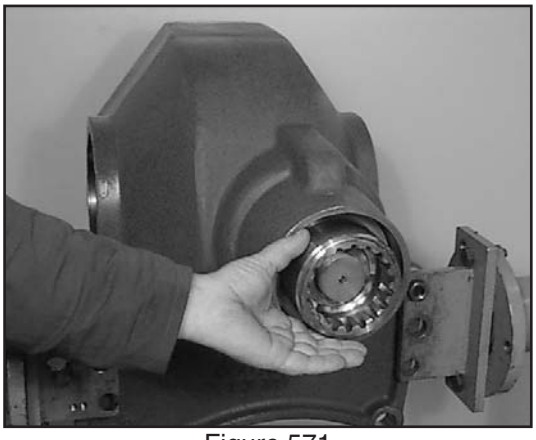


Figure 571

Press drive pinion out of the differential housing (Figure 572) and disassemble both bearing outer races.

Pay attention to the released components !

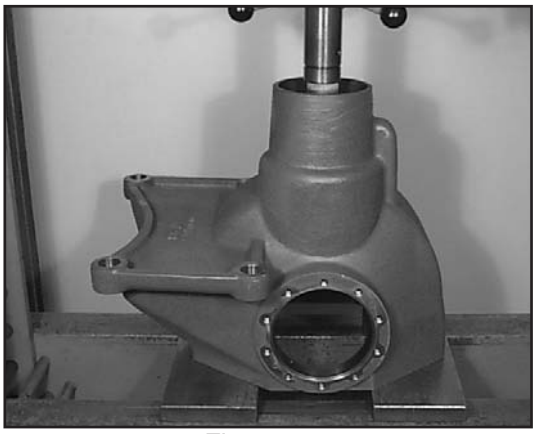


Figure 572

Press bearing inner race from the drive pinion.

(S) Grab sleeve 8327

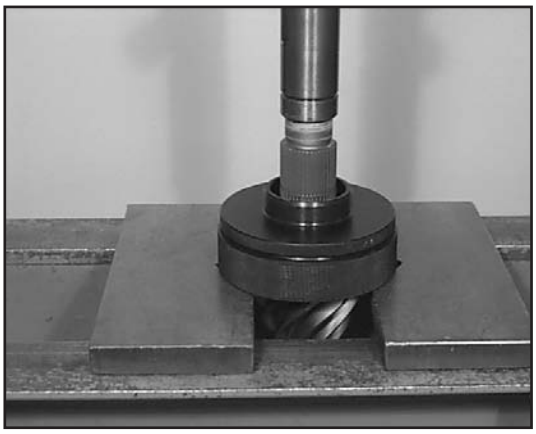


Figure 573

Assembly

Drive pinion

If crown wheel or drive pinion are damaged, both parts (bevel gear set) must be renewed together !

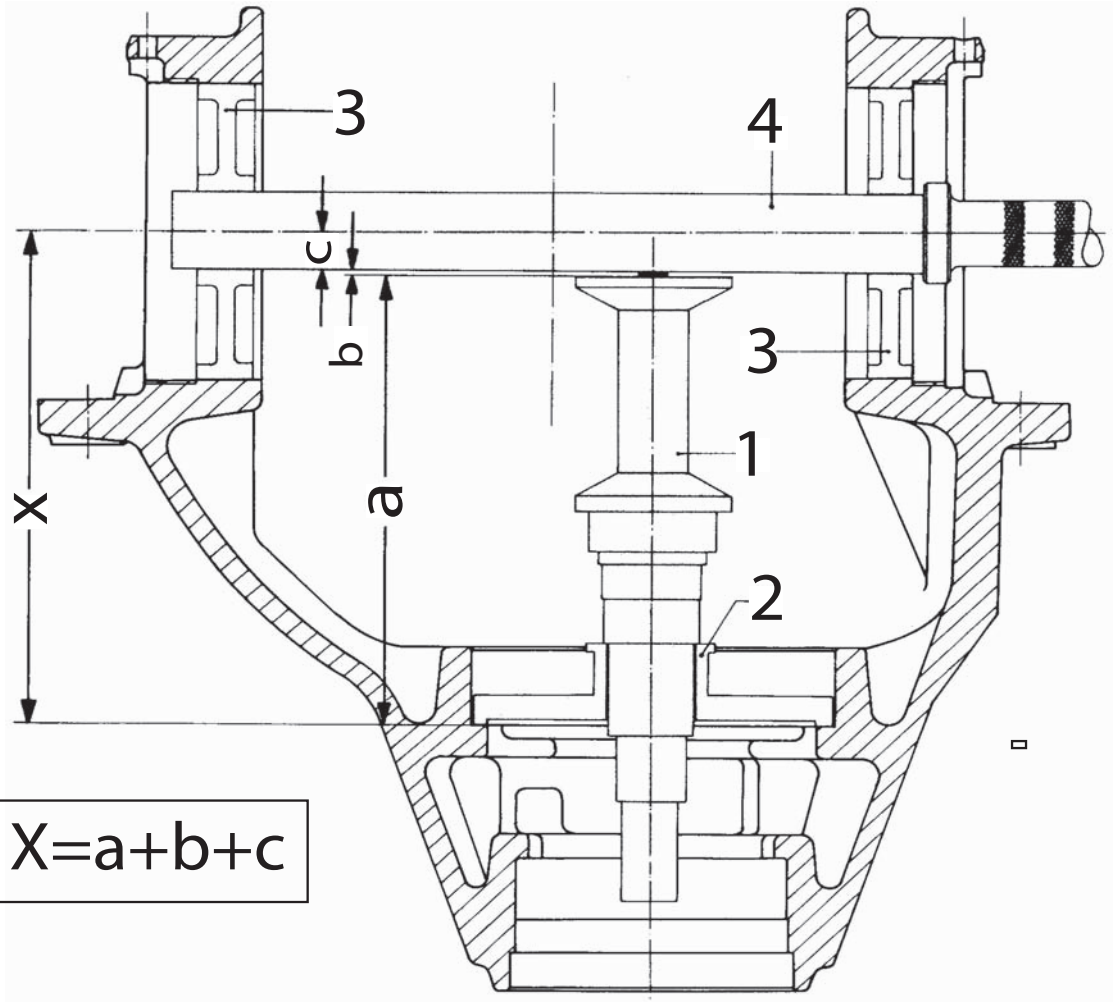
Pay attention to equal mating numbers !

Adjust Contact pattern – Bevel gear set (Draft to Figure 581)

Carry out the following measuring operations with utmost accuracy !
Inaccurate measurements give a faulty contact pattern !

Ref. Draft:

1 = Plug gauge (S) 505156
2 = Stop disk (S) 505157
3 = Fitting piece (S) 504727
4 = Measuring shaft (S) 505158



Insert stop disk (2) and plug gauge (1) into the bearing bore (drive pinion).

(S) Stop disk 505157
(S) Plug gauge 505156

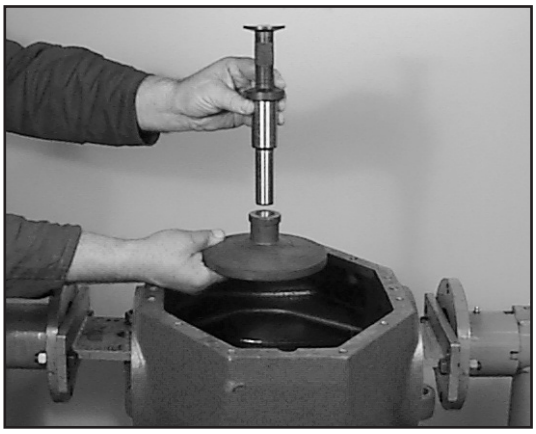


Figure 575

Introduce both fitting pieces (3) into the bearing bores (differential bearing).

(S) Fitting pieces 504728

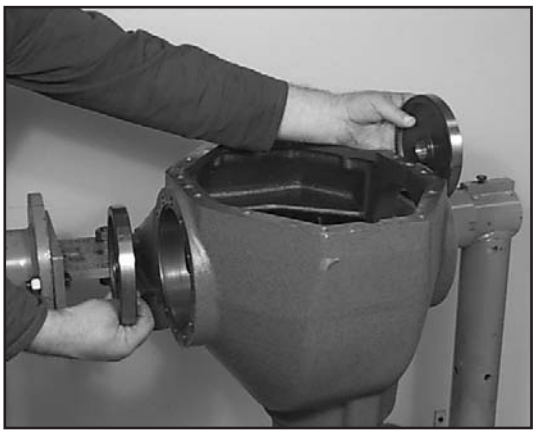


Figure 576

Introduce measuring shaft (4).

(S) Measuring shaft 505158

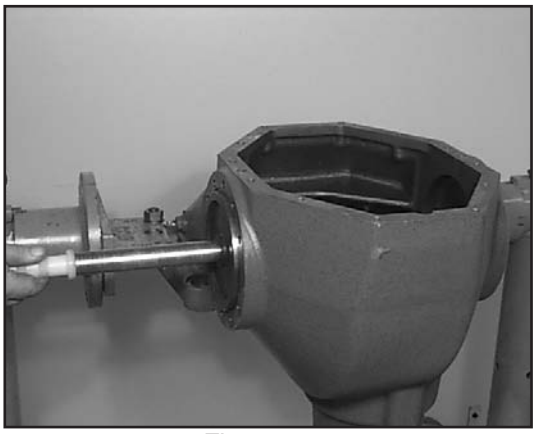


Figure 577

Determine Dimension by means of feeler gauge.

Dimension b e.g. ..... 2,50 mm

EXAMPLE „ O_1“:

Dimension a (stop disk + plug gauge)		224,00 mm
Dimension b e.g.	+	2,50 mm
Dimension c (1/2 Æ meassuring shaft)	+	15,00 mm
Gives Dimension X e.g.	=	**241,50 mm**

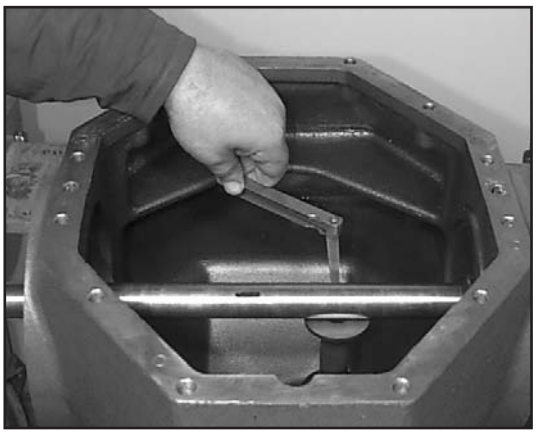


Figure 578

Read Dimension I (pinion dimension), see Arrow !

Dimension I e.g. ..... 198,00 mm

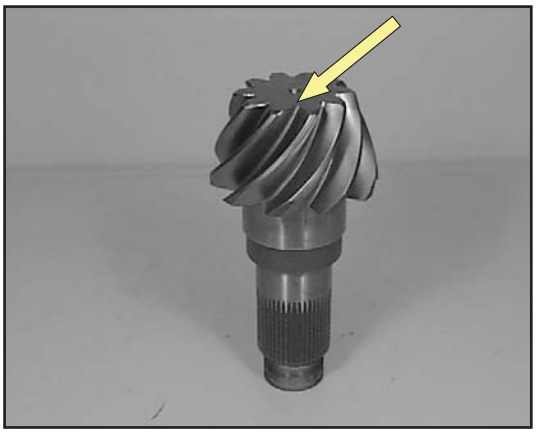


Figure 579

Measure Dimension II (bearing width).
Dimension II e.g. .... 42,30 mm

EXAMPLE: „ O_2“:

Dimension I e.g.		198,00 mm
Dimension II e.g.	+	42,30 mm
Gives Dimension Y	**=**	**240,30 mm**

(S) Gauge blocks	504173
(S) Straightedge	504170
(S) Digital Depth gauge	504175

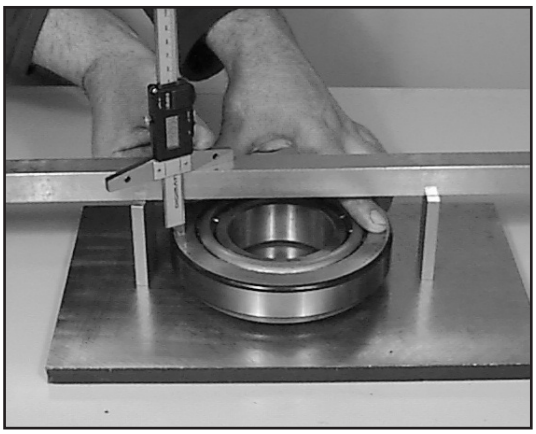


Figure 580

EXAMPLE: „ O_3“:

Dimension X		241,50 mm
Dimension Y	–	240,30 mm
Difference = Shim s	=	**1,20 mm**

Insert shim (e.g. s = 1,20 mm) and install bearing outer race until contact is obtained.

(S) Driver	505153
(S) Handle	504256

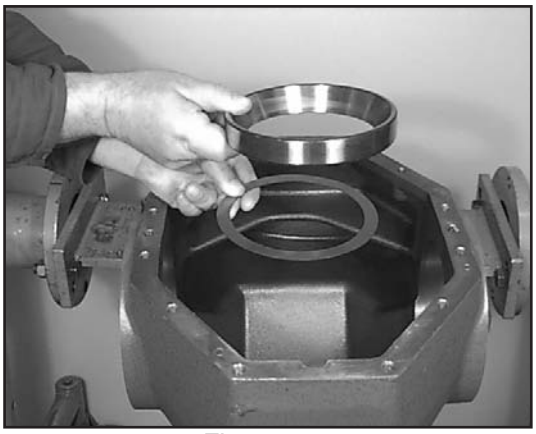


Figure 581

Tilt differential housing 180°.

Insert bearing outer race until contact is obtained.

(S) Driver	504716
(S) Handle	504195

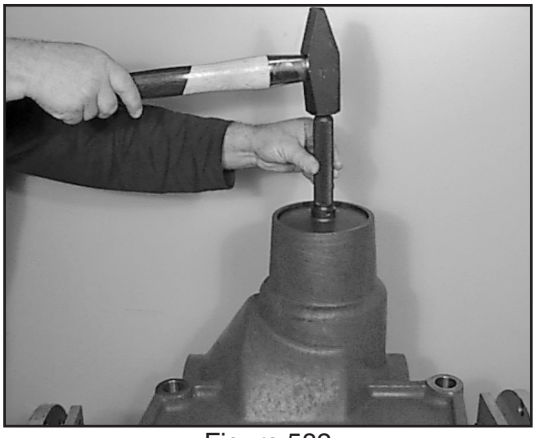


Figure 582

Press bearing inner race over the drive pinion until contact is obtained.

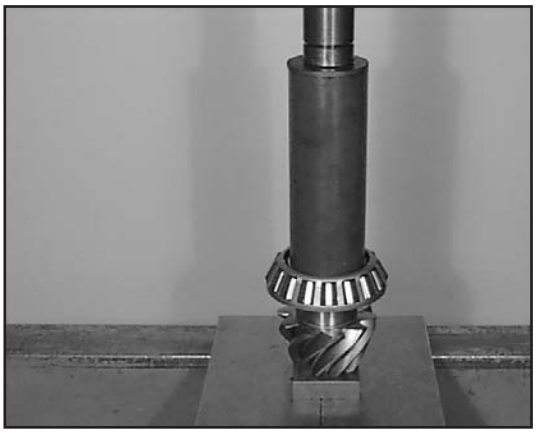


Figure 583

Adjust the Rolling moment of the Drive pinion bearing
T = 3,5 ... 4,5 Nm (without shaft seal) (Figure 584 ... 588):

Line up adjusting ring e.g. s = 8,15 mm.

We know from experience that the required rolling moment will be achieved if the adjusting ring (e.g. s = 8,15 mm), found at the disassembly is used !
However, the later check of the rolling moment is imperative!

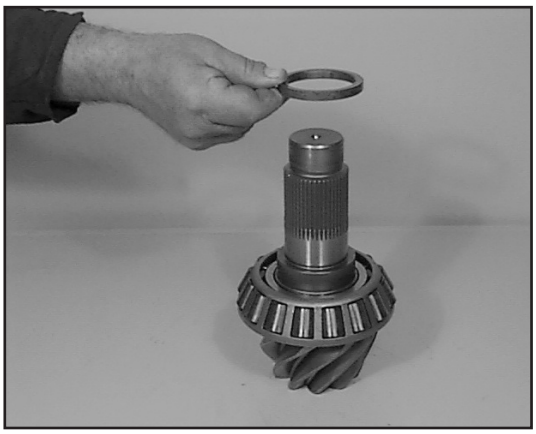


Figure 584

Position the drive pinion and line up the heated bearing inner race until contact is obtained.

Use protective gloves !

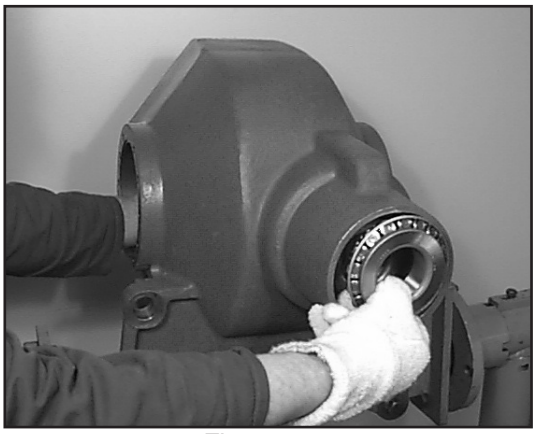


Figure 585

Line up the clutch sleeve.

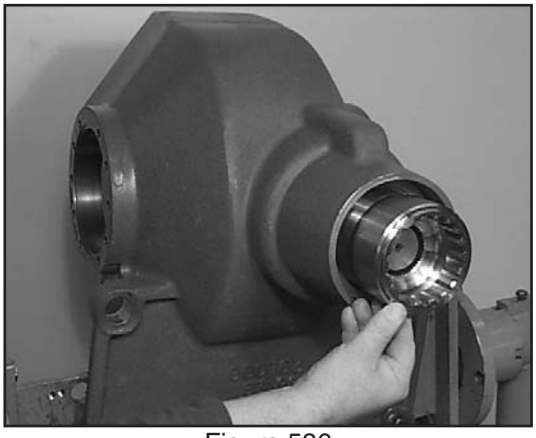


Figure 586

Line up the disk and tighten slotted nut.

Torque limit ..... 1200 Nm

During the tightening, rotate the drive pinion several times in both directions !

(S) Hook spanner	504726
(S) Counter support	504724
(S) Power amplifier	504719

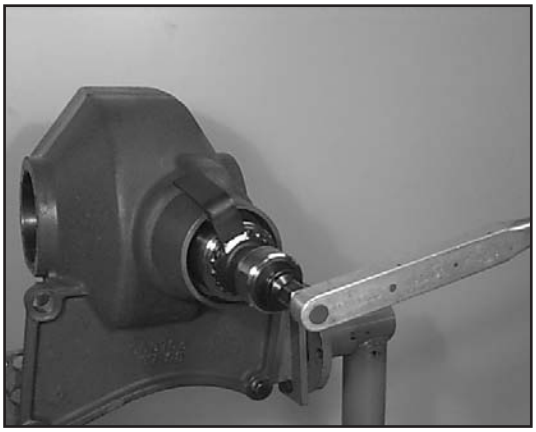


Figure 587

Check rolling moment T = 3,5 ... 4,5 Nm.

At deviations from the required rolling moment, correct with corresponding adjusting ring (Figure 584) !
Rolling moment too low – install thinner ring!
Rolling moment too high – install thicker ring!

After the performed adjustment of the rolling moment, loosen the slotted nut again and remove the clutch sleeve.

(S) Torque spanner	504720
(S) Connecting piece	504729

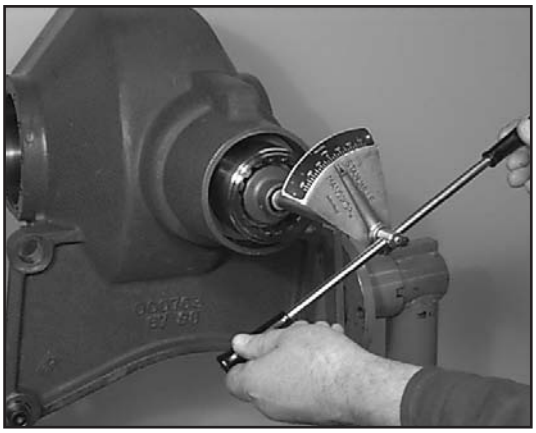


Figure 588

Install both shaft seals.

At application of the prescribed Special tool (S), the exact installation position is obtained, see also Figure 590 !
Grease sealing lip !
Wet outer diameter with sealing compound Loctite (Type-No. 574) !

(S) Driver	504715

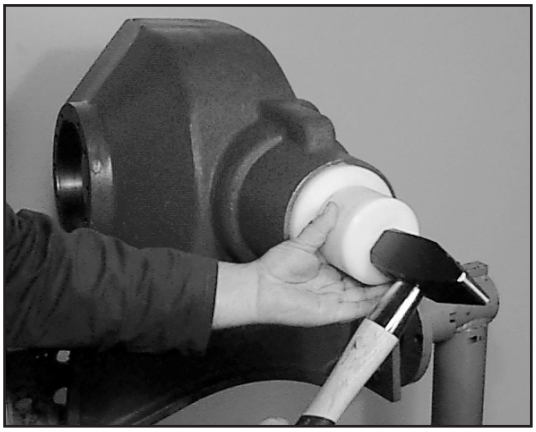


Figure 589

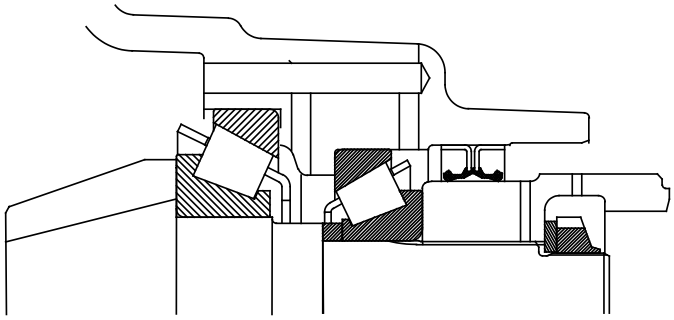


Figure 590

Line up the clutch sleeve.
Mount disk and tighten slotted nut finally.

Wet thread of slotted nut with Loctite (Type-No. 262) !
During the tightening, rotate the pinion several times in both directions !

Torque limit ..... 1200 Nm

(S) Hook spanner	504726
(S) Counter support	504724
(S) Power amplifier	504719

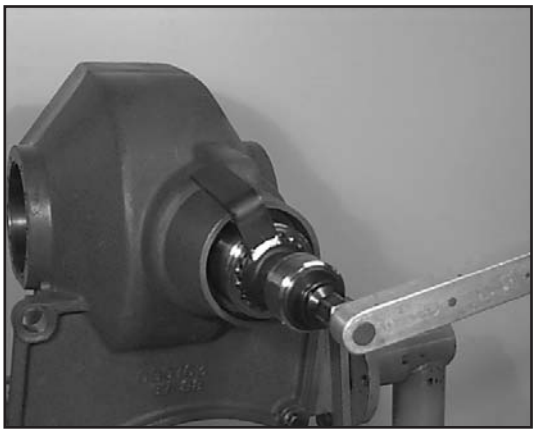
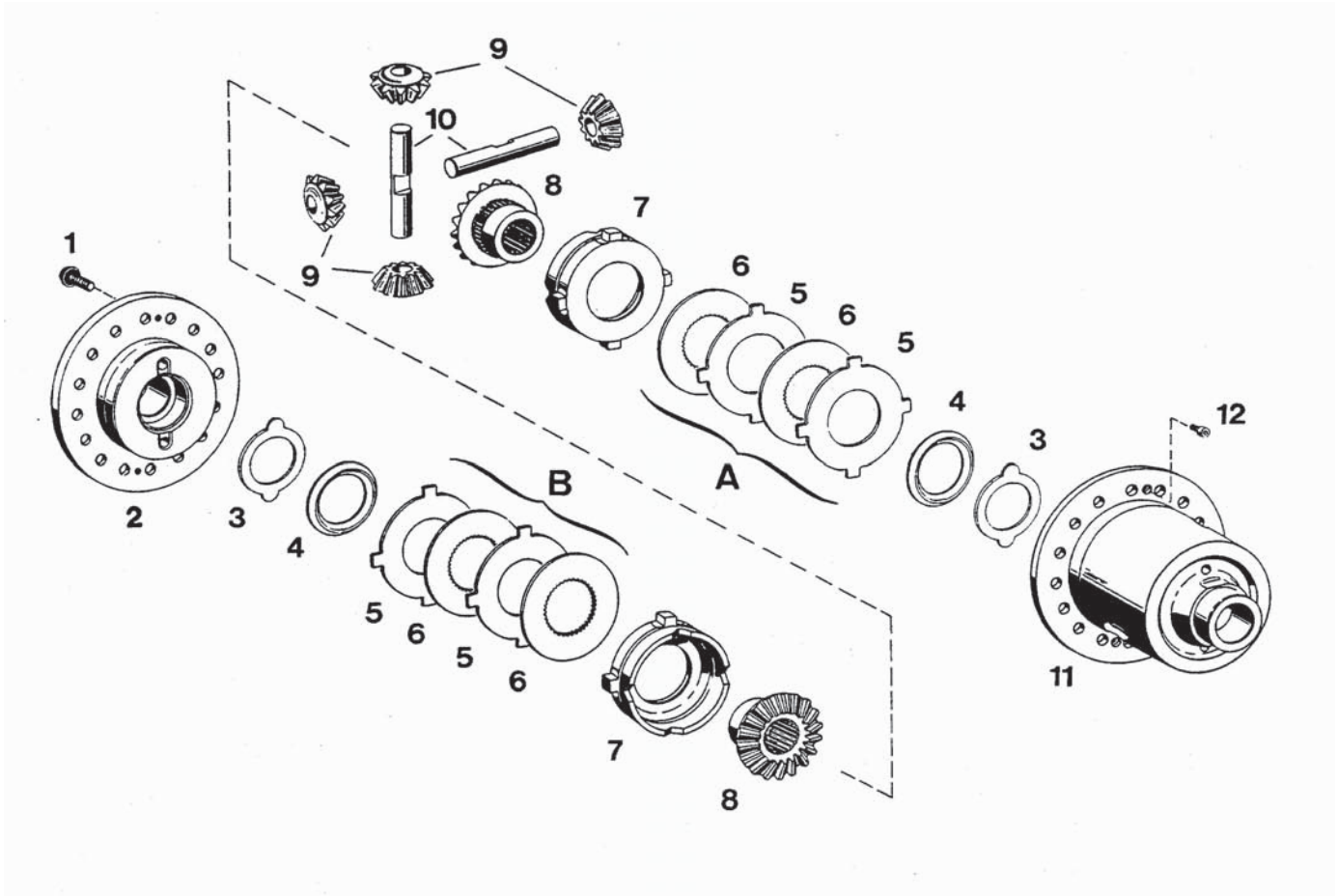


Figure 591

Differential DL-2400, Interlock value 45%

The following Perspective Illustration shows the components of the differential and its installation position.

1	=	Socket head screws (2x)	7	=	Thrust ring
2	=	Housing cover	8	=	Side gear
3	=	Thrust washer (steel)	9	=	Differential bevel gear
4	=	Thrust washer (brass)	10	=	Differential axle
5	=	Outer plate (optional)	11	=	Differential housing
6	=	Inner plate			



For the adjustment of the assembly play of the internal components (Figure 600 ... Example), outer plates of different thickness are available (s = 2,7 ... 3,3 mm) !
The outer plates must be selected in such a way that the height of the plate packs A and B is identical on both sides !

At the following assembly sequence, pay attention to the installation position of the components, see also Perspective Illustration/ Page 4.14 !
Oil the components according to ZF-List of lubricants TE-ML 05 !

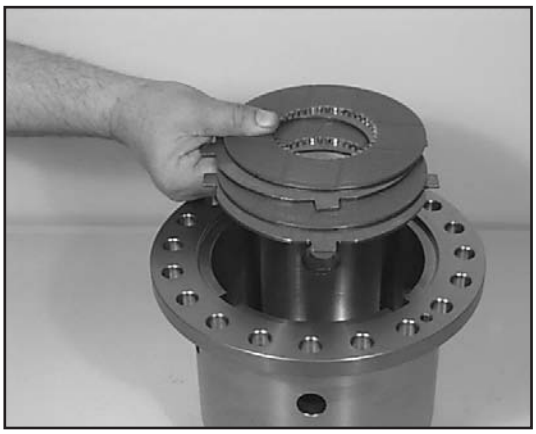
Install both thrust washers.



Figure

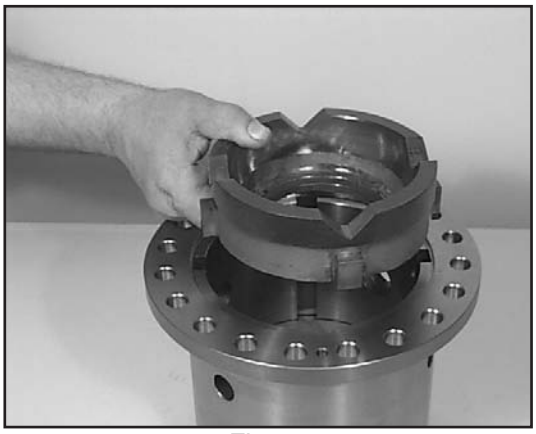
Introduce plate pack A.

Pay attention to the Note, Page 4.14 !



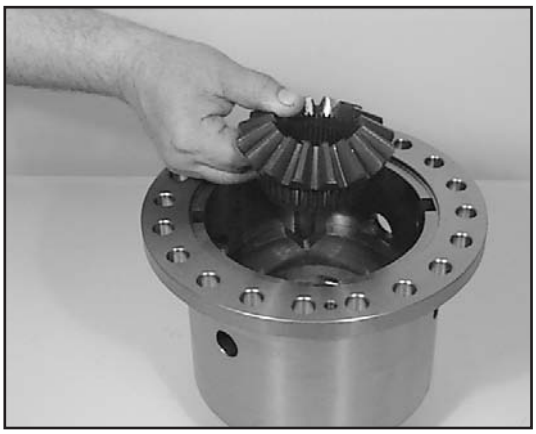
Figure

Introduce thrust ring.



Figure

Introduce side gear until both inner plates are accommodated



Figure

Insert complete differential spider.

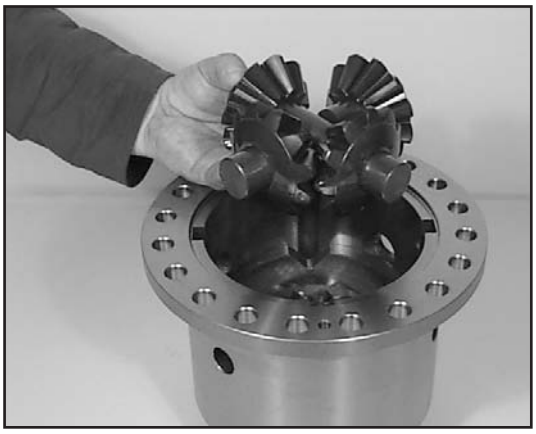


Figure 596

Install second side gear.

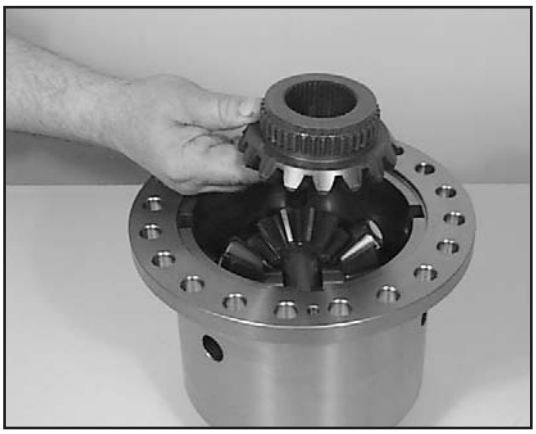


Figure 597

Introduce thrust ring.

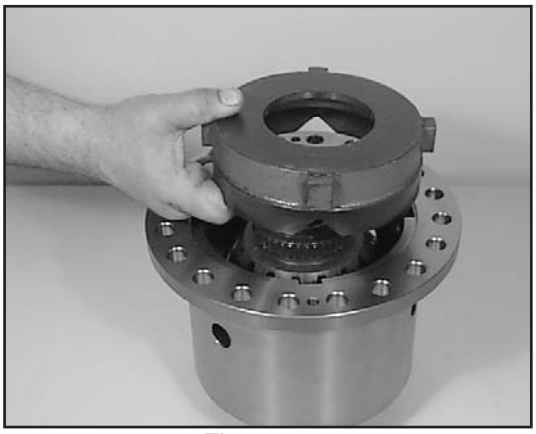


Figure 598

Install plate pack B alternating, starting with one inner plate.

Pay attention to the Note, Page 4.14 !



Figure 599

Check the Assembly play of the internal components = 0,2 ... 0,8 mm (Figure 600 ... Example “P“):

Determine Dimension I from the mounting face to the outer plate.

Dimension I e.g..... 4,30 mm

(S) Digital Depth gauge	504175
(S) Straightedge	504170
(S) Gauge blocks	504173

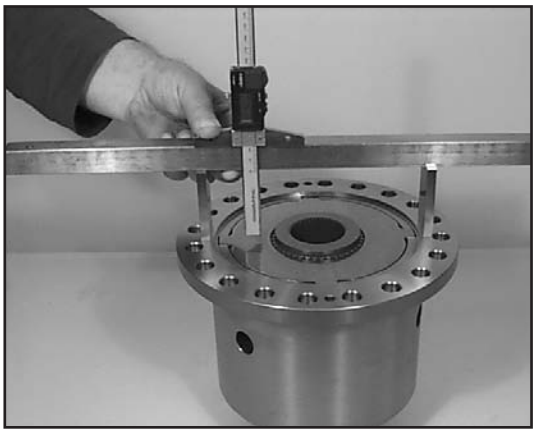


Figure 600

Measure Dimension II from the contact face to the mounting face.

Dimension II e.g. ..... 3,95 mm

(S) Digital Depth gauge	504175
(S) Straightedge	504170
(S) Gauge blocks	504173

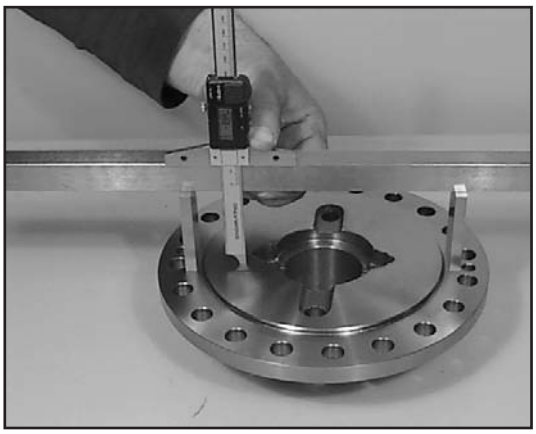


Figure 601

EXAMPLE “P“:

Dimension I e.g. ..... 4,30 mm
Dimension II e.g. ..... – 3,95 mm
Difference ^ Assembly play = 0,35 mm

At the assembly of new plates, aim at the lower value of the assembly play !
Any necessary corrections have to be carried out with corresponding outer plates !

Pay attention to the Note, Page 4.14 !

Make both thrust washers adhere with grease in the housing cover.

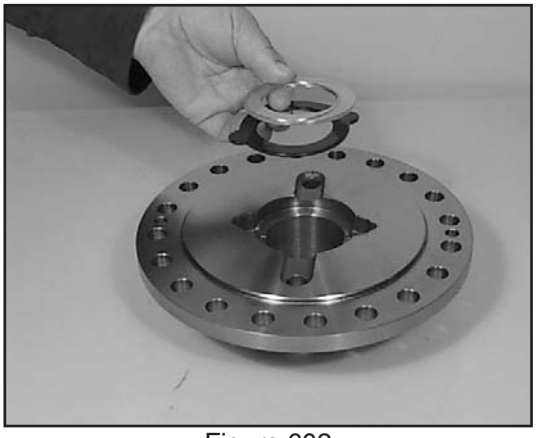


Figure 602

Fix housing cover with two socket head screws.

Torque limit (M10/8.8) ..... 46 Nm



Figure 603

Install adjusting screws (3 pieces) and press differential into the crown wheel until contact is obtained.

(S) Adjusting screws 504722

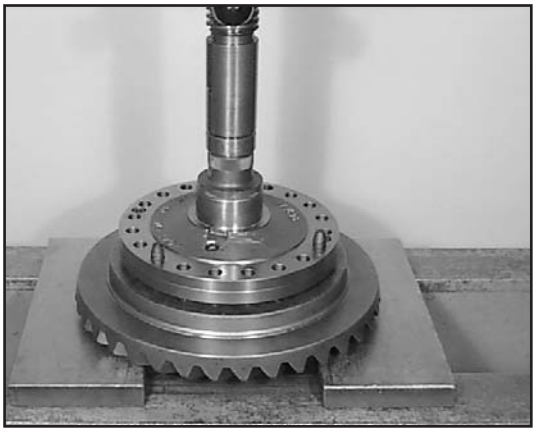


Figure 604

Locate differential by means of press.
Screw crown wheel, differential housing and housing cover together.

Torque limit ..... 385 Nm
(Locking screws M16x1,5/12.9)

Only use of <u>new</u> locking screws permitted !

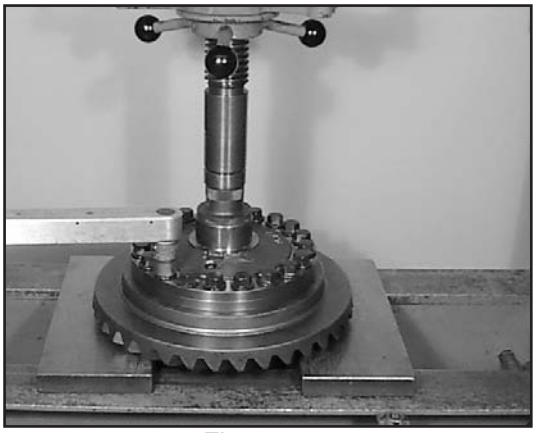


Figure 605

Press crown wheel-side as well as opposite bearing inner race against shoulder.

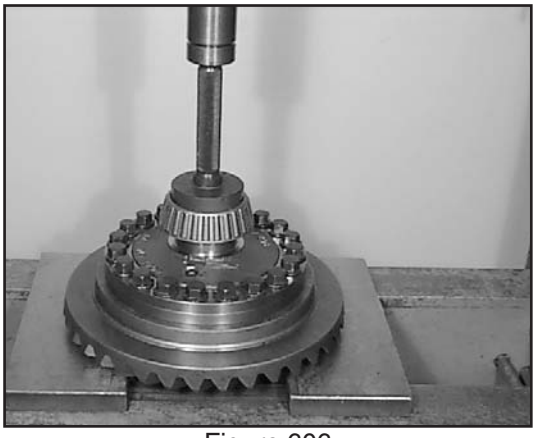


Figure 606

Insert the differential into the axle drive housing, using lifting device.

(S) Gripper tongs 505155

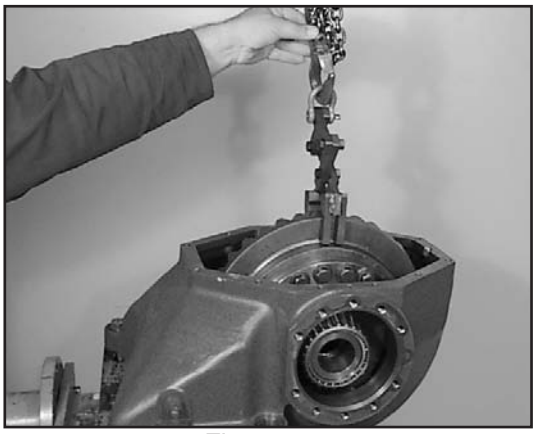


Figure 607

Adjust Backlash – Bevel gear set 0,20 ... 0,30 mm and Bearing rolling moment – Differential T = 3 ... 4 Nm (Figure 608 ... 619):

Insert shim e.g. s = 2,40 mm into the bearing cover I (crown wheel side).

The two bearing covers of the differential bearing are different ! In this connection, pay attention to the markings applied at the diasassembly ! We know from experience, that the required backlash is obtained if the shim (e.g. s = 2,40 mm), found at the disassembly is used !

However, the later check of the backlash is imperative !

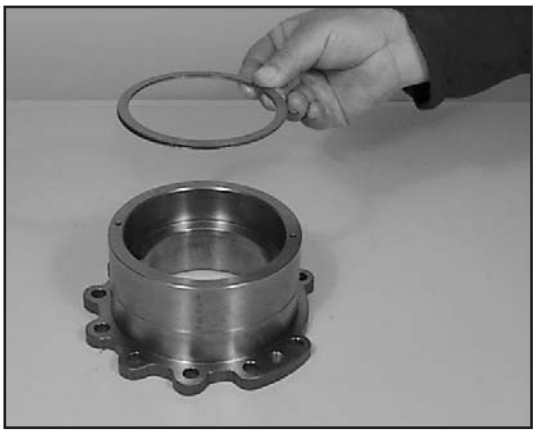


Figure 608

Introduce bearing outer race.

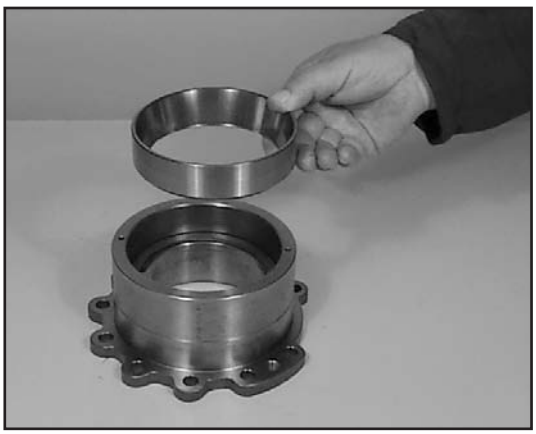


Figure 609

Install O-ring (Arrow).

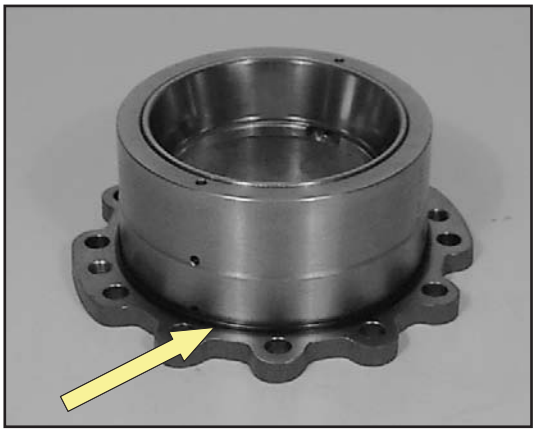


Figure 610

Install two adjusting screws.

Introduce bearing cover I and fasten it provisionally with four screws.

Torque limit ..... 79 Nm

(S) Adjusting screws 504186

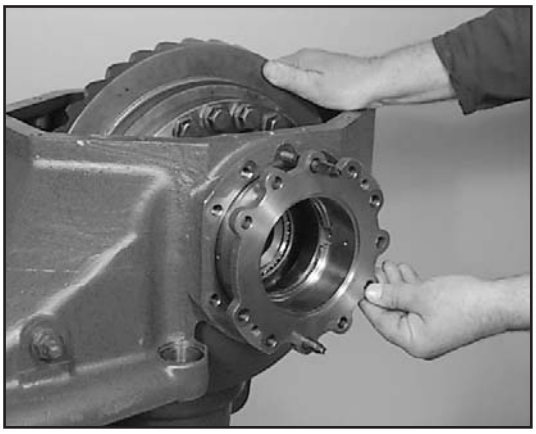


Figure 611

Tilt axle drive housing 90°.

Mount bearing outer race, press it uniformly on and determine Dimension I from the mounting face to the bearing outer race.

Dimension I e.g. ..... 41,60 mm

(S) Straightedge 504170
(S) Gauge blocks 504173
(S) Digital Depth gauge 504175

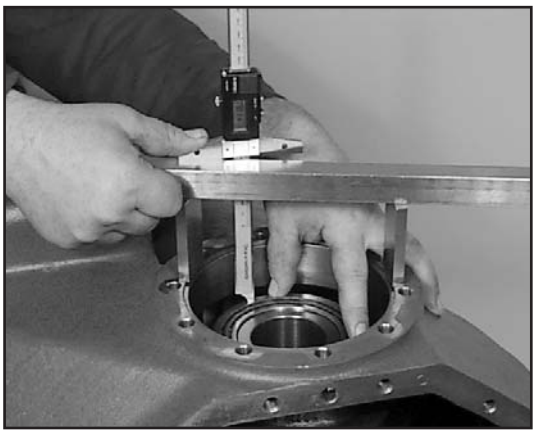


Figure 612

<u>Bearing cover II (opposite the crown wheel side)</u>:

Measure Dimension II from the mounting face to the locating face bearing outer race.

Dimension II e.g. ..... 39,90 mm

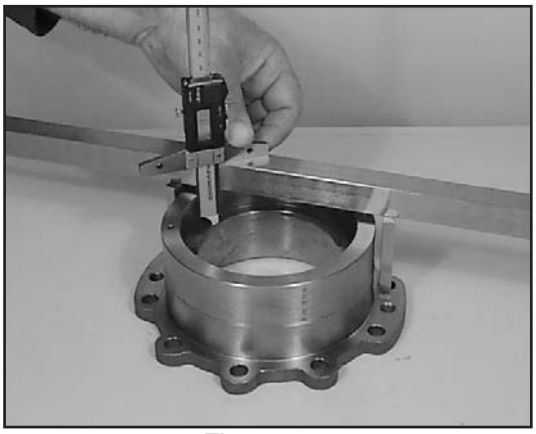


Figure 613

EXAMPLE “R“:

Dimension I e.g.		41,60 mm
Dimension II e.g.	–	<u>39,90 mm</u>
Difference	=	1,70 mm
Required bearing preload e..g.	+	<u>0,30 mm</u>
<u>Gives Shim s</u>	**=**	**<u>2,00 mm</u>**

Bearing preload = 0,3 ... 0,4 mm corresponds with the required bearing rolling moment T = 3 ... 4 Nm !

Install shim e.g. 2,00 mm and bearing outer race.



Figure 614

Install O-ring (Arrow).

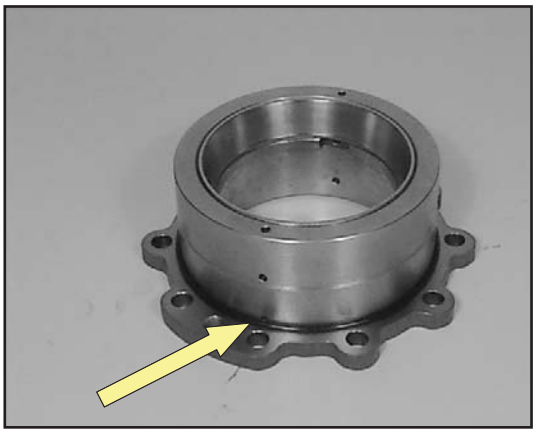


Figure 615

Install two adjusting screws.
Introduce bearing cover II and position it uniformly against shoulder, using four screws.

Torque limit ..... 79 Nm

During the tightening of the screws, rotate the crown wheel several times in both directions ! Now, relax the differential bearing by tapping onto both bearing covers (use plastic mallet) !

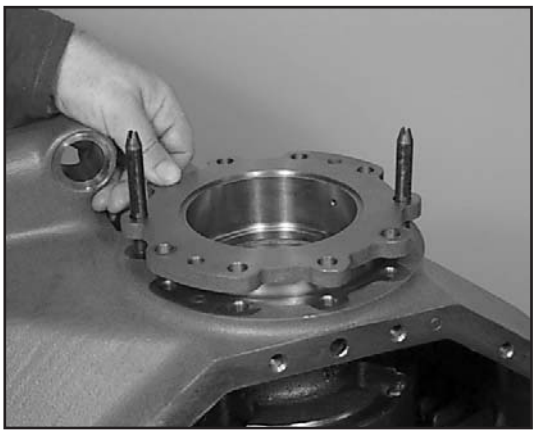


Figure 616

(S) Adjusting screws 504186

Tilt axle drive housing 90°.

Apply dial indicator right-angled on the outer Æ of a tooth flank and check the backlash.

(S) Magnetic stand 504171
(S) Dial indicator 504172

In case of necessary corrections of the backlash, the follow-ing specifications have to be observed !

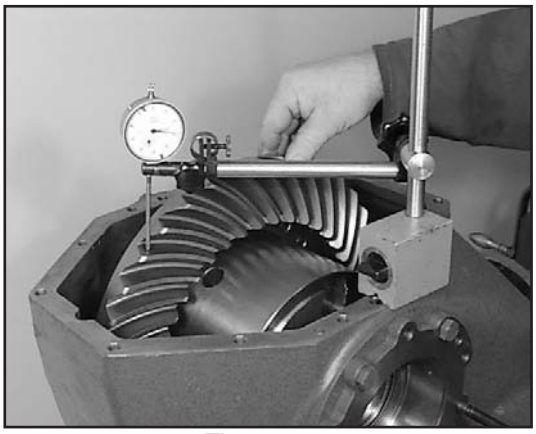


Figure 617

1. Backlash too low:
Install thinner shim on the crown wheel-side bearing cover I (Figure 608).
The shim for the determination of the bearing preload (bearing cover II, Figure 614) must be selected correspondingly thicker !

2. Backlash too high:
Install thicker shim on the crown wheel-side bearing cover I (Figure 608).
The shim for the determination of the bearing preload (bearing cover II, Figure 614) must be selected correspondingly thinner !

Check Contact pattern (Figure 618 and 619):

Wet some coasting flanks and traction flanks of the crown wheel with marking ink.

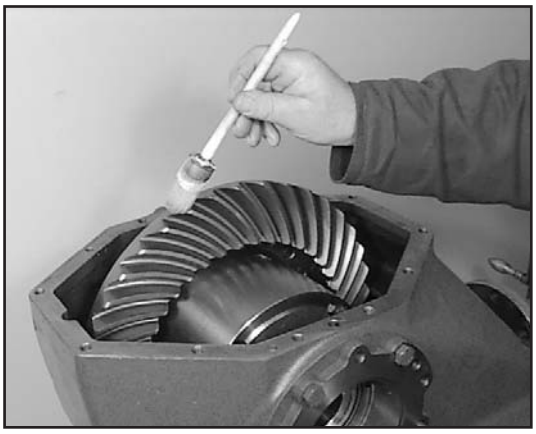


Figure 618

Roll the crown wheel several times in both directions over the drive pinion.

Compare the obtained contact pattern with the Examples of Contact patterns, Page 0.06 and 0.07.

In case of a contact pattern deviation, a measuring error has been made at the determination of the shim (Figure 581), which has to be absolutely corrected !

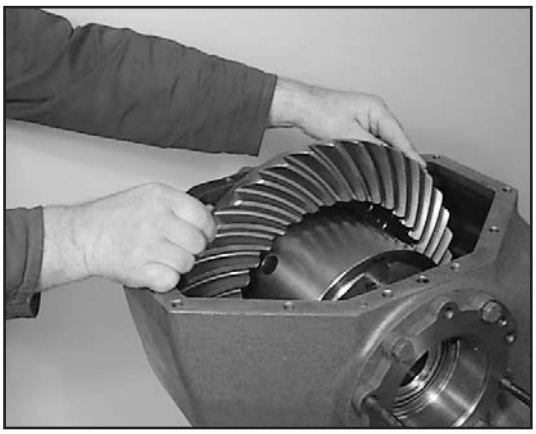


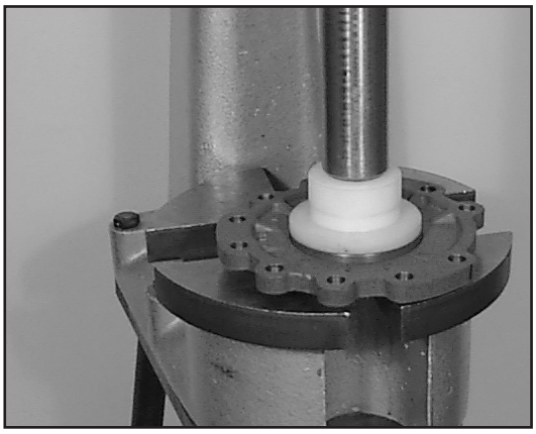
Figure 619

4.2.3 Pre-assemble and install Flange shaft

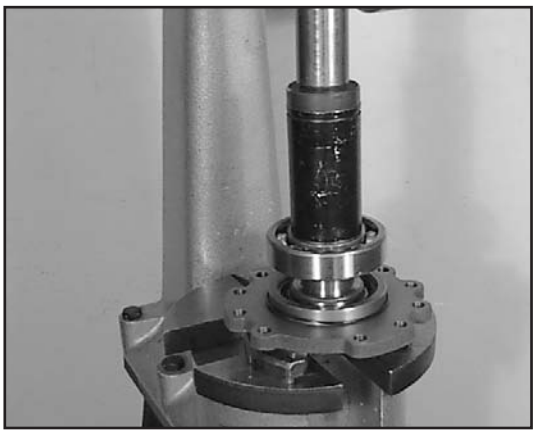
Lay seal retainer upon a plane base.
Press shaft seal in, with the sealing lip facing the oil chamber.

Wet outer diameter with spirit !
Grease sealing lip !
At application of the prescribed Special tool (S), the exact installation position is obtained!

(S) Driver 504164

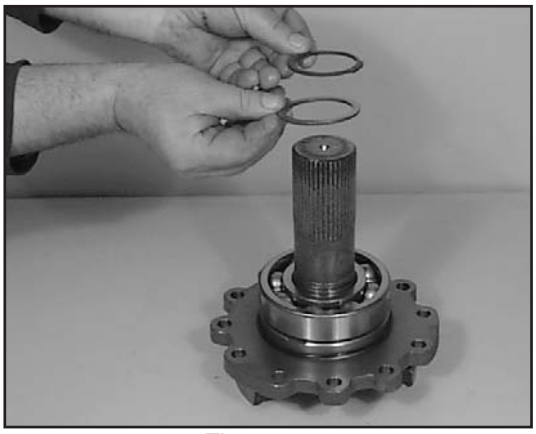

Figure 620

Line up seal retainer and press ball bearing against shoulder.

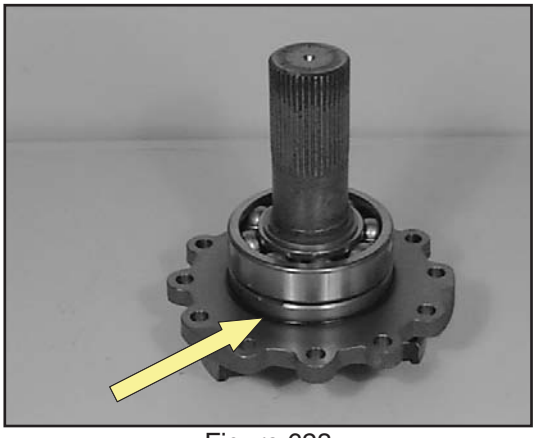

Figure 621

Adjust the ball bearing playfree, using shim and circlip.

(S) Set of external pliers 504231

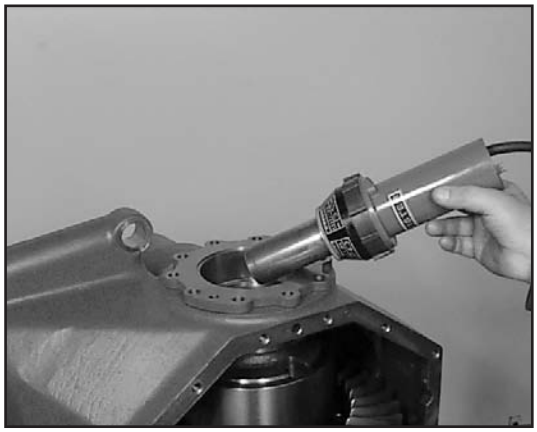

Figure 622

Install O-ring (Arrow).


Figure 623

Heat bearing bore (about 90° C).

(S) Hot-air blower 230 V 504193
(S) Hot-air blower 115 V 504194


Figure 624

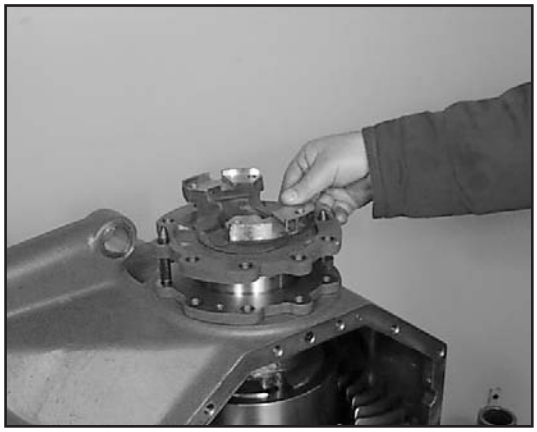
Introduce the flange shaft and fasten it uniformly by means of hex. head screws.
Torque limit (M12/8.8) ..... 79 Nm

LH and RH seal retainer are different !
Pay attention to the installation position and the radial installation location, see the markings, applied at the disas-sembly !

Now, install opposite flange shaft accordingly (Fig. 620 ... 625).

After the assembly of the two seal retainers, relax the differential bearing by tapping (use plastic mallet) !

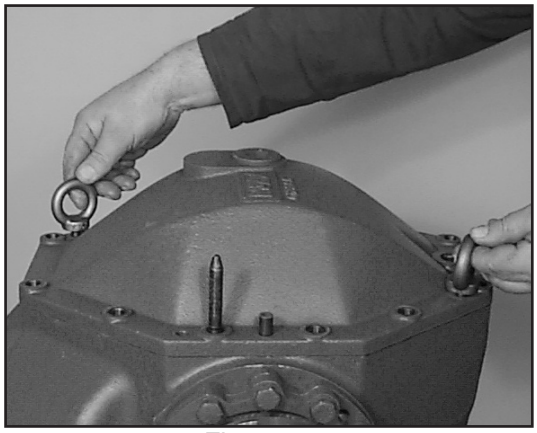
(S) Plastic mallet 504196


Figure 625

Wet mounting face with sealing compound Loctite (Type-No. 574).
Install two adjusting screws and position cover against shoulder.

Pay attention to the radial installation location !

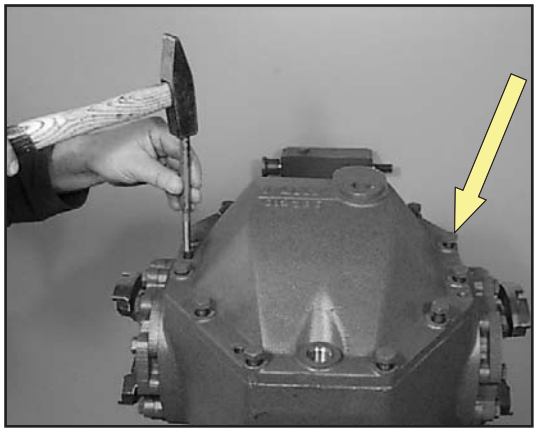
(S) Adjusting screws 504186


Figure 626

Locate cover by means of hex. head screws (do not tighten) and drive the two roll pins flush-mounted in.

Now, tighten the cover finally, using hex. head screws.

Torque limit (M12/10.9) ..... 115 Nm


Figure 627

Install connecting pipe and breather, see Arrow !

Install new sealing ring (Cu) !

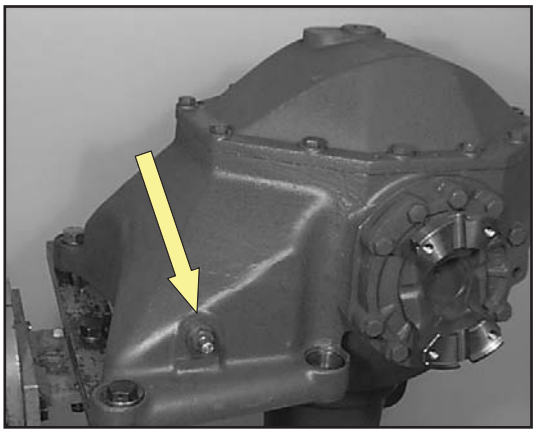


Figure 628

Mount Differential carrier on the Transmission

Adjust Axial play – Output shaft 0,3 $^{+0,2}$ mm (Figure 629 .... 633):

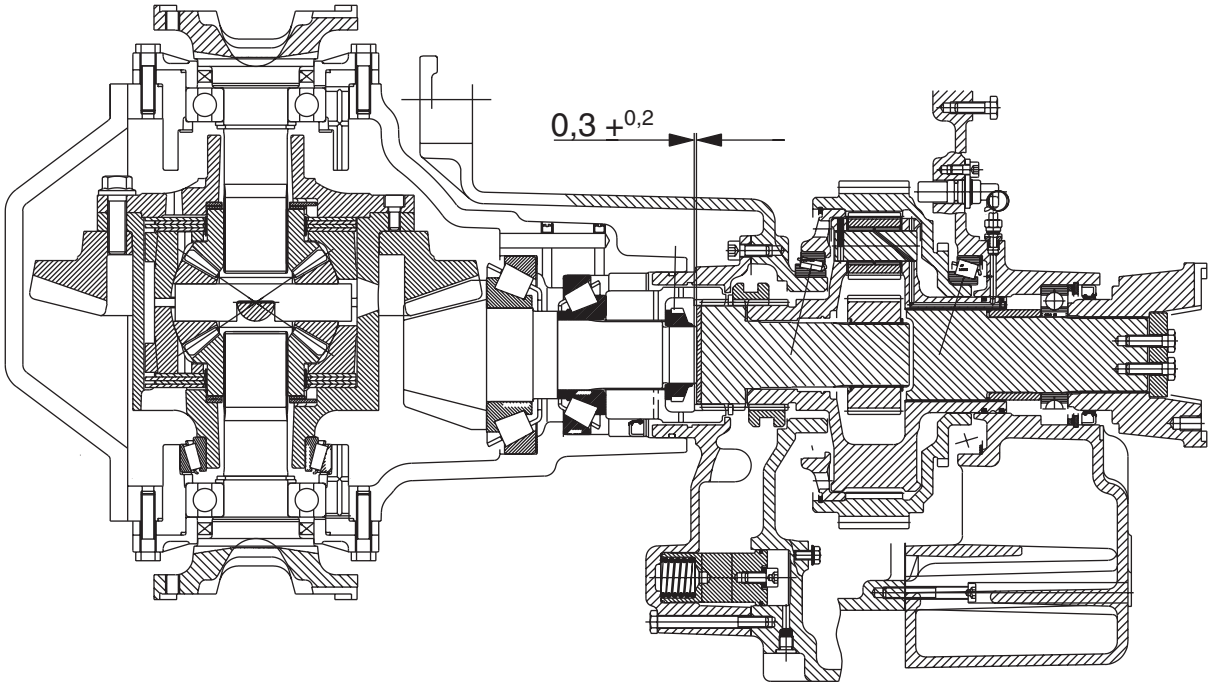


Figure 629

Measure Dimension I from the end face – clutch sleeve to the mounting face.

Dimension I e.g. ..... 291,90 mm

(S) Straightedge 504170
(S) Depth gauge 504718

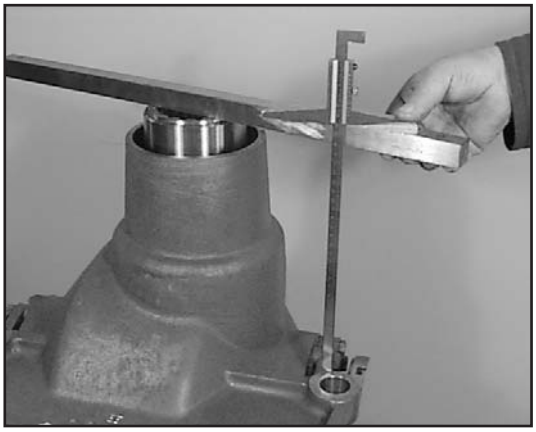


Figure 630

Determine Dimension II from the end face – clutch sleeve to the end face – drive pinion.

Dimension II e.g. ..... 49,00 mm

EXAMPLE S_1

Dimension I e.g.		291,90 mm
Dimension II e.g.	–	49,00 mm
Gives Dimension X e.g.		**242,90 mm**

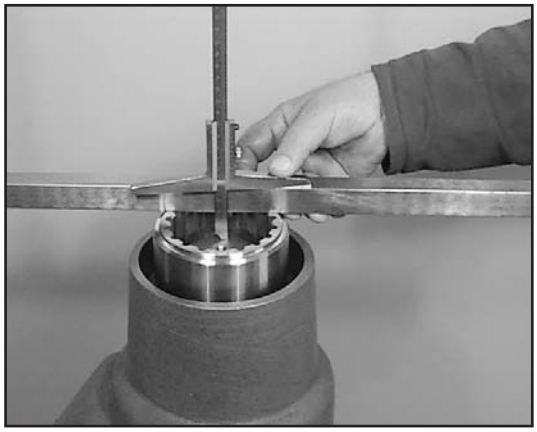


Figure 631

Housing dimension:

Position output shaft in arrow direction against shoulder.

Determine Dimension Y from the mounting face to the end face – output shaft.

Dimension Y e.g. ..... 246,80 mm

(S) Straightedge 504170
(S) Depth gauge 504718

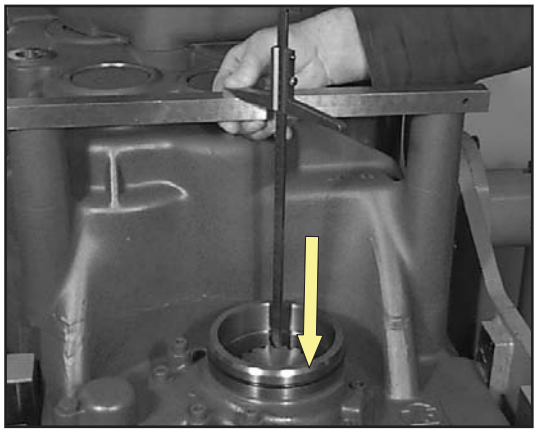


Figure 632

EXAMPLE S_2:

Dimension Y e.g.		246,80 mm
Dimension X e.g.	–	242,90 mm
Difference		3,90 mm
required Axial play e.g.	–	0,40 mm
Gives Shim s	**=**	**3,50 mm**

Make shim (Arrow 1) adhere with assembly grease on the end face of the drive pinion.

Install and grease O-ring (Arrow 2).

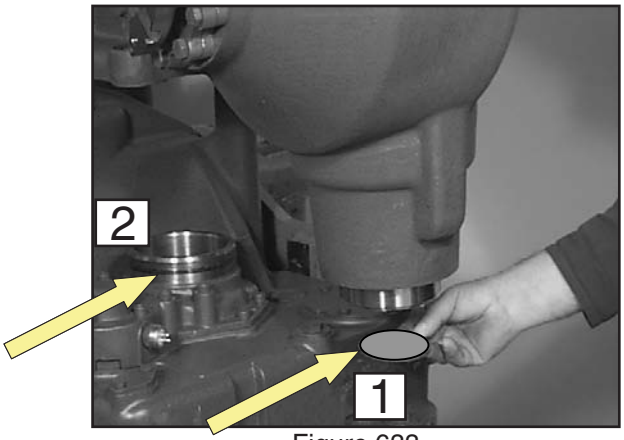


Figure 633

Introduce differential carrier until contact is obtained, using lifting device.

(S) Lifting chain 504198

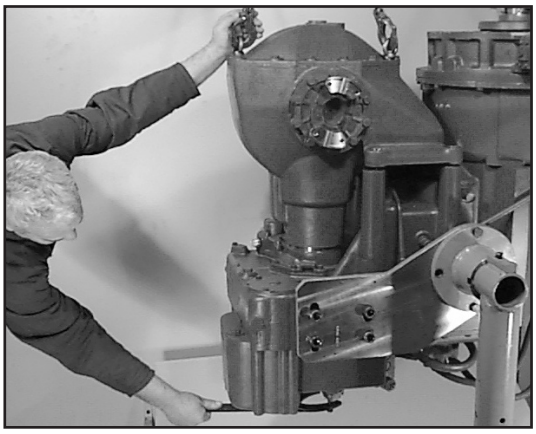


Figure 634

Tilt transmission 90°.

Fasten differential carrier on the gearbox housing, using socket head screws.

Torque limit (M30/10.9) ..... 1900 Nm

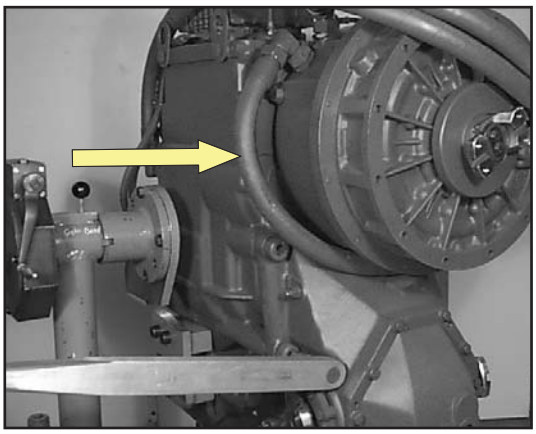
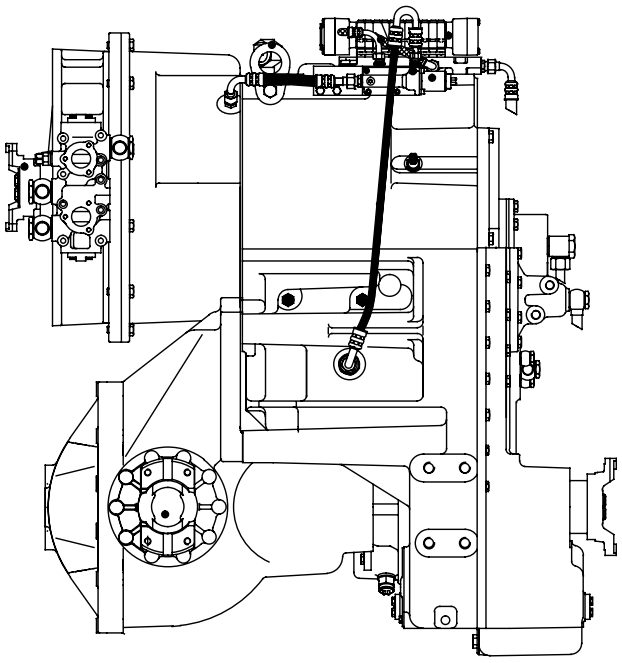


Figure 635

Prior to the commissioning of the unit, carry out the oil filling according to the Operating Instructions !



Use shims to get the correct position for the rear flange.
The flange shall be vertical accordingly to the plane and center of the articulated bearing. The cardan joint in articulated hinge, shall have the same distance from center to both end of the axle.

See figure 642 / 644 / 645.

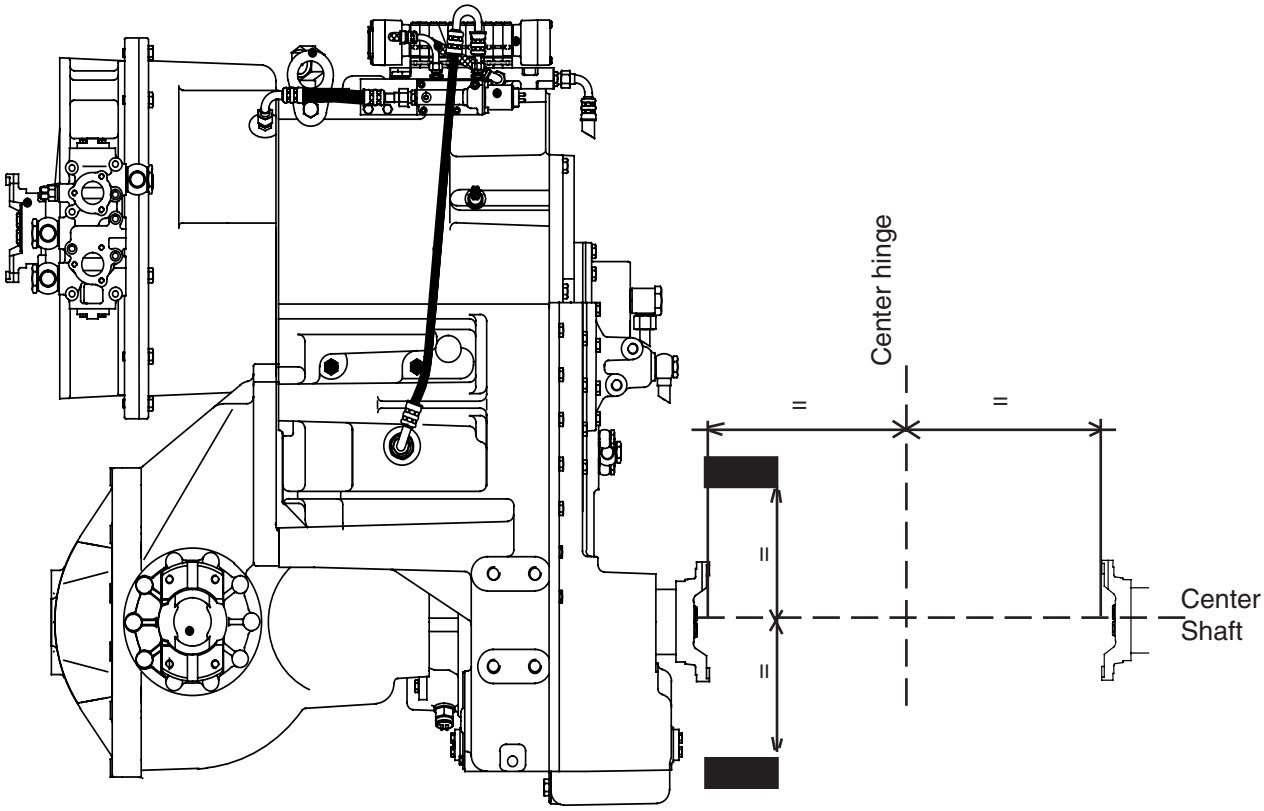


Figure 645

When the Engine and the Transmission is in correct position, please control the distance between the flanges.
At the top, the distance between the flanges shaft be of minimum 246 mm - to max 256 mm.

At the lower side the distanse shall be 12 mm less. That is when the Engine is in the correct position and the angle is 3,5°

See figure 646.

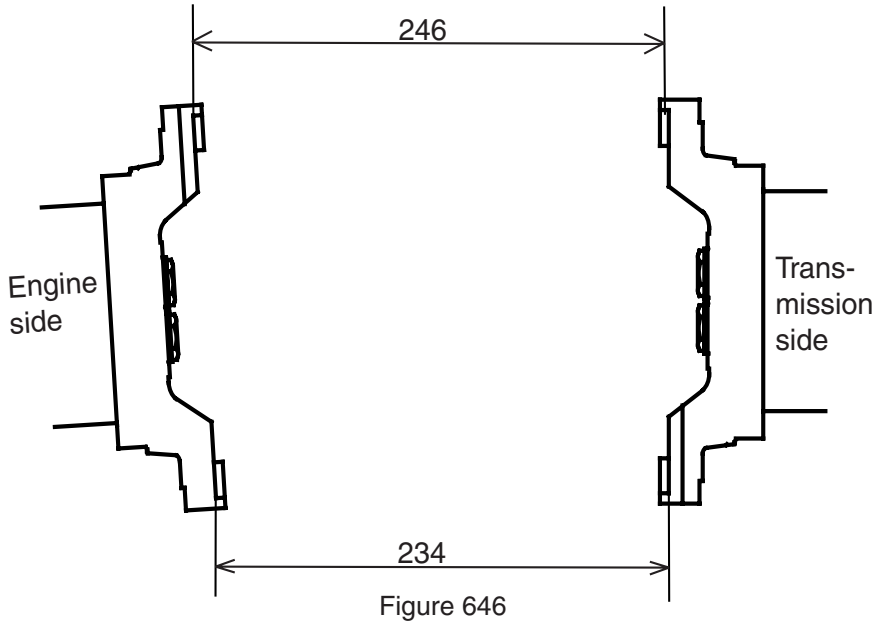
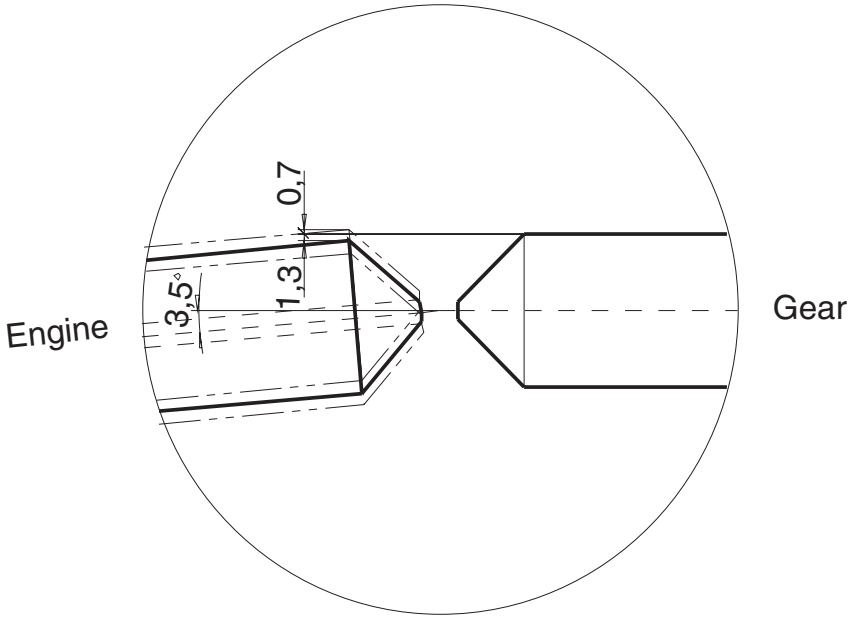


Figure 646



Use 2 tools No:037002 for position control of the flange.
It is very important for the cardan axle lifetime that it is correct.
The valid tolerance at the engine side tool is: + 0,7 - ÷ 1,3 mm.

See figure 647 !

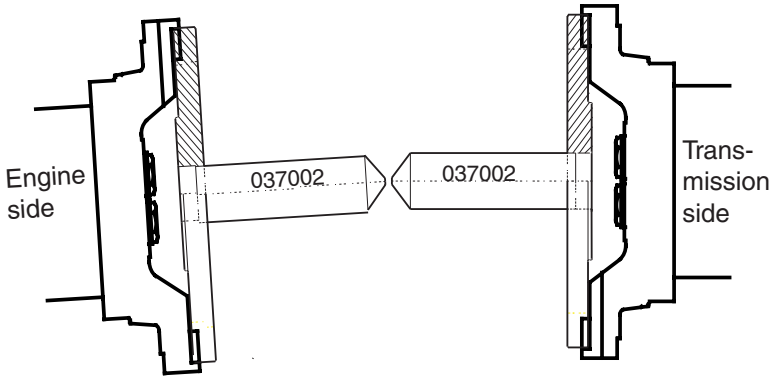


Figure 647

If correction is necessery, following shim are avaliable:

Shims for the rear Transmission bracket:	Part No: 502327 (1,25mm) 502328 (2.00mm)
Shims for the front Transmission bracket:	Part No: 140063 (1,25mm) 140062 (2,00mm)
Shims for the Engine brackets rear:	Part No: 140063 (1,25mm) 140062 (2,00mm)
Shims for the Engine brackets front:	Part No: 509580 (0,50mm) 509550 (1,25mm)

Use locking liquid at the screws and tighten with correct moment.

Finally check the measurement for the axle.

When assembling, brackets use
Loctite 262 or ThreeBond medium 1374 on thread.

Electronic Control unit EST-37A

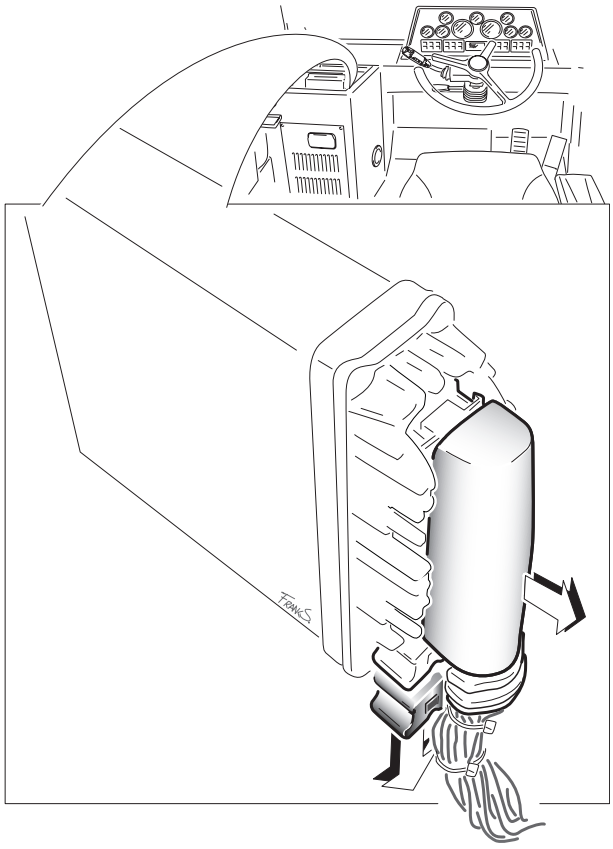
The basic functions of the automatic system are the automatic shifting of gears, adaption of the optimum shifting points, the comprehensive safety functions in relation to operating errors and overloads of the power-transmitting components with a comprehensive fault storage.
Due to the great number of the available TCU, the exact Technical Data must be taken from the respective installation drawing.

Description of the Basic functions:

The Powershift transmission of the Ergopower-Series 6 WG-310 is equipped with the Electronic transmission control EST-37A, developped for it.

The system is processing the desire of the driver according to the following criteria:

- Gear determination dependent on controller position driving speed and load condition.
- Protection from operating error as far as necessary, is possible via electronic protection (programming).
- Protection from over-speeds (on the base of engine and turbine speed).
- Automatic reversing (driving speed-dependent, depending on vehicle type).
- Pressure cut-off possible (vehicle-specific, only after contact with ZF).
- Change-over possibility for Auto- / Manual mode.

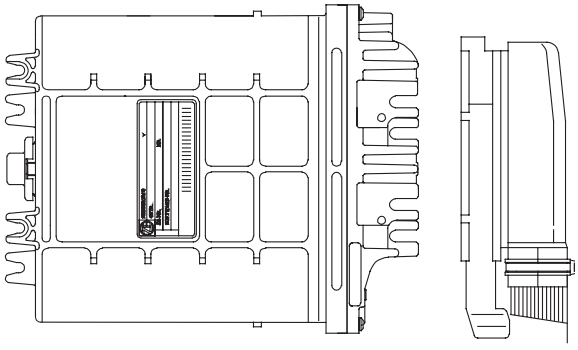


EST-37A; with filterbypass; Smart Software; CAN; engine brake; AutoRetarder; KD only via ED7
(TCU must be ordered separate)

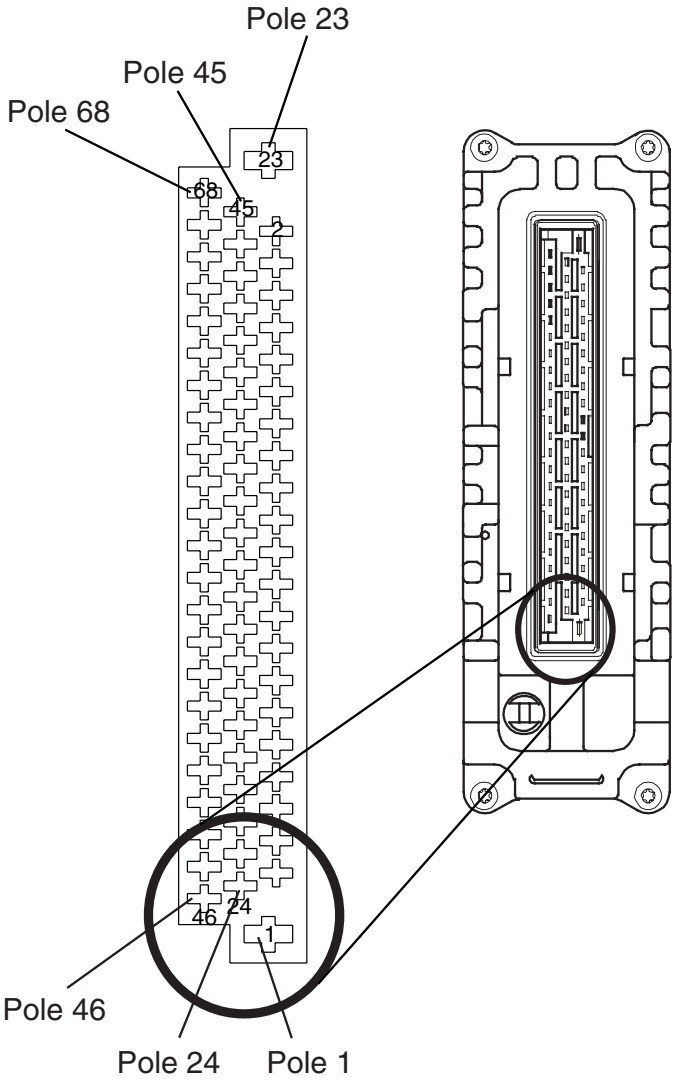
Important parts information

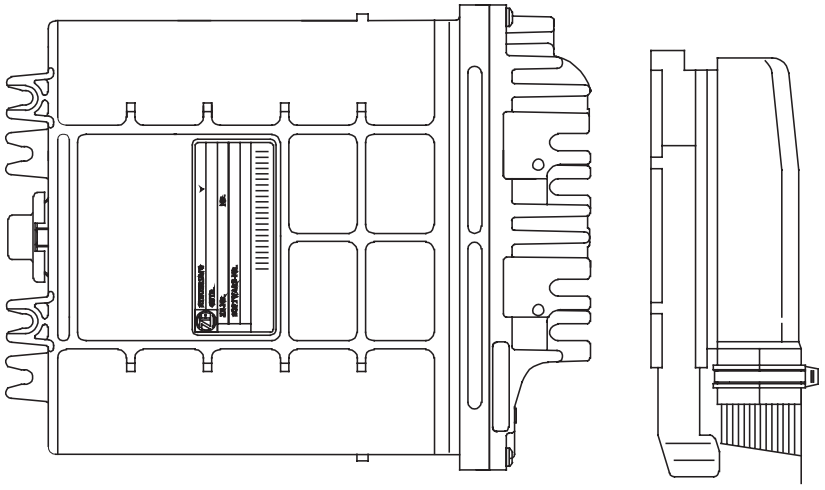
If the Transmission 6WG310 is to be returned to Moxy Trucks AS or ZF for repair or any others reasons, the Transmission controller EST-37A is to be returned together with the Transmission.

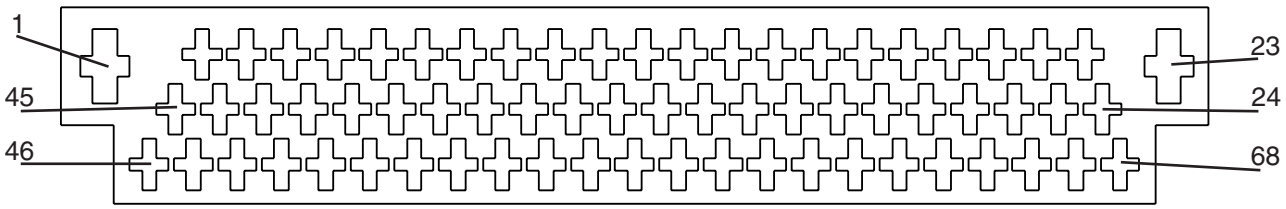
1.
Fasten the controller to the Transmission.
2.
Indicate in the delivery note the serial number of the **Transmission <u>and the controller.</u>**
This information will help us if the controller should be separated from the Transmission under transport.
3.
If the Transmission shoud have a waranty repair at other workshop, it is necessery that the testreport printing are following with the claim.



Pin in contact for the TCU



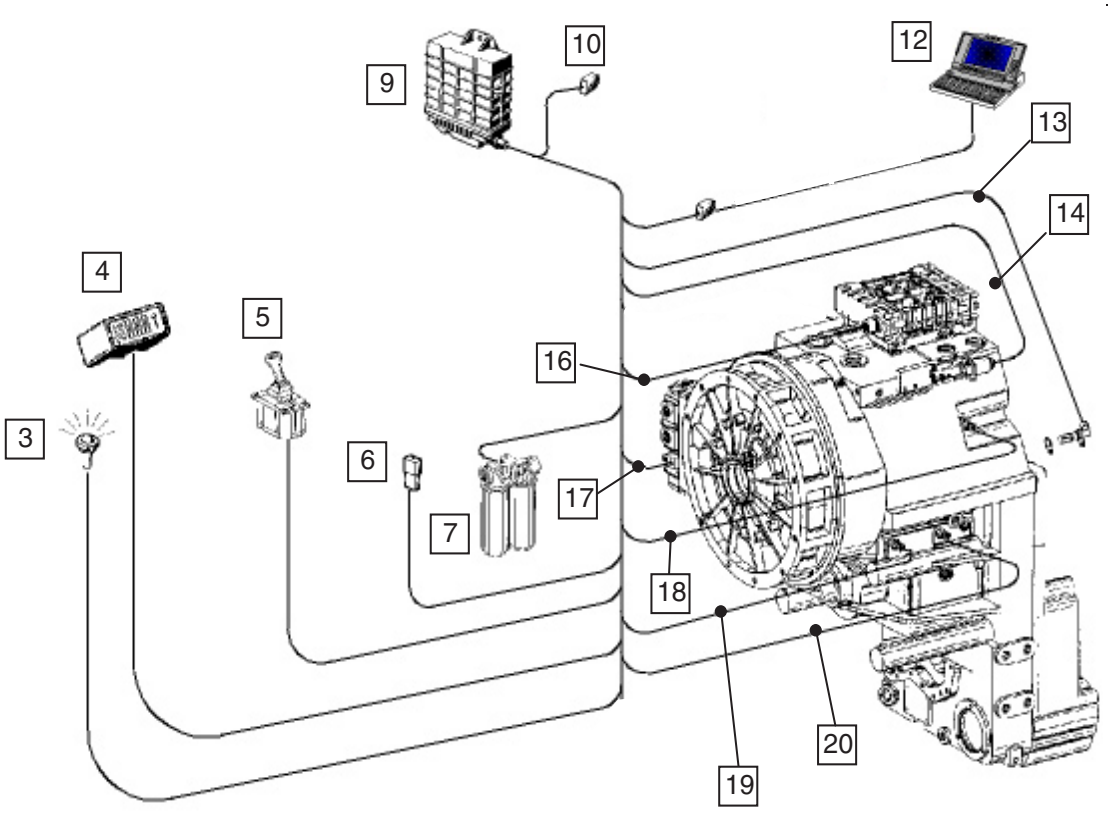




1	Ground connection
2	Ground connection
3	Joint
4	Rpm output shaft
5	Solenoid emergency retarder.
6	Not connected
7	Relay reverse light
8	Terminal block ???
9	Solenoid Y5
10	Solenoid Y1
11	Solenoid diff lock
12	Rpm Engine
13	Rpm Engine
14	Display
15	TCU Diagnosis port
16	Not connected
17	Front frame cable set
18	TCU Diagnosis port
19	Sensor Transmission input shaft
20	Not connected
21	Retarder brake
22	Kick down
23	Fuse transmission controller 30
24	Not connected
25	DEC2 Can-bus
26	DEC2 Can-bus
27	DEC2 Can-bus
28	DEC2 Can-bus
29	Gear selector manu/auto
30	Switch Diff. Lock
31	Not connected
32	Solenoid Y3
33	Solenoid Engine brake
34	Lock up light

35	Not connected
36	Speedometer
37	Not connected
38	Not connected
39	Temp sensor sump (156)
40	Not connected
41	Turbine RPM
42	Internal gear chain RPM
43	Gear selector forward
44	Engine brake
45	Relay TCU supply and control back up light
46	Temp sensor retarder
47	Not connected
48	Not connected
49	Temp sensor retarder
50	Not connected
51	Solenoid Y6
52	Main alarm
53	Terminal block ???
54	Not connected
55	Solenoid Y4
56	Solenoid Y2
57	Solenoid retarder
58	Not connected
59	Not connected
60	Not connected
61	Not connected
62	RPM output shaft
63	Gear selector T+
64	Gear selector Reverse
65	Gear selector T-
66	Gear restriction
67	Relay supply parking brake alarm
68	Fuse transmission controller 30

Family package of the EST-37A



Legend ref. Figure

3 = Warning lamp

4 = Display

5 = Controller VST-3

6 = Supply system connection

7 = Fine filter with maintenance switch / Cable to filter contamination switch

9 = Electro control unit EST37

10 = CAN-connection

12 = Diagnosis Laptop with ZF-Diagnostic system Testmann and AEB

13 = Cable to speed sensor output and speedometer

14 = Cable to lock-up

16 = Cable to Electro hydraulic control with proportional valves

17 = Cable to temperature measuring point behind the converter

18 = Cable to inductive transmitter – speed engine

19 = Cable to inductive transmitter – speed turbine

20 = Cable to inductive transmitter – speed central gear train

Electro-hydraulic shift control unit

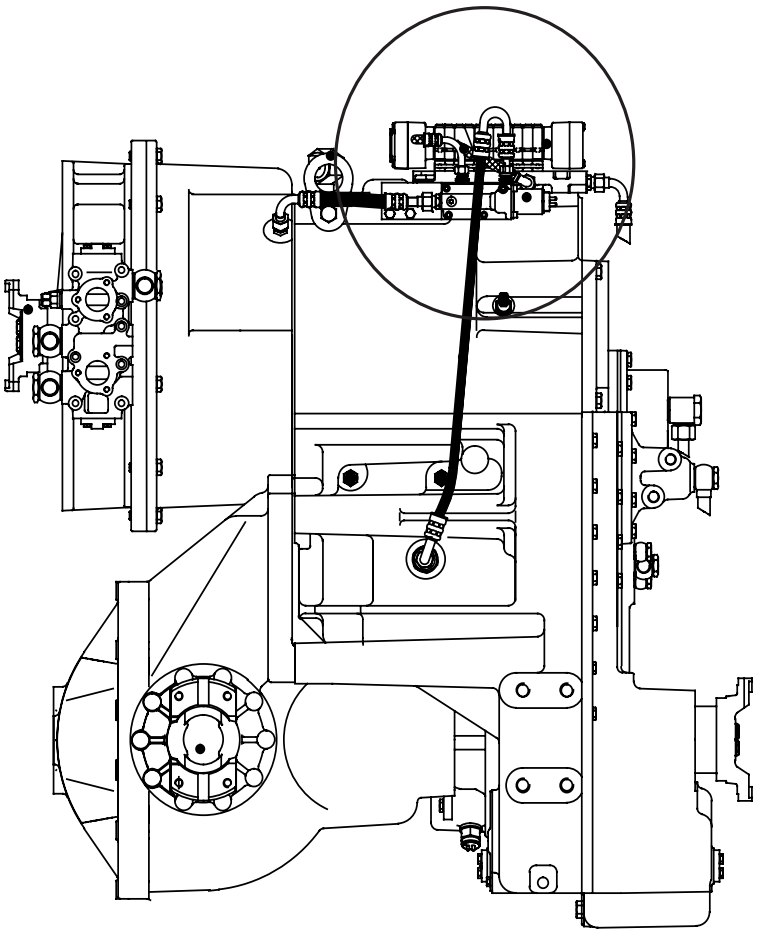
Transmission control:

The six clutches of the transmission are selected via the 6 proportional valves P1 to P6.
The proportional valve (pressure regulator unit) is composed of pressure regulator (e.g. Y6), follow-on slide and vibration damper.
The control pressure of 9 bar for the actuation of the follow-on slides is created by the pressure reducing valve.
The pressure oil (16+2 bar) is directed via the follow-on slide to the re-spective clutch.
Due to the direct proportional selection with separate pressure modulation for each clutch, the pressures to the clutches, which are engaged in the gear change, will be controlled. In this way, a hydraulic intersection of the clutches to be engaged and disengaged will become possible.
This is creating spontaneous shiftings without traction force interruption.

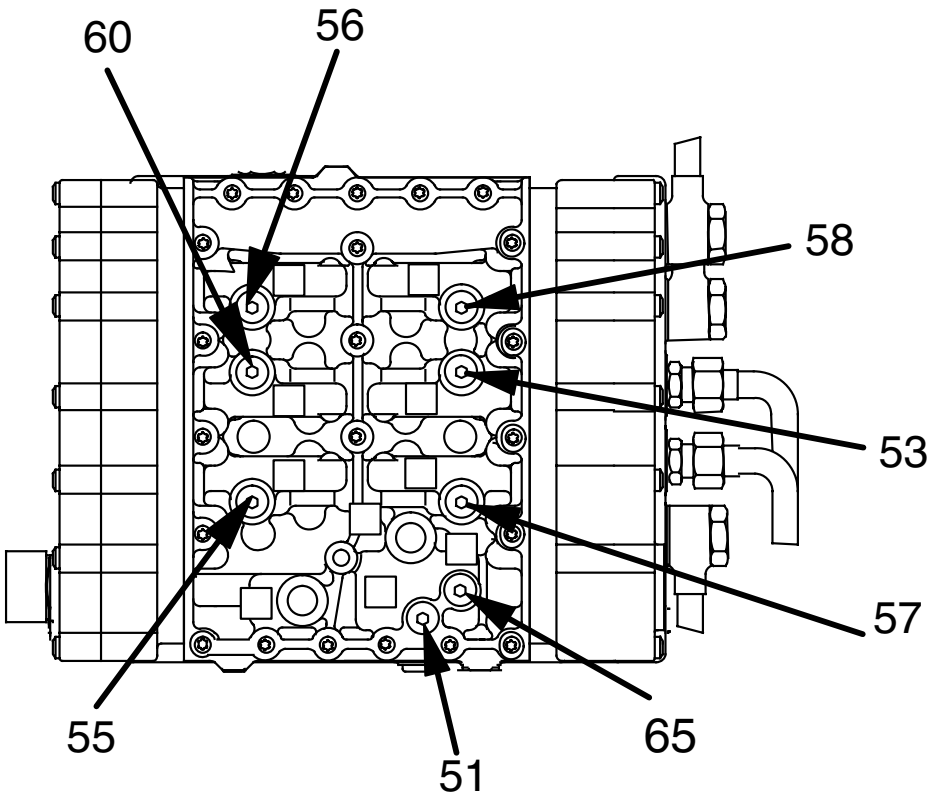
At the shifting, the following criteria will be considered:
- Speed of engine, turbine, central gear train and output.
- Transmission temperature.
- Shifting mode (up-, down-, reverse shifting and gear engagement out of Neutral).
- Load condition (full and part load, traction, thrust, inclusive consideration of load cycles during the gear change).

The main pressure valve is limiting the max. control pressure to 16+2 bar and releases the main flow to the converter and lubricating circuit.
In the inlet to the converter, a converter safety valve is installed which protects the converter from high internal pressures (opening pressure 8,5 bar).
Within the converter, the oil serves to transmit the power according to the well-known hydro-dynamic principle

See in the section: DESCRIPTION / Function of the Converter.



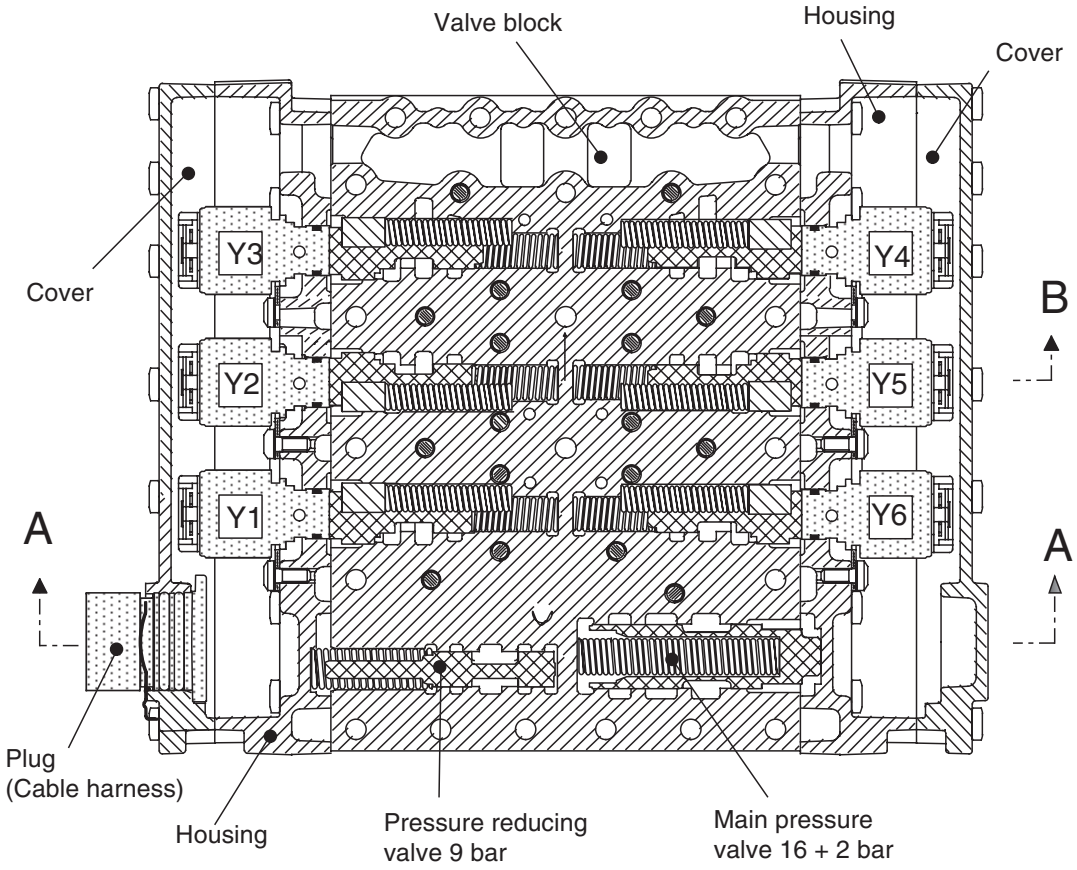
Electro-hydraulic control unit HSG-94

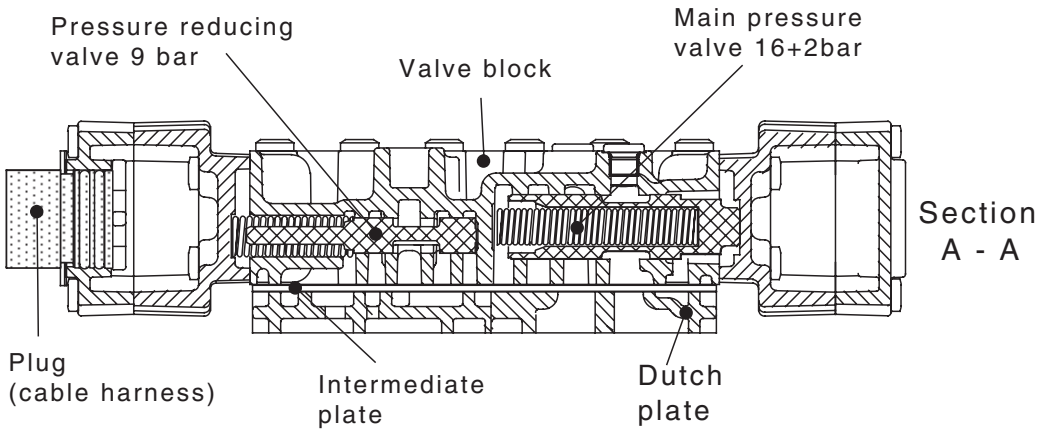


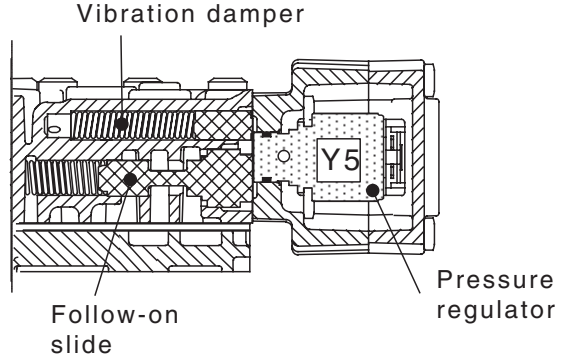
	Measuring point
51	In front of conv. – opening pressure
53	Clutch forward
55	Clutch reverse
56	Clutch K1
57	Clutch K2
58	Clutch K3
60	Clutch K4
65	System pressure

Electro hydr. shift control valve, cross section

The following drafts are showing the sectional Illustrations of the HSG-94







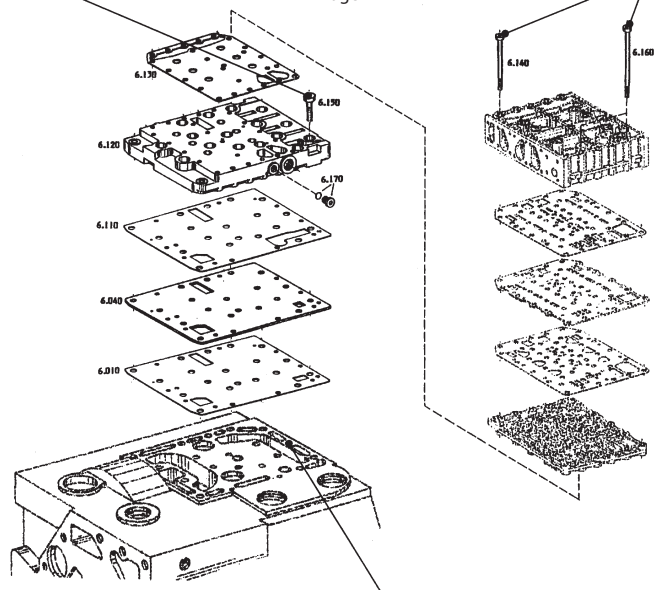
Section B - B
Proportional
valve P5

504254

Tool for the Electro-hydraulic
Control unit HSG-94

504253

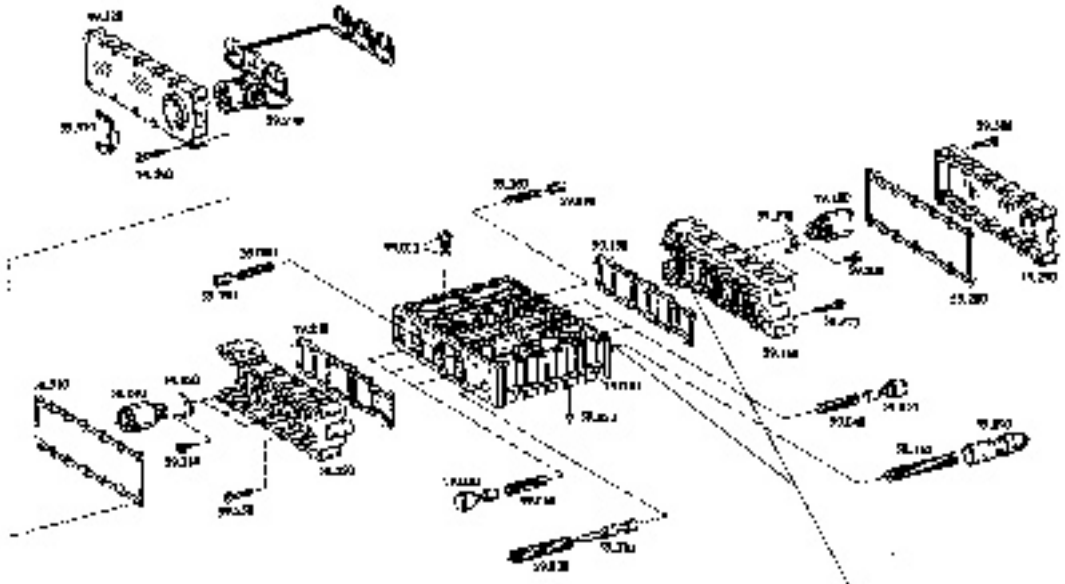
Page 1



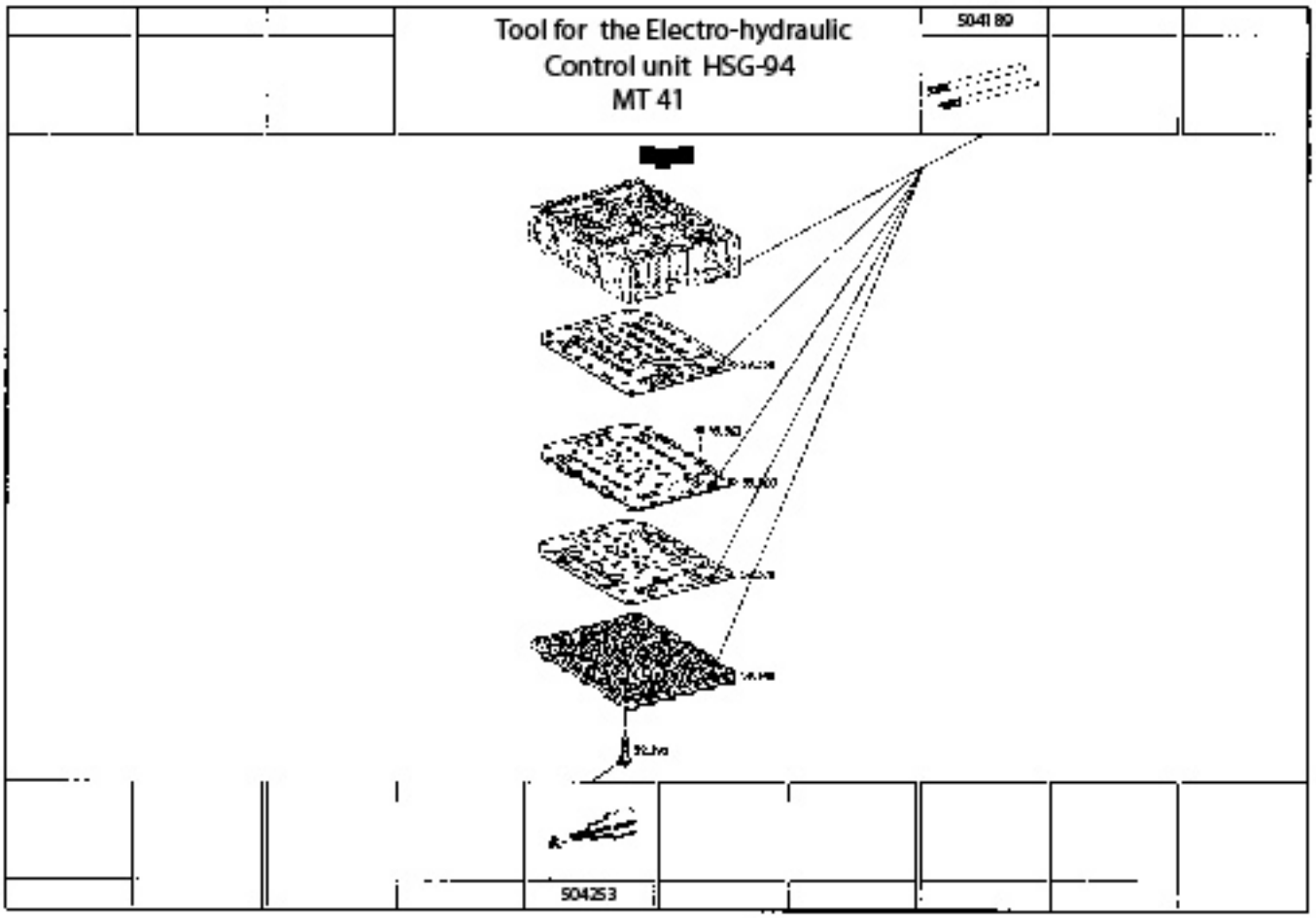


504185

Tool for the Electro-hydraulic
Control unit HSG-94
MT 41



504188


Tool for the Electro-hydraulic
Control unit HSG-94
MT 41
504189
504253

DISASSEMBLY

Summary for the Tool, see chapter 2.0

Loosen socket head screws and remove selector housing.

(S) Box spanner TX-27 504253

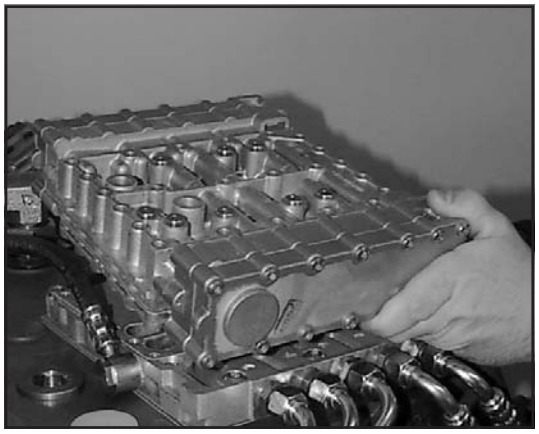


Figure1

Separate hose lines from the intermediate plate.
Loosen socket head screws and separate intermediate plate as well as gaskets and intermediate sheet from gearbox housing.

(S) Box spanner TX-40 504254

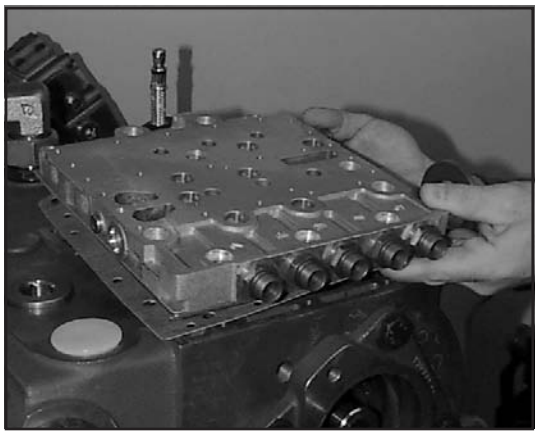


Figure 2

Mark installation position of the cable harness to the valve block.

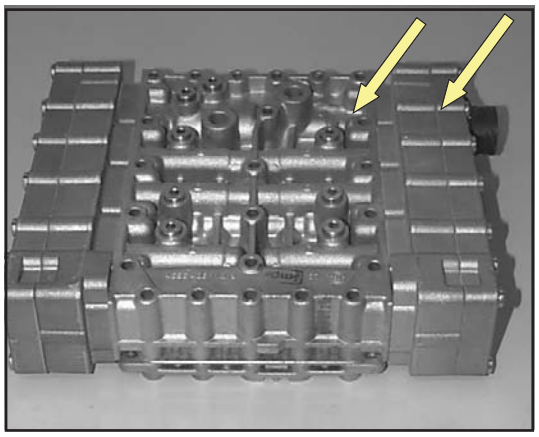


Figure 3

Loosen socket head screws.

Separate duct plate, gaskets and intermediate sheet from the valve block.

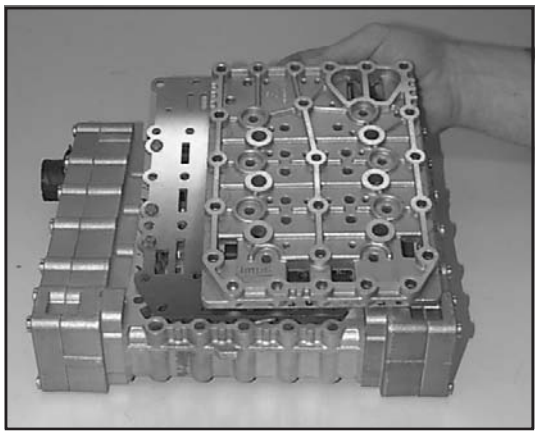


Figure 4

Remove retaining clip.

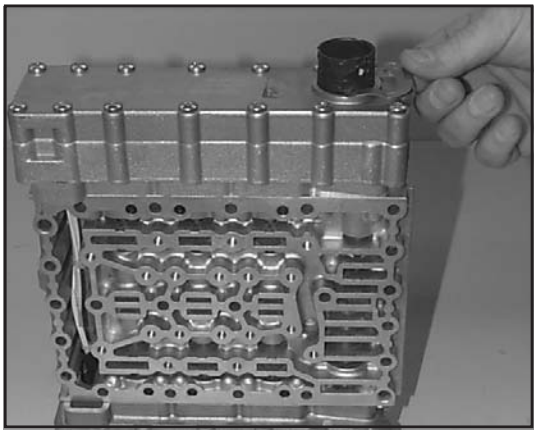


Figure 5

Losen socket head screws and remove cover.
Demount opposite cover.

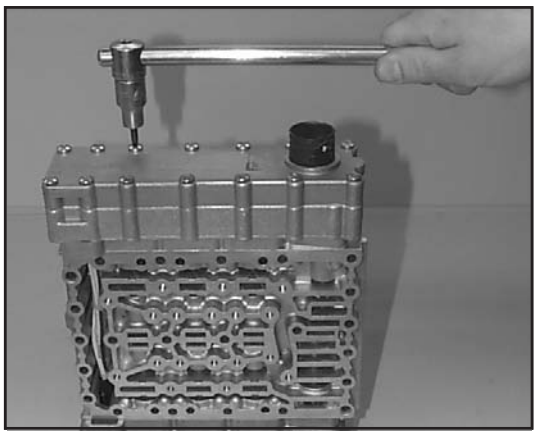


Figure 6

Demount pressure regulator and remove cable harness.

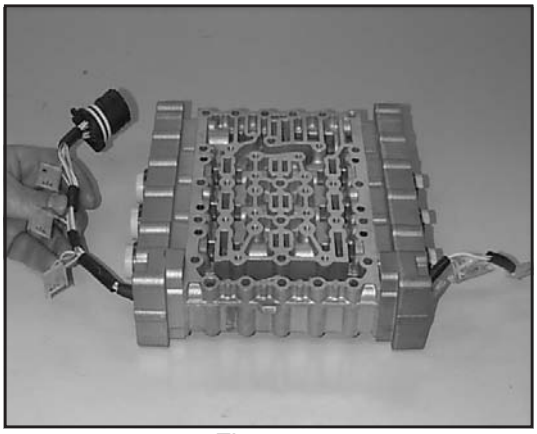


Figure 7

Loosen socket head screws, remove retaining plates and demount pressure regulator.

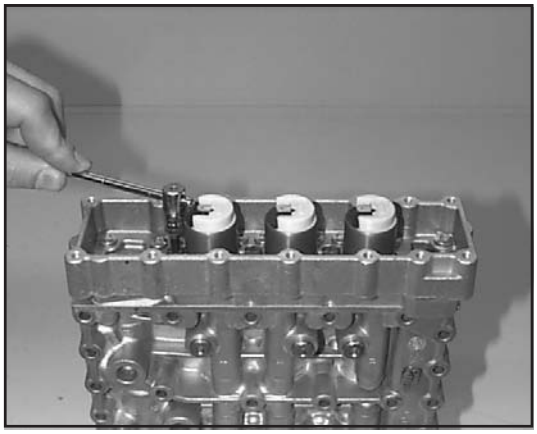


Figure 8

Loosen two socket head screws and locate the housing provisionally by means of adjusting screws.

(Housing is spring-loaded).
Now, loosen the remaining socket head screws.

(S) Adjusting screws 504188

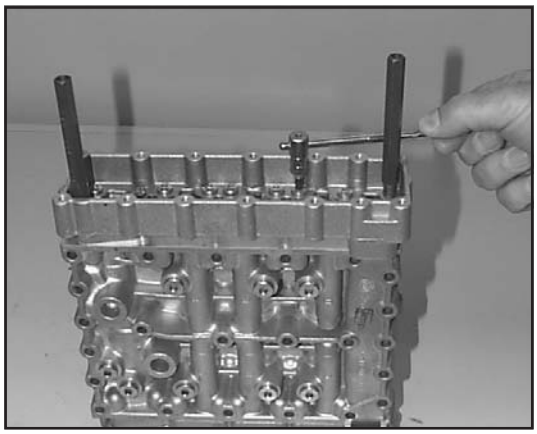


Figure 9

Separate housing from valve body by uniform loosening of the adjusting screws.

(S) Adjusting screws 504188

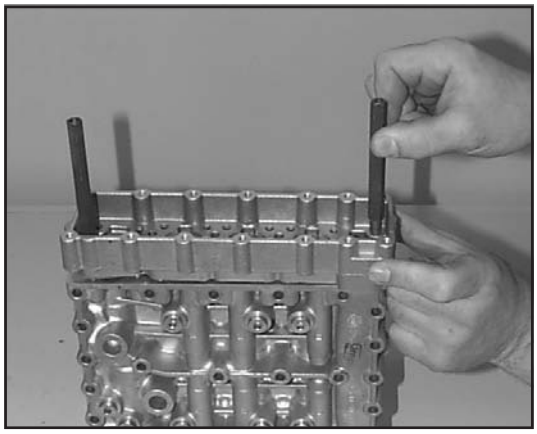


Figure 10

Remove components.

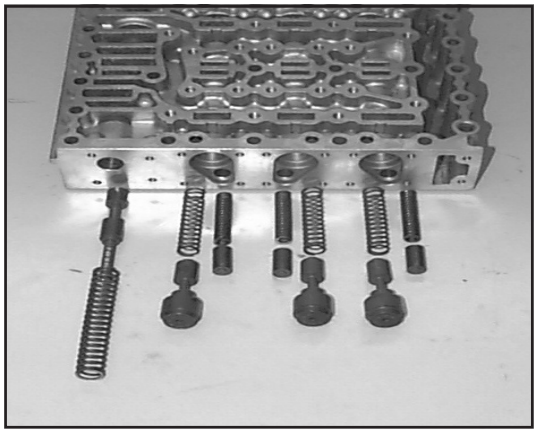


Figure 11

Remove opposite pressure regulators, housing as well as compo-nents accordingly.

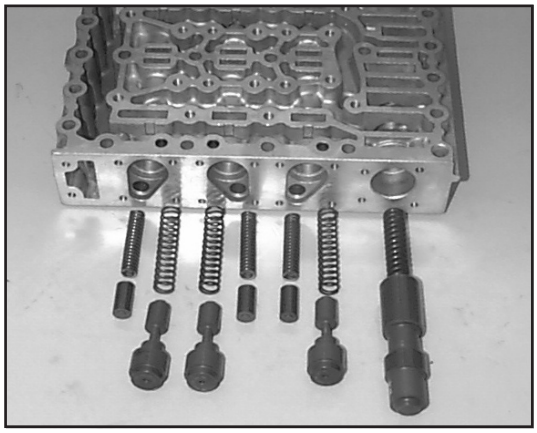


Figure 12

ASSEMBLY

Check all components for damage and renew if necessary !
Prior to the installation, check the free travel of the moving parts in the housing !
Spools can be exchanged individually !
Prior to the assembly, oil the components according to ZF-List of lubricants TE-ML 03 !

Insert orifices with the concave side showing upward, until contact is obtained !

Installation position, see Arrows !

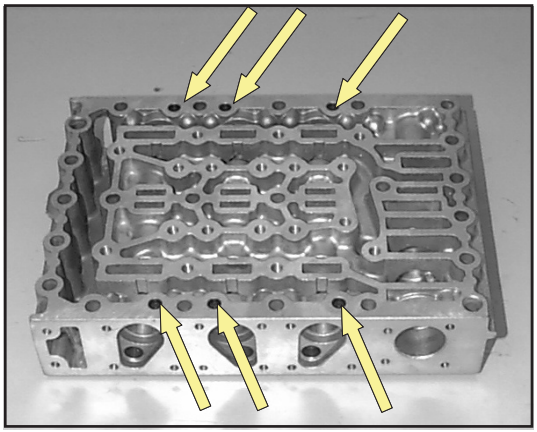


Figure13

The Figure on the left shows the following components:

1 = Vibration damper (3x spool and compression spri
2 = Follow-on slide (3x spool and compression spri
3 = Pressure reducing valve (1x spool and compression spri

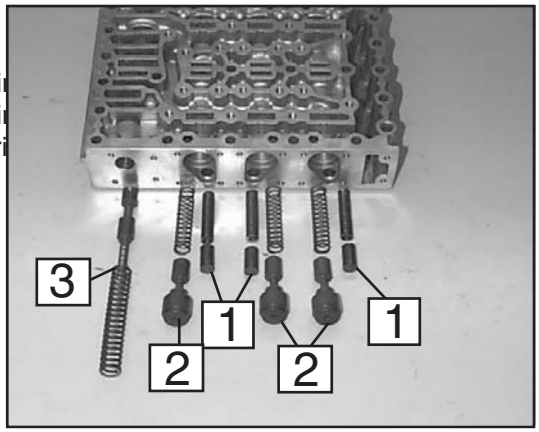


Figure 14

Install components according to Figure 14.

Preload the compression springs of the follow-on slides and locate the spools provisionally by means of cylindrical pins ∅ 5,0 mm (assembly aid), see Arrows/Figure 15 !

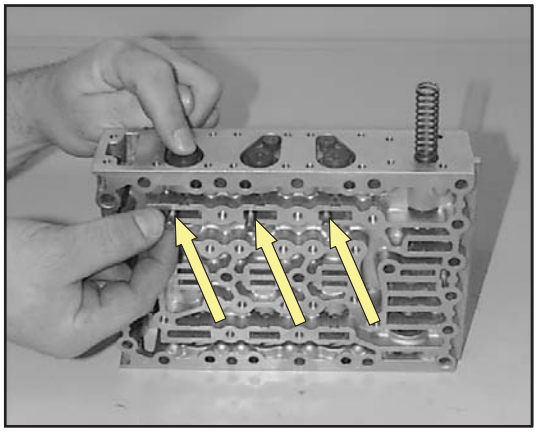


Figure 15

Install two adjusting screws.

Line up flat gasket (Arrow) and housing cover (see Figure16).

Now, bring housing cover by means of adjusting screws uniformly against shoulder (Figure 17).

(S) Adjusting screws 504188

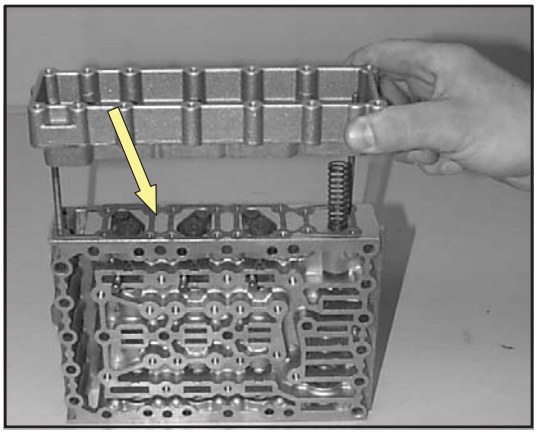


Figure 16

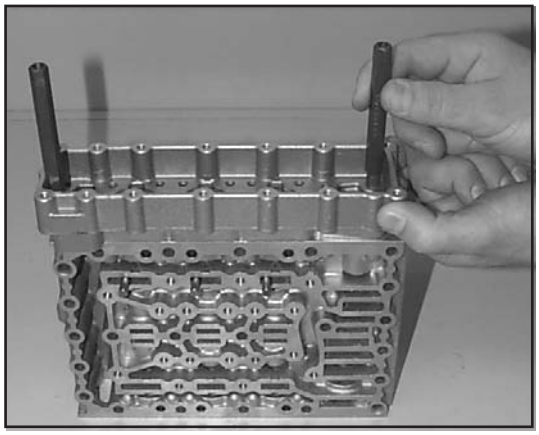


Figure17

Preload spool and remove the cylindrical pins (assembly aid) again.

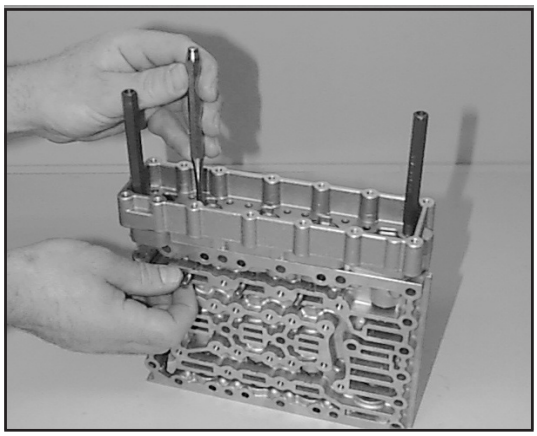


Figure 18

Fasten housing cover by means of socket head screws.

Torque limit..... 5,5 Nm

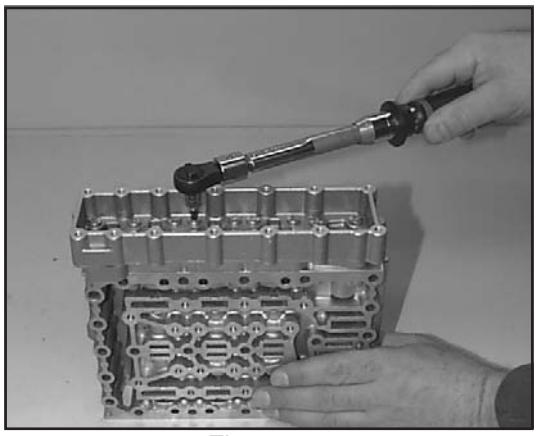


Figure 19

Introduce pressure regulators and fix them by means of retaining plates and socket head screws.

Install retaining plates, with the claw showing downward !
Pay attention to the radial installation position of the pres-sure regulators, see Figure !

Torque limit ..... 5,5 Nm

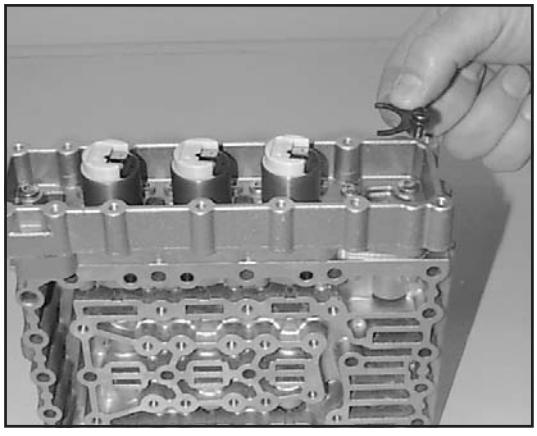


Figure 20

Pre-assemble opposite side

The Figure on the left shows the following components:

1 = Main pressure valve (1x spool and compression spring)
2 = Follow-on slide (3x spool and compression spring)
3 = Vibration damper (3x spool and compression spring

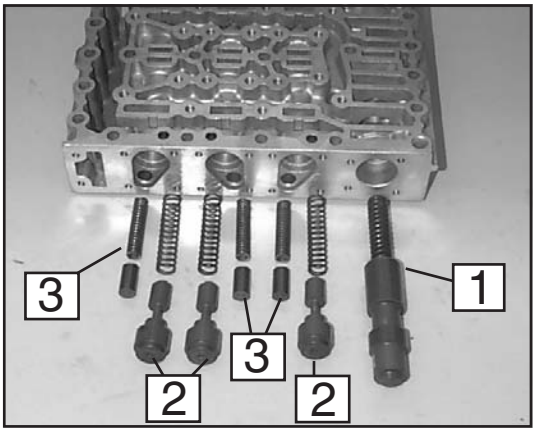


Figure 21

Install components according to Figure 21.

Preload compression springs of the follow-on slides and fix the spools provisionally with cylindrical pins Æ 5 mm (assembly aid), see Arrows !

Install two adjusting screws.

Line up flat gasket (Arrow 1) and housing cover and bring them uniformly against shoulder, using adjusting screws.

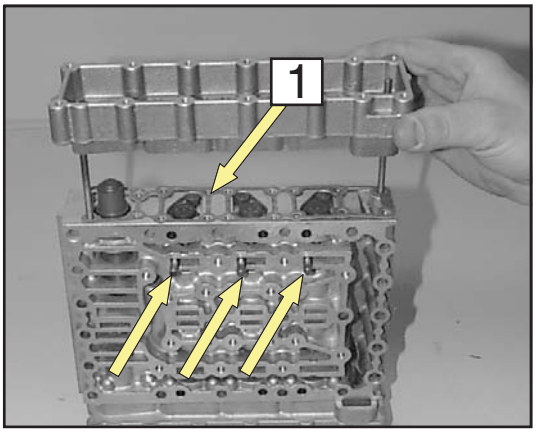


Figure 22

Now, fasten housing cover by means of socket head screws.

Torque limit ..... 5,5 Nm

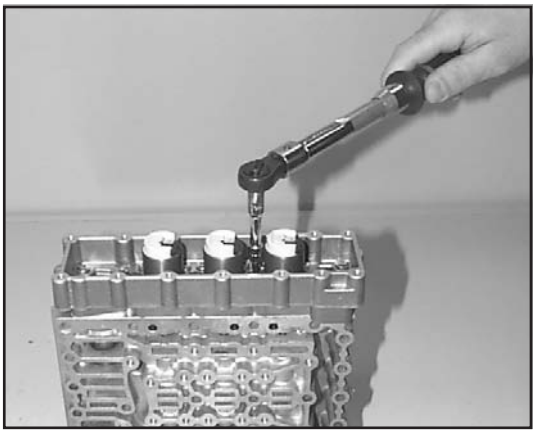
Remove cylindrical pins (assembly aid) again.

(S) Adjusting screws 504188

Introduce pressure regulators and fix them by means of retain-ing plates and socket head screws.

Install retaining plates, with the claw showing downward !
Pay attention to the radial installation position of the pres-sure regulators, see Figure !

Torque limit ..... 5,5 Nm


Figure 23

Introduce cable harness and connect pressure regulators (6x).

Pay attention to the installation position of the cable harness, see also markings (Figure 3) !

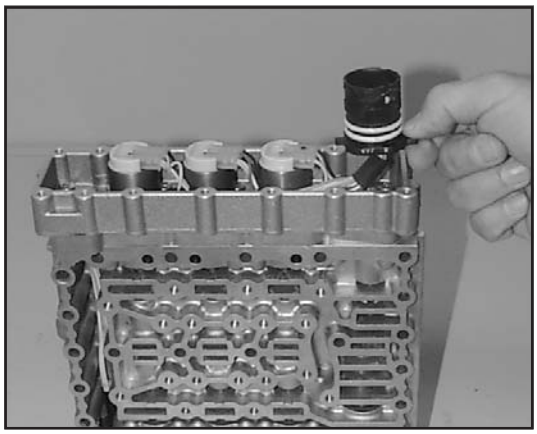


Figure 24

Mount flat gasket (Arrow).

Introduce femal connector, with the groove facing the guide nose of the cover, until contact is obtained.

Fasten cover with socket head screws.
Torque limit ..... 5,5 Nm

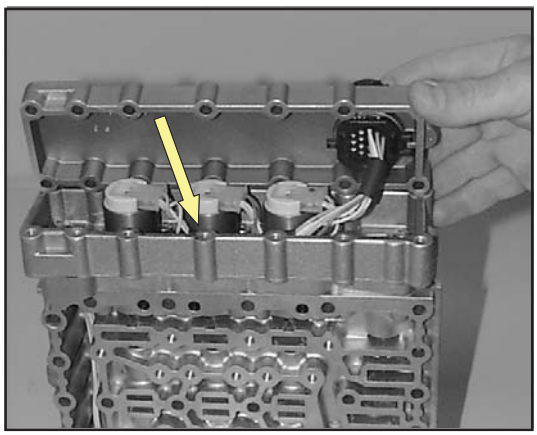


Figure 25

Locate the femal connector by means of retaining clip.

Install opposite cover.

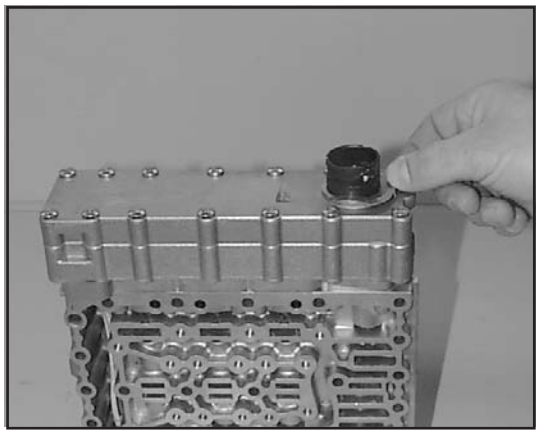


Figure 26

Install two adjusting screws and mount gasket I.

Pay attention to the different gaskets, see Figure 27 and 30 !

(S) Adjusting screws M6 504189

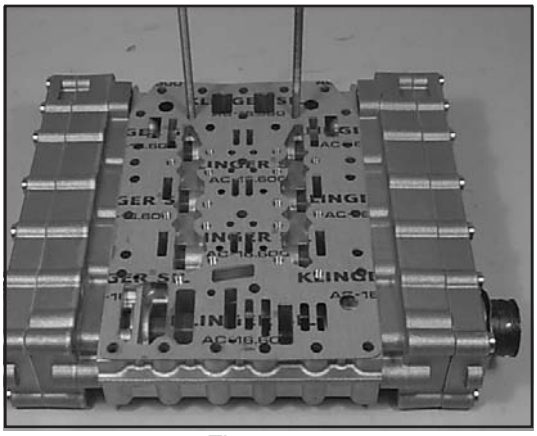


Figure 27

Intermediate plate – Version with strainers:

Insert strainers (6x) flush-mounted into the bores of the intermediate plate, see Arrows !

Pay attention to the installation position – strainers are showing upward (facing the duct plate) !

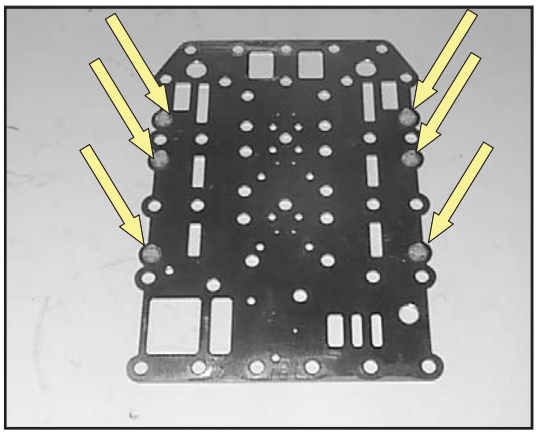


Figure 28

Mount intermediate with the strainers showing upward.

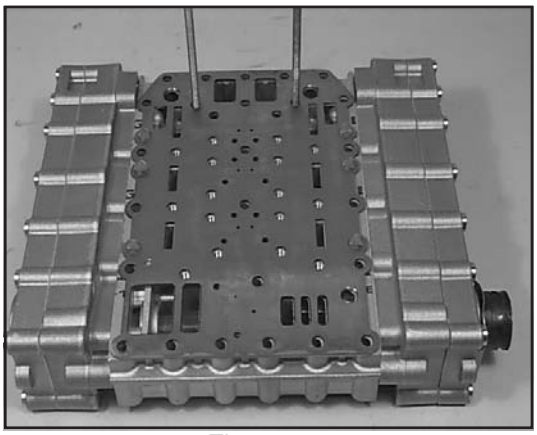


Figure 29

Mount gasket II.

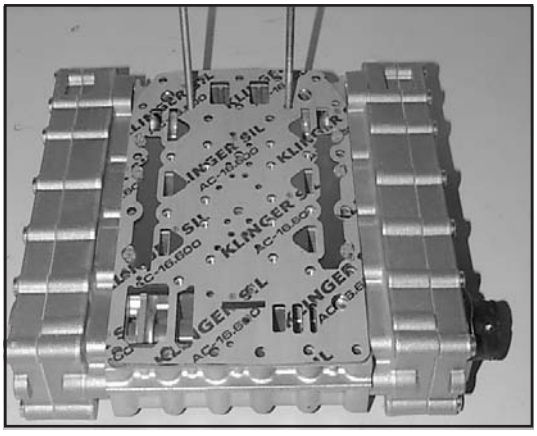


Figure 30

Mount duct plate (Arrow) and fasten it uniformly by means of socket head screws.

Torque limit ..... 11 Nm

(S) Box spanner TX-27 504253

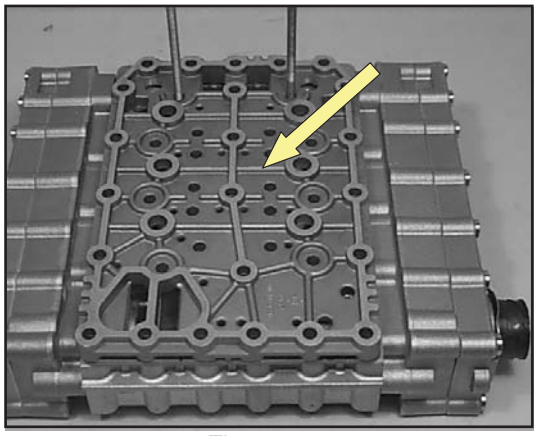


Figure 31

Equip screw plugs (8x) with new O-rings and install them.

Torque limit ..... 6 Nm

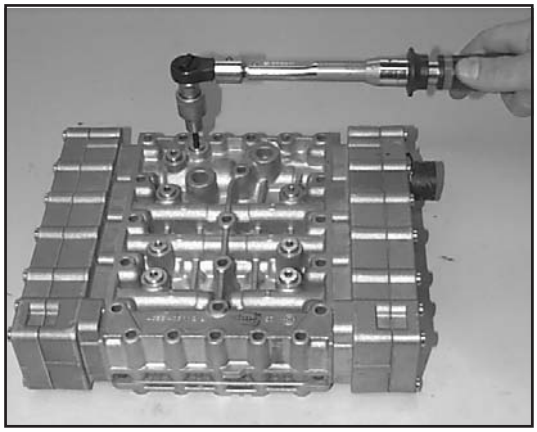


Figure 32

Attach Hydraulic control unit (HSG-94) (Figure 33 ... 40)

Screw orifice into the housing bore (Arrow) and secure it by means of center punch !

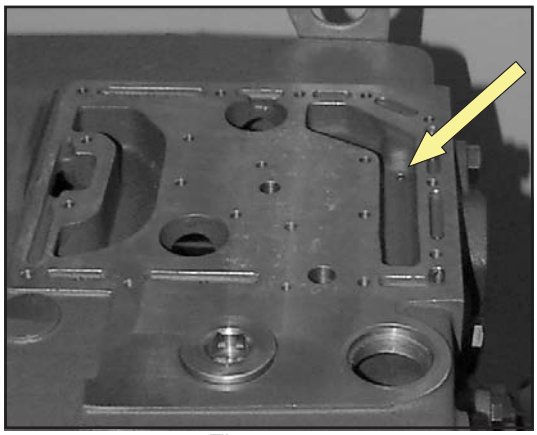


Figure 33

Install connecting fittings 1 ... 6.

Install screw plugs 7.

Torque limit Connecting fittings..... Nm
Torque limit Screw plugs (M10x1) ..... 6 Nm

Install always new O-rings !

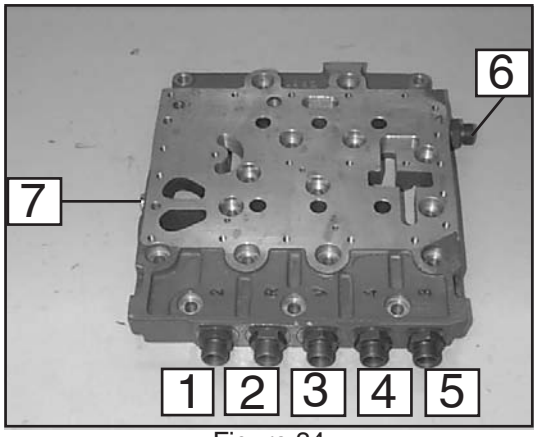


Figure 34

Install two adjusting screws (M8) and mount housing gasket.

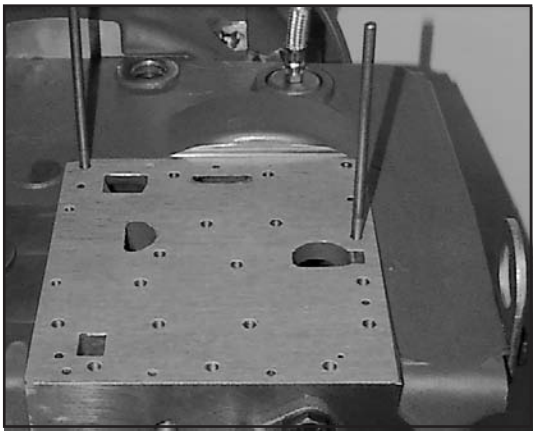


Figure 35



At the following steps (Figure 35 ... 39), pay attention to the installation positions of the different gaskets !

(S) Adjusting screws M8 504185

Mount intermediate plate.

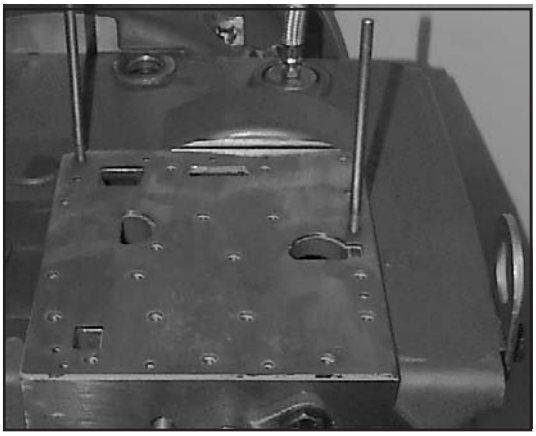


Figure 36

Mount 2nd gasket.

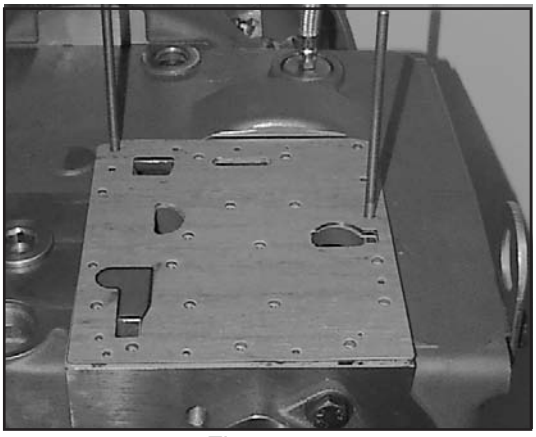


Figure 37

Mount plate and fasten it uniformly by means of socket head screws.

Torque limit (M8/10.9) ..... 23 Nm

(S) Box spanner TX-40 504254

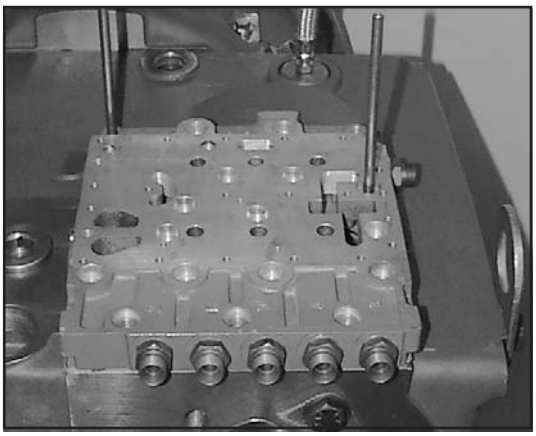


Figure 38

Install 2 adjusting screws (M6).

Mount gasket (Arrow).

(S) Adjusting screws M6 504189

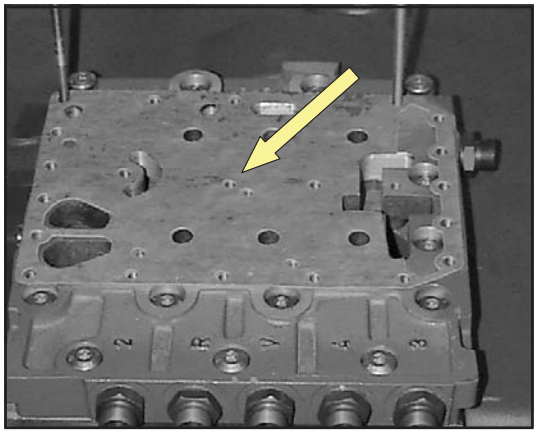


Figure 39

Fasten complete valve block uniformly with socket head screws (2 pieces M6 x 105 and 21 pieces M6 x 80 mm).

Pay attention to the position of the two socket head screws (M6 x 105), see Arrows !

Torque limit ..... 11 Nm

(S) Box spanner TX-27 504253

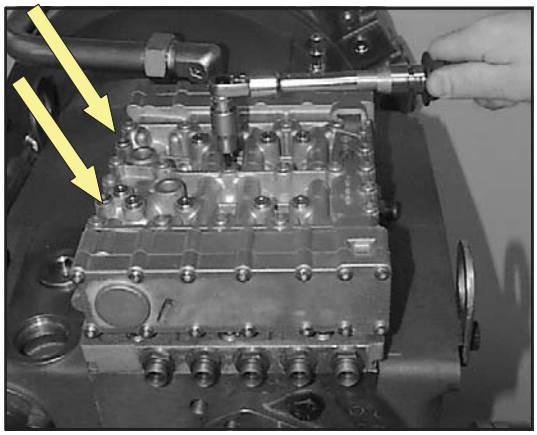
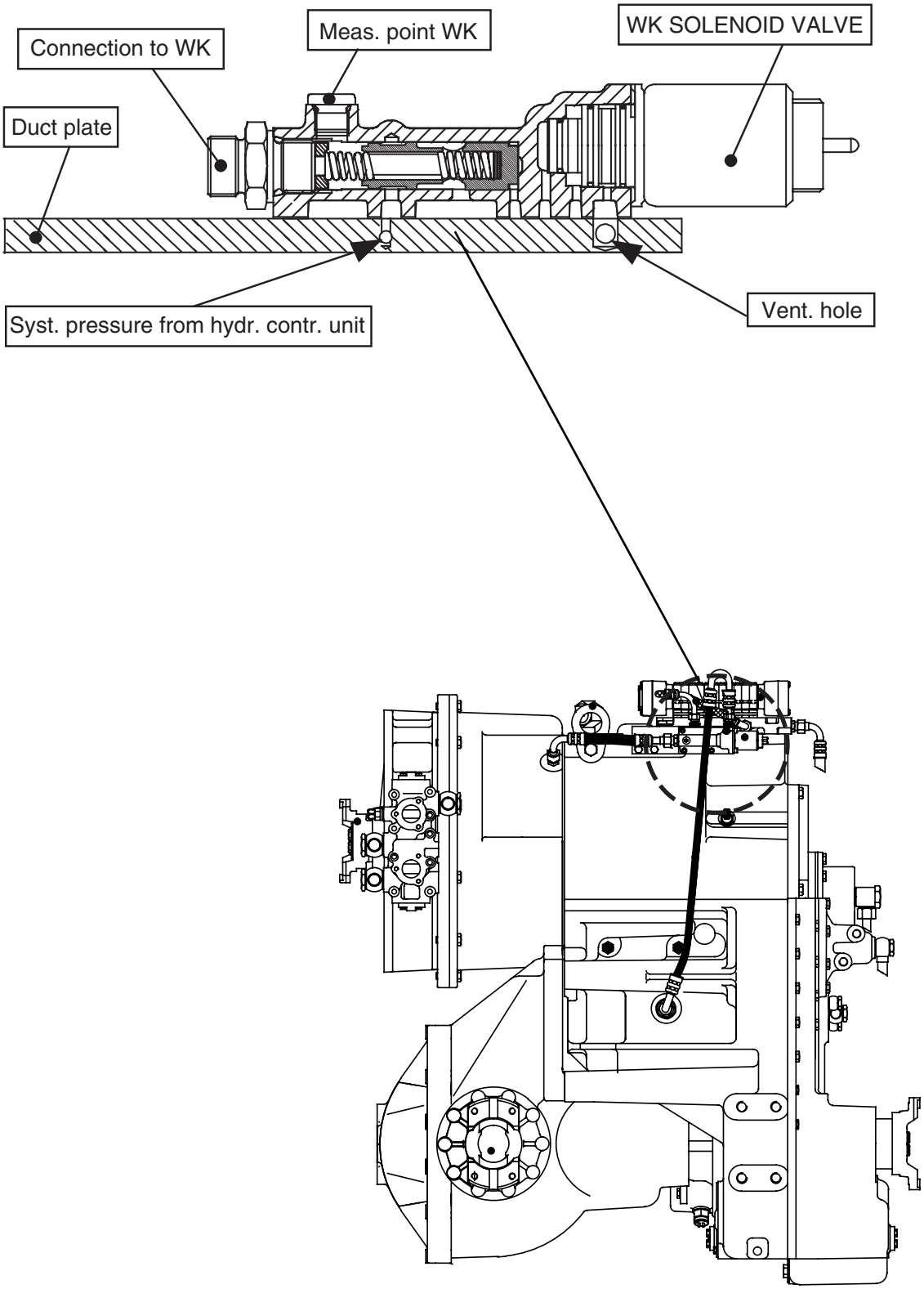


Figure 40

WK-Valve

WK Solenoid shift valve



DISASSEMBLY

Remove hose lines.

Loosen hex. head screws and separate WK-valve from housing

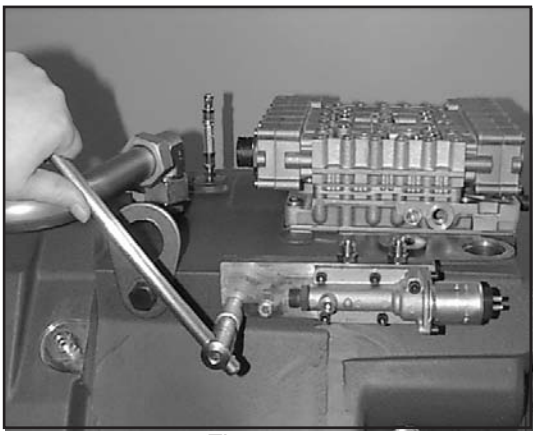


Figure 41

Loosen socket head screws, separate selector housing from adapter plate, and remove components.

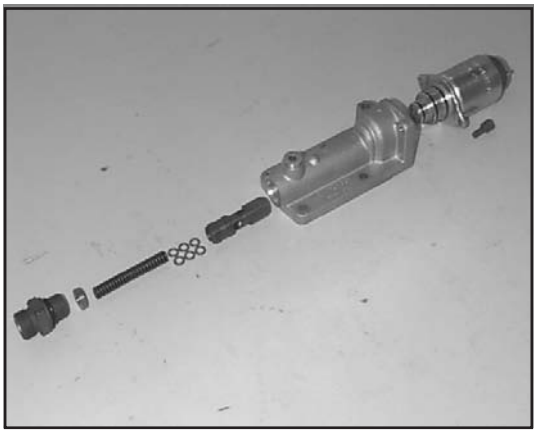


Figure 42

ASSEMBLY

Insert set screw 1 with Loctite (Type-No. 649).
Equip both connecting fittings 2 with new O-rings and install them.

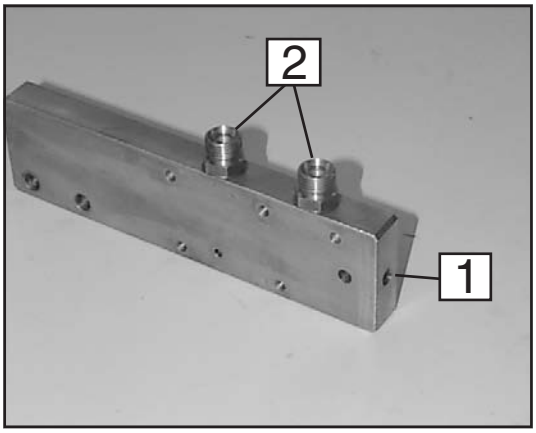


Figure 43

Install WK-Valve components according to the Figure on the left.
1 = Solenoid valve
2 = Socket head screw + Spring washer (2x)
3 = Selector housing
4 = Piston
5 = Shim rings (empirical value, 6 units/0,5 mm thick, each)
6 = Compression spring
7 = Stop (optional, empirical value A = 3,0 mm)
8 = Connecting fitting (install new O-ring)

With the shim rings 5 and the stop 7, the WK pressure 13 ±1 bar will be determined !
Install stop 7, with the stepped plane face facing the com-pression spring !

Torque limit socket head screws (M5/8.8) .... 5,5 Nm

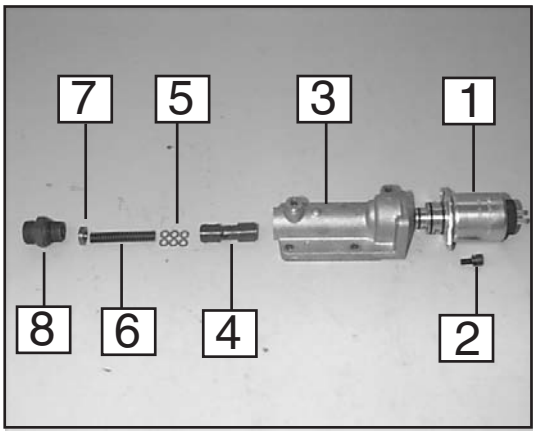
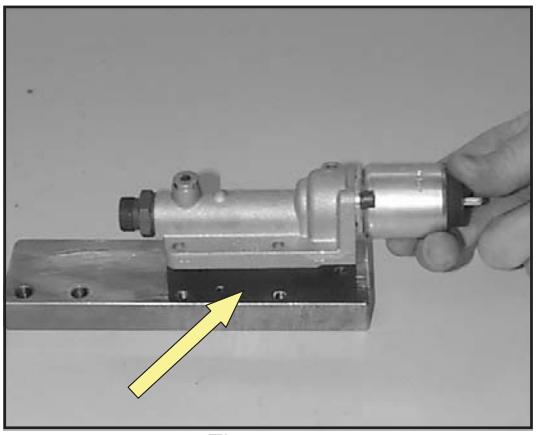


Figure 44

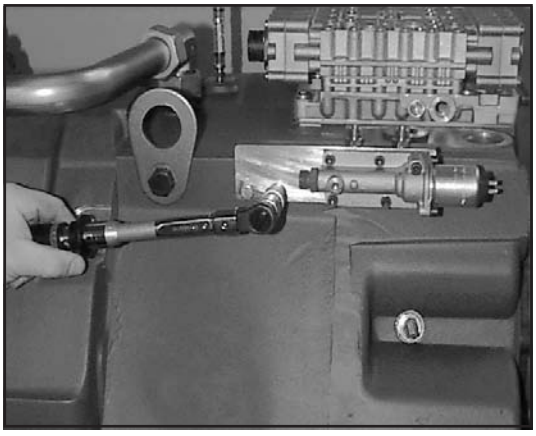
Mount gasket (Arrow) and fasten selector housing by means of socket head screws (mount flat washers).

Torque limit (M6/8.8) ..... 9,5 Nm


Figure 45

Fasten WK-valve on the gearbox housing, using hex. head screws.

Torque limit (M8/8.8) ..... 23 Nm


Figure 46

Retarder

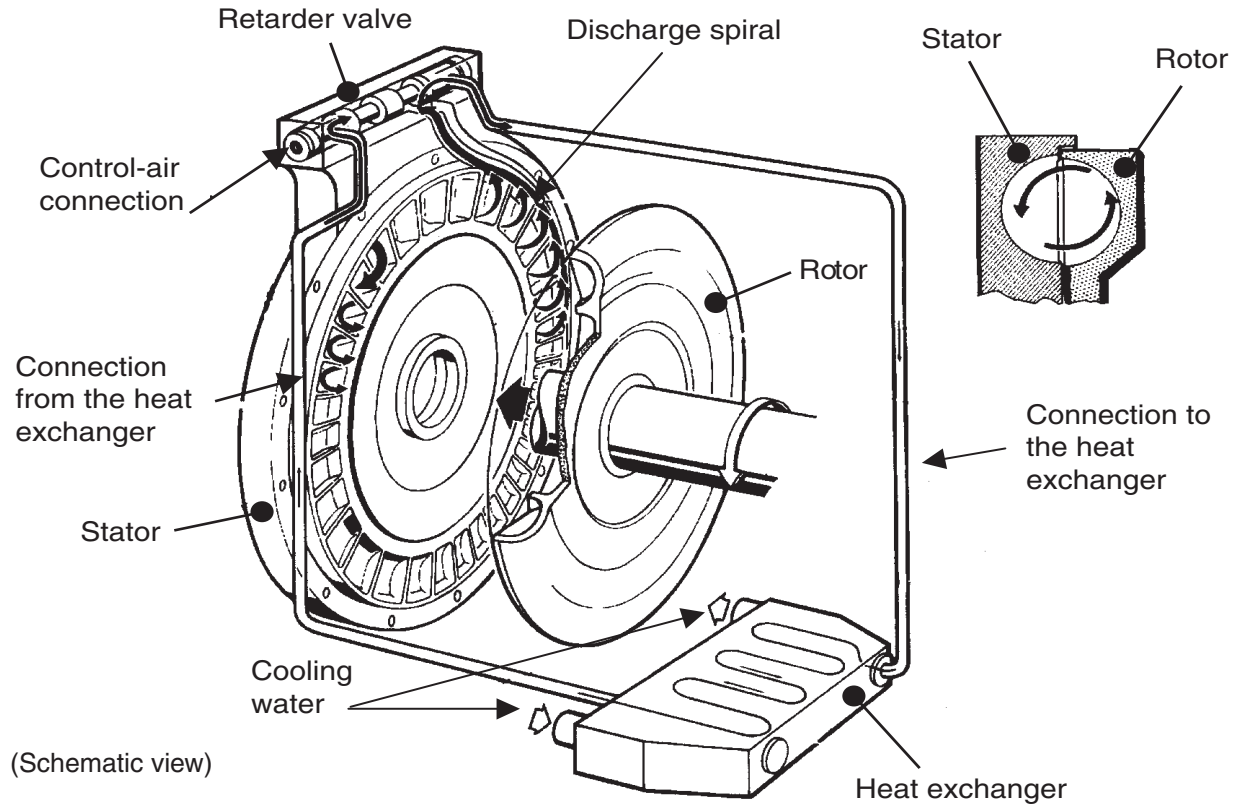
Function of a retarder

General:

The hydrodynamic Retarder (fluid brake), installed upon request, is arranged between engine and torque converter thus achieving a good braking effect in all gears.
The Retarder is a wear-free, gear-depending acting hydrodynamic-brake.
The application of the Retarder is therefore especially to recommend at longer downgrade drives or to brake down out of high driving speeds, because in this way, the service brake will be saved and in an emergency case, the full braking effect (no fading) of the service brake will be disponible.
This is the case of a so-called primary retarder, i.e. it is positively engaged with the engine. Therefore, in the lower gear, higher braking moments can be achieved then in the correspon-ding higher gears.
Because of this fact, it is necessary that the installed WK must be closed, so that the full retarder moment can become effective.

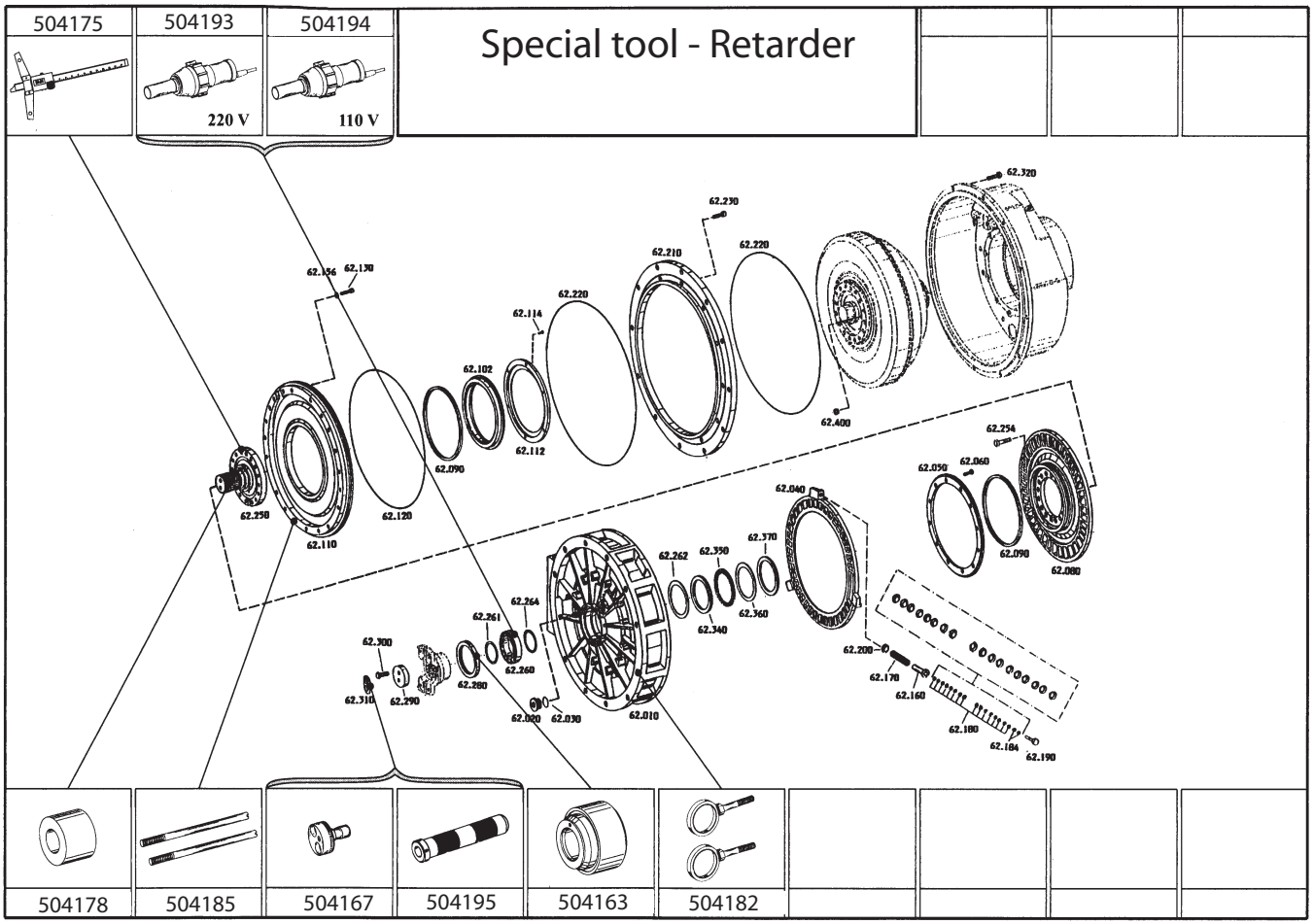
Layout and Function of the Retarder:

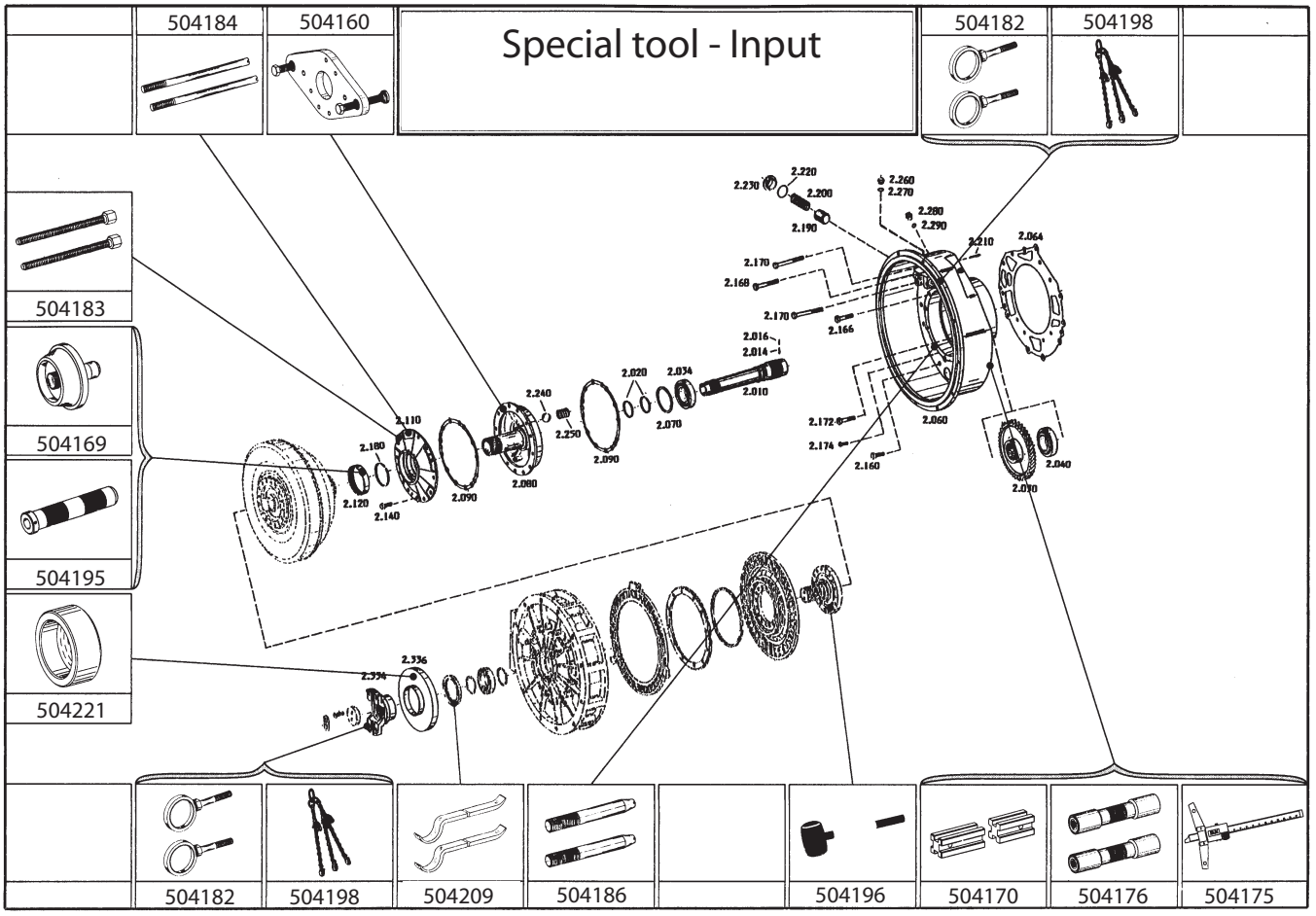
The Retarder in its functional components (see Draft) is composed of the Rotor, the Stator and the Control device. The Rotor (the rotating part of the retarder) is driven from the overrunning vehicle via axle, universal shaft, transmission and shift clutch.
The two-piece stator is composed of the stator itself, which is rigidly connected with the gear-box housing and the stator ring. This stator ring is a vane ring which is arranged between rotor and stationary stator, and serves to reduce the idling losses.
The control device is a valve block which is controlled by means of compressed air.
In shut off condition, i.e. without oil filling, the stator ring will be hold in a position by spring force by which bypass ducts between rotor and stator impellers will be created.
In the retarder mode, i.e. with oil filling, the stator ring will be displaced by the circulating oil by exceeding the spring forces up to a stop.
In this position, it is creating together with the stationary part of the stator a closed impeller ring „counter-rotating“, to the rotor.



(Schematic view)

Retarder reconditioning tool





Disassembly the retarder

Summary for the Tools for retarder disassembly and assembly, see previous side

Fasten the complete transmission on the assembly car.

(S) Assembly car	504213
(S) Clamping bracket	504214

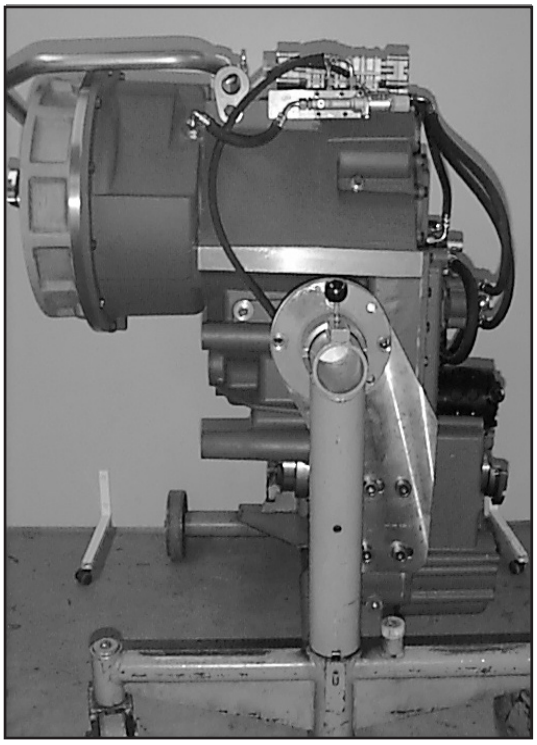


Figure 50

Separate pipes from selector housing.
Loosen hex. head screws and separate pressure regulator from housing.

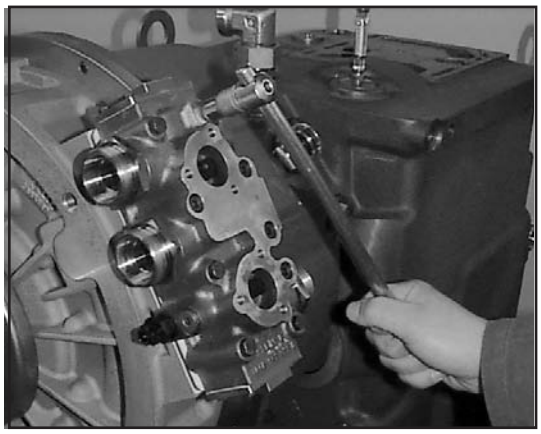


Figure 51

Remove components.

Cover is spring-loaded.

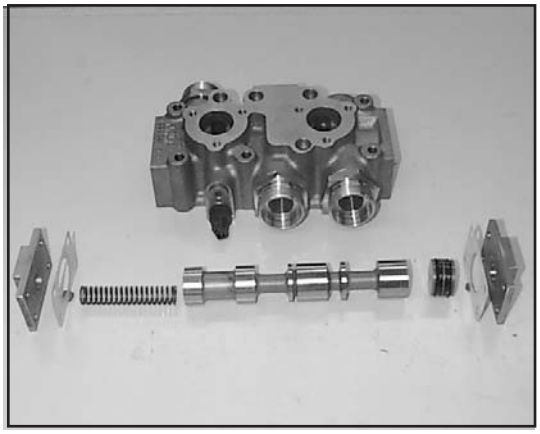


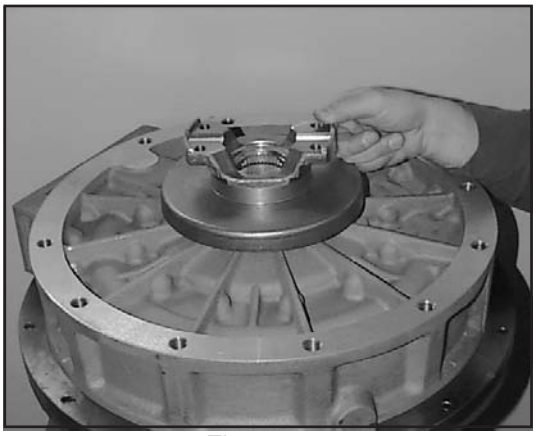
Figure 52

Tilt gearbox housing 90°.

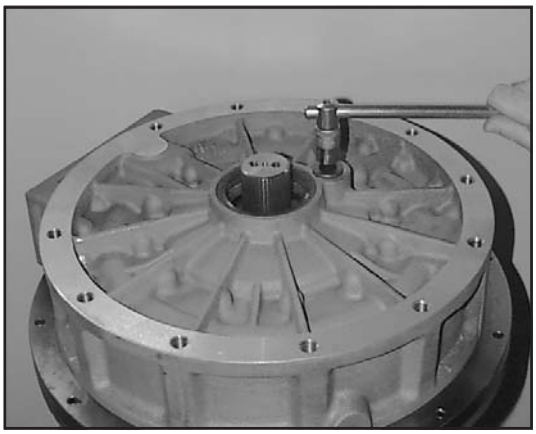
Remove lock plate.
Loosen hex. head screws and pull off input flange.

If only operations on the transmission are necessary, the complete retarder can be separated, along with the converter, from the converter connecting housing by loosening the screw connection (Figure 56) !

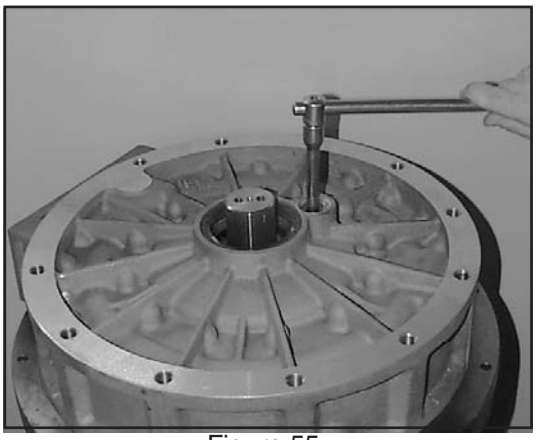
.


Figure 53

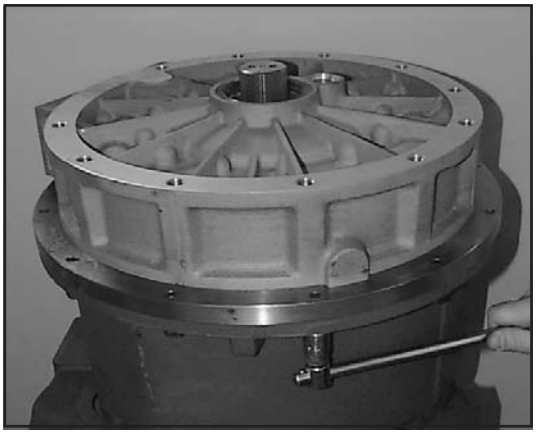
Loosen screw plug.


Figure 54

Loosen the first hex. head screw and remove it by means of magnetic rod.
Demount the remaining hex. head screws accordingly


Figure 55

Loosen screw connection.


Figure 56

Mark the radial installation position of the retarder to the converter connecting housing !

Separate the complete retarder from the converter connecting housing, using lifting device.

(S) Set of eye bolts 504182



Figure 57

Loosen socket head screws, separate spacer ring from stator housing.

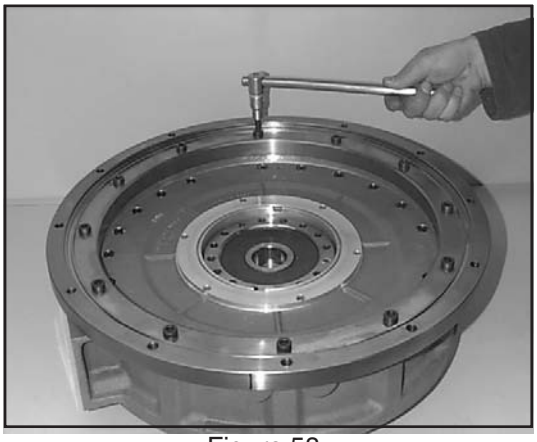


Figure 58

Loosen socket head screws and separate cover from stator housing.

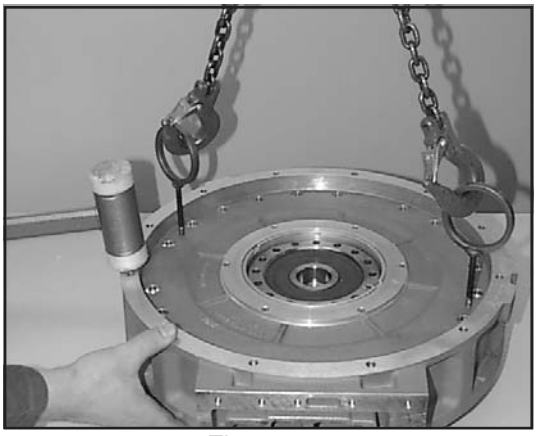


Figure 59

Drive flange shaft out.

Pay attention to the released components !

(S) Plastic mallet 504196

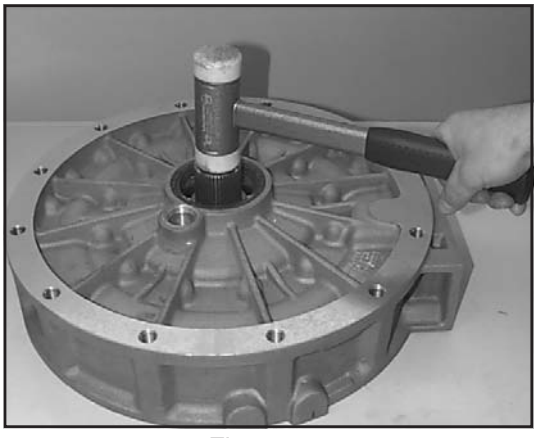


Figure 60

Separate rectangular ring from rotor.

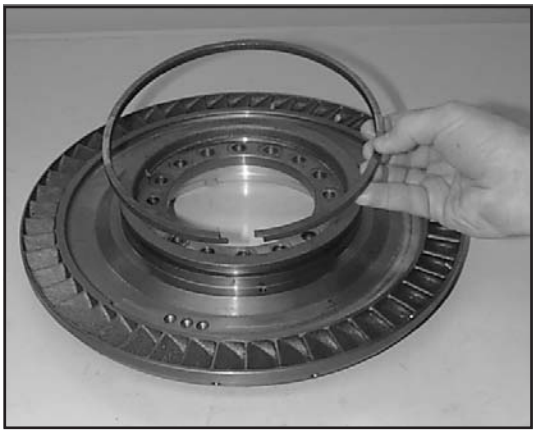


Figure 61

Remove the rectangular ring on the opposite side.
If necessary, separate the ring (Arrow) from the rotor.

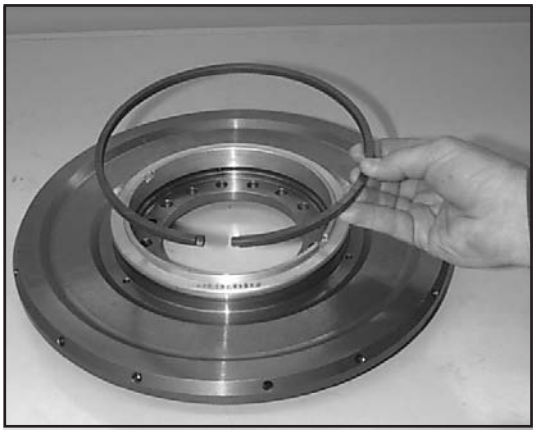


Figure 62

Loosen hex. head screws and remove thrust ring.

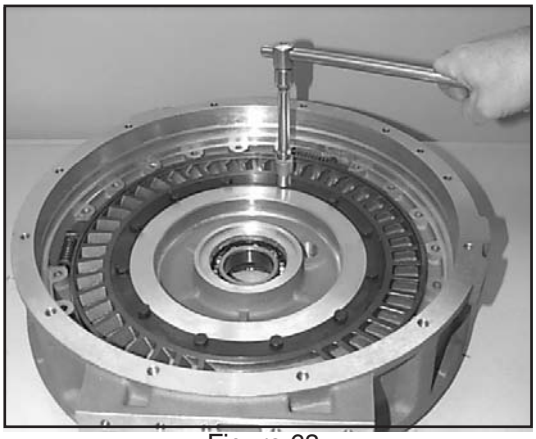


Figure 63

Remove stator ring.

Pay attention to the released components !

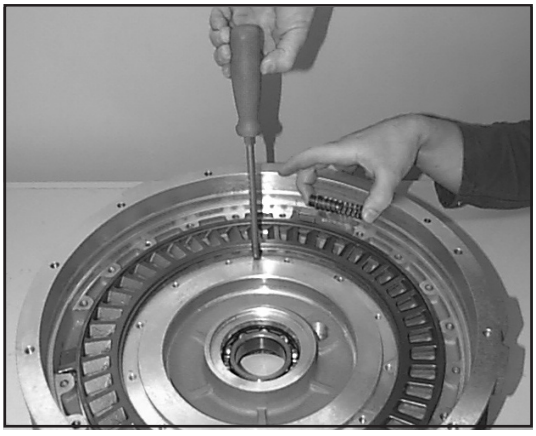


Figure 64

Pry shaft seal out of the bore.

(S) Pry bar 504209

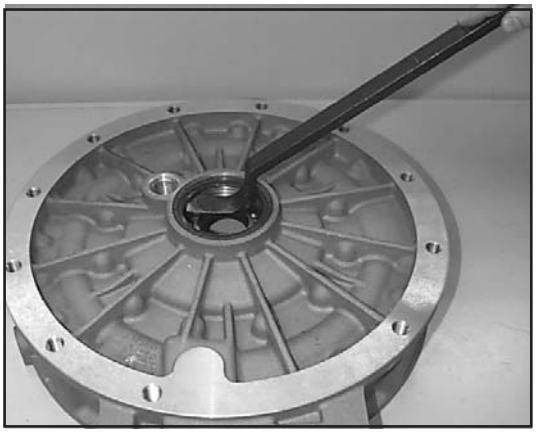


Figure 65

Drive ball bearing out.

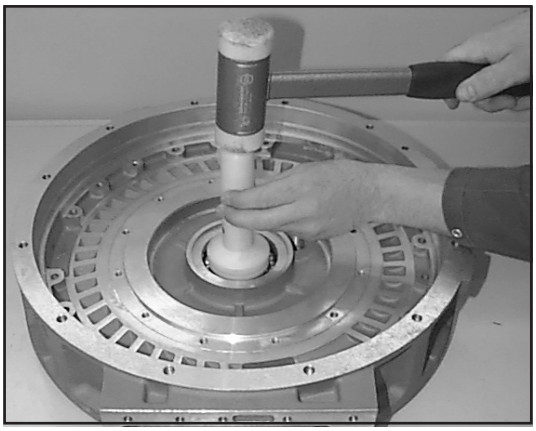


Figure 66

ASSEMBLY

Insert ball bearing until contact is obtained.

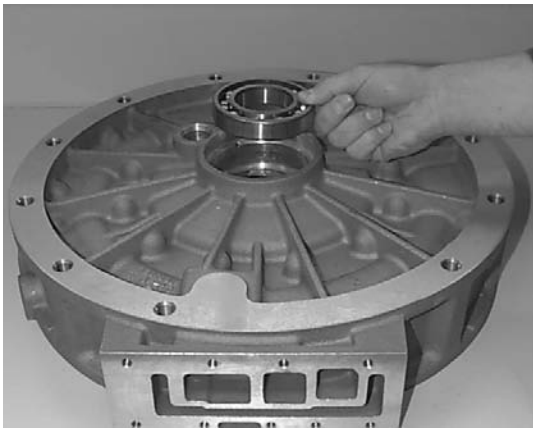


Figure 71

Insert ball bearing until contact is obtained.

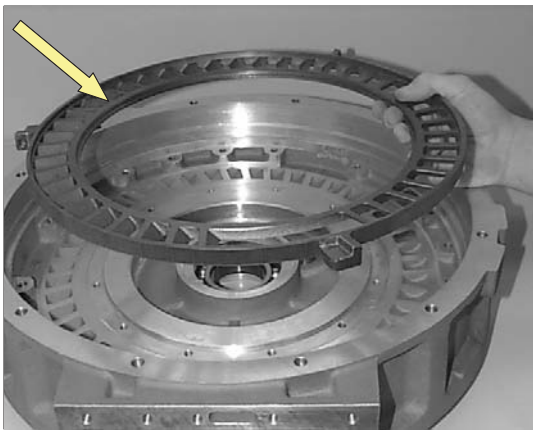


Figure 72

Fasten thrust ring by means of hex. head screws.

Torque limit (M8/8.8) .....23 Nm

Pay attention to the installation position – shoulder (Arrow) is showing upward !
Secure hex. head screws with Loctite (Type-No. 243) !

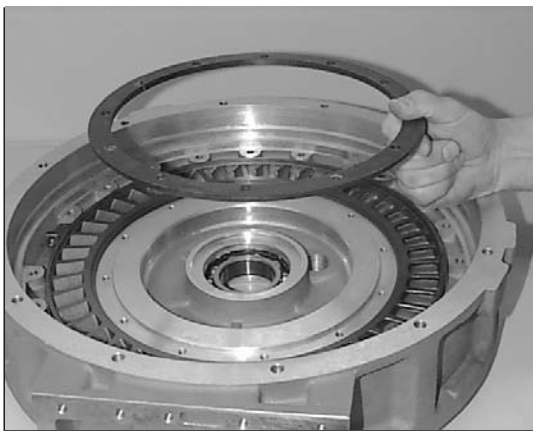


Figure 73

Pre-assemble dampers (3 pieces) according to Figure 25 and Figure 26.

The Installation dimension B = 1,6 $^{+0,5}$ mm results from the alternating stacking of the cup spring packs (8 packs with 6 cup springs each) !

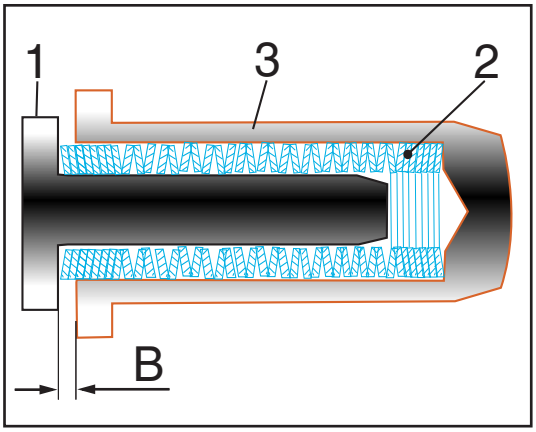


Figure 74

Ref. Figure 74 and 75:

1 = Guide pin
2 = Cup spring packs (8 packs with 6 cup springs each)
3 = Spring guide
4 = Compression spring
5 = Spring guide

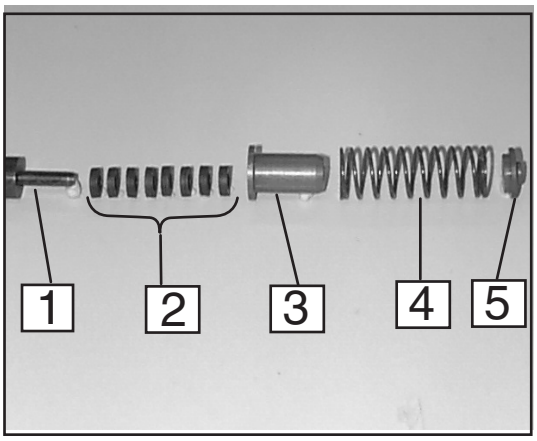


Figure 75

Install the pre-assembled dampers, see Arrows.

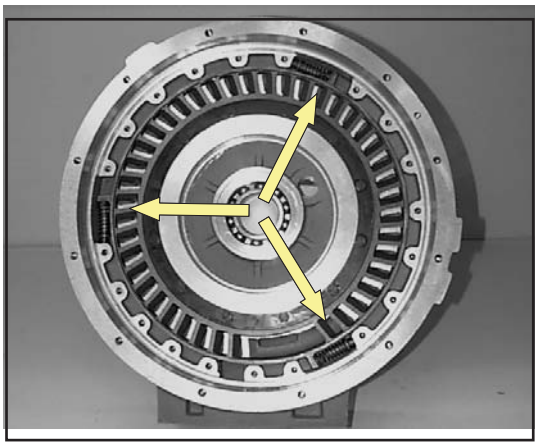


Figure 76

Introduce rectangular ring into the recess of the rotor (Figure 77) and preload it by means of cylindrical pins Æ 6 mm (assembly aid), see Figure 78 !

Install rectangular ring with the marking „Top“ see Arrow, showing upward (to the prime mover) !

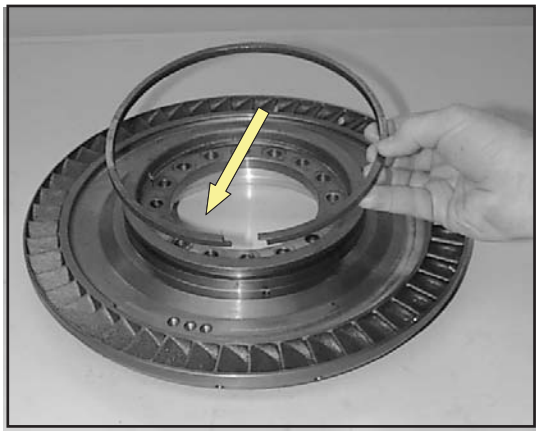


Figure 77

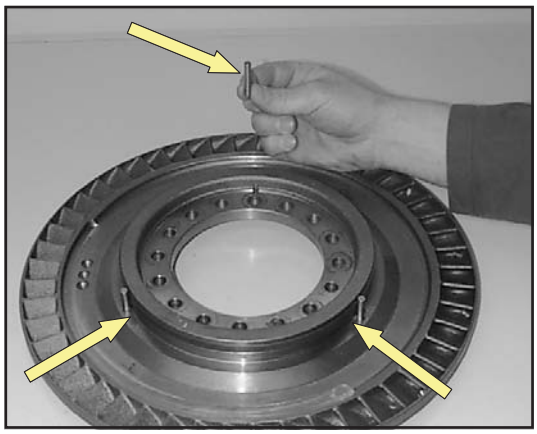


Figure 78

Grease rectangular ring.
Introduce rotor into the stator housing until contact is obtained and remove cylindical pins again.

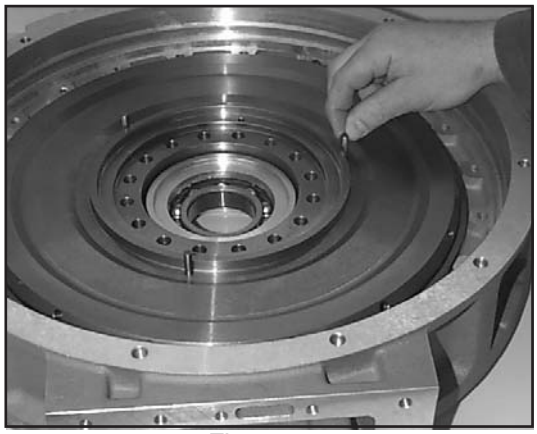


Figure 79

Grease rectangular ring.

Introduce rotor into the stator housing until contact is obtained and remove cylindical pins again.

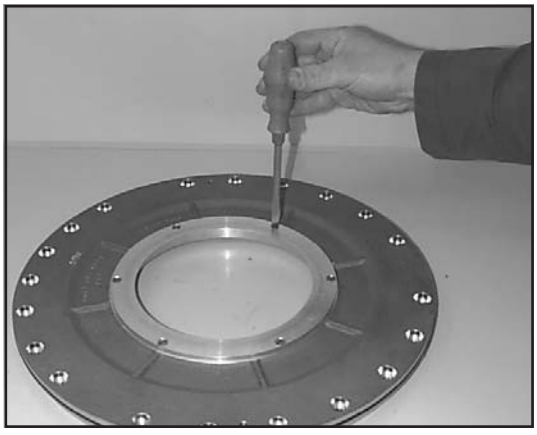


Figure 80

Insert ring into the cover, with the oil grooves showing downward.



Figure 81

Introduce rectangular ring.

Install rectangular ring with the marking „Top“ see Arrow, showing upward (to the prime mov er) !

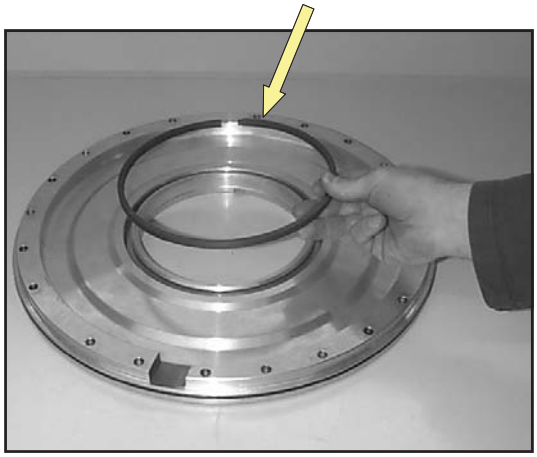


Figure 82

Insert O-ring into the annular groove of the cover (Arrow) and grease it.

Install two adjusting screws and pull cover uniformly against shoulder, using 3 socket head screws.

Pay attention to the radial installation position !

(S) Adjusting screws M8 504185

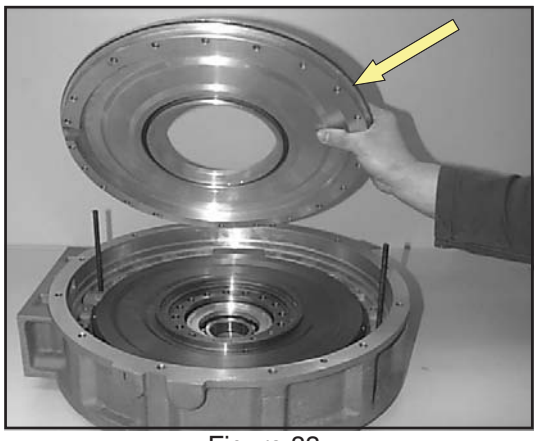


Figure 83

Fasten cover finally by means of socket head screws (install flat washers).

Secure socket head screws with Loctite (Type-No. 243) !

Torque limit (M8/10.9) ..... 23 Nm

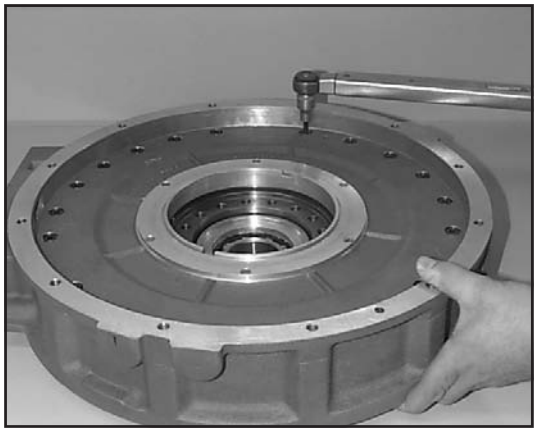


Figure 84

Adjust Rotor dimension

(distance between Rotor – Stator ring) = 1,5 ... 2,0 mm

(Figure 85 ... 89):

Line up axial washer s = 1,0 mm, axial roller cage and housing disk s = 5,75 mm.

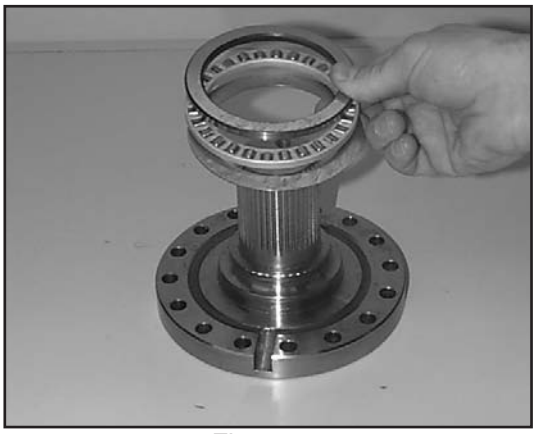


Figure 85

Determine Dimension I from the housing disk to the mounting face.

Dimension I e.g. ..... 13,10 mm

(S) Digital Depth gauge 504175

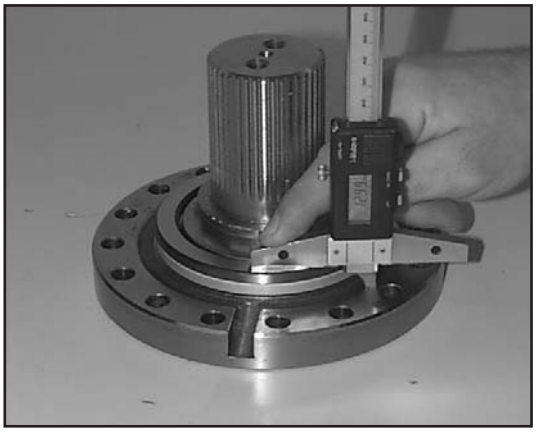


Figure 86

Determine Dimension II from the mounting face (flange shaft) to the plane face/stator (contact face – axial bearing).

Dimension II e.g. ..... 14,00 mm

EXAMPLE A:

Dimension II		14,00 mm
Dimension I	–	13,10 mm
Difference		0,90 mm
Rotor play e.g.	+	1,60 mm
gives Shim e.g.	s =	2,50 mm

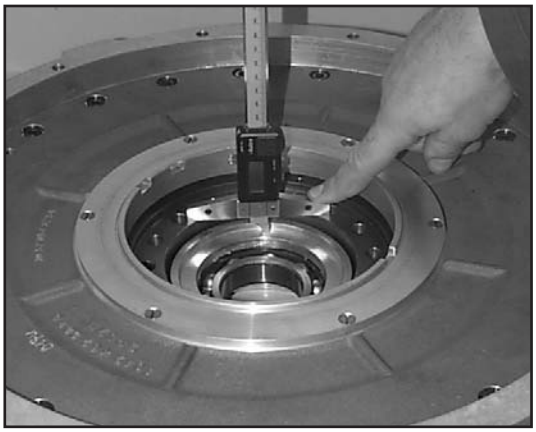


Figure 87

Insert housing disk s = 5,75 mm, axial roller cage and axial washer s = 1,0 mm..

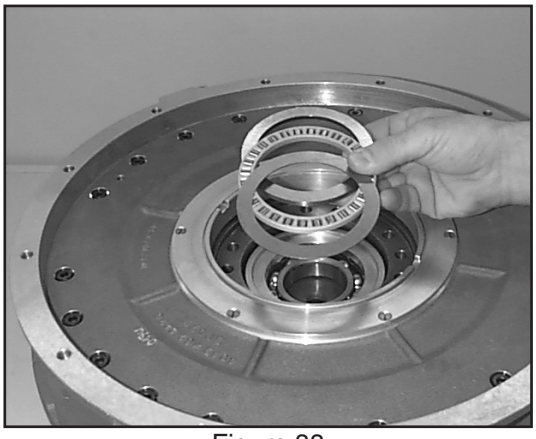


Figure 88

Mount shim s = 2,5 mm (see Example A, Figure 85 - 88

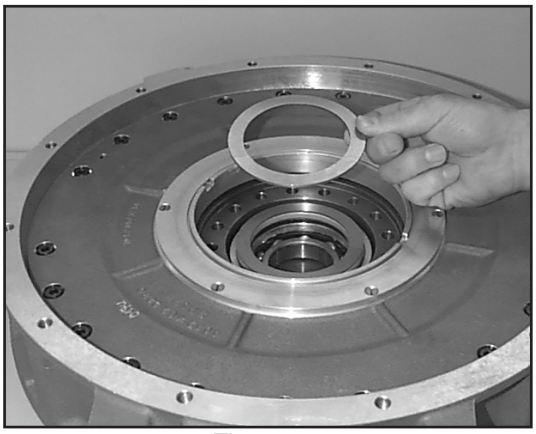


Figure 89

Adjust Axial play – Ball bearing 0,10 ... 0,20 mm
(Figure 90 ... 93):

Check exact contact of ball bearing (Arrow) once more and place pre-assembled stator housing over the plug gauge.

The ball bearing must be resting on the whole plane face (bearing inner and outer race) !

(S) Plug gauge 504178

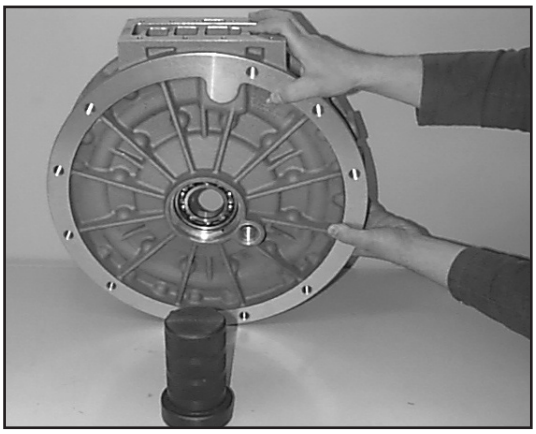


Figure 90

Determine Dimension I from the shim to the bearing inner race.

Dimension I e.g. ..... 25,20 mm

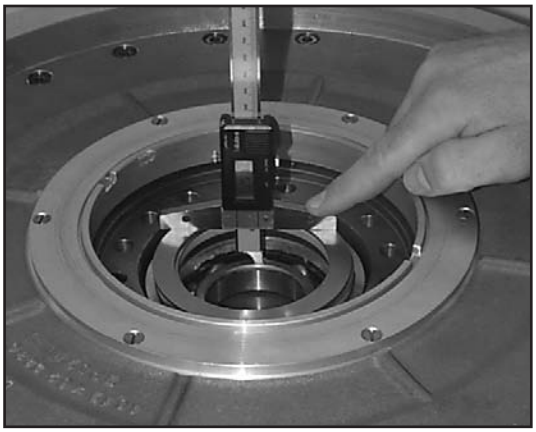


Figure 91

Determine Dimension II from the locating face (ball bearing) to the contact face (shim).

Dimension II e.g. ..... 25,05 mm

EXAMPLE B_1:

Dimension II - Dimension I **= Dimension X**
25,05 mm - 25,20 mm **= - 0,15 mm**

Minus dimension (X = - 0,15 mm) corresponds with the pressure !

EXAMPLE B_2:

Required play - Dimension X **= Shim**
0,15 - (- 0,15) **= 0,30 mm**

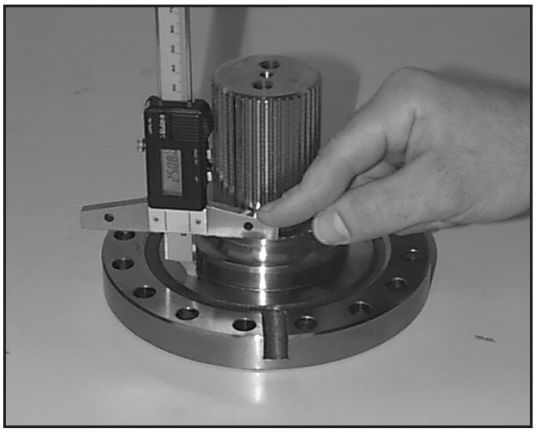


Figure 92

Mount shim s = 0,3 mm (see Example $B_{2,}$ Page 2.11) with grease.

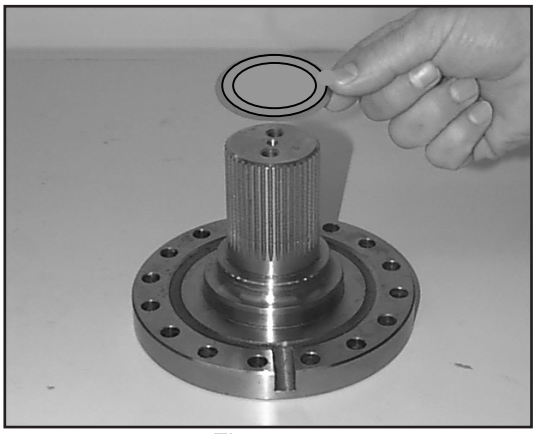


Figure 93

Heat bearing inner race.

(S) Hot-air blower 230 V 504193
(S) Hot-air blower 115 V 504194

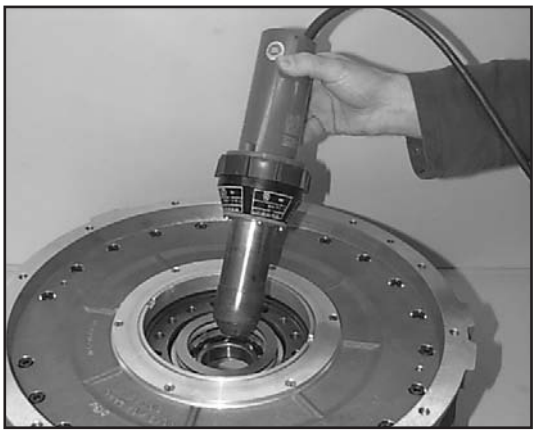


Figure 94

Introduce flange shaft until contact is obtained.

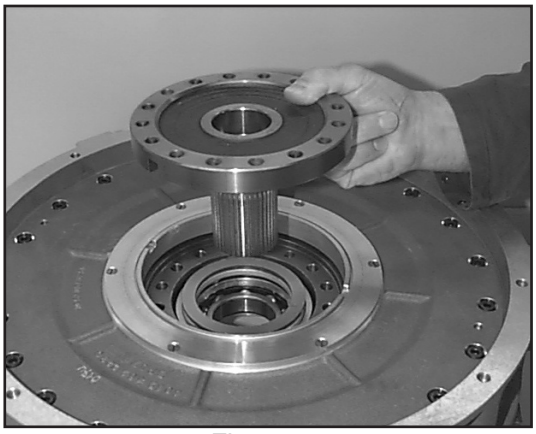


Figure 95

Install shaft seal (Arrow), using driver.

At application of the prescribed driver (S), the exact installation position is obtained !
Grease the sealing lip of the shaft seal !
Wet outer diameter with spirit !

(S) Driver 504163

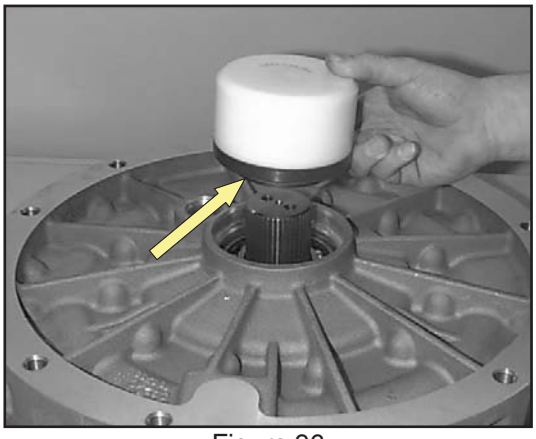


Figure 96

Clean O-ring.

O-ring groove must be perfectly clean

Grease O-ring (Arrow) and insert it into the annular groove of the spacer ring.

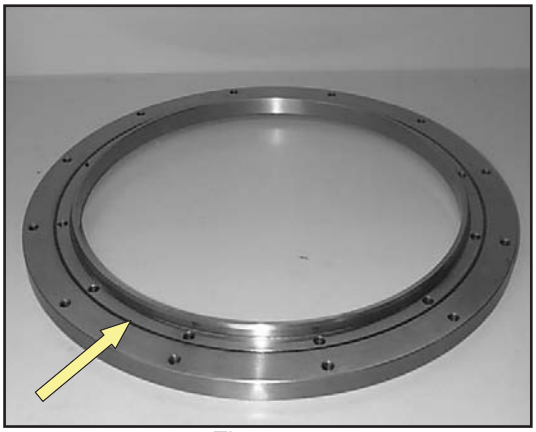


Figure 97

Fasten spacer ring by means of socket head screws.

Torque limit (M10/8.8, DIN 6912) ..... 46 Nm
and secured with Loctite 262.

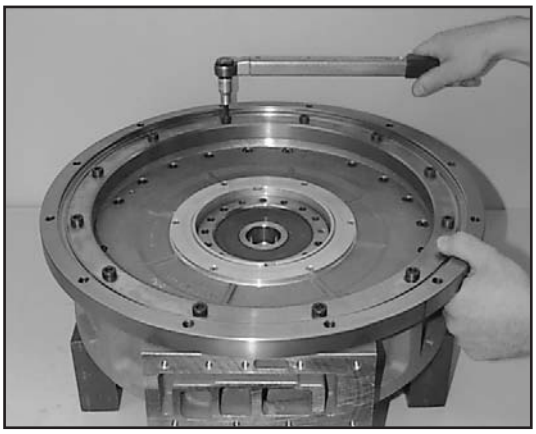


Figure 98

Insert O-ring (Arrow) into the annular groove of the converter bell.

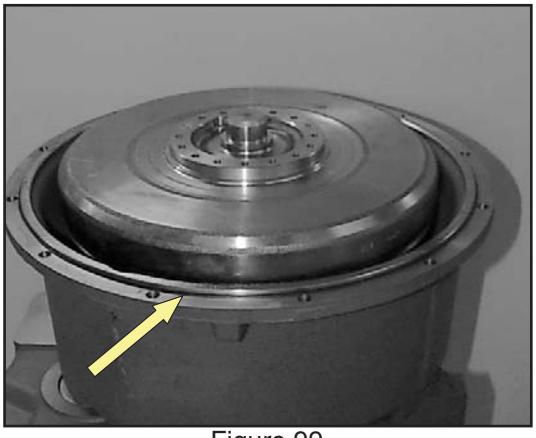


Figure 99

Place the complete retarder on the converter bell until contact is obtained, using lifting device, and fasten it by means of hex. head screws.

Pay attention to the radial installation position of the retarder.
Binding are the Specifications of the Vehicle Manufacturer, resp. the markings applied at the disassembly !

Torque limit (M12/8.8) ..... 79 Nm
(S) Set of eye bolts 504182



Figure 100

Fasten rotor and flange shaft on the converter, using hex. head screws.

Tighten hex. head screws uniformly (180° displaced) as well as secure them with Loctite (Type-No. 243) !

Torque limit (M10/8.8) ..... 46 Nm

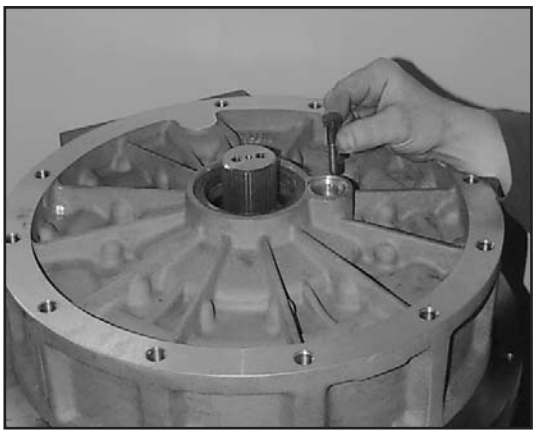


Figure 101

Equip screw plug with new O-ring and install it.

Torque limit (M30x1,5) ..... 90 Nm

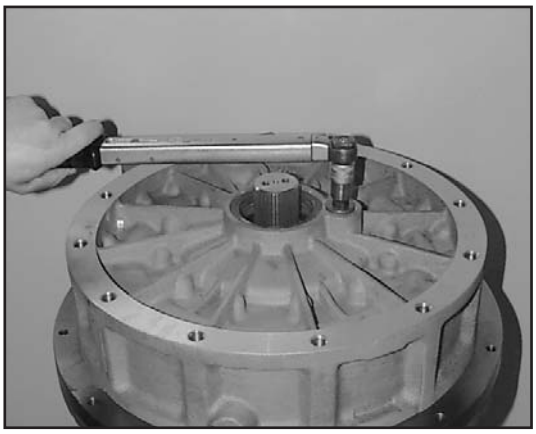


Figure 102

Line up shim (s = 1,5 mm).

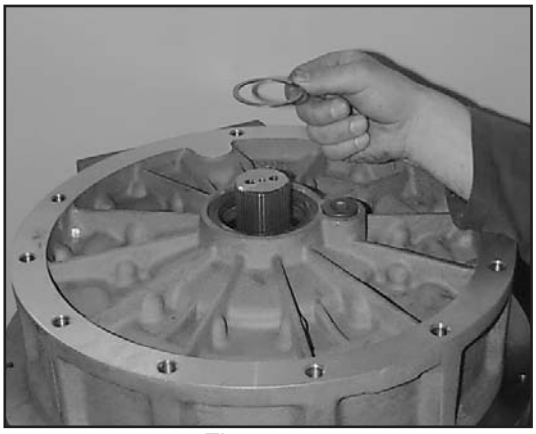


Figure 103

Install dust plate (Arrow).

At application of the prescribed driver (S), the exact installation position is obtained !

(S) Driver 504221

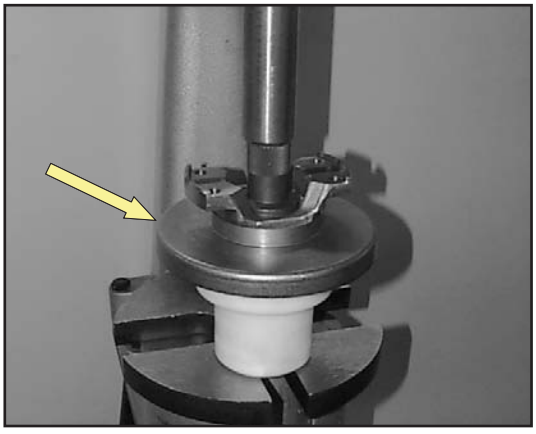


Figure 104

Line up input flange and fasten it by means of disk and hex. head screws.

Wet contact face of the disk with Loctite (Type-No. 574) !

Torque limit (M10/8.8) ..... 46 Nm

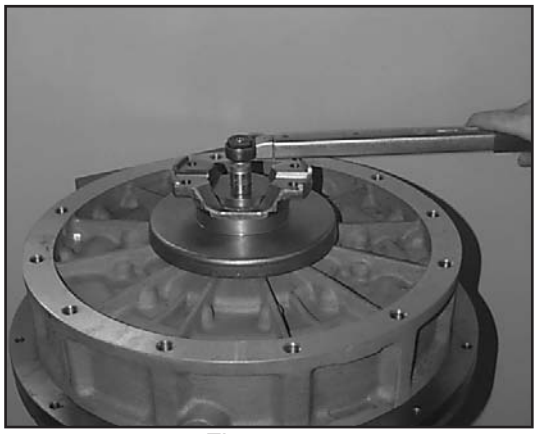


Figure 105

Fix hex. head screws with lock plate.

(S) Driver	504167
(S) Handle	504195

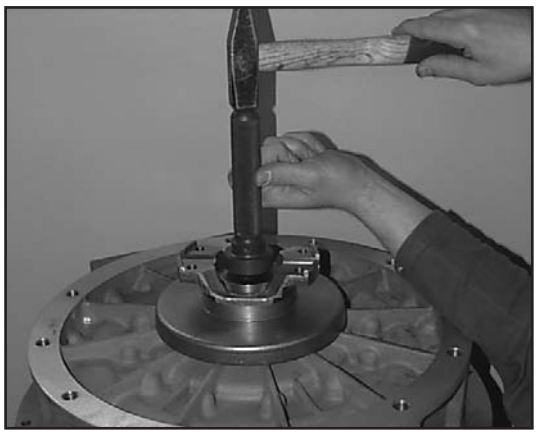


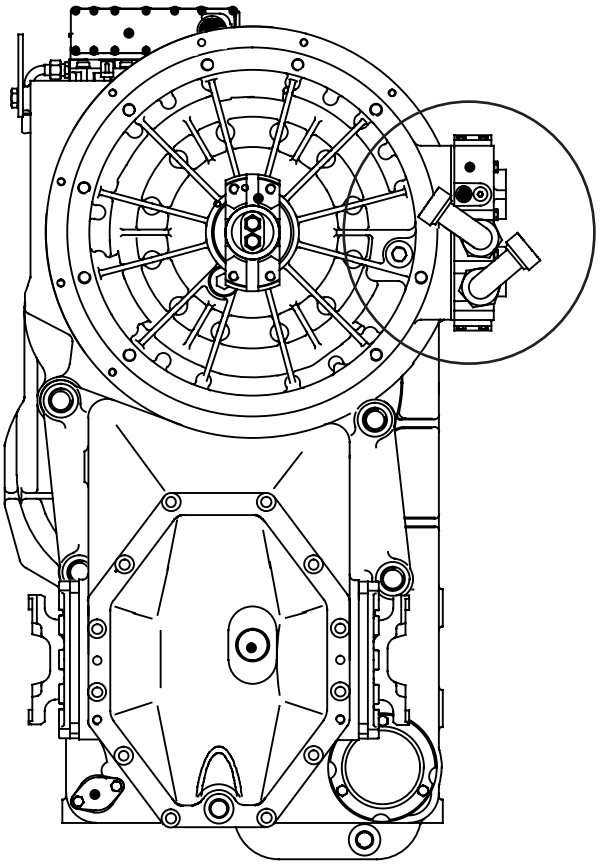
Figure 106

Retarder valve

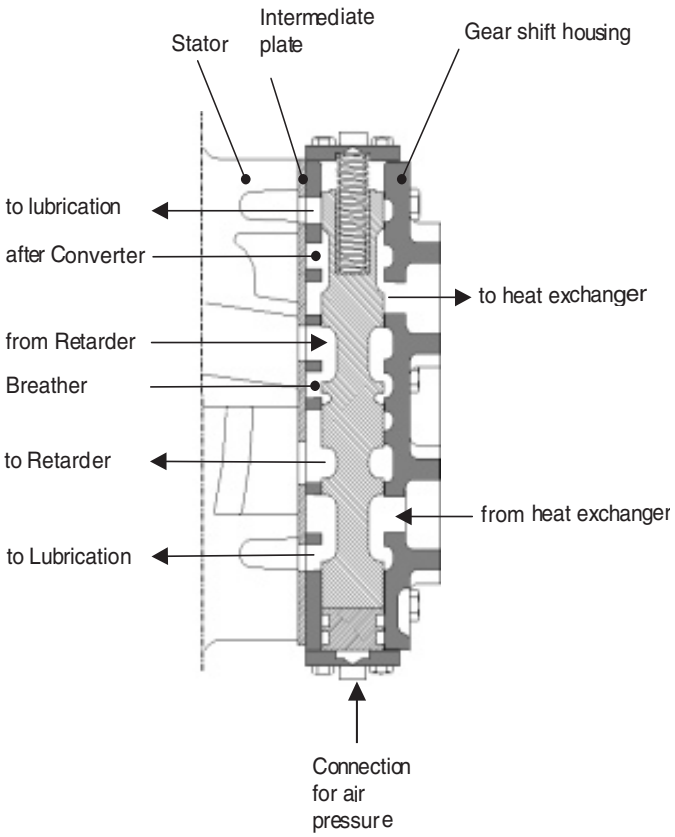
The braking procedure itself will be started via a hand- or foot-actuated control valve.
With this valve it is possible to adjust a certain air pressure and with it the desired brake performance infinitely variable. The possible air pressure value is in this situation between 3,5 and 8 bar, because only from about 3 bar on, the existing preload of the cooling circuit is overcome.
The retarder control valve, pressurized with this compressed air, released by it the correspon-ding oil stream into the retarder circuit.

Due to the rotation and the impeller configuration of the rotor, the oil will be directed into the stator and comes from there back again to the rotor, in order to start the circuit anew (see Draft).

Due to the actual reversion of the oil, the rotary motion of the rotor and with it the speed of the vehicle will be retarded.
This energy, converted in this way from speed into pressure, will be finally transfered by fluid friction into thermal energy and then delivered via a heat exchanger to the cooling water.
If during the retarder operation the shift clutch will be actuated, a 3/2-way valve is blocking the compressed air supply to the control valve, in this way, the retarder will be cut-off, thus saving the shift clutch.

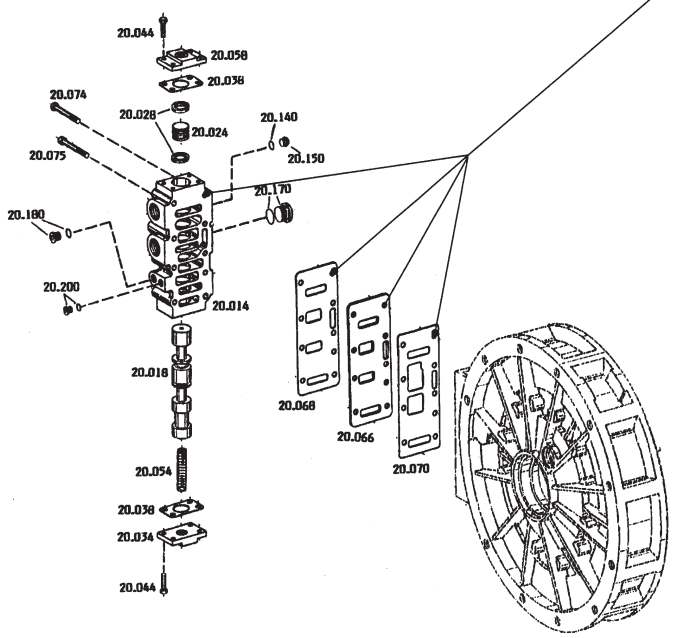


Retarder valve not connected



Special tool - Press. regulator

504185



Pre-assemble and mount Retarder:

Install components according to Figure 107 and 108.

1	=	Selector housing	
2	=	Screw plug (M14x1,5,	Torque limit 35 Nm
3	=	Screw plug (M26x1,5,	Torque limit 80 Nm
4	=	Screw-in sleeve	
5	=	Temperature sensor	Torque limit 35 Nm
6	=	Screw plug (M14x1,5,	Torque limit 35 Nm

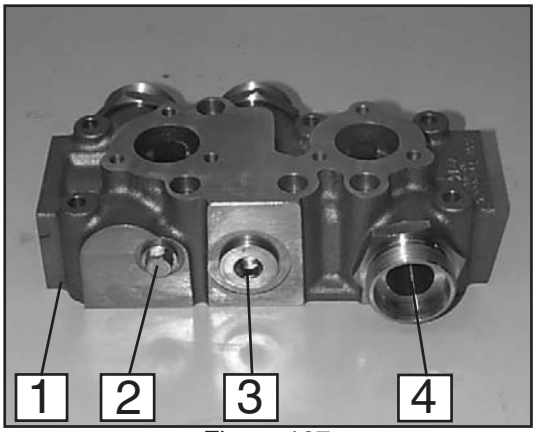


Figure 107

Equip screw plugs (2, 3 and 6) as well as temperature sensor (5) with new O-rings !
Wet thread of the screw-in sleeves (4) with Loctite (Type-No. 262) !

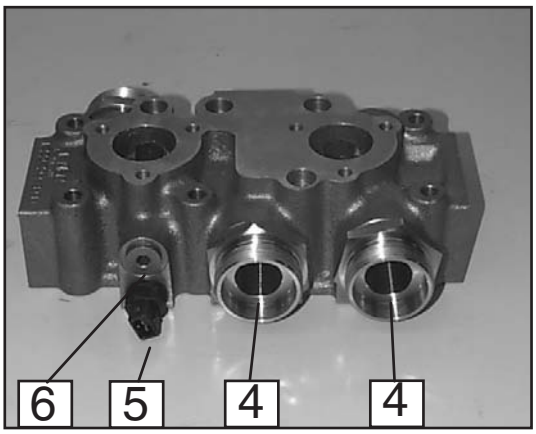


Figure 108

Install components according to the Figure on the left:

1	=	Selector housing
2	=	Cover
3	=	Gasket
4	=	Compression spring
5	=	Spool
6	=	Spool
7	=	Grooved rings (2x)
8	=	Gasket
9	=	Cover (with pressure port)

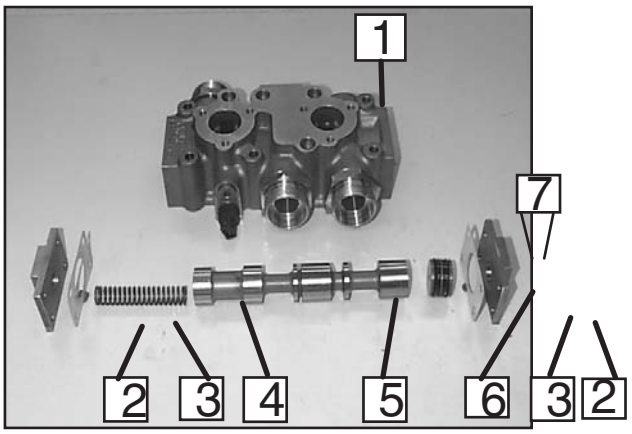
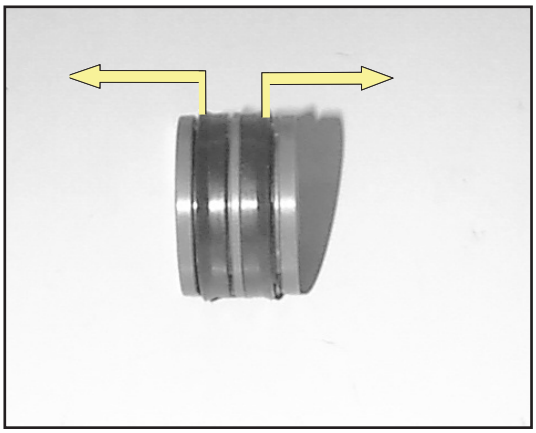


Figure 109

Install grooved rings 7, with the sealing edge always showing in Arrow direction, see Figure 110 !


Figure 110

Install two adjusting screws and line up the gasket.

(S) Adjusting screws M8 504185

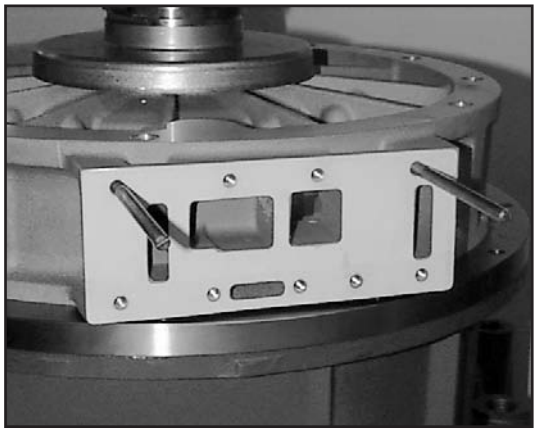


Figure 111

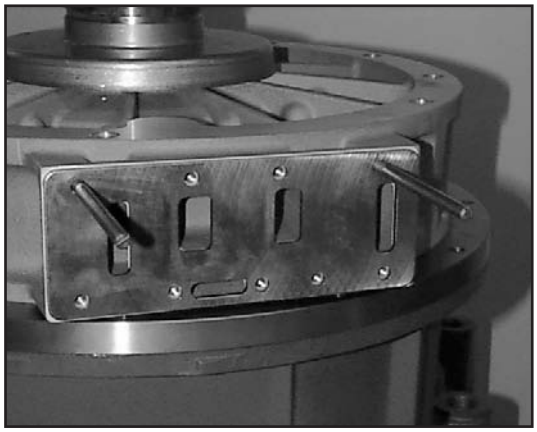


Figure 112

Install 2nd gasket.

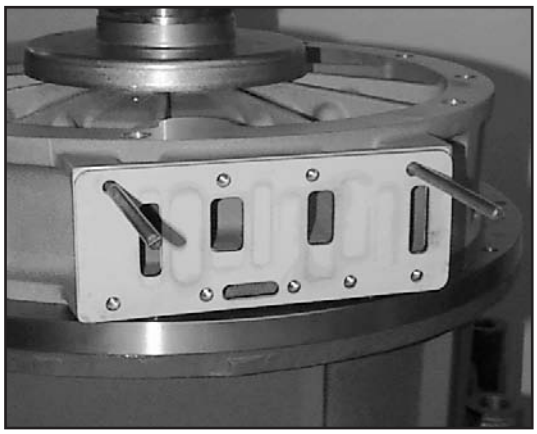


Figure 113

Line up the pre-assembled selector housing and fasten it with hex. head screws and socket head screws.

Torque limit (M8/8.8) ..... 23 Nm

Install retarder - oil lines according to the Perspective Illustration of the respective Spare Parts List.

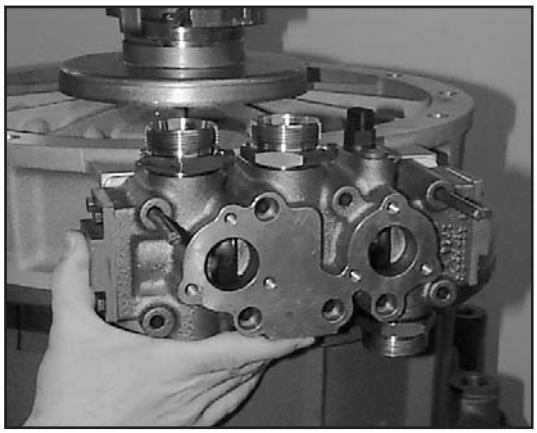
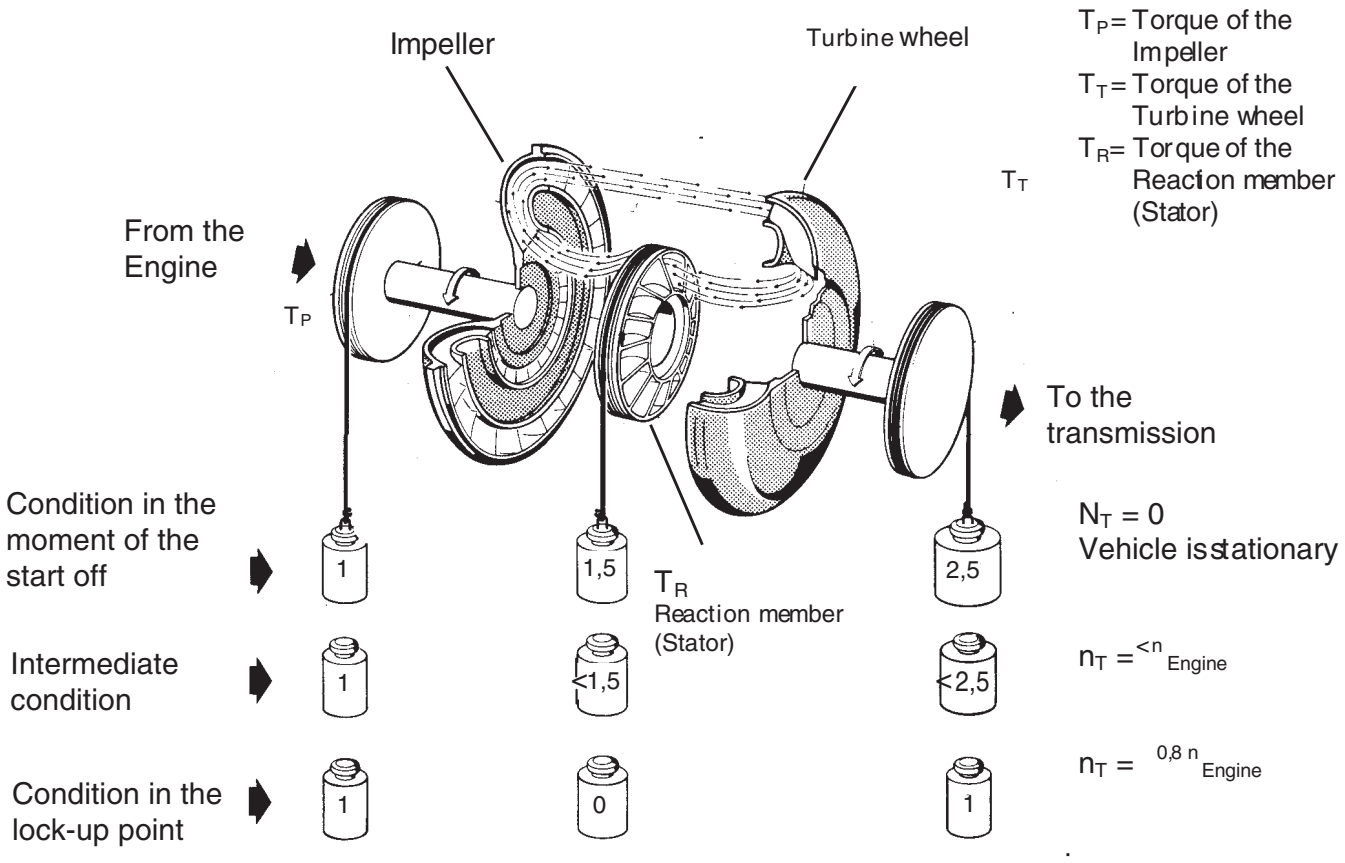


Figure 114

Converter

Function of the Converter:

FUNCTION OF A HYDRODYNAMIC TORQUE CONVERTER (SCHEMATIC VIEW)



The converter is working according to the Trilok-System, i.e. it assumes at high turbine speed the characteristics, and with it the favourable efficiency of a fluid clutch.
The converter is designed according to the engine power so that the most favourable operating conditions are obtained for each installation case.

The Torque converter is composed of 3 main components:

Impeller – Turbine wheel – Stator (Reaction member)

These 3 impellers are arranged in such a ring-shaped system that the fluid is streaming through the circuit components in the indicated order.

Pressure oil from the transmission pump is constantly streaming through the converter. In this way, the converter can fulfill its task to multiply the torque of the engine and at the same time, the heat created in the converter is dissipated via the escaping oil.
The oil which is streaming out of the impeller, enters into the turbine wheel and is there rever-sed in the direction of flow.
According to the rate of reversion, the turbine wheel and with it also the output shaft is receiv-ing a more or less high reaction moment.

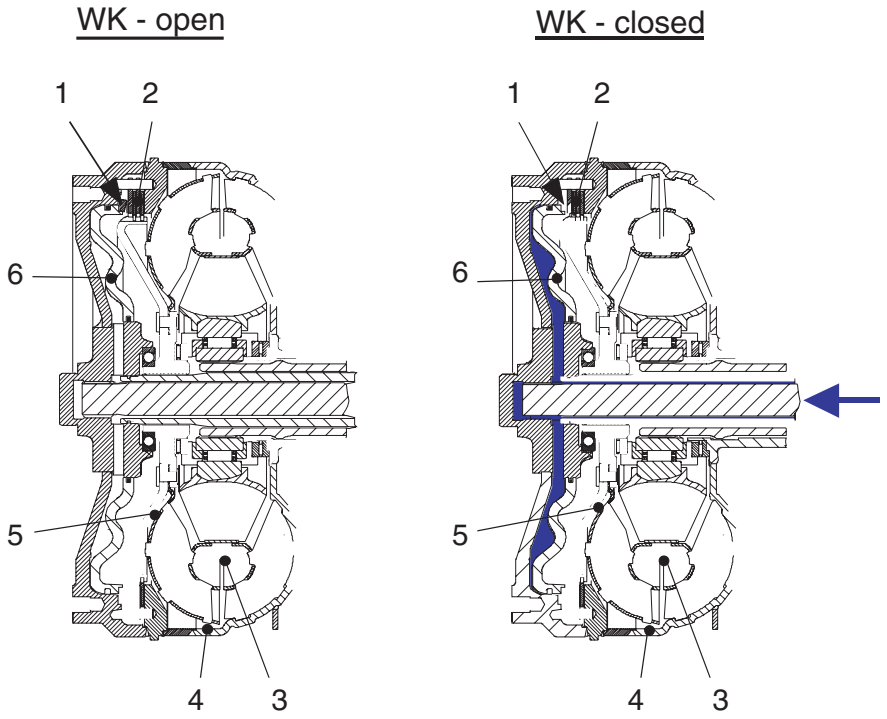
The stator (reaction member) following the turbine, has the task to reverse the oil, streaming out of the turbine once more and to deliver it under the suitable discharge direction to the im-peller.

Due to the reversion, the stator is receiving a reaction moment.
The relation turbine moment/impeller moment is called torque multiplication. This is the hig-her, the greater the speed difference of impeller and turbine wheel will be.

Therefore, the maximum torque multiplication is created at stationary turbine wheel.
With increasing output speed, the torque multiplication is decreasing. The adaption of the output speed to a certain required output moment will be infinitely variable and automatically achieved by the torque converter.
When the turbine speed is reaching about 80% of the impeller speed, the torque multiplication becomes 1,0 i.e. the turbine moment becomes equal to that of the impeller moment.
From this point on, the converter is working similar to a fluid clutch.

A stator freewheel serves to improve the efficiency in the upper driving range, in the torque multiplication range it is backing-up the moment upon the housing, and is released in the clutch range.
In this way, the stator can therefore rotate freely.

Converter (WK)



At closed WK, the slip between impeller and turbine wheel, and with it the hydraulic loss in the converter is equal to „Zero“ (see Figure WK-open/closed)

The WK will be automatically shifted dependent on the turbine speed.
The pressure oil (12 + 2 bar) for the closing of the WK, is directed via a solenoid shift valve (see Figure next page) to the piston (6), which is compressing the plate pack.

Removal of transmission, ass'y

NOTE!
Place the dump truck on level ground and apply parking brake

Start with the propeller shaft in the articulation hinge.

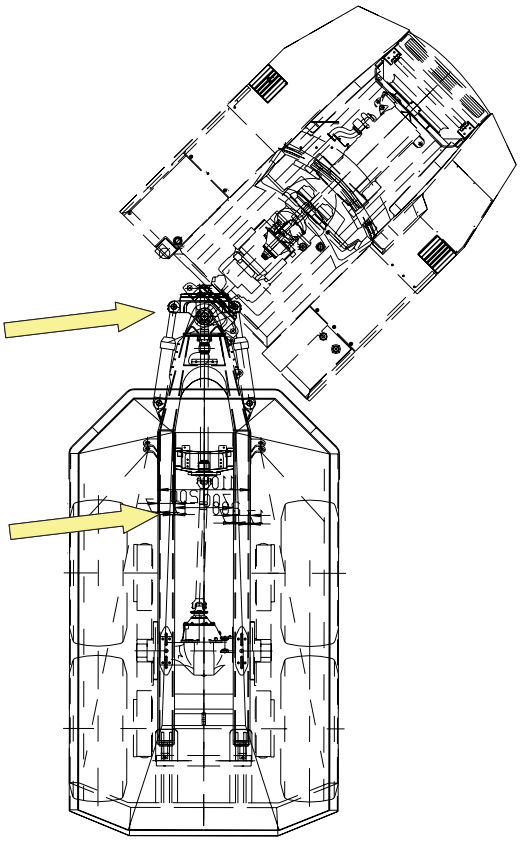
For best working, start the engine and turn the machine to full right direction.

Release articulation propeller shaft from the transmission output flange.
Start the engine and line up the machine

Apply articulation lock.

Turn off main switch in battery case.

Raise the dump body and lock it with the safety support.



Place wheel chocks to the front wheel

Prepare to drain the hydraulic oil:

By pumping a several times (20 - 25) with the brake pedal, to emptying the 5 brake accumulators.



Drain both hydraulic oil reservoirs, see chapter 7 maintenance - 2000 hour service in the Operating & Maintenance Manual.

1 Main reservoir
2 Emergency steering reservoir

(**Oil capacity approx. 190-200 l.)**

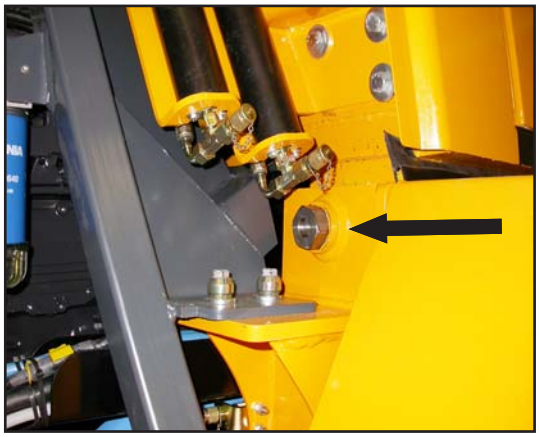
NOTE:
See in the hydraulic chapter about the filling procedure.



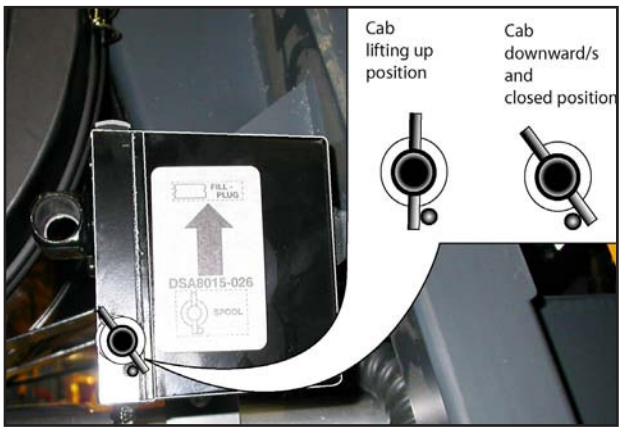


Tilting the cab:
Open the bonnet and take away the cab bolt, left and right hand side.

Nv 46 mm



Turn the direction valve on the pump in lifting up position.



With the handle, pump and raise the cab.

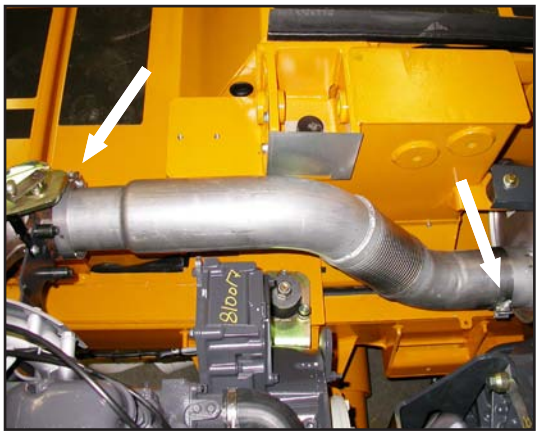
When lower the cab, turn the direction valve to the down position and with the handle lower the cab.





Disassemble the exhaust parts

Disassemble the front V-clamp and the rear clamp, remove the exhaust pipe.



Disassemble the rear pipe V-clamp and the front and rear suspensions.

Screw M12x30 ISO4017-10.9

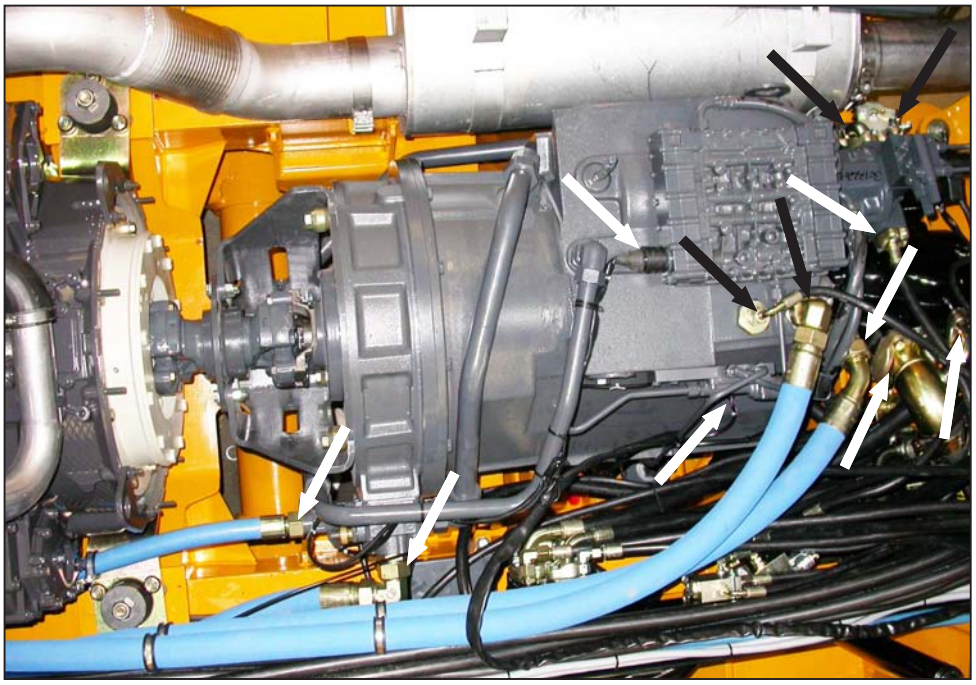
Lift out the muffler with the suspension bracket



Disassemble of the hydraulic hoses at the transmission

Realease all (19 pcs) of the hydraulic hoses connected to the transmission.

Realease all of the wiring on the electrical points. (Total included ground cabel are 11 electrical connections have to disconnected.)

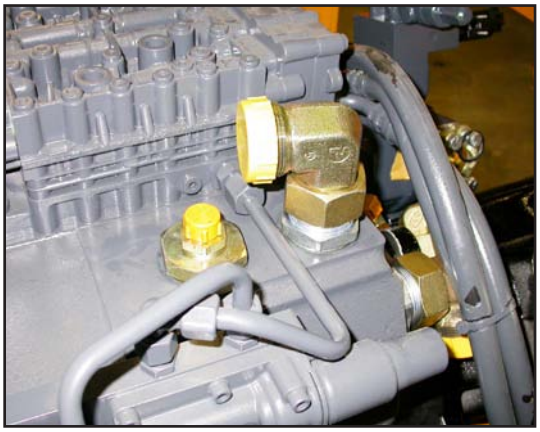


Disconnect both of the hoses and the L-nipple from the emergency steering pump from the articulated hinge side.

Protect the hydraulic nipple on the pump with plastic plug or similar.

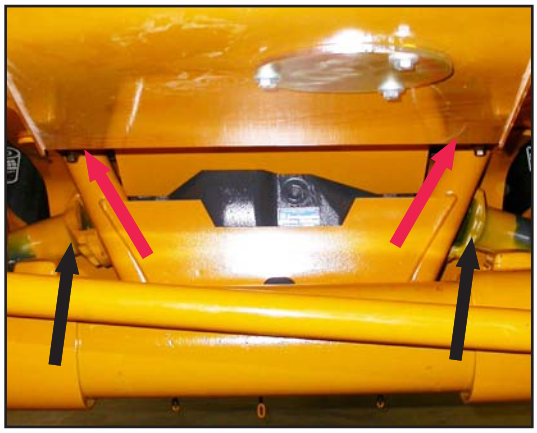
NOTE!
Remember to mark the hoses.



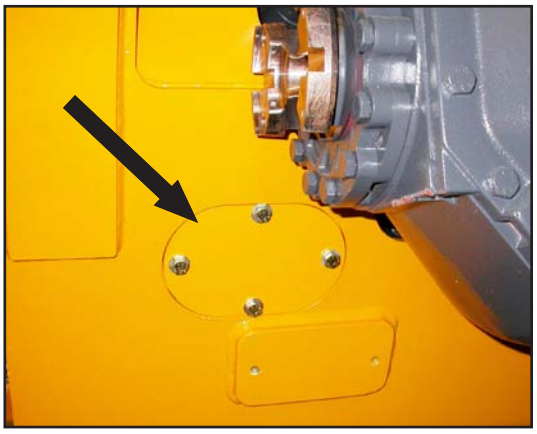


Dismount the protection guard for the diff and both front axle propeller shaft at differential side.

From machine 810013 are screws for the propeller shaft changed to UNF thread on outer and inner sides:



- **When assembling, use Loctite 262 or ThreeBond medium 1374 on thread.**
- **Tightening torque (1/2" x 2 1/4" -10.9 UNF): 120 Nm.**



Remove from the rear bottom guard the inspection cover plate (arrow).



Disassemble the lower rear transmission attachment.
If shim are assembled, use the shims at the same place when assemblying.

Hold with combonation wrench 36 mm and from the lower side, trough the opening the bottom guard use standard tool as shown at the picture.

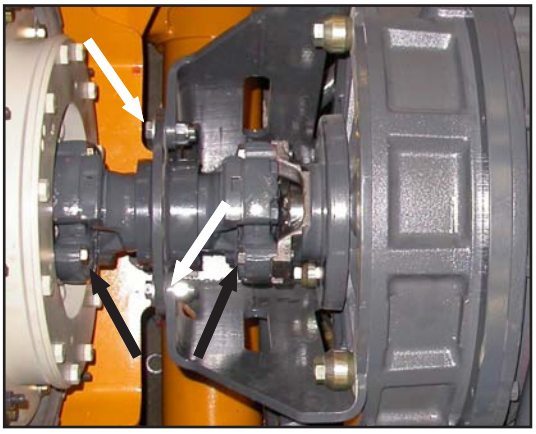
Assembly:
Torque limit: 960 Nm



Pipe 36 mm ¾#
Extension L= 4"
Arm with ¾#
Combination wrench 36 mm



Dismount the axle catcher bow. (white arrow)



Dismount converter prop. shaft. (red arrow)

Front screw: M12x50 ISO4014-10.9 EL

Rear screw: ½" UNF x2" NS 965--8.8

Disassemble the front transmission bracket attachment.

If shim are assembled, use the shims at the same place when assemblying.

Use standard tool as shown on the picture below or similar.



Assembly:
Torque limit 560 Nm



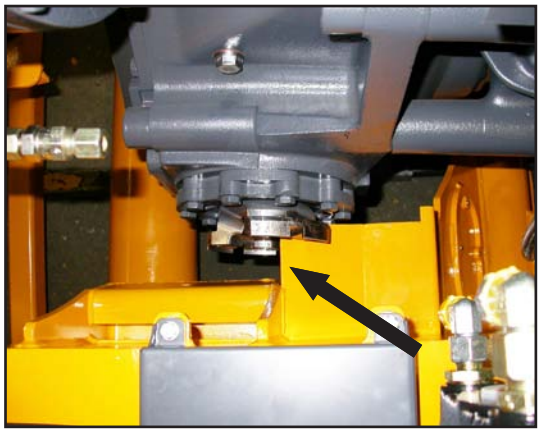
Pipe 30 mm ¾#
Extension L= 4"
Arm with ¾#
Combination
wrench 30 mm

Check around the transmission that all connections to the front frame equipment not are connected to the transmission.

Assemble the lifting device and start lifting the transmission out of the frame.

Carefylly !

Be aware that the transmission have to be moved frontwards, twisted to the right side on front. In this position carefully lift up the transmission.
Be specially aware of the transmission differential otput flange and the back side.



Picture show the left side, front diff, output flange.

Place the transmission safely on a rack or similar.

Secure the transmission.

Manual transmission

Disassembly

Fasten the complete transmission on the assembly car.

(S) Assembly car	504213
(S) Support	504214

Remove all oil lines.

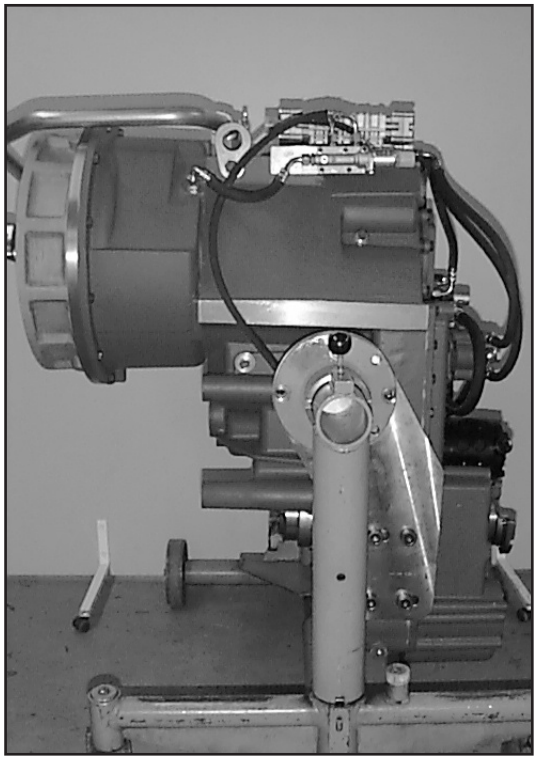
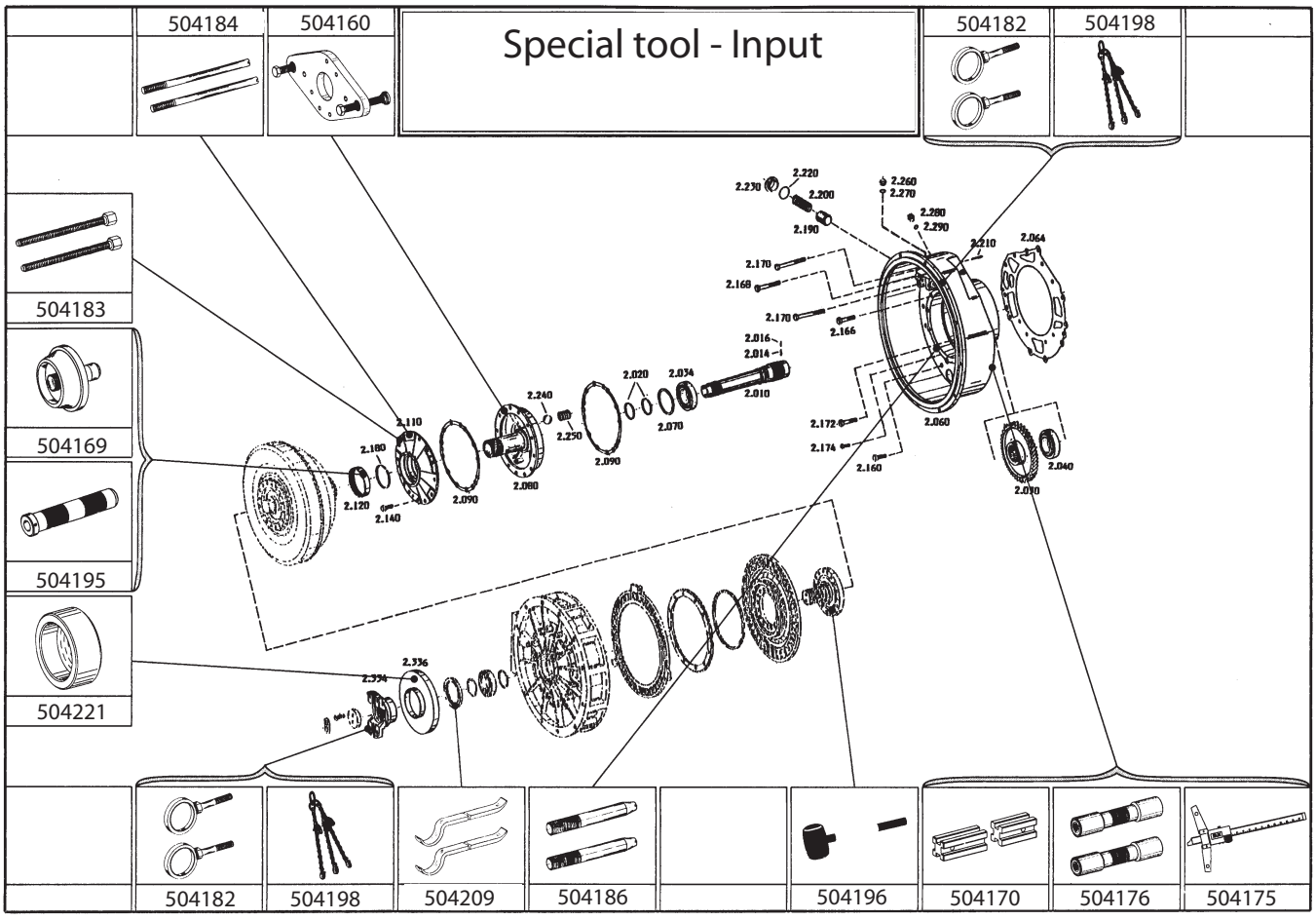


Figure 120



Loosen hex. head screws and lift complete retarder along with converter out of the converter bell using a lifting device.

(S) Lifting chain 504198
(S) Set of eye bolts 504182

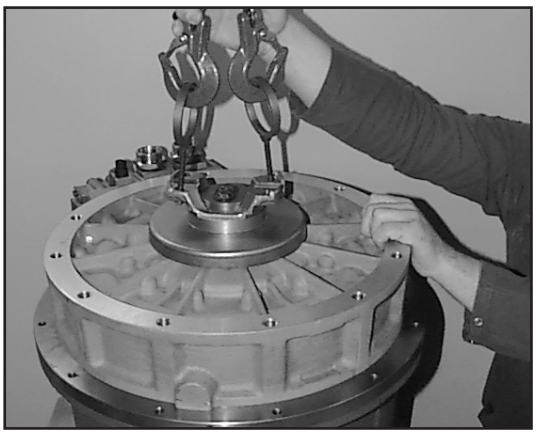


Figure 121

Drive

Unfix screw union and separate cover from converter bell by means of forcing screws (3xM10).

(S) Forcing screws 504183

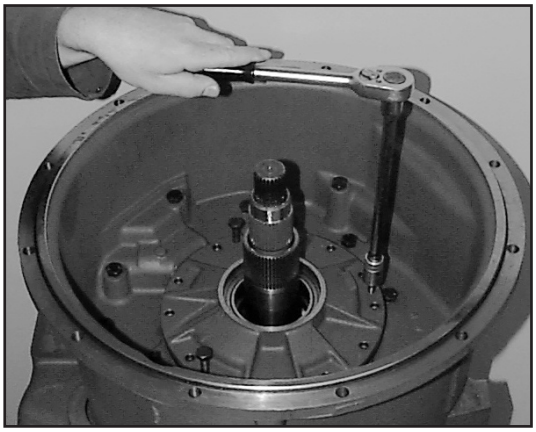


Figure 122

Pull oil feed flange by means of special device out of the converter bell.

(S) Puller device 504160

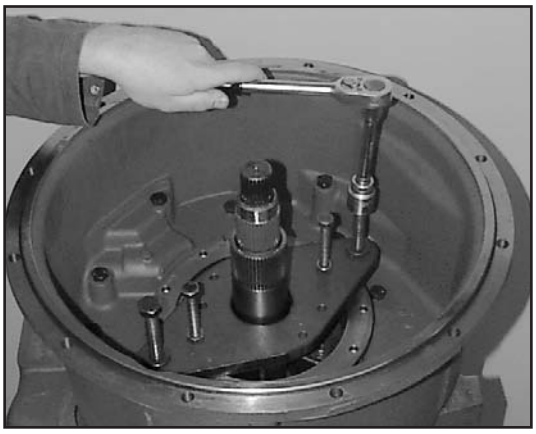


Figure 123

Remove converter safety valve (ball + spring, see arrow).

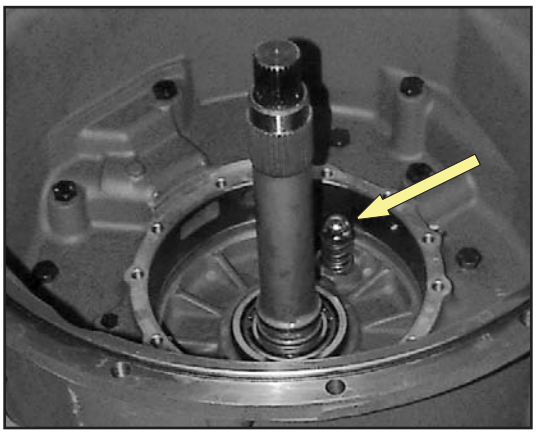


Figure 124

Loosen screw connection (M8 and M12). Separate converter bell from the transmission using lifting device.

(S) Lifting chain 504198
(S) Set of eye bolts 504182



Figure 125

Remove shim.



Figure 126

Remove both rectangular rings (arrow).

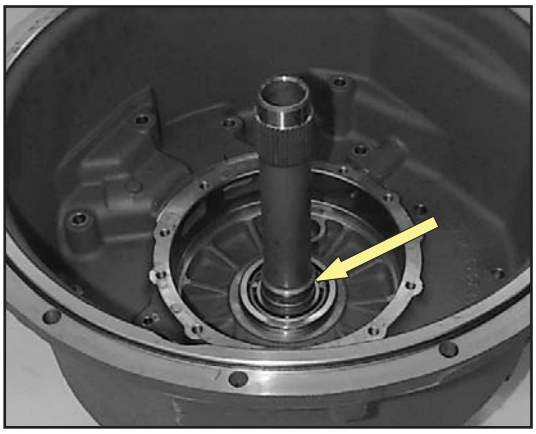


Figure 127

Press input shaft out of the spur gear bearing.
Remove released bearing inner race and spur gear.

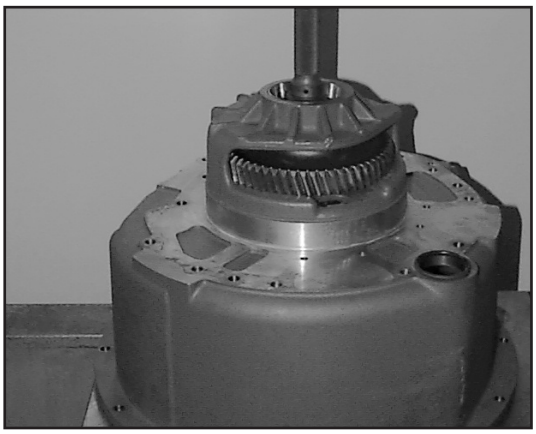


Figure 128

Press bearing inner race off the input shaft.

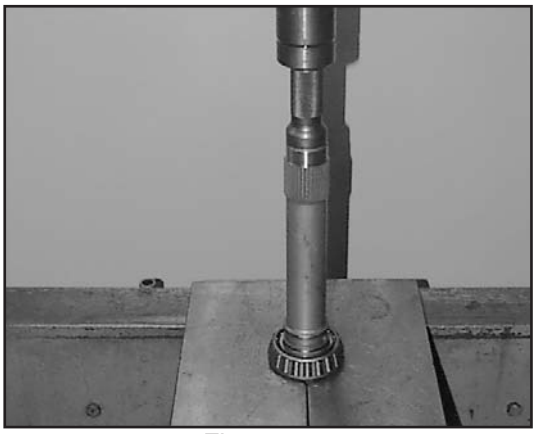


Figure 129

Remove pressure back-up valve.

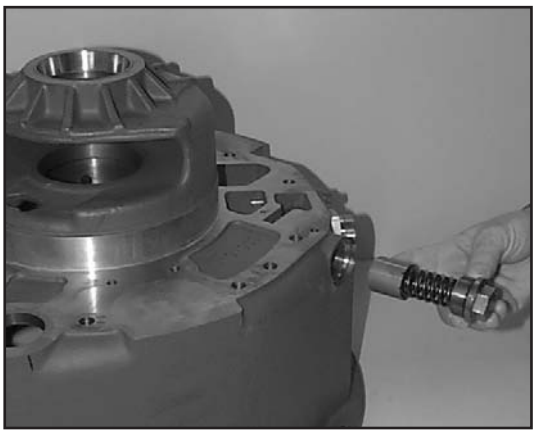


Figure 130

Pull the complete input shaft out of the gearbox housing or out of the pump.



Figure 131

Squeeze out rectangular ring (arrow).

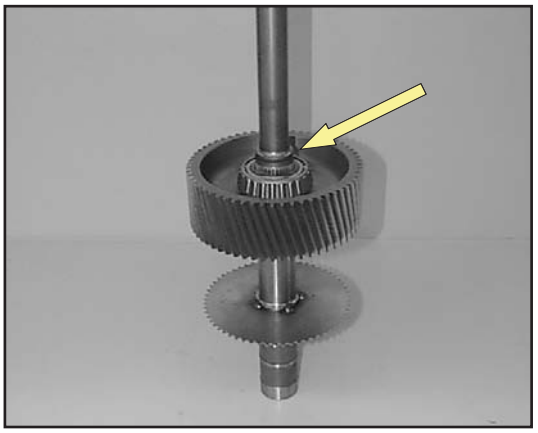


Figure 132

Separate spur gear from shaft and squeeze out circlip (arrow).

(S) Set of pliers 504232

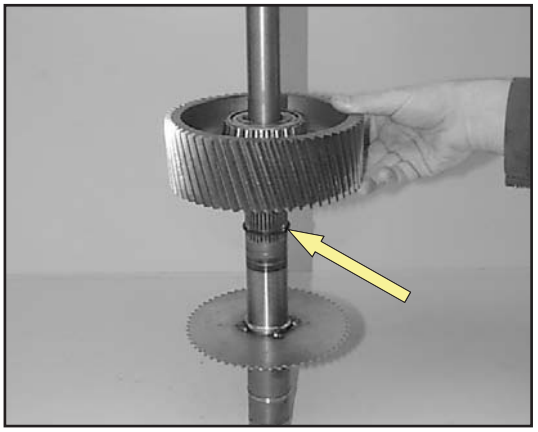


Figure 133

Pull bearing inner race off the spur gear.

(S) Grab sleeve 504239
(S) Basic tool 504238



Figure 134

Fasten shaft in vice.
Unscrew socket head screw and remove clamping disc.

Use protective jaws!

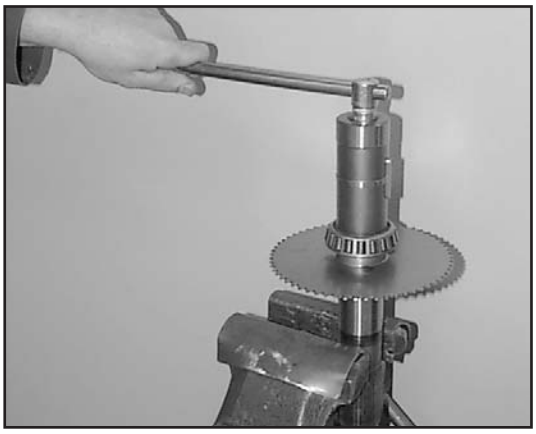


Figure 135

Pull bearing inner race and driver off the shaft.

Support puller on the end face – input shaft!
Pay attention to the released shims!

(S) 3-leg-puller 504236

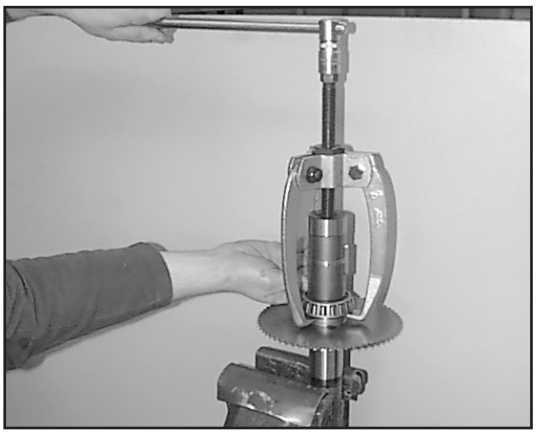


Figure 136

Separate bearing inner race from driver.

Pay attention to the released washers !

If necessary, squeeze out circlips (3x).

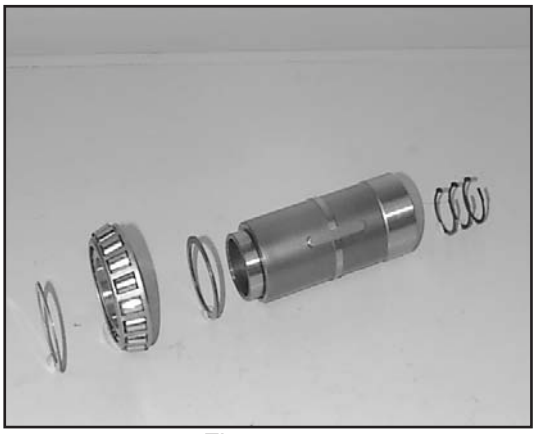


Figure 137

Transmission pump

Tilt gearbox housing by 180°.

Loosen hex. head screws and separate both pump flanges from the housing.

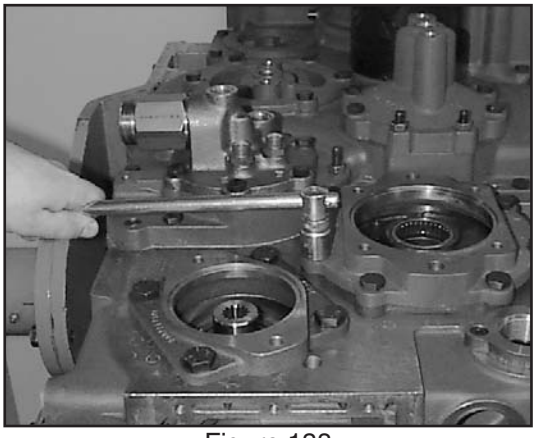
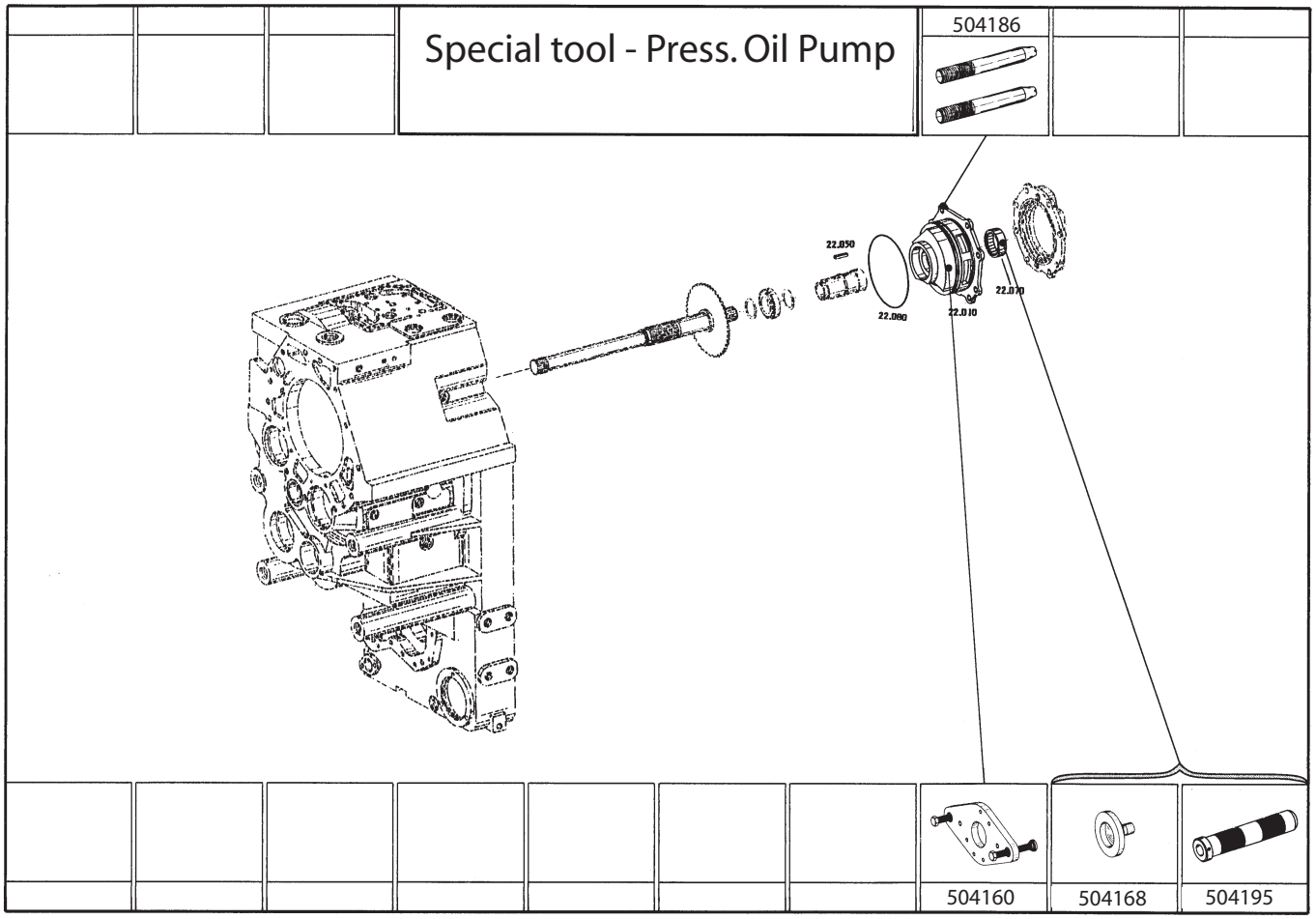
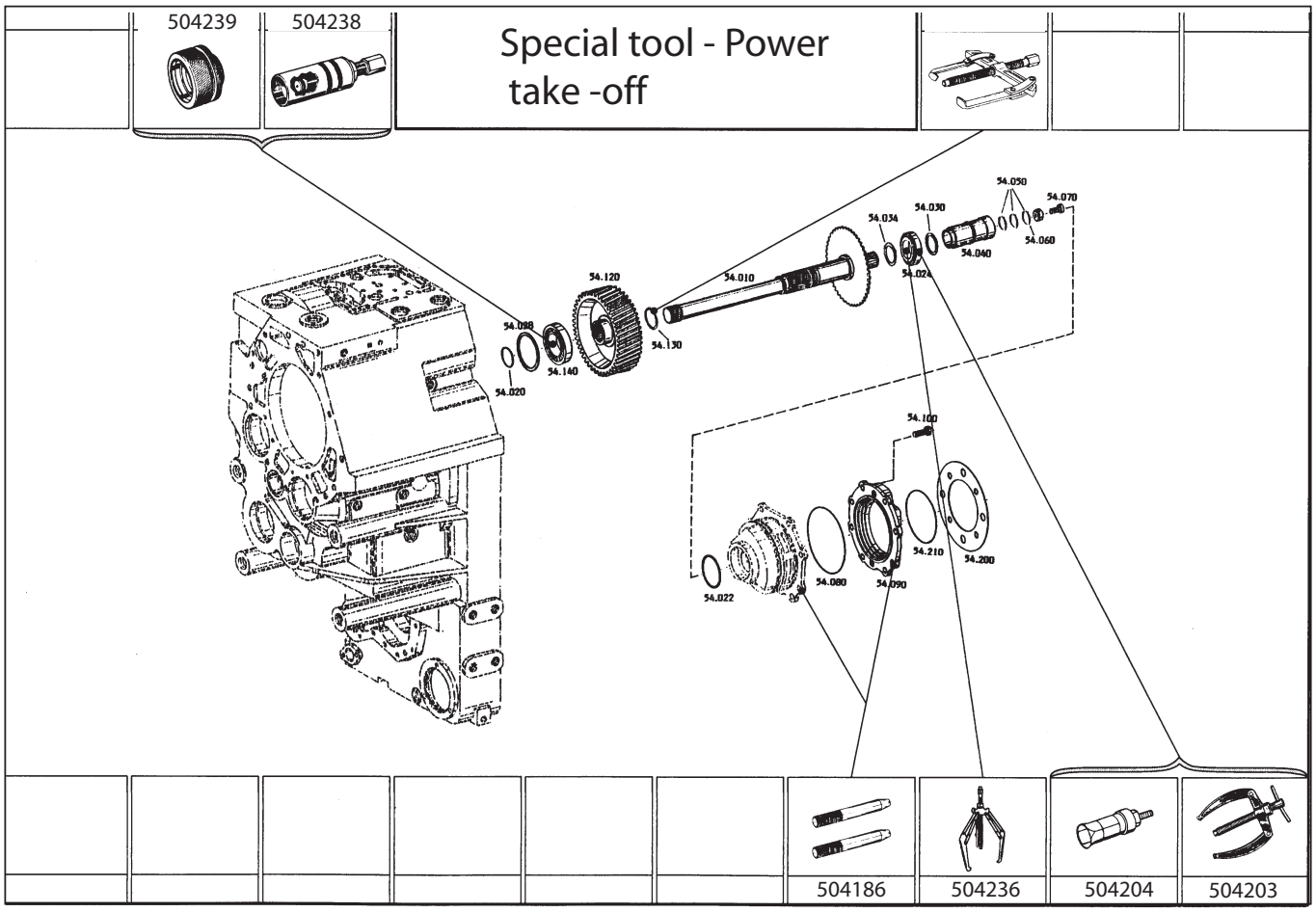


Figure 138

Special tool - Press. Oil Pump



Special tool - Power take -off



Loosen socket head screws (M8) and position puller device. Pull transmission pump out of the housing bore.

Tapping onto the housing face will support pulling out!

(S) Puller device 504160

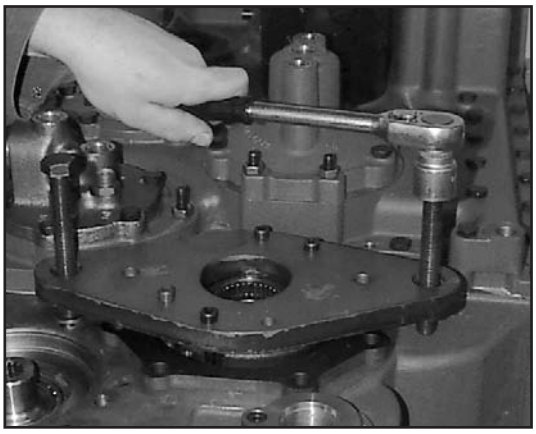


Figure 139

Pull bearing outer race out of the bore and remove spacer.

(S) Internal puller 504204
(S) Counter support 504203

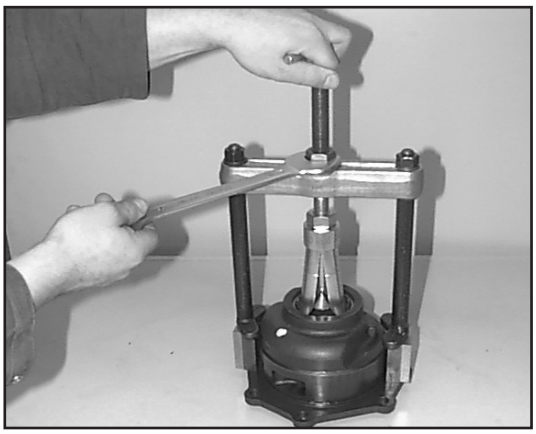


Figure 140

Loosen socket head screw, dismantle pump cover and remove rotor set

If traces of wear should be encountered in the pump housing or the housing cover, the complete pump has to be renewed!

Now, introduce the rotor set with the chamfer on the tooth crest showing downwards and install housing cover again.

Torque limit (M8/8.8) ..... M_A = 23 Nm
Torque limit (M6/8.8) ..... M_A = 9,5 Nm

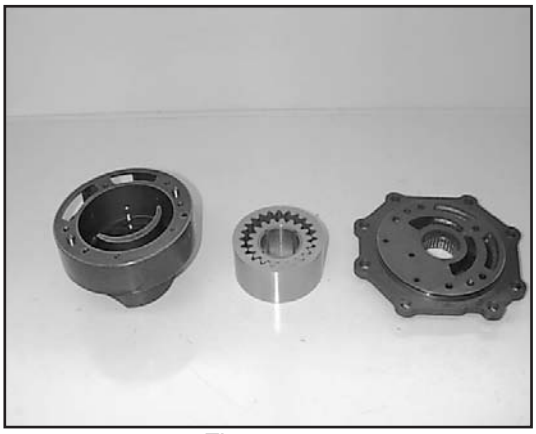


Figure 141

3.1.3 Emergency steering pump

Loosen hex. head screws and pry emergency steering pump out of the housing.

(S) Crow bar 504210

Mark installation position!

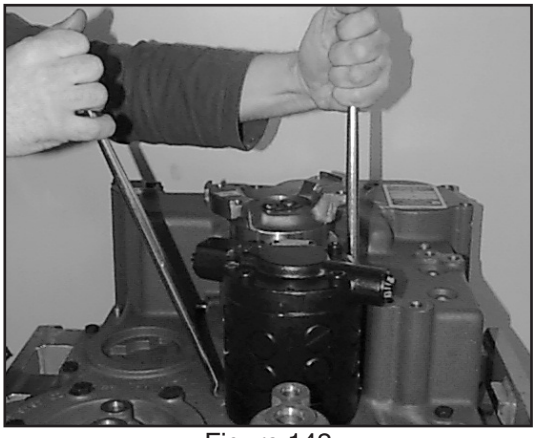
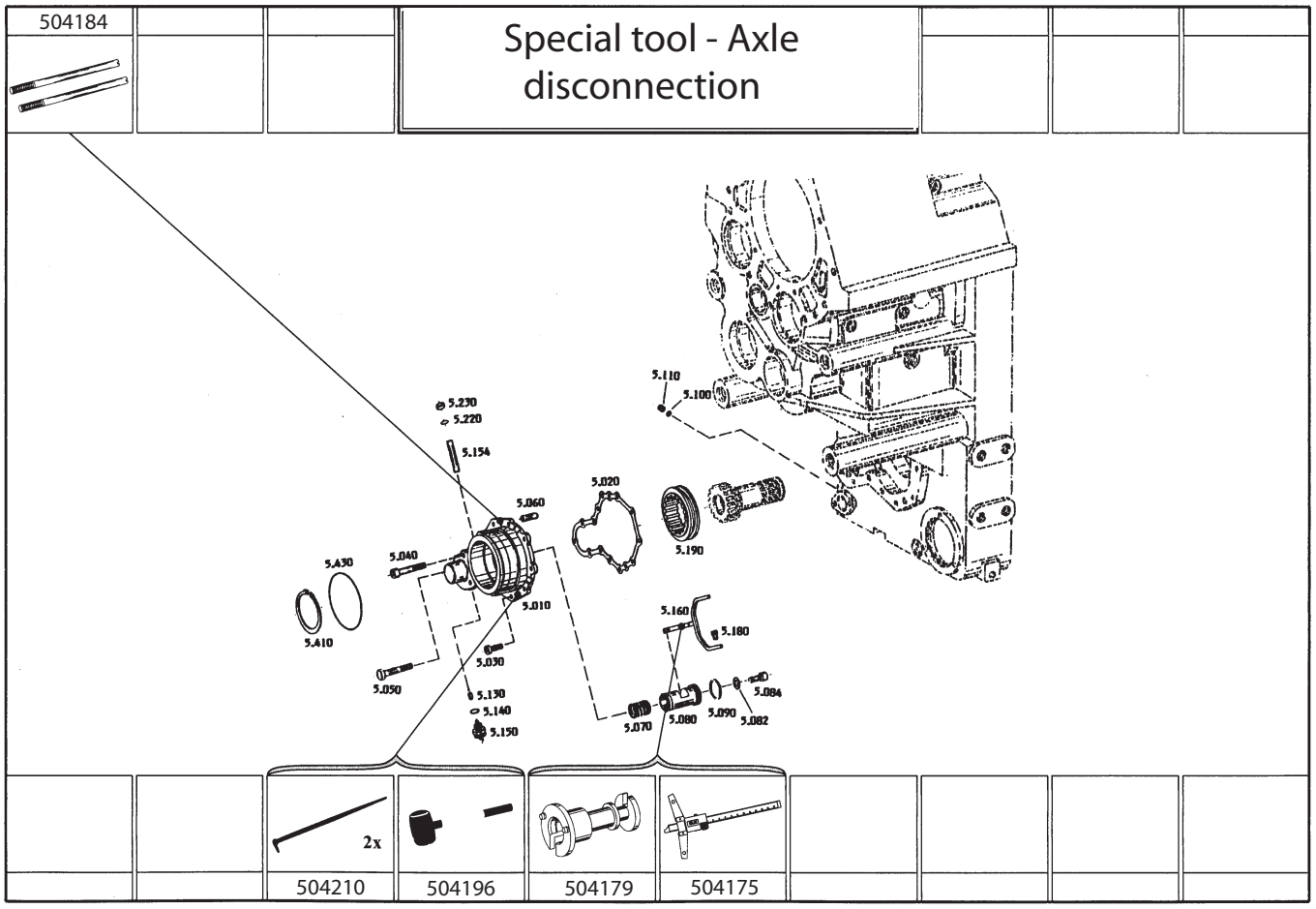
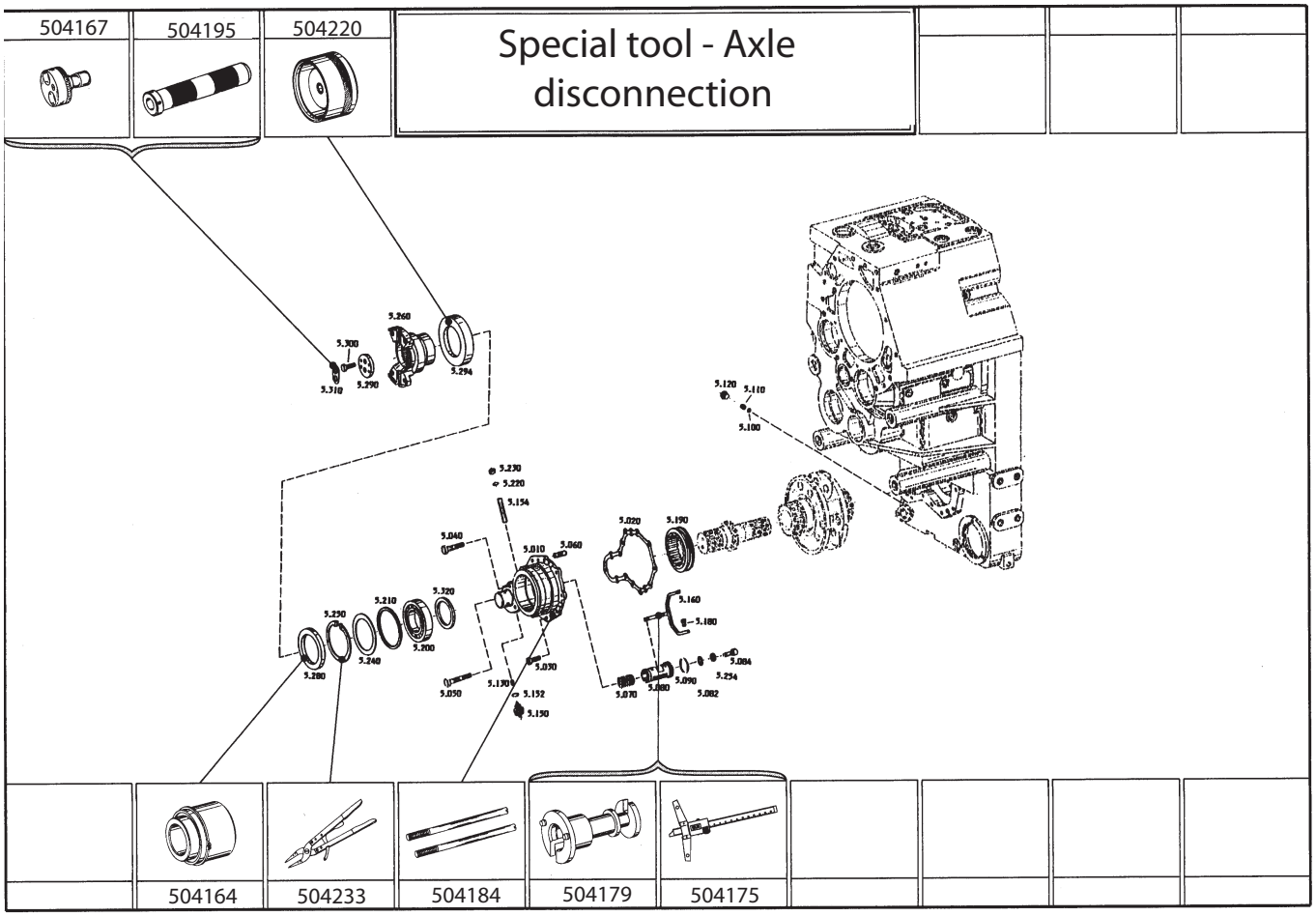


Figure 142

Axle disconnection





Remove lock plate.

Loosen hex. head screws and remove disc.
Pull output flange off the shaft.

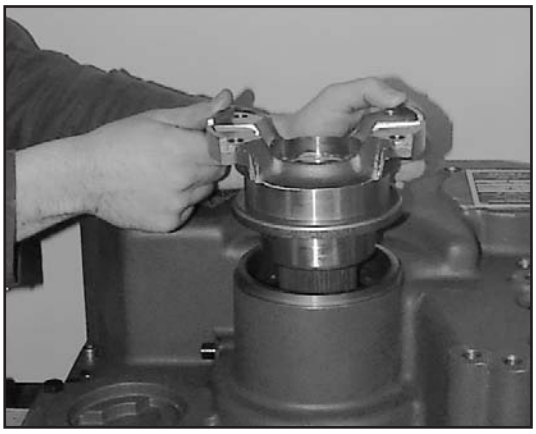


Figure 143

Tilt gearbox housing by 180°.

Loosen hex. head screws, dismantle cover and remove filter.

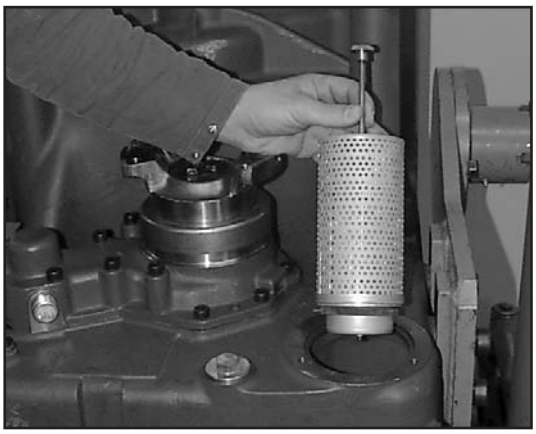


Figure 144

Axle disconnection device – design with intermediate axle differential

Remove lock plate, loosen hex. head screws and pull off output flange.

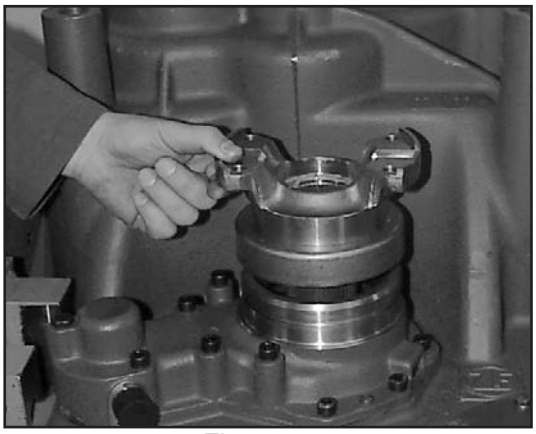


Figure 145

Loosen socket head screws and hex. head screws.

Separate axle disconnection device from the housing using pry bars.

During the separating procedure, drive out the output shaft by tapping downward!

(S) Pry bar	504210
(S) Plastic hammer	504196

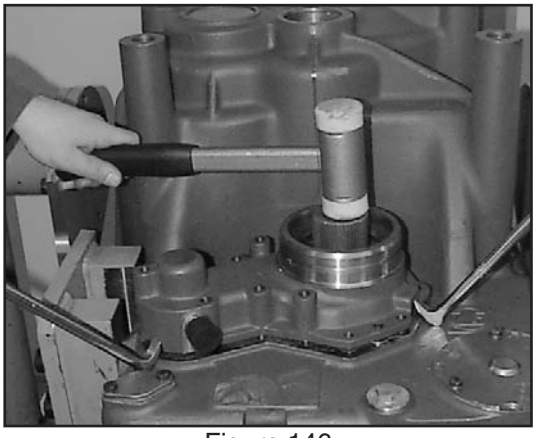


Figure 146

Dismantle switch and detent pin.

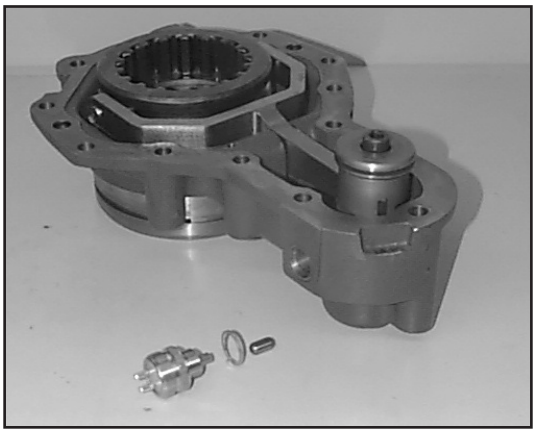


Figure 147

Disassemble switch and detent pin.

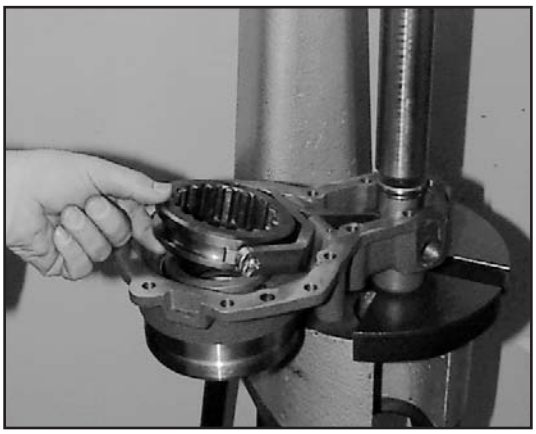


Figure 148

Remove cover as well as circlip and drive pin out of the bore using a striker.

Remove the released components.

(S) Striker 504224

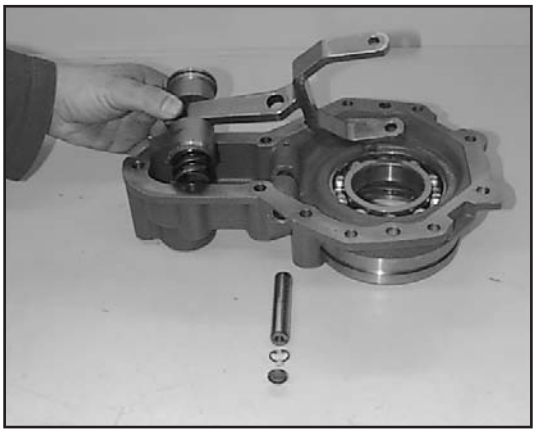


Figure 149

Remove shaft seal.

Squeeze out circlip and remove spacer as well as shim (Figure 150).

Now, remove the ball bearing.

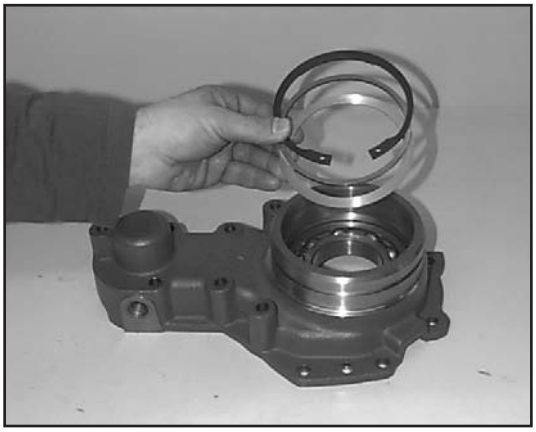
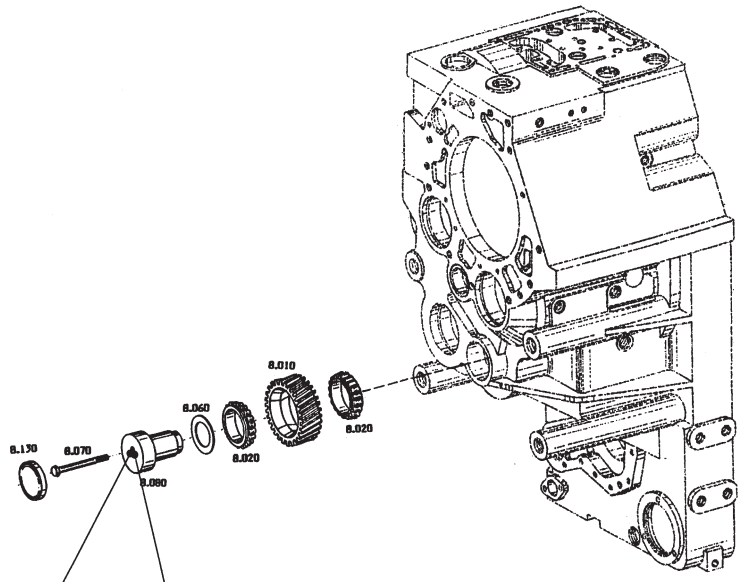
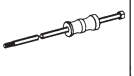


Figure 150

Special tool - Gearbox housing




504187


504225

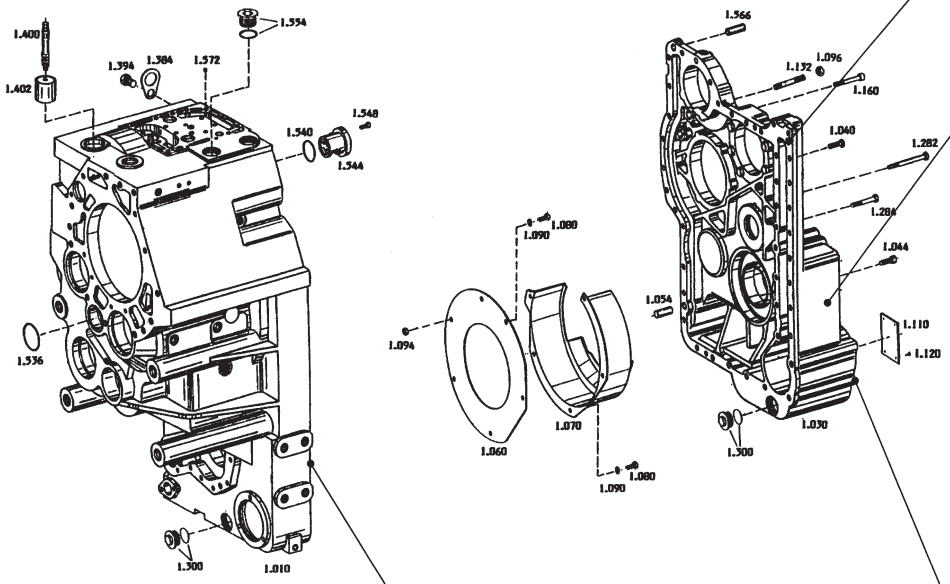
Special tool - Gearbox housing

504183



504196






504184

3.1.5 Countershaft

Remove sealing cover and loosen hex. head screws.

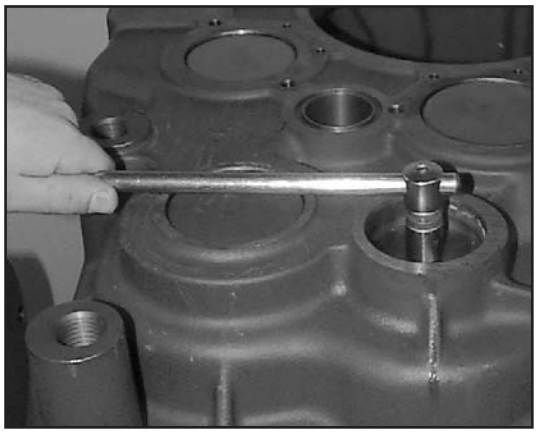


Figure 151

Tilt gearbox housing by 90°.

Drive countershaft axle off the housing bore or the countershaft support by means of a striker.

(S) Striker 504225

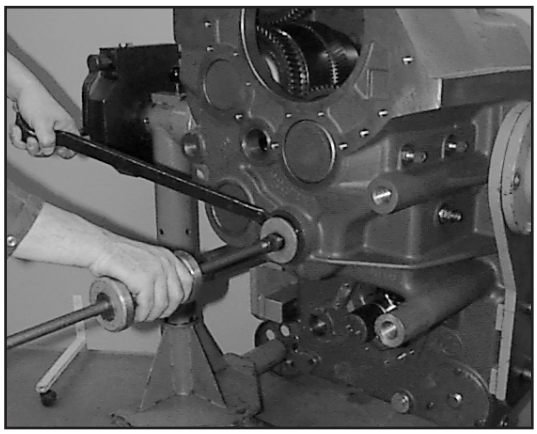


Figure 152

3.1.6 Disassemble inductive transmitter (3x)

612 = n – Turbine
608 = n – Central gear train
606 = n – Engine

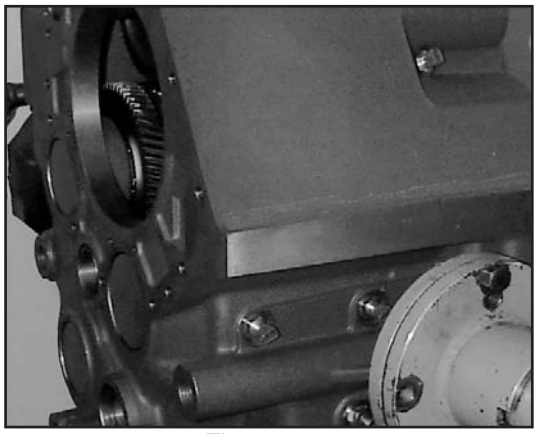


Figure 153

Tilt gearbox housing by 90°

Loosen hex. head screw and pull bearing cover KV/K1, KR/K2 and K4/K3 from the housing bore.

Mark installation position of the bearing covers!

(S) Striker 504225
(S) Set of threads 504191

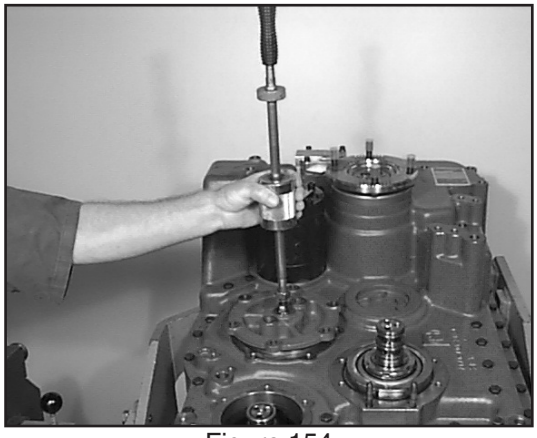


Figure 154

Loosen screw connection and separate housing cover by means of back-off screws (arrows) and lifting device from the gearbox housing.

During the separating procedure, drive out the output shaft by tapping continuously downwards!

(S) Back-off screws	504183
(S) Lifting device	504198
(S) Plastic hammer	504196

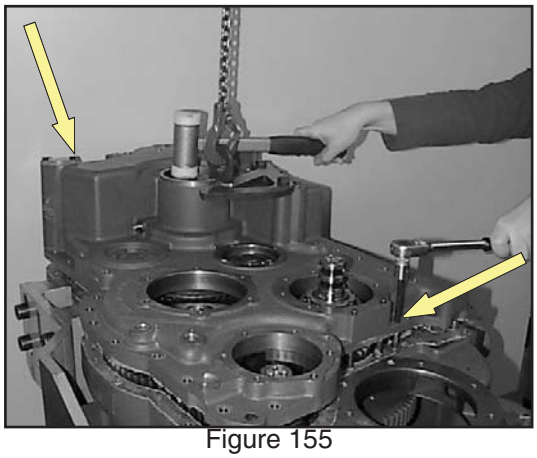


Figure 155

Loosen hex. head screws and remove cover plate.

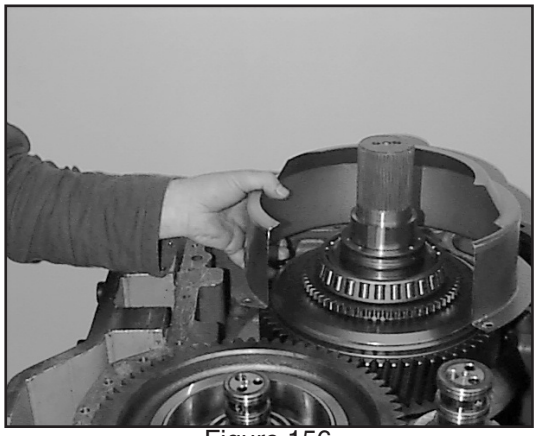


Figure 156

Assembly,
see the section: Manual transmission assembly

Interaxle differential:

Description:

The differential, installed in the output, has the task to transmit different torques on the vehicle axles and to function as intermediate compensation in the driving direction (longitudinal direction of the vehicle).
Due to the existing differential lock, both functions can be put out of service and a rigid con-nection between the axles can be created.

Function:

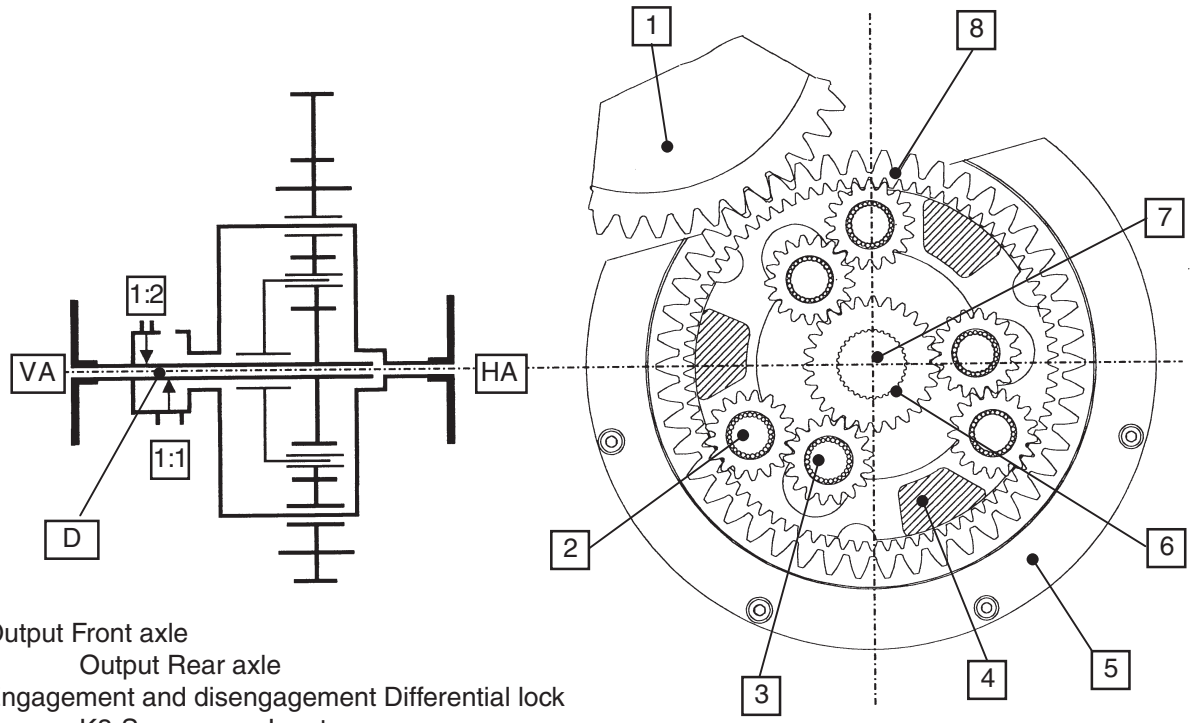
The planetary drive (differential) is designed in such a way that the external internal gear will be driven.

The output is realized via the planet carrier (4) – great lever arm – and via the internal sun gear (6) – small lever arm.
Due to these different lever arms (diameters), a torque splitting of 1 : 2 is given in the actual case as follows:

- Front axle 1/3
- Rear axle 2/3

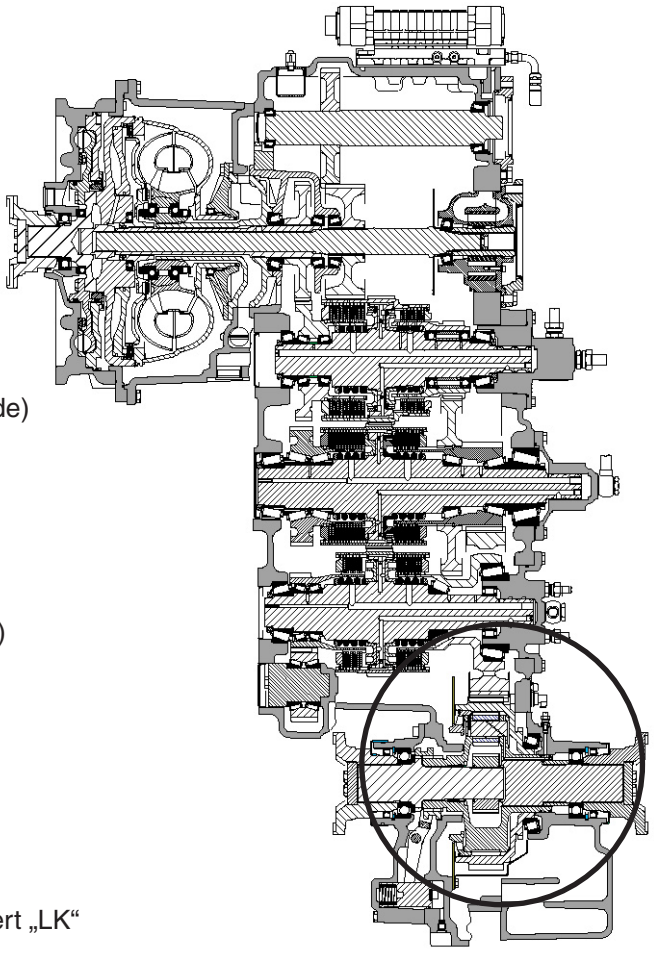
Due to the special arrangement of the planetary gears (2 and 3) - Ravignaux-System – the required inversion takes place within the planetary drive, so that both outputs (planet carrier and sun gear) are running in the same direction of rotation.

If an axle of the vehicle is showing slip, a rigid connection between the vehicle axles can be created by the differential lock.
In this condition, a torque output of 1 : 1 is realized.

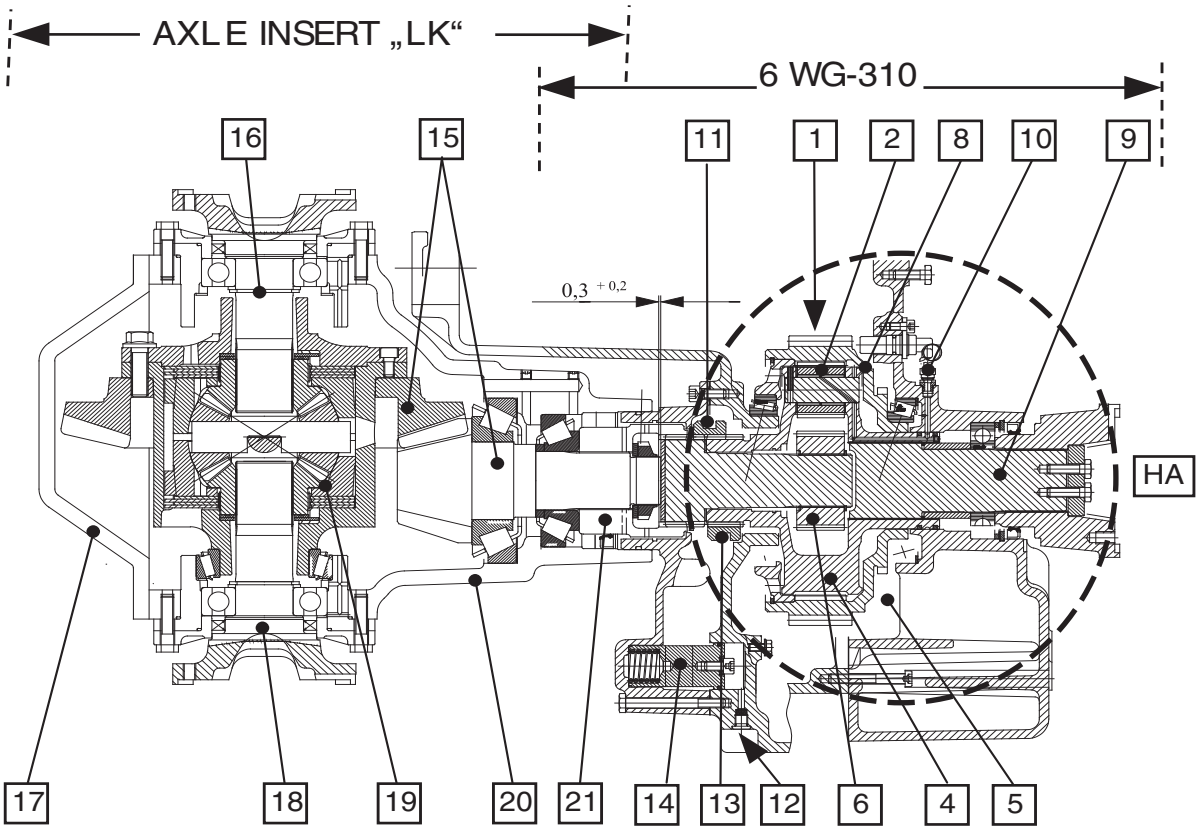


VA = Output Front axle
HA = Output Rear axle
D = Engagement and disengagement Differential lock
1 = K3-Spur gear – Input
2 = Planetary gear (Ravignaux-System outer hole circle))
3 = Planetary gear (Ravignaux-System inner hole circle)
4 = Planet carrier
5 = Screening plate
6 = Sun gear
7 = Output shaft to the Front axle
8 = Internal gear

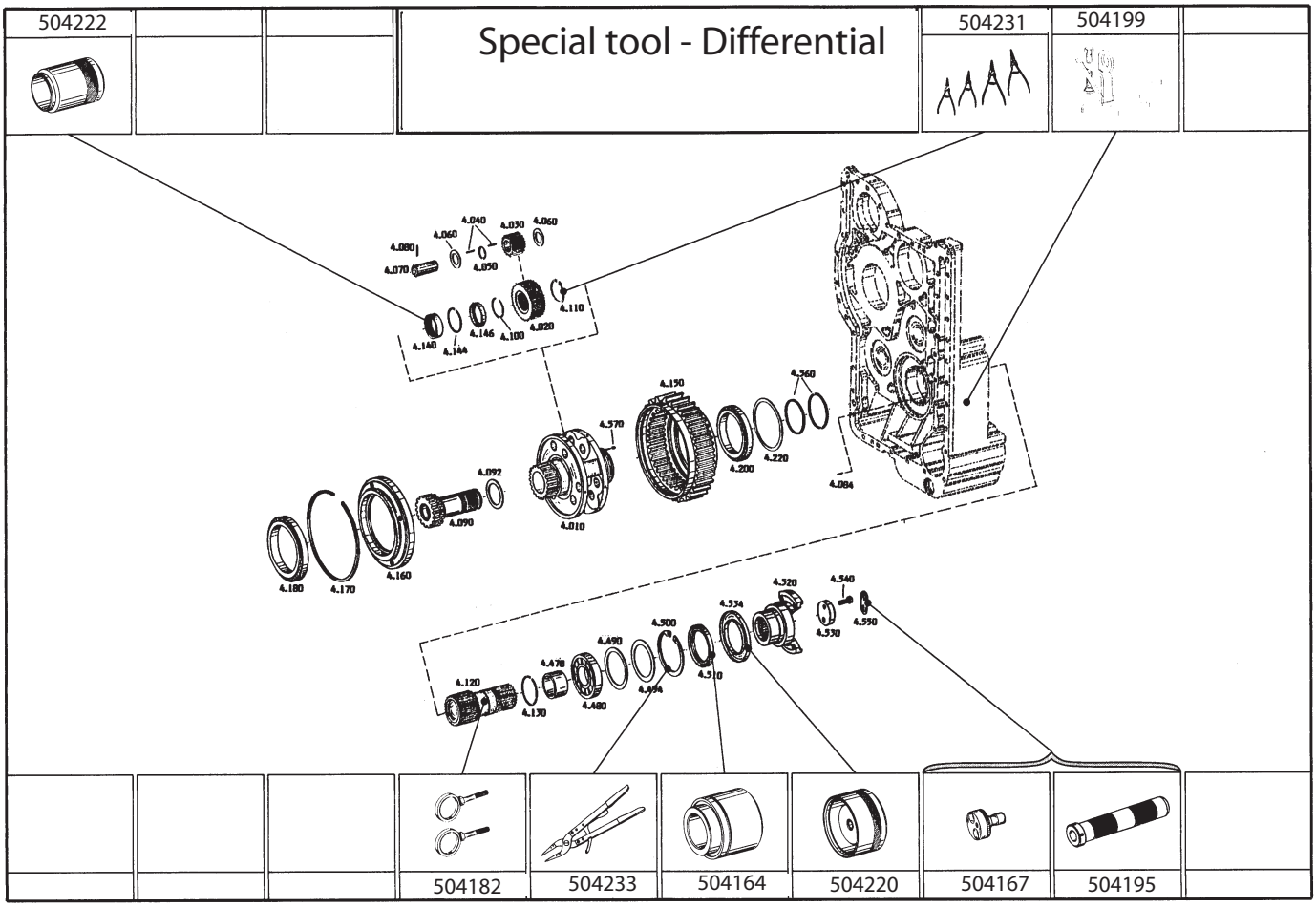
Interaxle differential with mounted Differential carrier „LK“



HA= Output Rear axle
1 = K3-Spur gear – Input
2 = Planetary gear
(Ravignaux-System outer hole circle)
4 = Planet carrier
5 = Screening plate
6 = Sun gear
7 = Output shaft to the Front axle (converter-side)
8 = Internal gear
9 = Output shaft to the Rear axle (rear-side)
10 = Connection lubrication Interaxle differential
11 = Sliding sleeve Differential lock (engaged)
12 = Connection actuation Differential lock (hydraulic or pneumatic)
13 = Sliding sleeve Differential lock (disengaged)
14 = Pneumatic or hydraulic engagement and disengagement of the Differential lock
15 = Bevel gear set
16 = Output front axle - RH
17 = Cover with oil fillter- and oil drain plug
18 = Ouput front axle - LH
19 = Limited – slip differential
20 = Differential housing
21 = Adapter Transmission 6 WG-310 / Axle insert „LK“



Interaxle differential disassembly



Lift differential out of the gearbox by means of lifting device.

(S) Lifting device 504198
(S) Set of eye bolts 504182



Figure 157

Remove plate and disassemble bearing inner race.

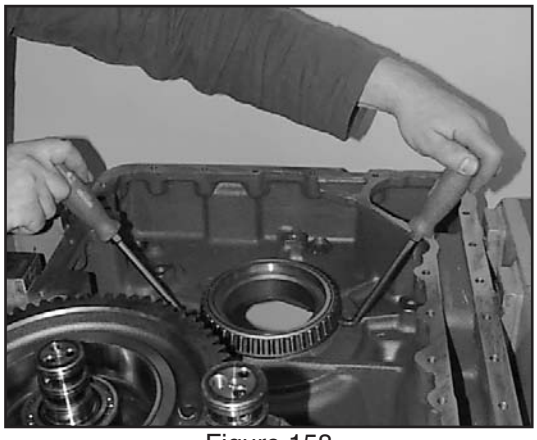


Figure 158

Squeeze out both rectangular rings (arrow) and remove them.

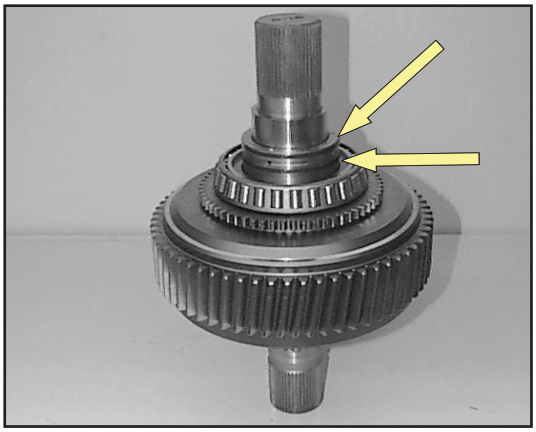


Figure 160

Remove bush.



Figure 161

Squeeze out snap ring and pull output shaft off the planet carrier.

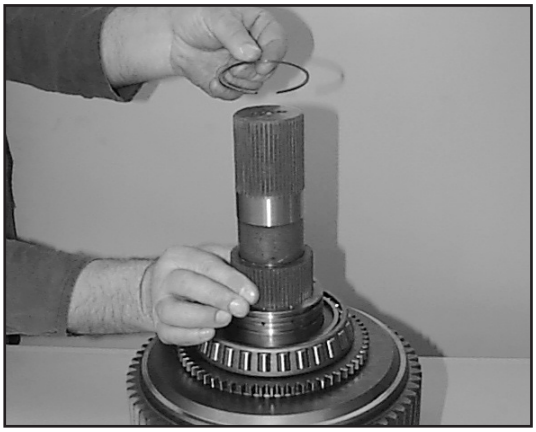


Figure 162

Squeeze out circlip (sun gear fixing).

(S) Set of external pliers 504231



Figure 163

Pull bearing inner race off the internal gear.

(S) Quick-acting grip	504252
or grab sleeve	504247
(S) Basic tool	504246

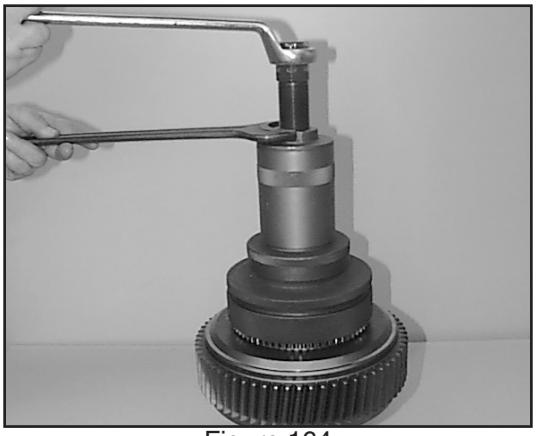


Figure 164

Squeeze out snap ring.

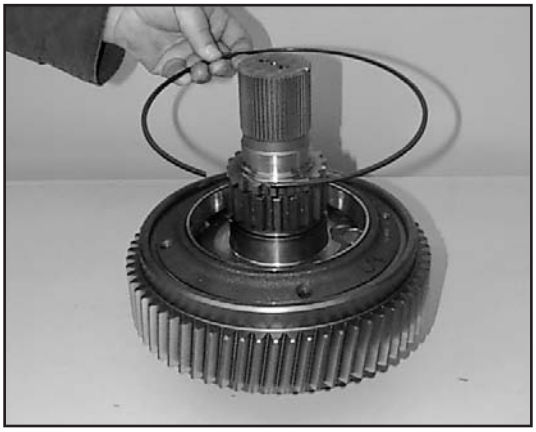


Figure 165

Press internal gear and planet carrier out of the internal gear.

Figure 167 shows the released components!

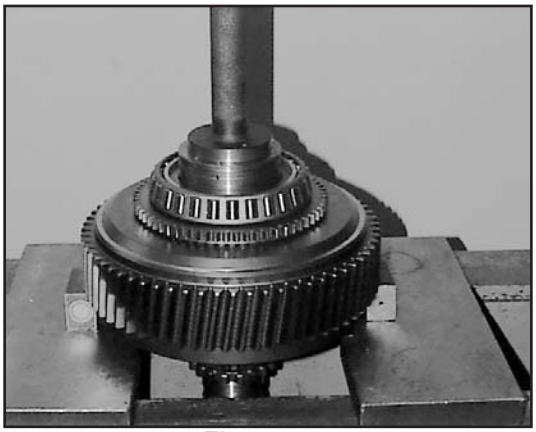


Figure 166

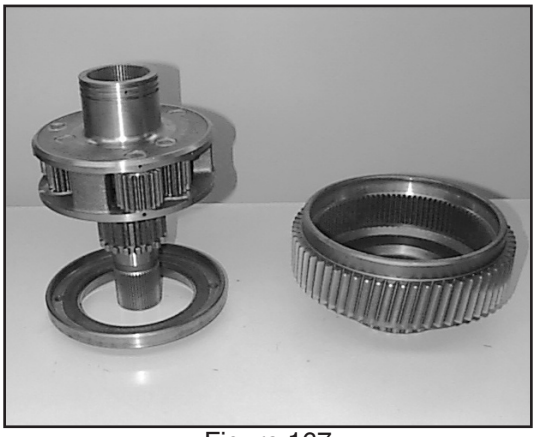


Figure 167

Carefully drive in roll pin (arrow) until contact is obtained.

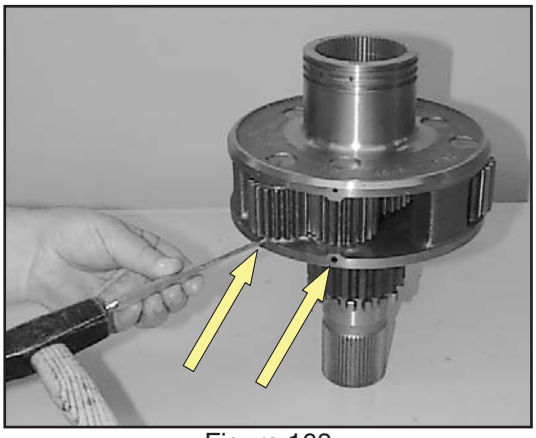


Figure 168

Drive out planet bolt and remove planet gears.

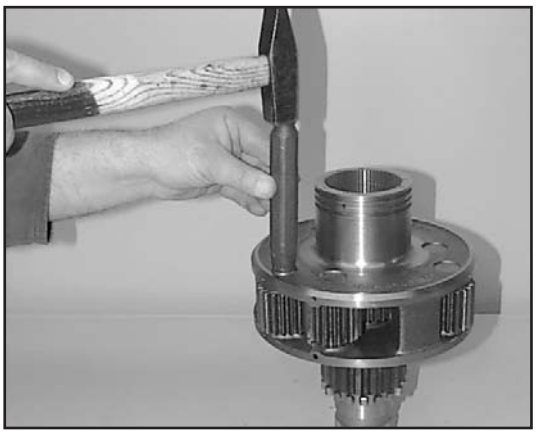


Figure 169

Press output shaft far enough downward until the sun gear can be removed, also see Figure 171!

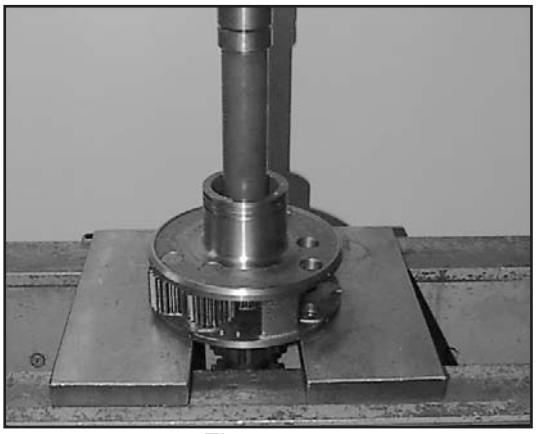


Figure 170

Squeeze out snap ring (arrow) and separate output shaft from planet carrier.

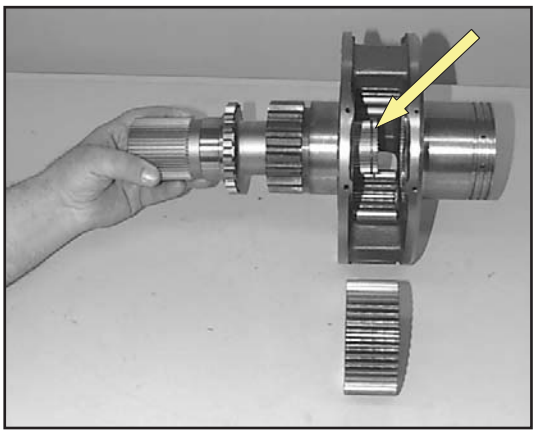


Figure 171

If necessary, pry baffle ring out of the planet carrier bore, squeeze out snap ring (Figure 172) and drive out needle bearing (Figure 173).

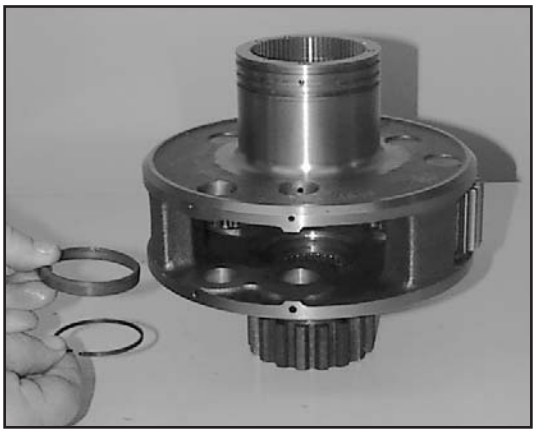


Figure 172

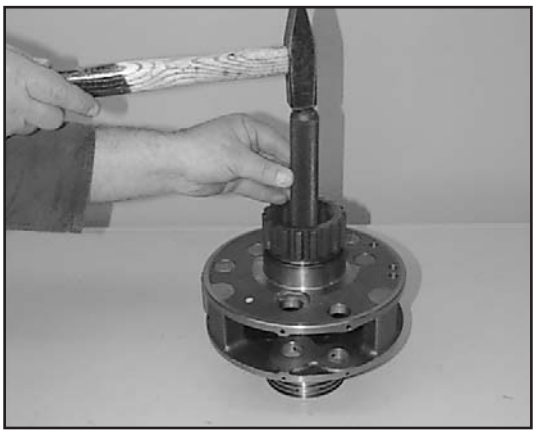
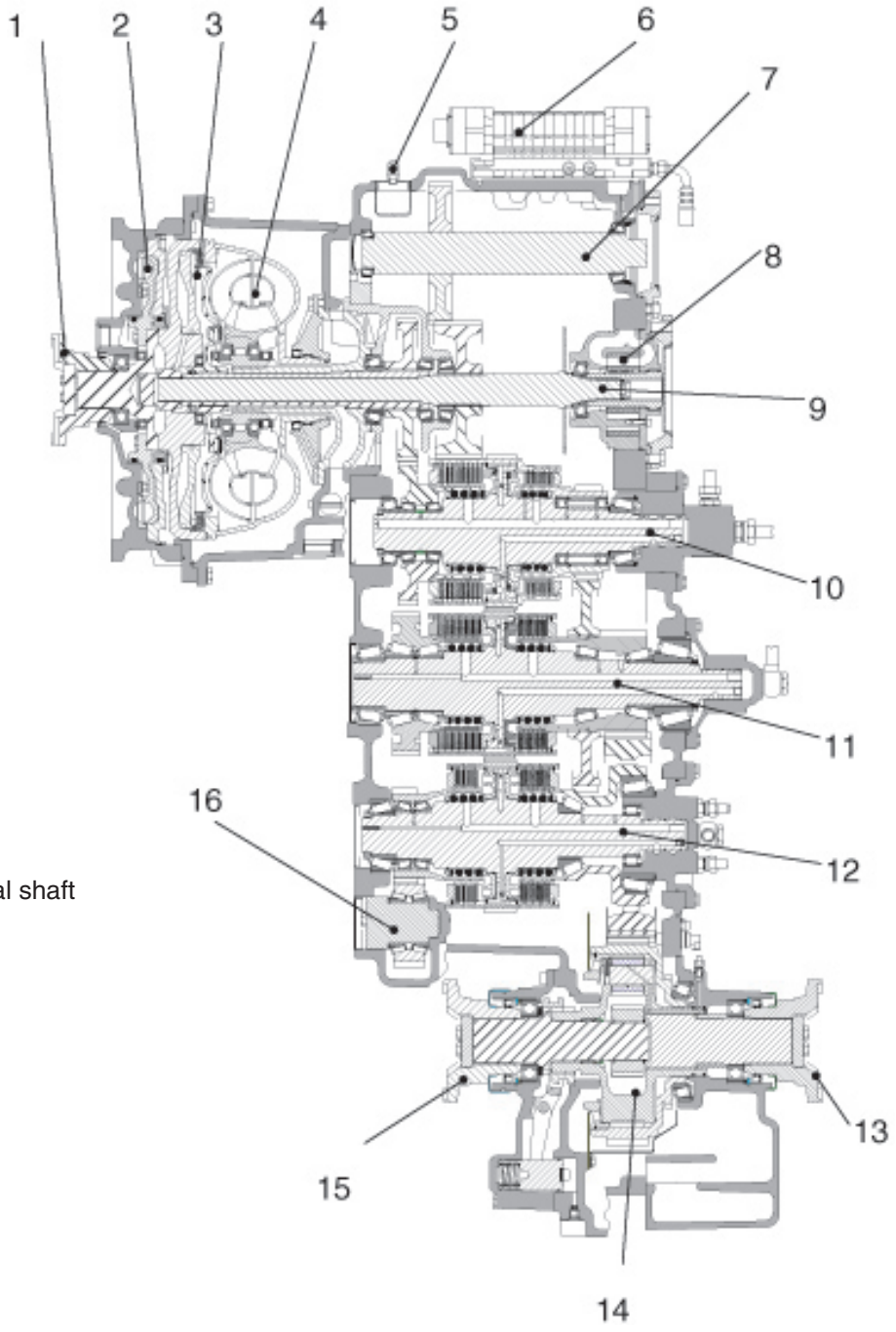


Figure 173

Assembly the interaxle diff, see the section:

Interaxle differential assembly

Clutches, Powershift transmission



1 = Input flange - Drive via universal shaft
2 = Retarder
3 = WK
2 = Converter
5 = Breather
6 = Electrohydraulic control unit
7 = 2nd Power take-off
8 = Transmision pump
9 = 1st Pover take off
10 = Clutck axle "KV/K1"
11 = Clutc axle "KR/K2"
12 = Clutch axle "K4/K3"
13 = Output flange rear side
14 = Interaxle differential
15 = Output flange (converter-side)
16 = Countershaft

Multi-disk clutch

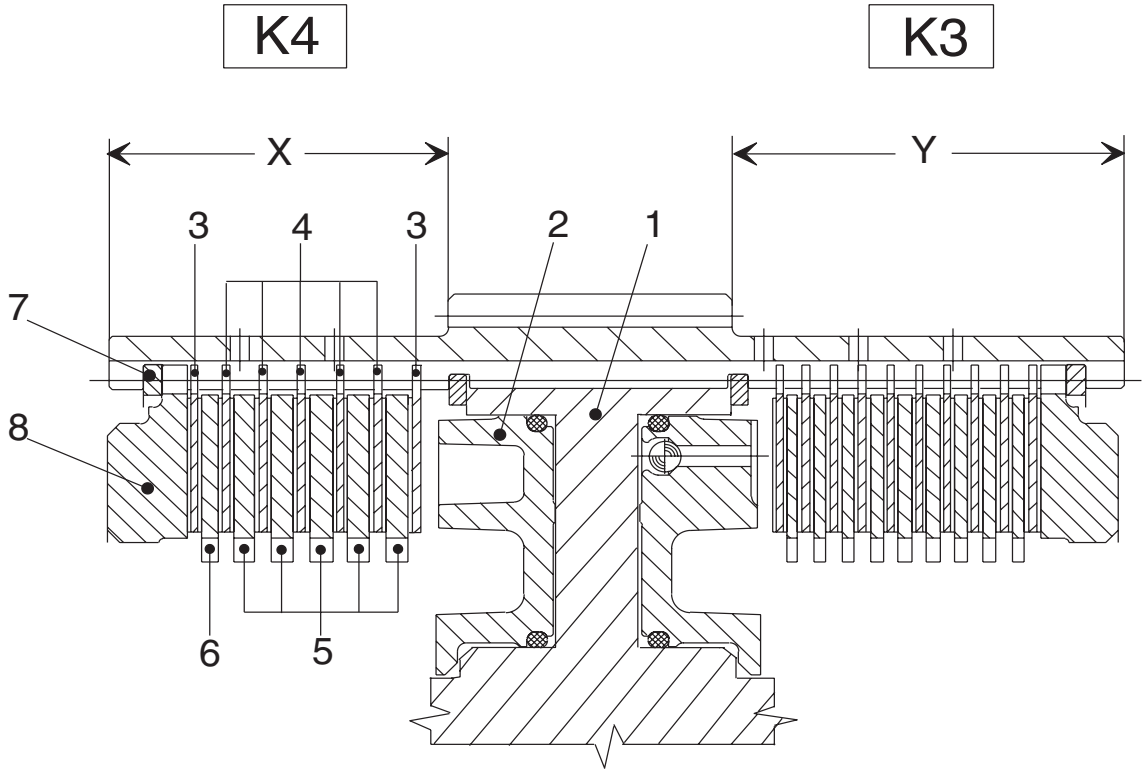
The multi-speed reversing transmission in countershaft design is power shiftable by hydrauli-cally actuated multi-disk clutches.
All gears are constantly meshing and carried on antifriction bearings.

The gear wheels, bearings and clutches are cooled and lubricated with oil.

The 6-speed reversing transmission is equipped with 6 multi-disk clutches. (Figure example)
At the shifting, the actual plate pack is compressed by a piston, movable in
axial direction, which is pressurized with pressure oil.
A compression spring takes over the pushing back of the piston, thus the release of the plate pack.
As to the layout of the transmission as well as the specifications of the closed clutches in the single speeds.

See in chapter 2.3 Disassembly & Assembly for other clutches.

Example of the Multi-disk clutches

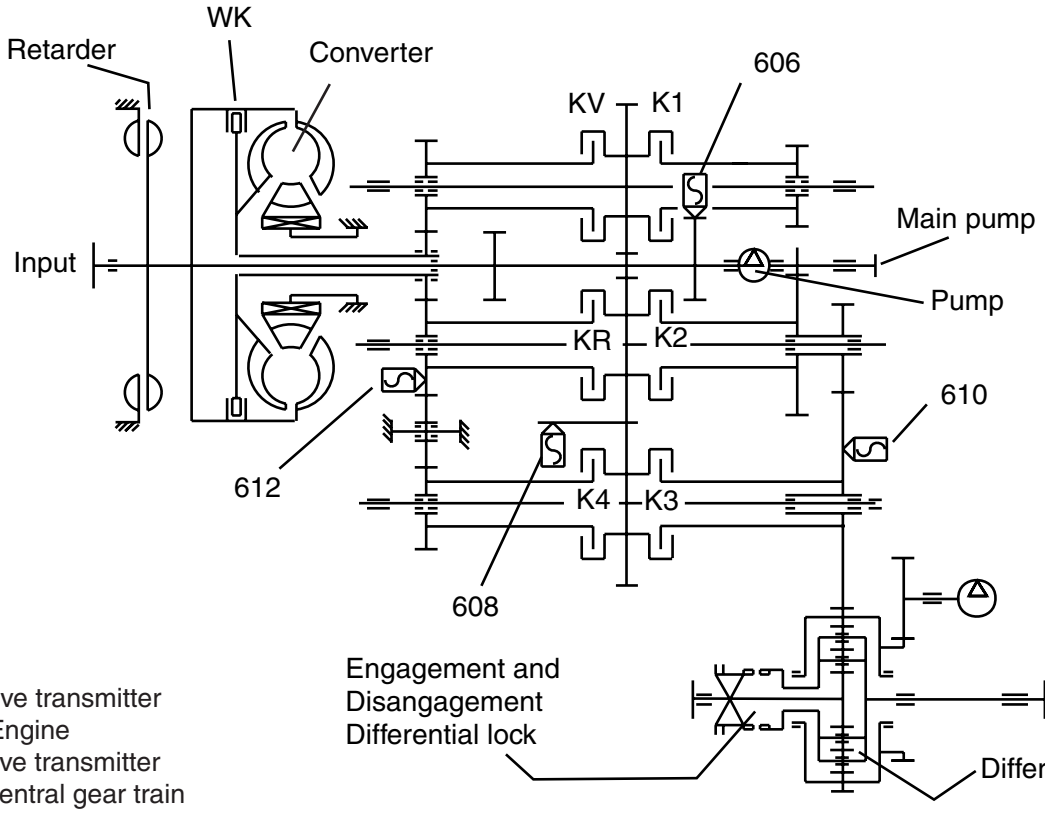


Item.	Designation	Quantity	s (mm)	Remark
1	Plate carrier	1		
2	Piston	1		
3	Outer plate	2	1,85	One-side coated
4	Outer plate	5	2,5	Coated on both sides
5	Inner plate	5	3,5	
6	Inner plate	1	2,5 ... 4,0	Optional
7	Snap ring	1	2,55 ... 3,10	Optional
8	End shim	1		
Number of friction surfaces: 12				
Plate clearance: 2,2 ... 2,4 mm				

Clutch chart

DRIVING DIRECTION	PRESSURE REGULATOR UNDER VOLTAGE							ENGAGED CLUTCHES	
	Speed	Y1	Y2	Y3	Y4	Y5	Y6		
FORWARD	1			●		●		K1	KV
	2		●	●				K4	K1
	3					●	●	KV	K2
	4		●				●	K4	K2
	5				●	●		K3	KV
	6		●		●			K4	K3
REVERSE	1	●		●				KR	K1
	2	●					●	KR	K2
	3	●			●			KR	K3
NEUTRAL									

ENGAGED CLUTCH	KR	K4	K1	K3	KV	K2
POSTITIONS ON VALVE BLOCK	F	E	D	C	B	A
CONSEC. NO. OF MEAS. POINTS	55	60	56	58	53	57



606 = Inductive transmitter
n – Engine
608 = Inductive transmitter
n – Central gear train
610 = Speed sensor
n – Output
612 = Inductive transmitter
n – Turbine

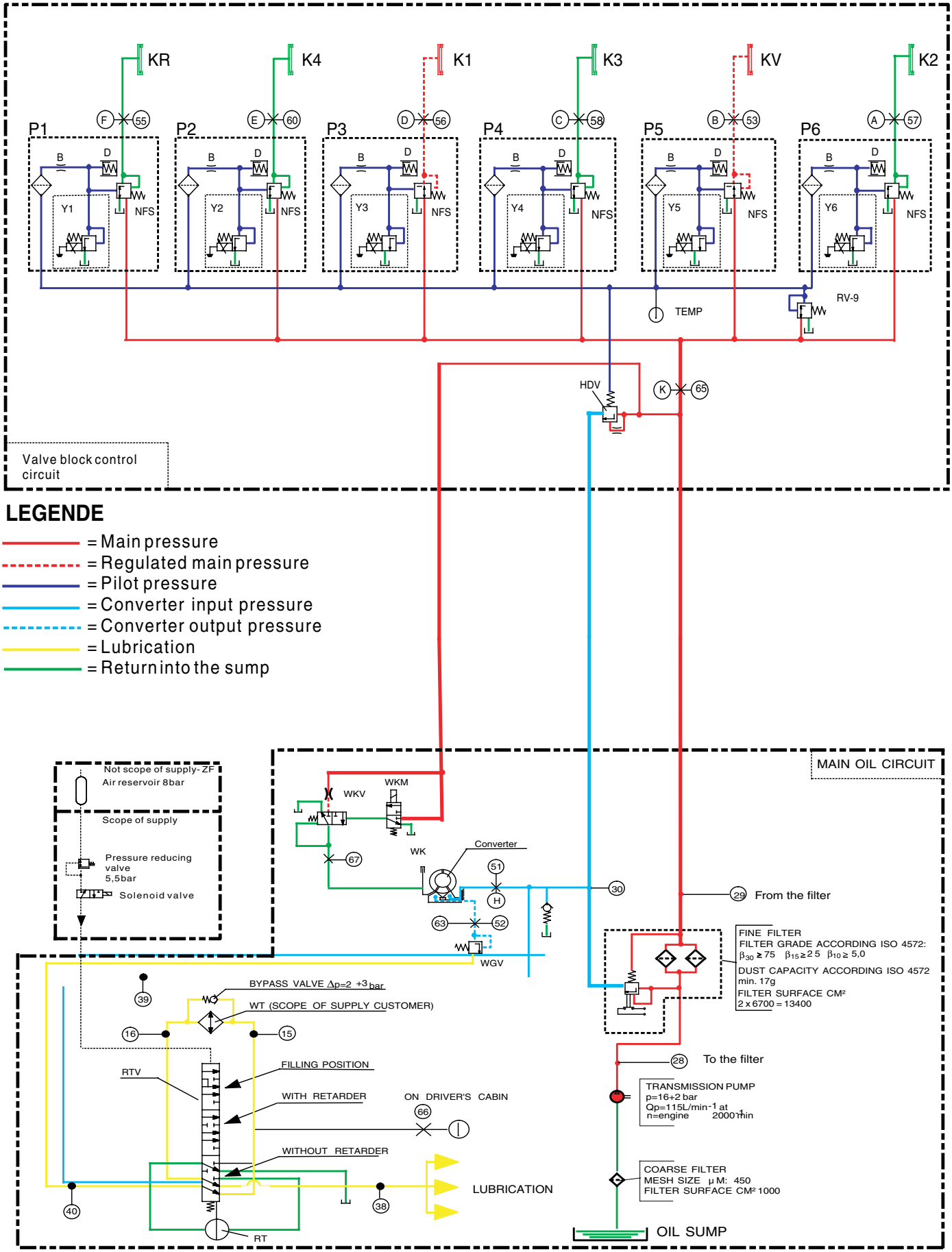
Plate clearanse in the single Multi-disc clutches

Type	K1 (mm)	K2 (mm)	K3 (mm)	K4 (mm)	KV (mm)	KR (mm)
WG-310	2,6 +0,2	2,2 +0,2	2,2 +0,2	2,2 +0,2	2,8 +0,2	2,2 +0,2

No	Measuring point and values
15	To the cooler
16	From the cooler
28	To the ZF-filter
29	From the filter
30	From the filter bypass to the converter
38	From cooler lubrication (via retarder valve)
39	In front of conv. to cooler (via retarder valve)
40	After converter to cooler (via retarder valve)
51	In front of conv. – opening pressure 8,5 bar
52	After converter – opening pressure 5 bar
53	Clutch forward KV 16 + 2 bar
55	Clutch reverse KR 16 + 2 bar
56	Clutch K1 16 + 2 bar
57	Clutch K2 16 + 2 bar
58	Clutch K3 16 + 2 bar
60	Clutch K4 16 + 2 bar
63	Temp. after conv. (short time 120°C)
65	System pressure 16 + 2 bar
66	Temp. after retarder (short time 150°C)
67	LU – control pressure 12 + 2 bar

Denomination of the positions
to Oil circuit diagram, next page.

Oil circuit diagram



Disassemble Multi-disc clutches

Disassemble clutch K4/K3, KR/K2 and KV/K1 by means of lifting device.



At the disassembly of the clutch K4/K3, slightly lift clutch KR/K2 and displace it in arrow direction, see figure on the left!

(S) Set of eye bolts 504182

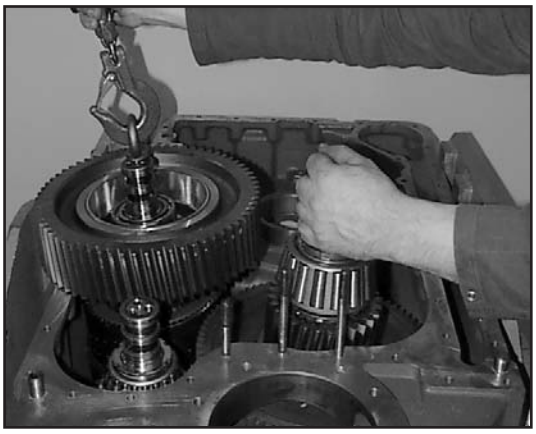


Figure 175

The figure on the left shows the clutches in disassembled condition.



Figure 176

Remove countershaft gear.



Figure 177

Disassemble and dismantle power take-off

Squeeze out circlip and remove shims.

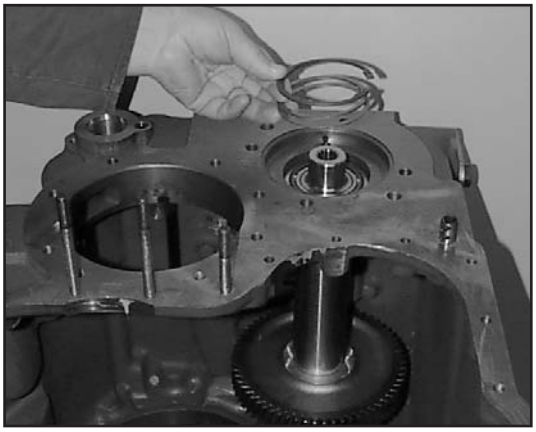


Figure 178

Lift output shaft by means of pry bar until the bearing outer race is free.

(S) Pry bar 504209

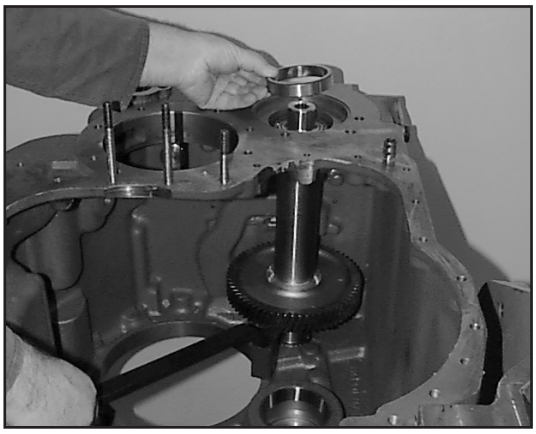


Figure 179

Take output shaft out of the housing.

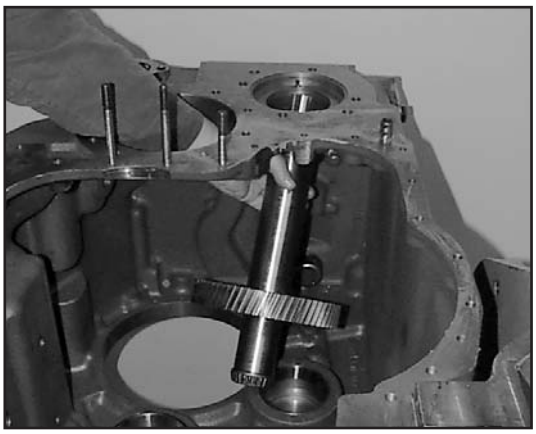


Figure 180

Pull bearing outer race out of the housing bore.

(S) Internal puller 504202
(S) Counter support 504201

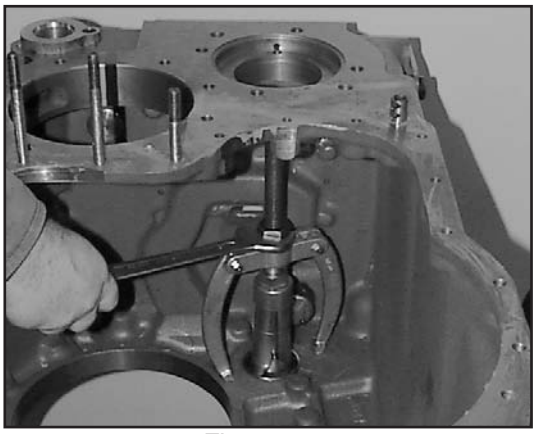


Figure 181

Pull bearing inner race off the shaft (Figure 182).

Press opposite bearing inner race off the shaft.

The separation of shaft and gear is not possible (shrink fit)!

(S) Grab sleeve 504241
(S) Basic tool 504161

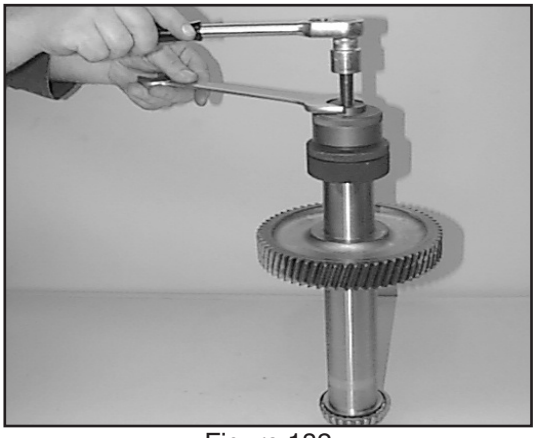
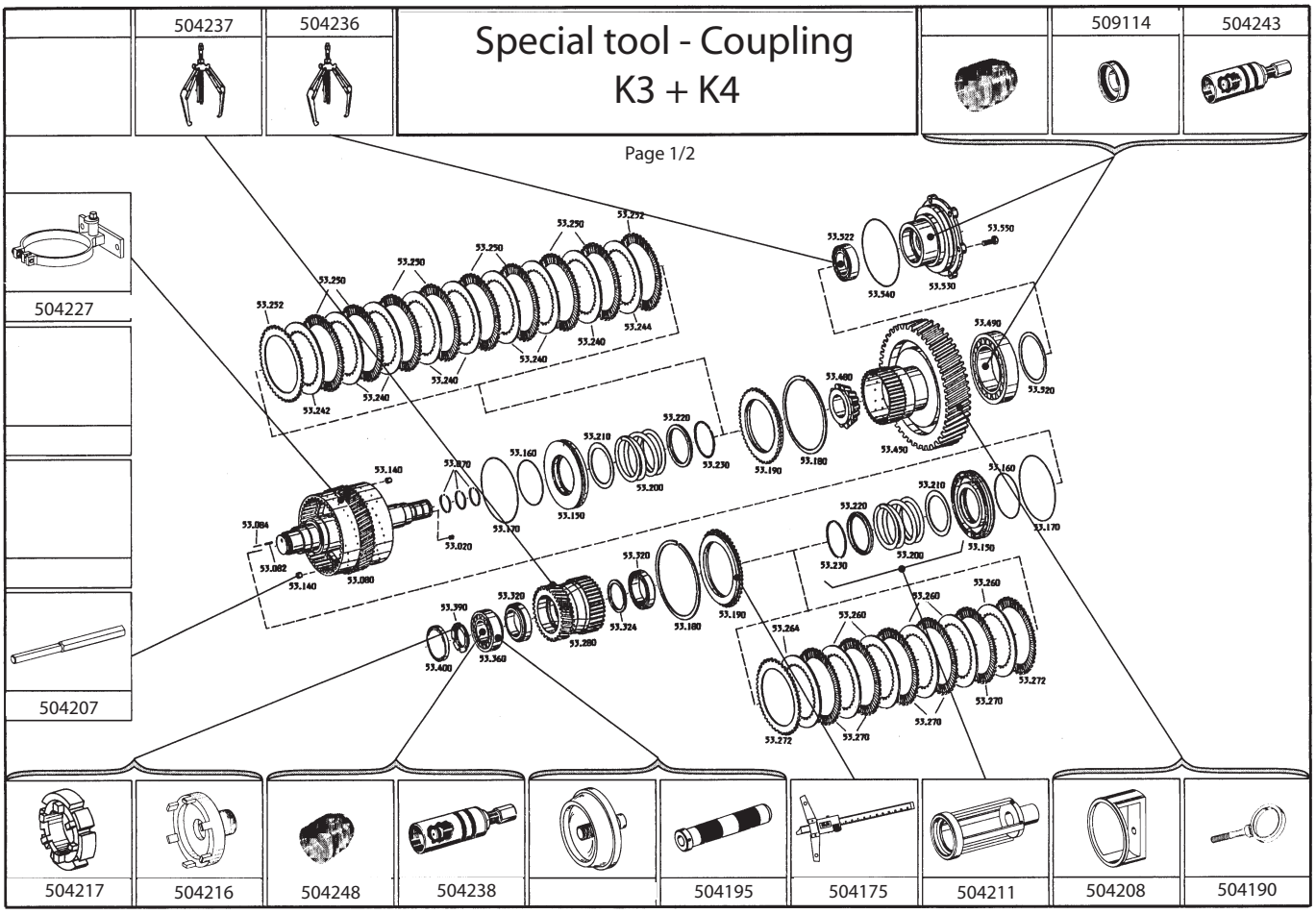


Figure 182

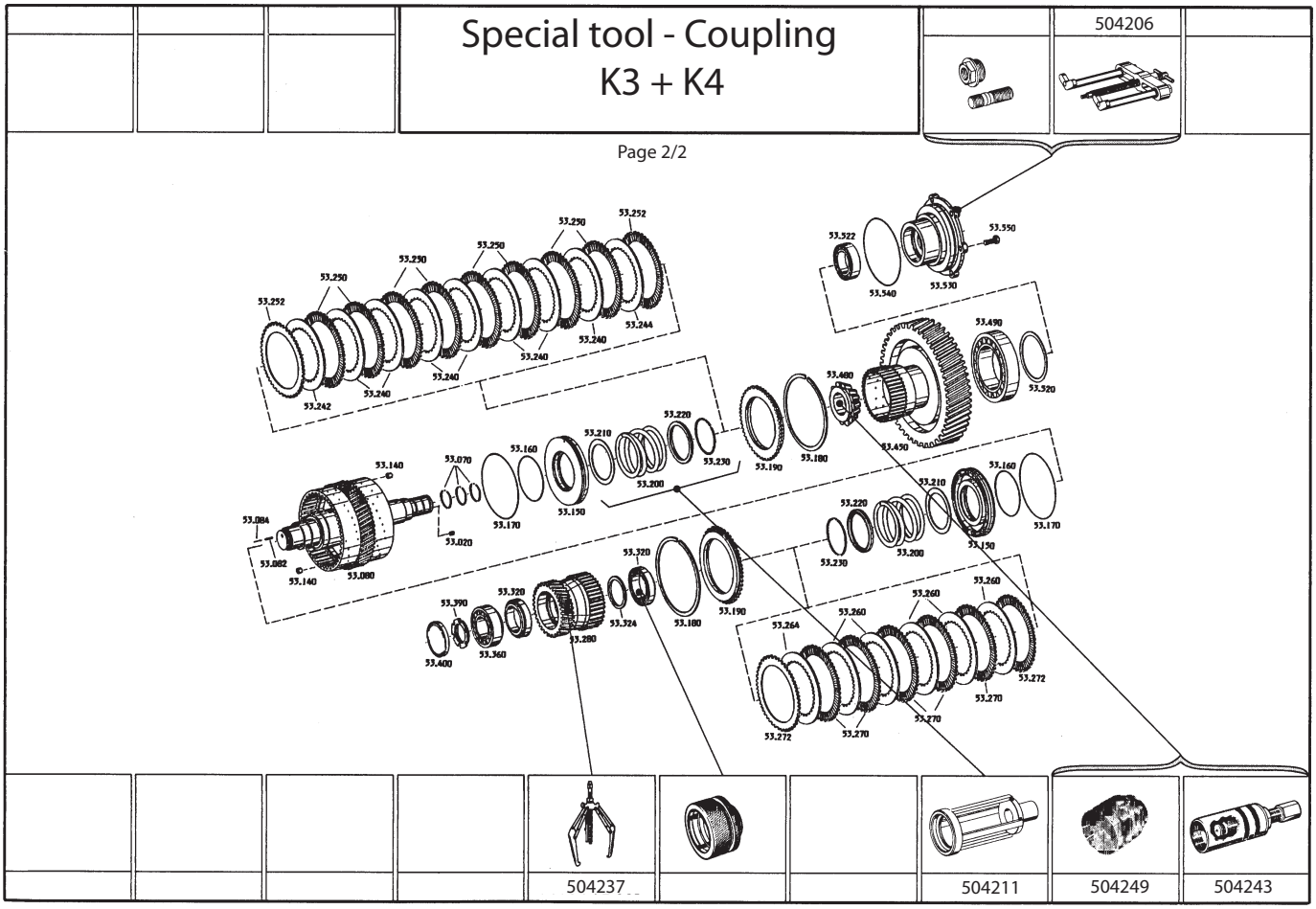
Special tool - Coupling K3 + K4

Page 1/2



Special tool - Coupling K3 + K4

Page 2/2



Dismantle multi-disc clutch – K3/K4

Fasten clutch by means of clamping ring (S) on the assembly car.

(S) Clamping ring 504226
or 504227

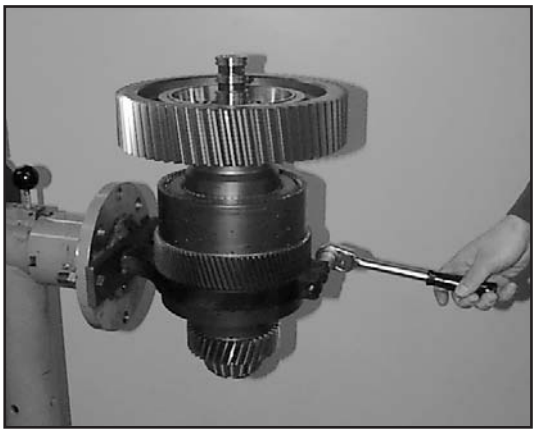


Figure 185

Pull roller bearing off plate carrier.

(S) 3-leg puller 504236

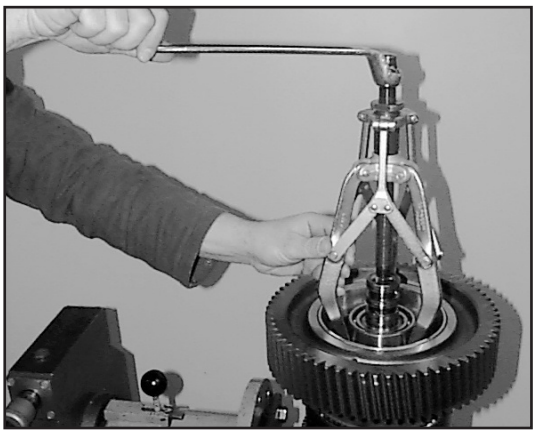


Figure 186

Separate spur gear K3 from plate carrier.

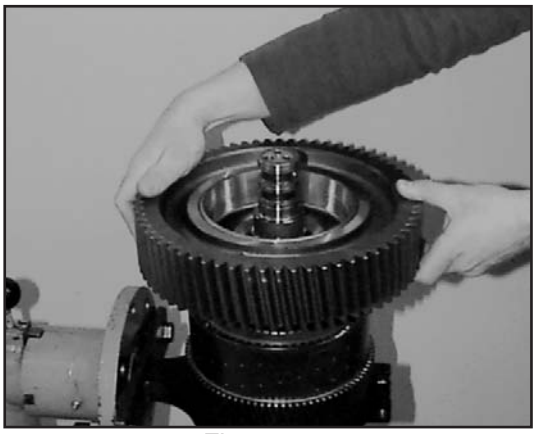


Figure 187

Pull bearing inner race off plate carrier.

(S) Quick-acting grip 504249
(S) Basic tool 504243

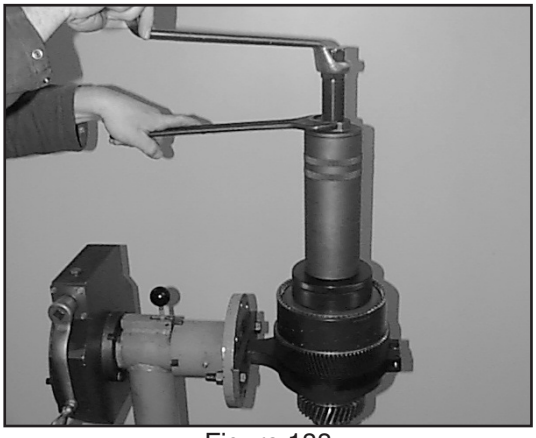


Figure 188

Squeeze snap ring out.

Disassemble end shim and plate pack K3.

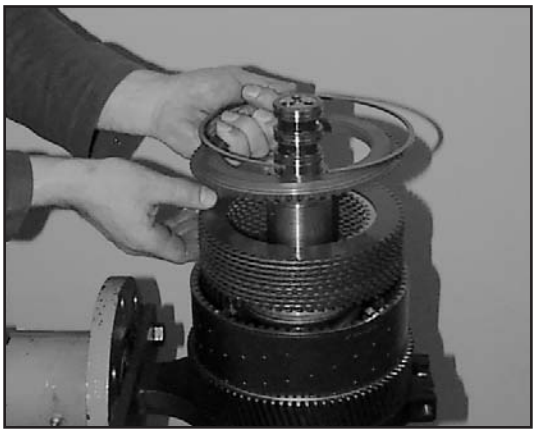


Figure 189

Tilt plate carrier 90°.
Loosen slotted nut.

Slotted nut is secured with Loctite!
To prevent damage to the thread, heat up slotted nut prior to loosen it (abt. 120° C)!

(S) Hook spanner	504217
(S) Hook spanner	504216
(S) Hot-air blower 230 V	504193
(S) Hot-air blower 115 V	504194

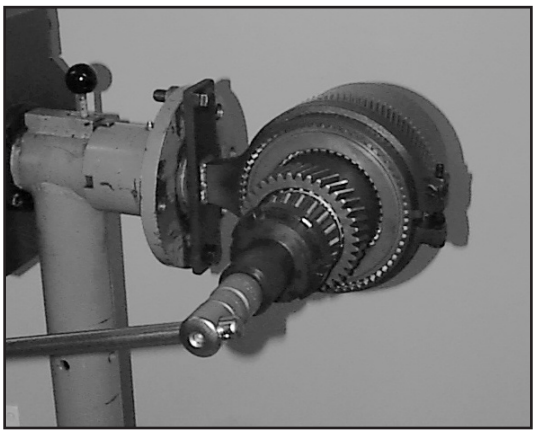


Figure 190

Tilt plate carrier by 90°.

Pull off tapered roller bearing.

(S) Grab sleeve	504248
(S) Grab sleeve	504238

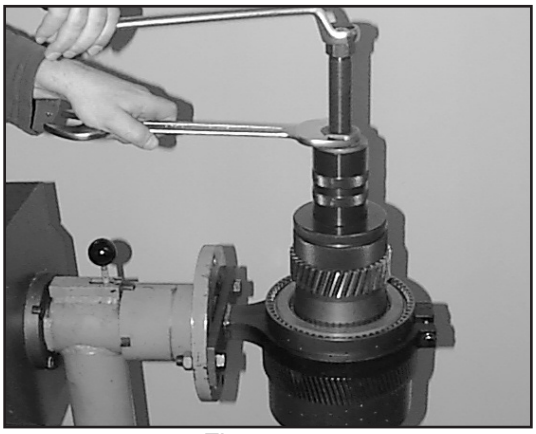


Figure 191

Pull spur gear K4 off plate carrier.

(S) 3-leg puller	504237



Figure 192

Remove adjusting ring.

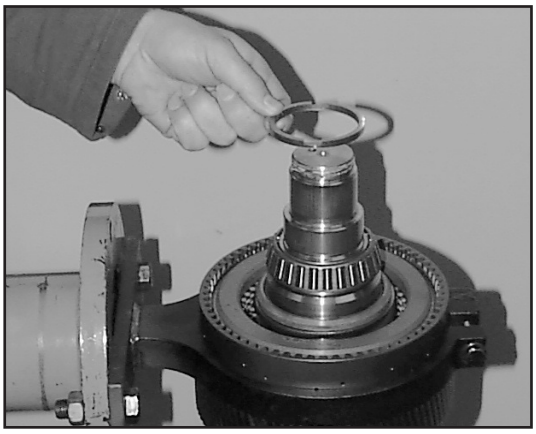


Figure 193

Pull off tapered roller bearing.

(S) 3-leg puller 504236

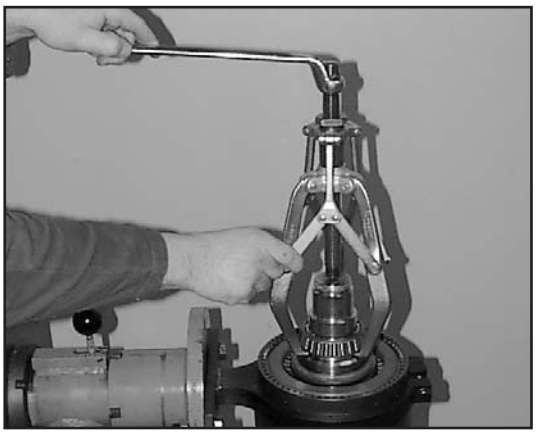


Figure 194

Squeeze out snap ring.

Disassemble end shim and plate pack K4.

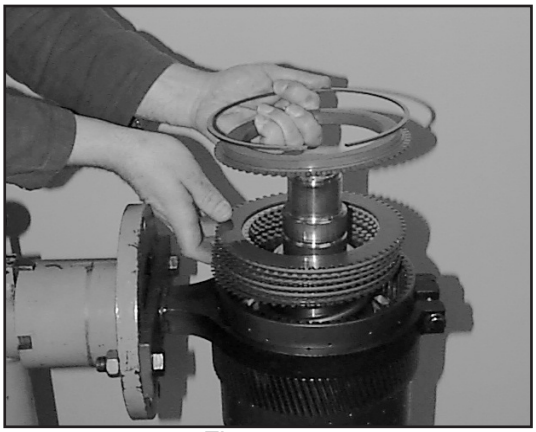


Figure 195

Pre-load compression spring by means of special device (S).
Squeeze out snap ring and remove the released components.

Accordingly disassemble opposite components (K3-side).

(S) Pressure piece 504211

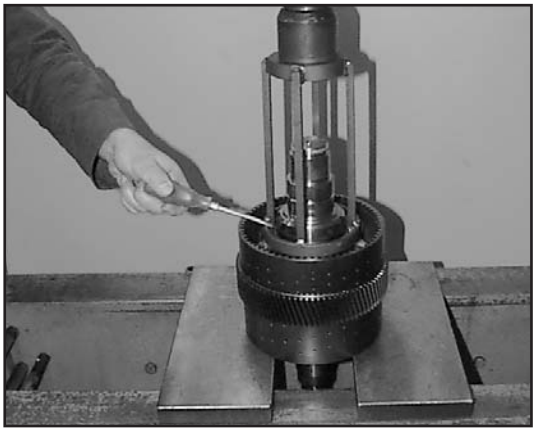


Figure 196

Separate both pistons with compressed air from the plate carrier.

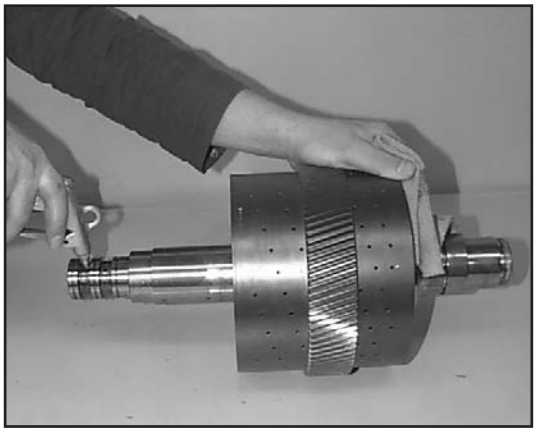
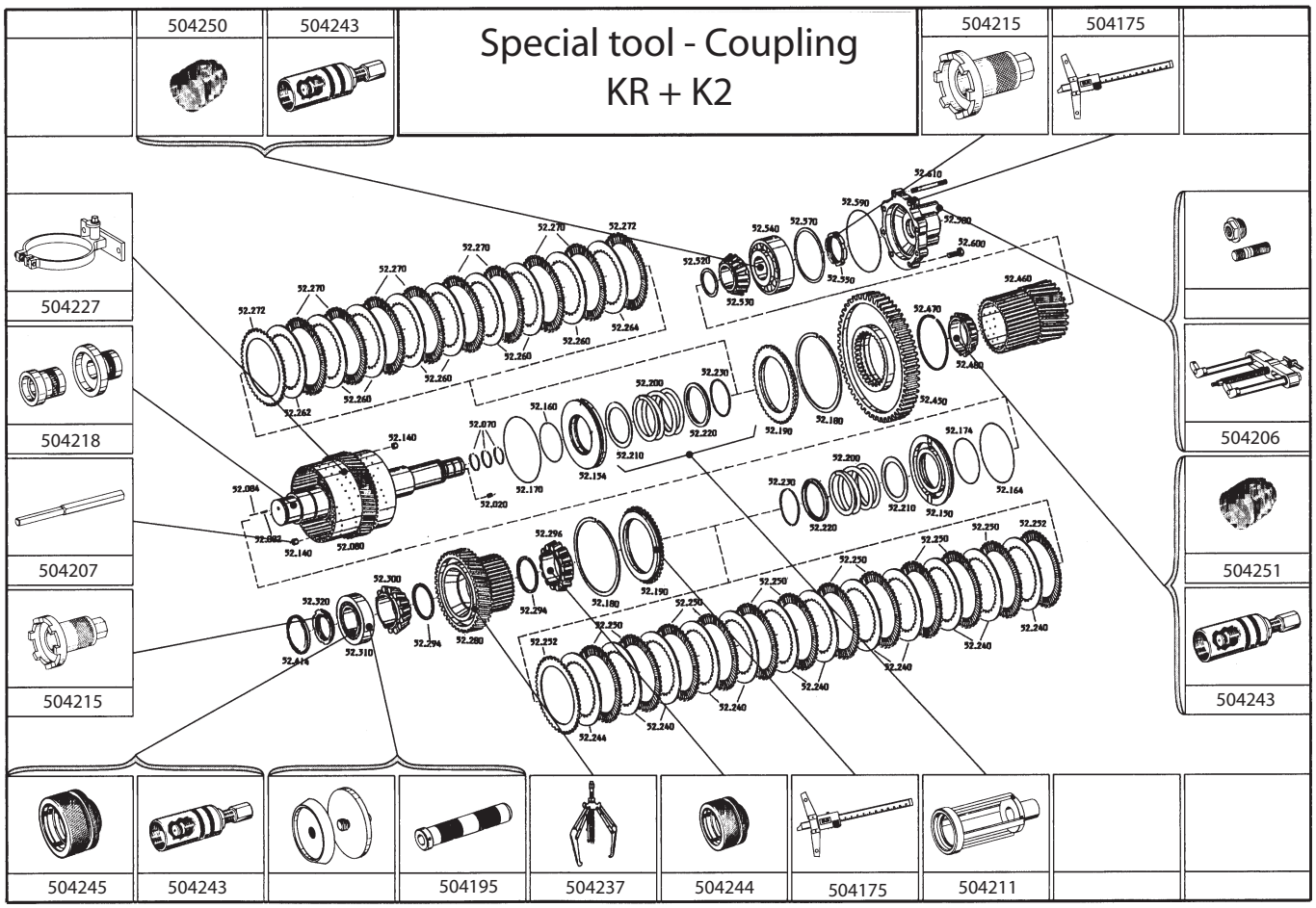


Figure 197

Dismantle multi-disc clutch KR/K2



Fasten clutch by means of clamping ring (arrow) on the assembly car.

(S) Clamping ring 504226
or
(S) Clamping ring 504227

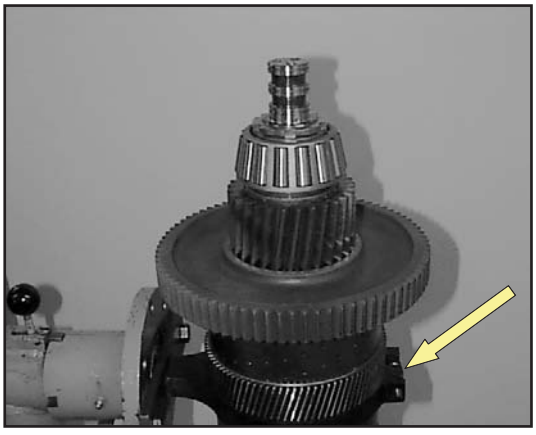


Figure 198

Tilt plate carrier by 90°.

Loosen slotted nut.

Slotted nut is secured with Loctite!
To prevent damage to the thread, heat slotted nut prior to loosen it (abt. 120° C)!

(S) Hook spanner 504215

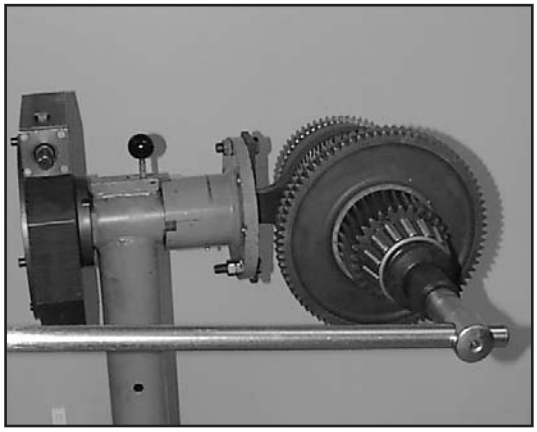


Figure 199

Pull tapered roller bearing off plate carrier.

(S) Grab sleeve 504250
(S) Basic tool 504243

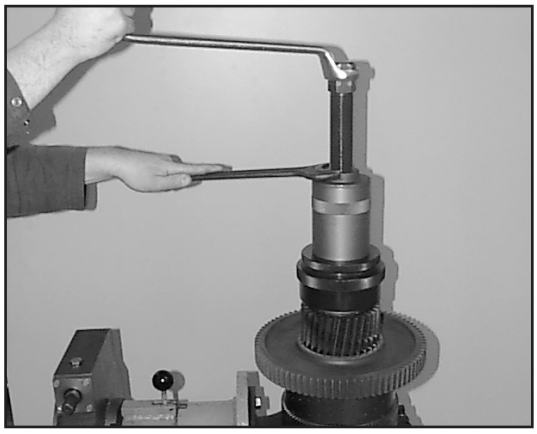


Figure 200

Press spur gear K2 from the plate carrier.

Pay attention to released plate carrier!

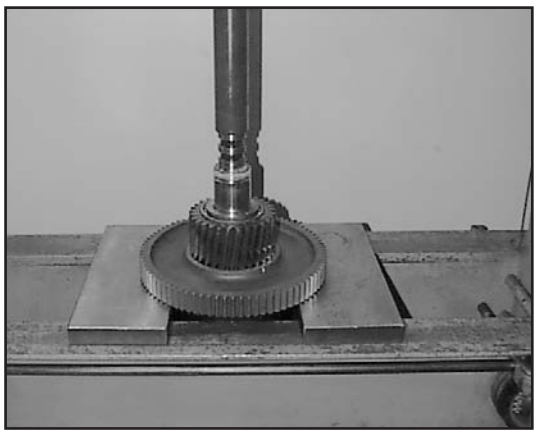


Figure 201

Fix plate carrier by means of clamping ring (S).

Remove shim.

(S) Clamping ring 504226
or 504227

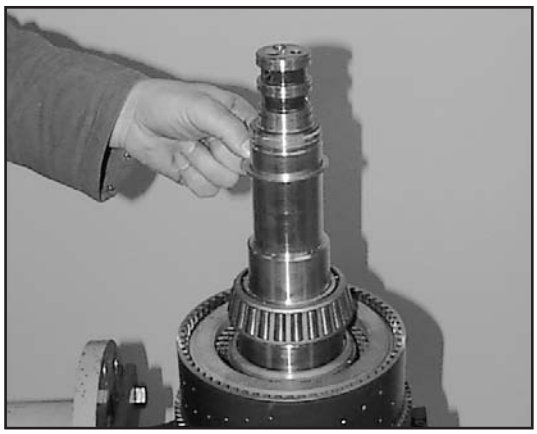


Figure 202

Pull tapered roller bearing off plate carrier.

(S) Grab sleeve 504251
(S) Basic tools 504243

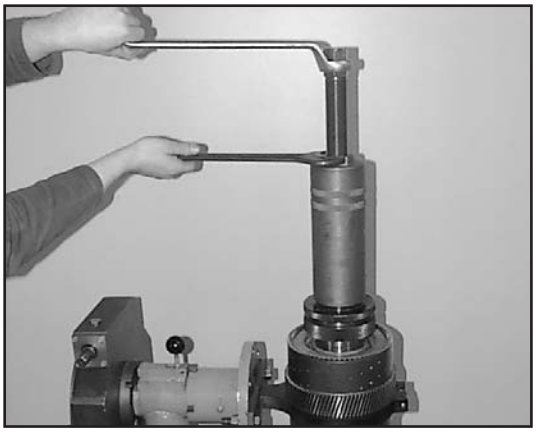


Figure 203

Squeeze snap ring out.

Disassemble end shim and plate pack K2.

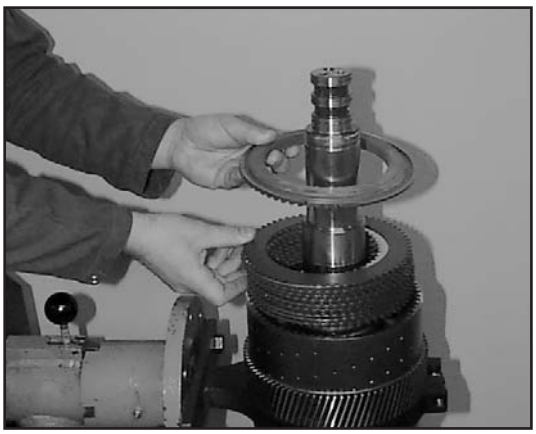


Figure 204

Tilt plate carrier by 90°.

Loosen slotted nut.

Slotted nut is secured with Loctite!
To prevent damage to the thread, heat slotted nut prior to loosen it (abt. 120° C)!

(S) Hook spanner 504215
(S) Hot-air blower 230 V 504193
(S) Hot-air blower 115 V 504194

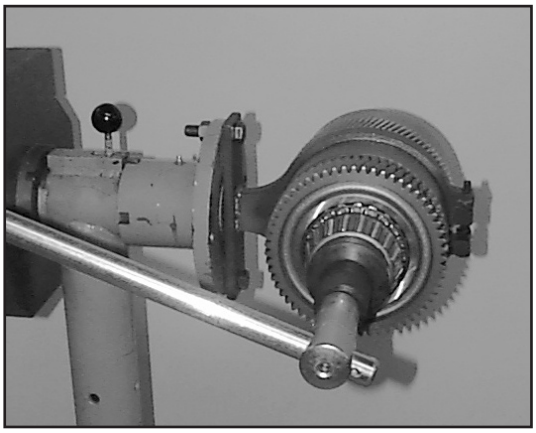


Figure 205

Pull tapered roller bearing from plate carrier.

(S) Grab sleeve 504245
(S) Basic tool 504243

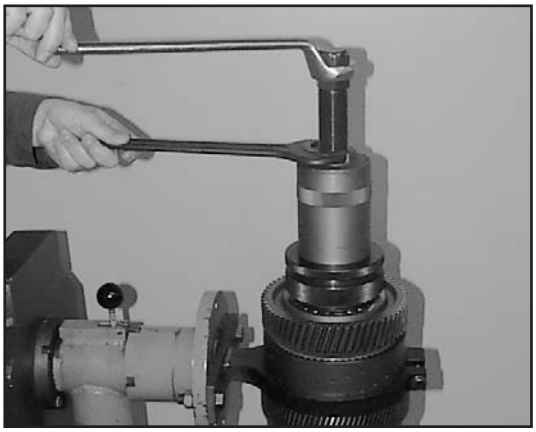


Figure 206

Pull tapered roller bearing from plate carrier.

(S) 3-leg puller 504237

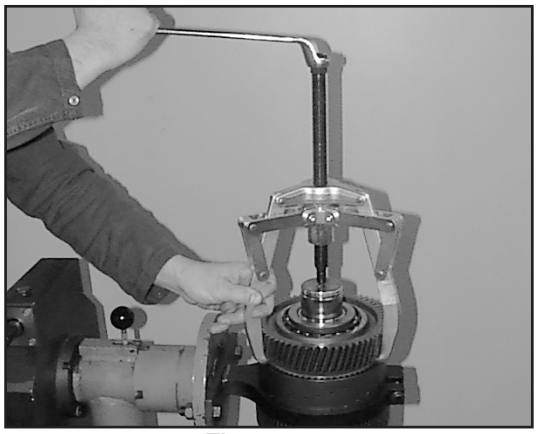


Figure 207

Remove adjusting rings.

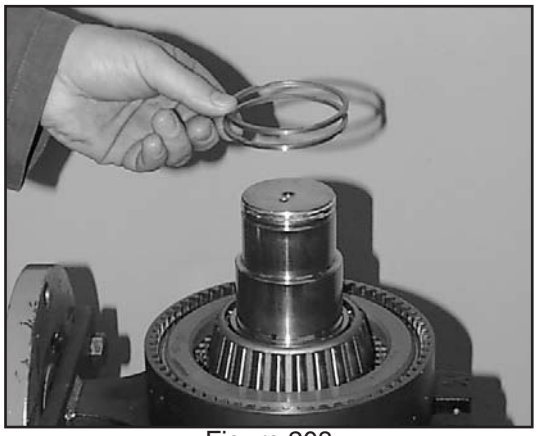


Figure 208

Squeeze out snap ring.

Disassemble end shim and plate pack KR.



Figure 209

Pull tapered roller bearing off plate carrier.

(S) Grab sleeve 504244
(S) Basic tool 504243

Then, disassemble both pistons (as described in Figure 196 and 197).

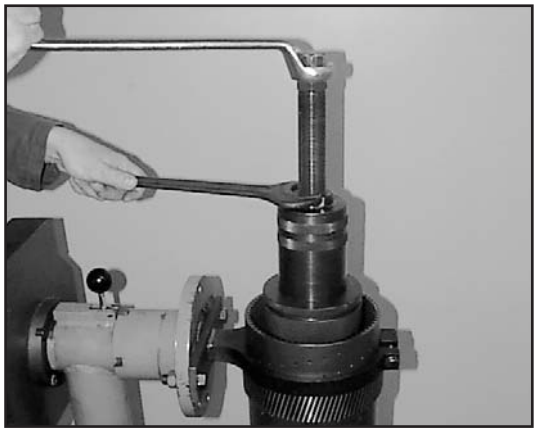
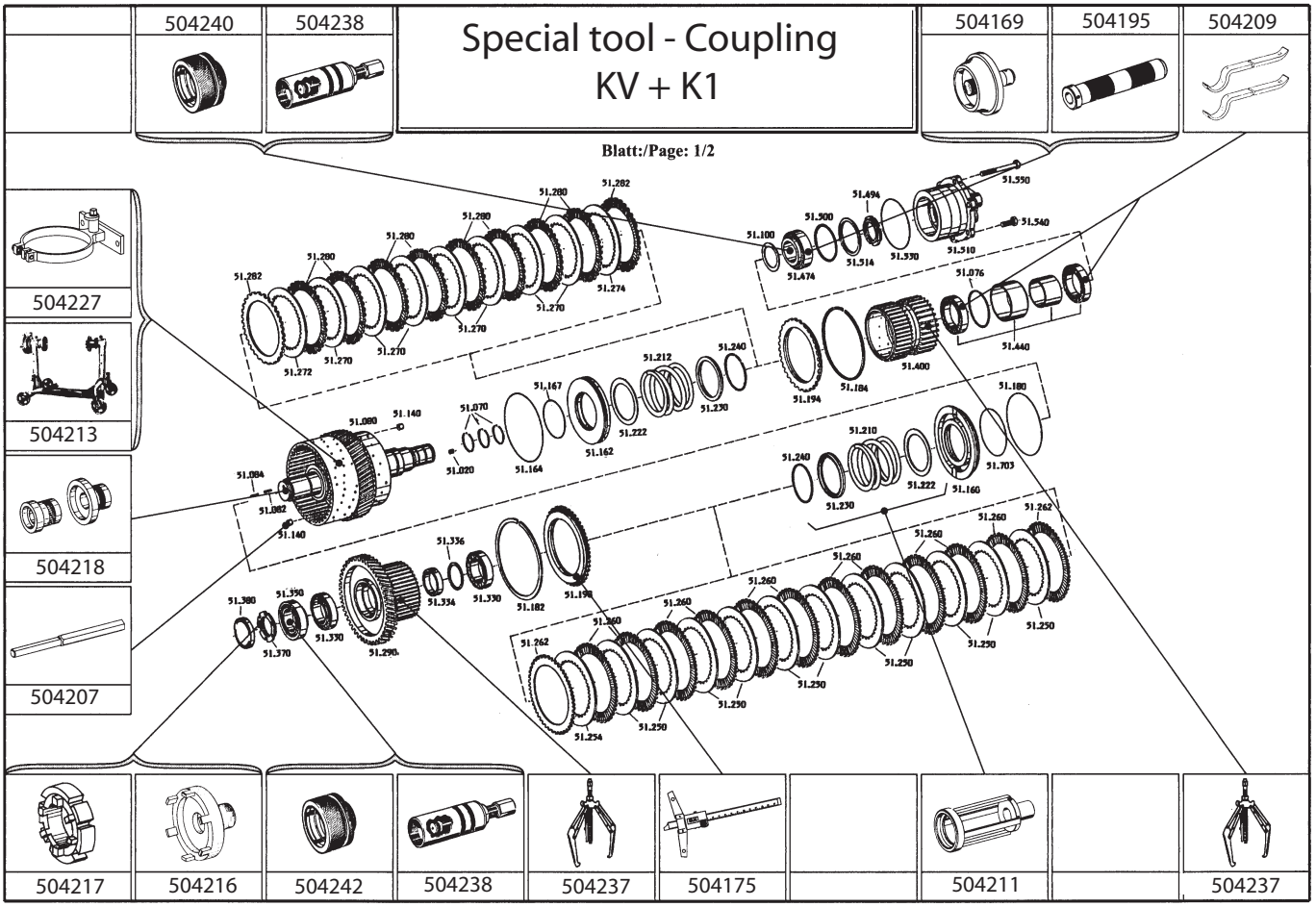


Figure 210

Special tool - Coupling KV + K1

Blatt:/Page: 1/2



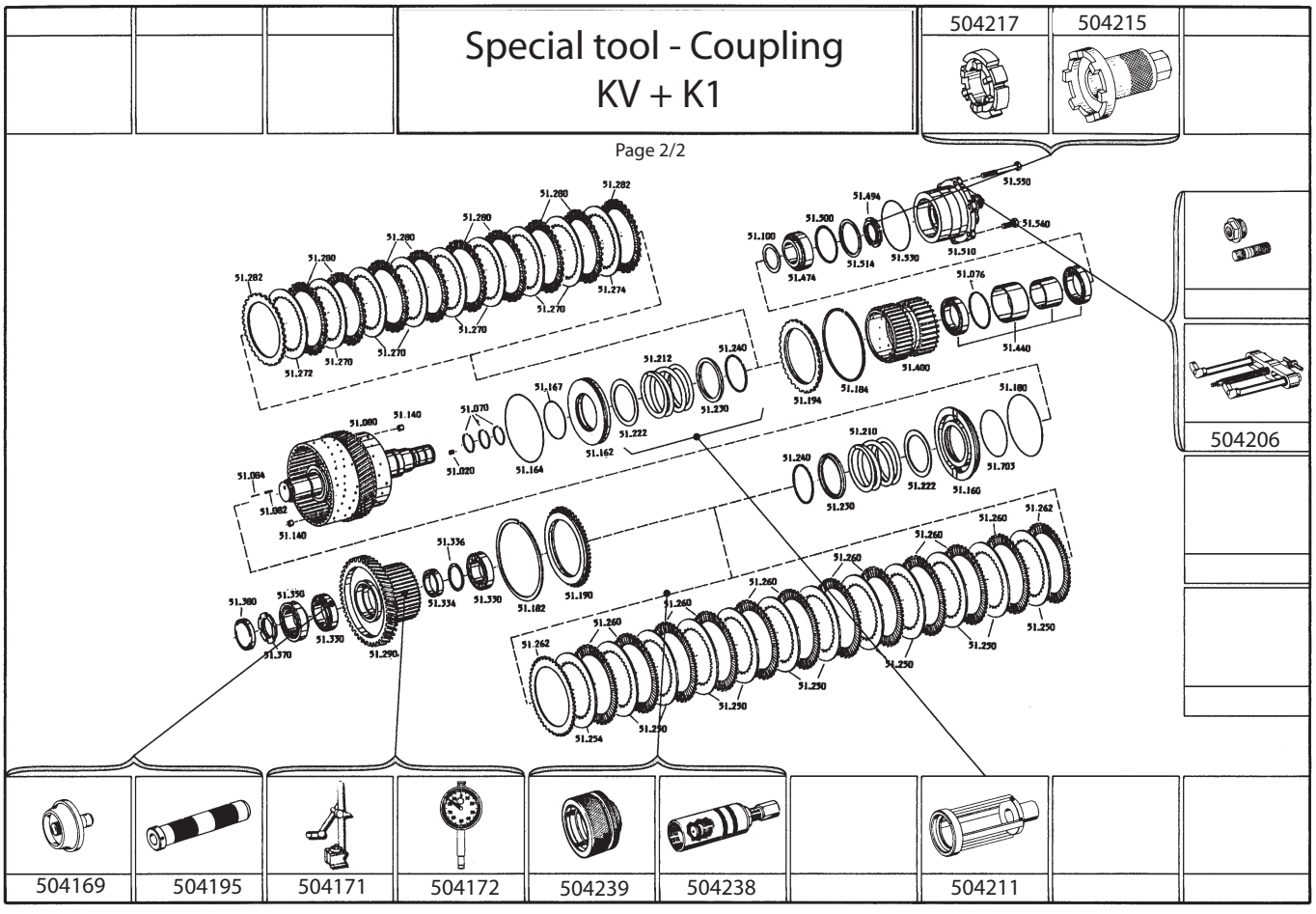
504240 504238 504169 504195 504209

504227 504213 504218 504207

504217 504216 504242 504238 504237 504175 504211 504237

Special tool - Coupling KV + K1

Page 2/2



504217 504215 504206

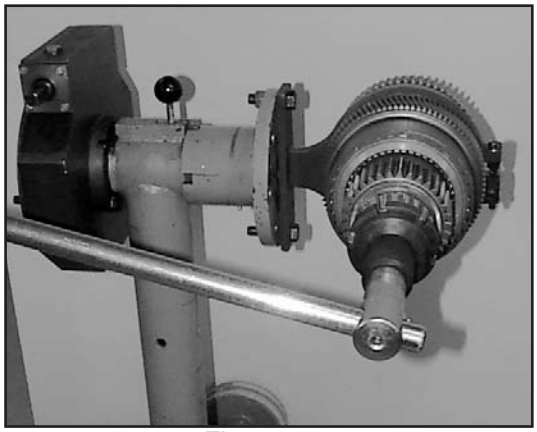
504169 504195 504171 504172 504239 504238 504211

Dismantle multi-disc clutch KV/K1

Fasten clutch by means of clamping ring on the assembly car.
Loosen slotted nut (Figure 211).

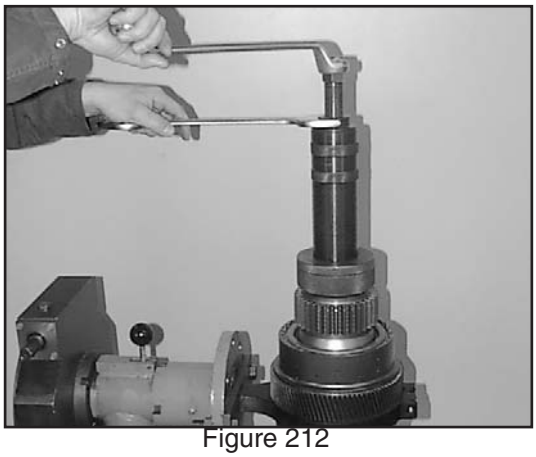
Slotted nut is secured with Loctite!
To prevent damage to the thread, heat the slotted nut prior to loosen it (abt. 120° C)!

(S) Clamping ring	504226	or
	504227	
(S) Hook spanner	504217	
(S) Hook spanner	504215	


Figure 211

Pull tapered roller bearing off plate carrier.

(S) Grab sleeve	504240
(S) Basic tool	504238


Figure 212

Remove disc.

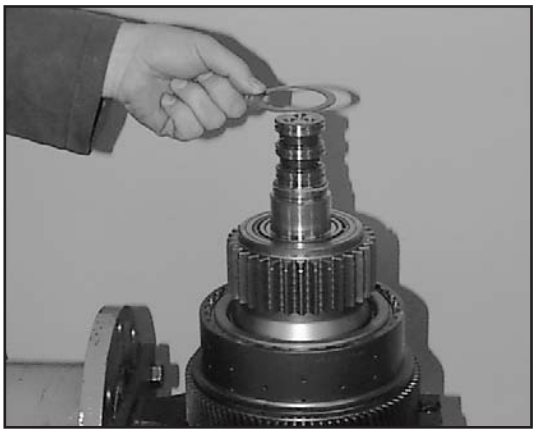


Figure 213

Pull cylindrical gear K1 off plate carrier.

(S) 3-leg puller 504237

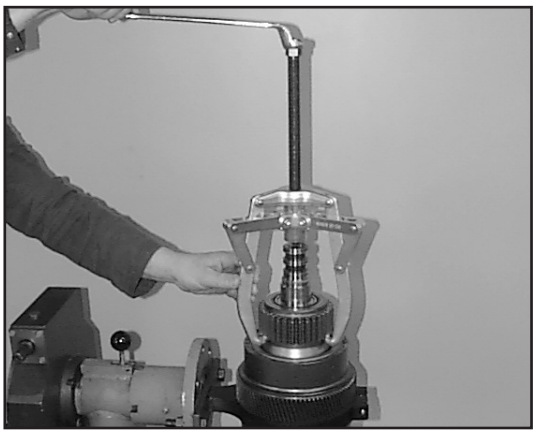


Figure 214

The figure on the left shows the spur gear bearing -K1.

Bearing 1 is available only as sub-assembly.

If the disassembly of the plate pack-side ball bearing (arrow) is necessary – also see Fig. 217 and 218 – the complete bearing must be renewed!

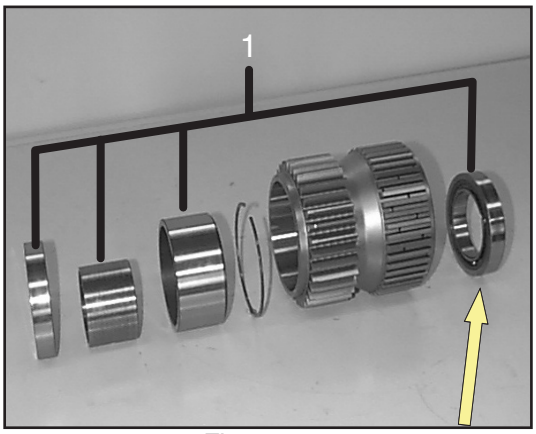


Figure 215

Remove bush.

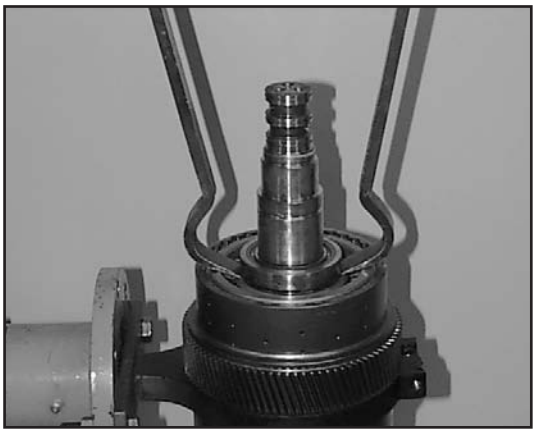


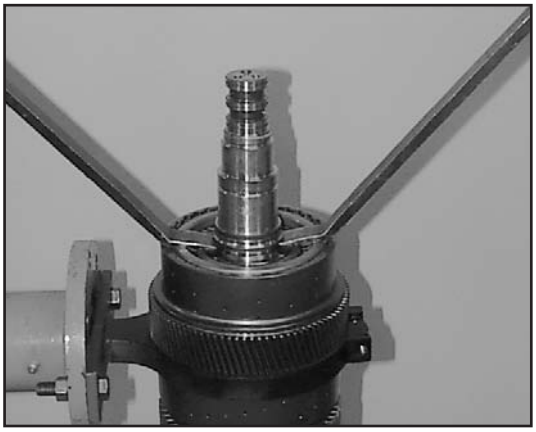
Figure 216

Pull ball bearing from plate carrier (Figure 217 and 218).

Pay attention to the released balls!

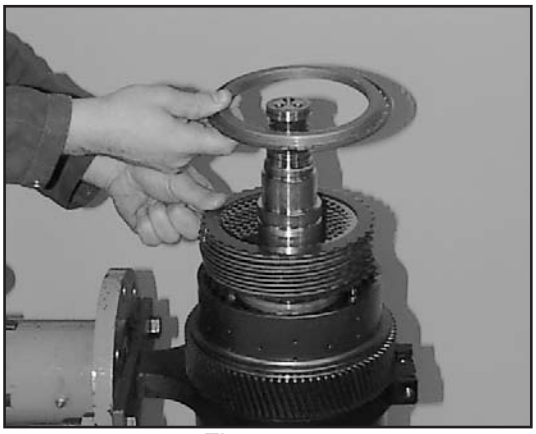
(S) Pry bar 504209


Figure 217


Figure 218

Squeeze out snap ring.

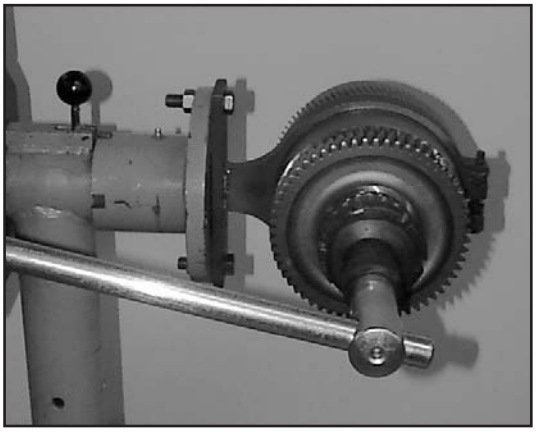
Disassemble end shim and plate pack K1.


Figure 219

Tilt plate carrier by 90°.
Loosen slotted nut.

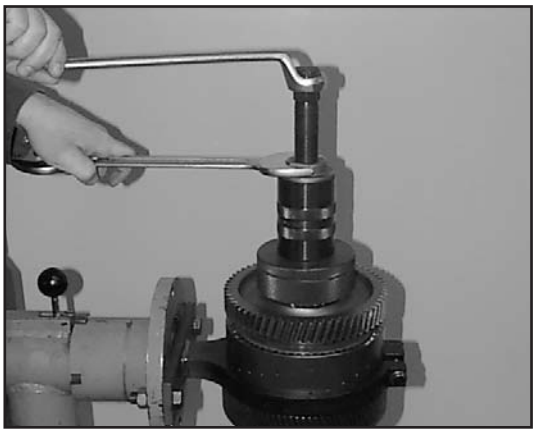
Slotted nut is secured with Loctite!
To prevent damage to the thread, heat slotted nut prior to loosen it (about 120°C).!

(S) Hook spanner 504217
(S) Hook spanner 504216
(S) Hot-air blower 230 V 504193
(S) Hot-air blower 115 V 504194


Figure 220

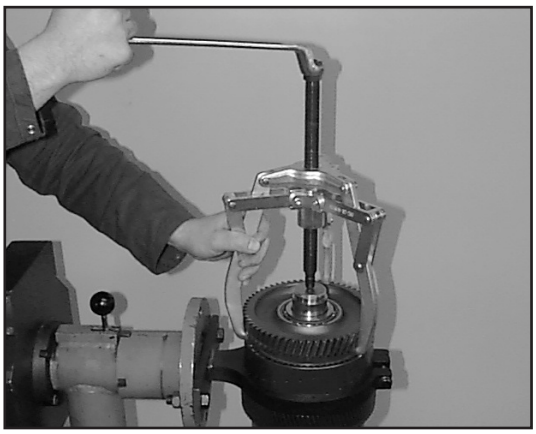
Pull tapered roller bearing off plate carrier.

(S) Grab sleeve 504242
(S) Basic tool 504238

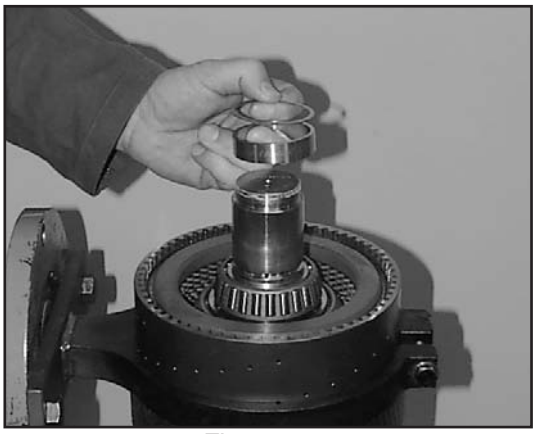

Figure 221

Pull spur gear KV off plate carrier.

(S) 3-leg puller 504237


Figure 222

Remove shim and ring.

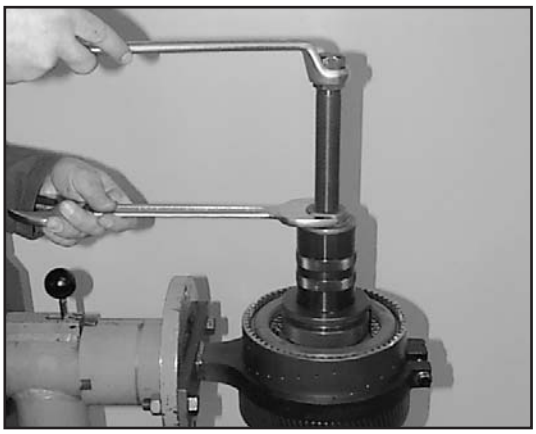

Figure 223

Pull tapered roller bearing off plate carrier (Figure 224).

Squeeze out snap ring.

Disassemble end shim and plate pack KV.
Disassemble both pistons (as described under Figure 196 and 197).

(S) Grab sleeve 504239
(S) Basic tool 504238


Figure 224

Manual transmission assembly

Mount studs (arrows).

Wet thread with Loctite (type-no. 243)!

Depending on the transmission version, differences concerning number and length of the studs are possible.
See in this connection the corresponding Spare Parts List.

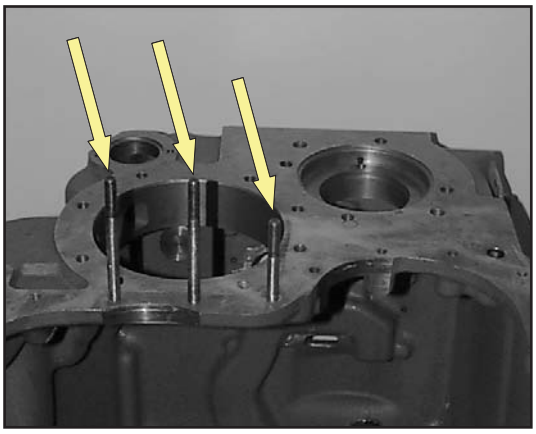


Figure 230

Line up O-ring (arrow).
Insert bush into the housing bore until contact is obtained and fasten it.

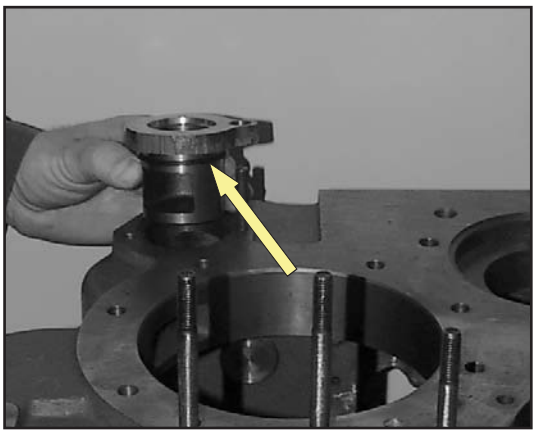


Figure 231

Power take-off

Supercool shaft (about – 80° C), heat up gear (abt. + 120° C) and line it up, or press it against shoulder.

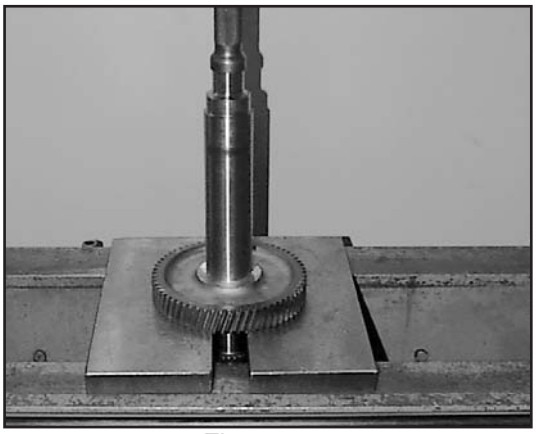


Figure 232

Press bearing inner race against shoulder.
Press opposite bearing inner race against shoulder.

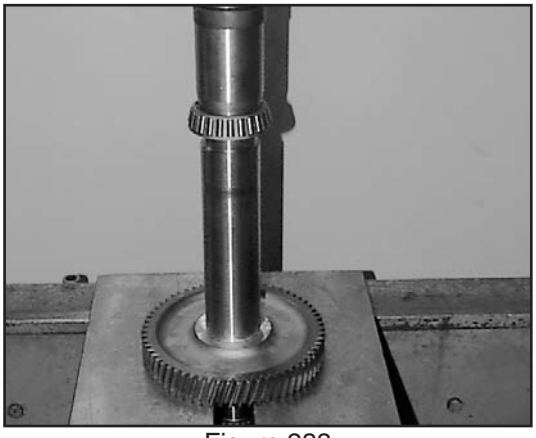


Figure 233

Insert bearing outer race (arrow) into housing bore until contact is obtained.

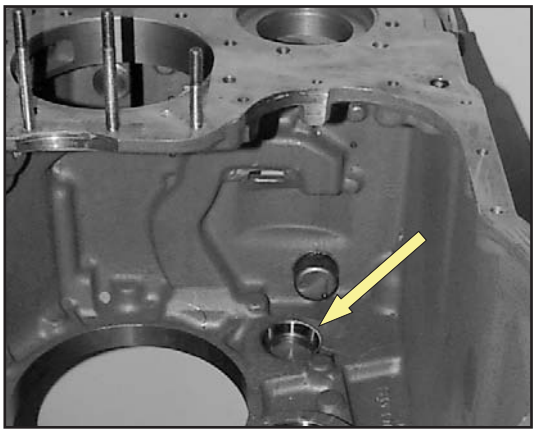


Figure 234

Position pre-assembled pto-shaft in the housing and insert bearing outer race until contact is obtained.

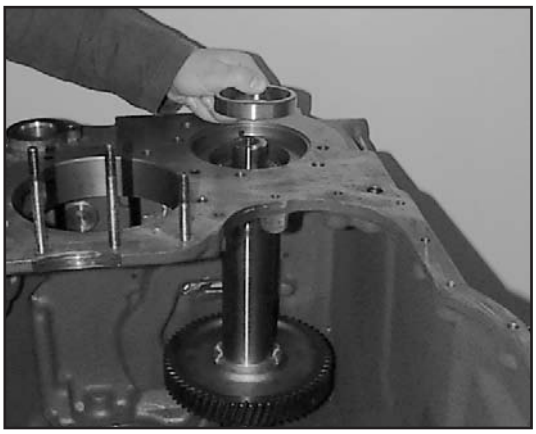


Figure 235

Adjust axial gap – power take-off bearing max. 0,10 mm, using shim(s) and circlip.

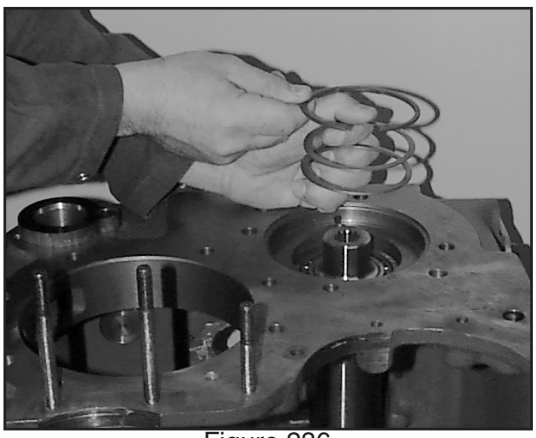


Figure 236

Tilt gearbox housing by 180°.

Insert sealing disc (arrow) with the concave side showing downwards into the housing bore until contact is obtained.

Wet contact surface with Loctite (type-no. 262)!

Do not damage the centric orifice hole Æ 0,8 mm during the installation of the sealing disc!

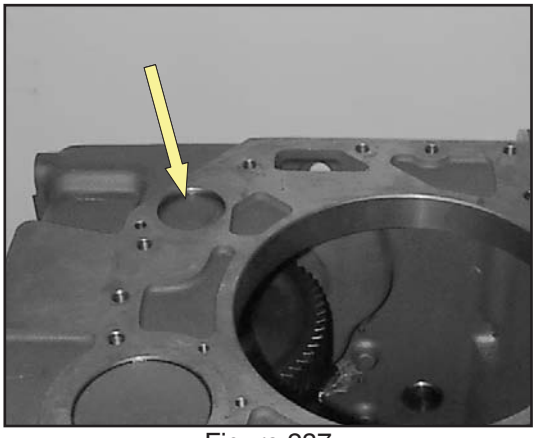


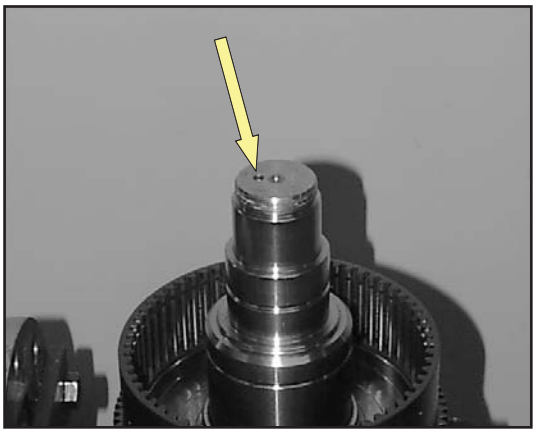
Figure 237

Reassemble multi-disc clutch-K3/K4

Lift plate carrier with the K4-side showing downwards into the clamping ring (S) and fix it.
Now, tilt plate carrier by 180°.

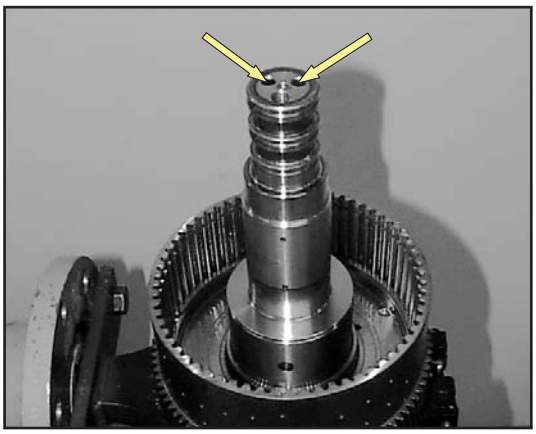
Insert both roll pins (6x24 and 3,5x24 mm) flush into the end face-side bore of the plate carrier, see arrow/Figure 239

(S) Clamping ring	504226
or	504227


Figure 239

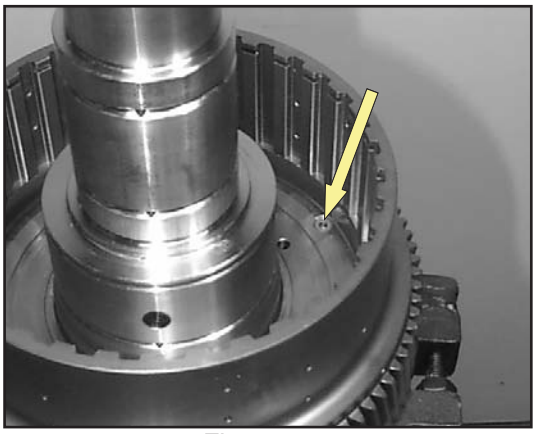
Tilt plate carrier by 180°.

Wet both roll pins (arrows) with Loctite, type-no. 262, and install them.

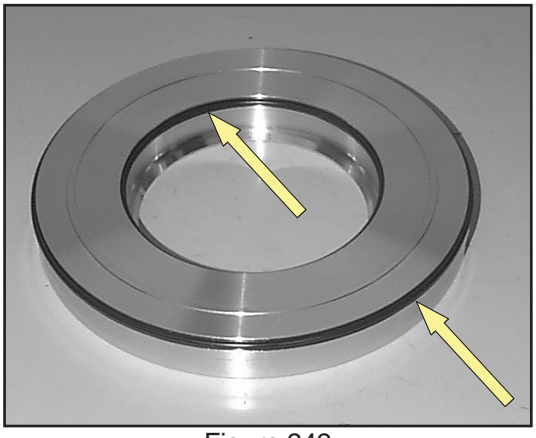

Figure 240

Insert purge valve (arrow) with the chamfer showing downwards.

(S) Settling tool	504207


Figure 241

Insert both O-rings **scrollfree** into the ring grooves of the piston, see arrows!


Figure 242

Oil O-rings and piston bearing surfaces.

Uniformly insert piston K3 until contact is obtained.

Observe the installation position of the piston, see Figure!

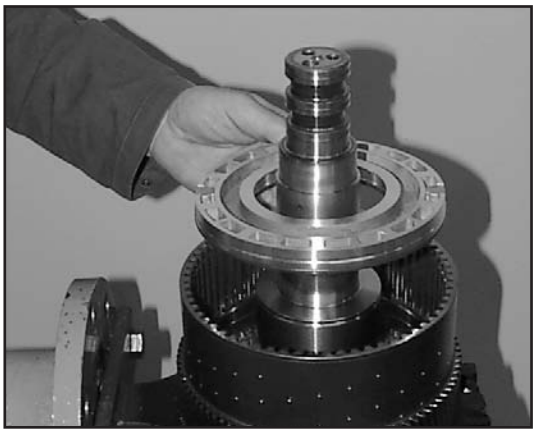


Figure 243

Introduce intermediate washer and compression spring.

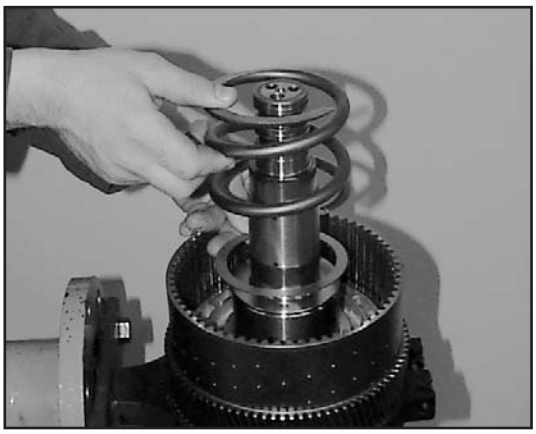


Figure 244

Lay guide ring with the chamfer (arrow) showing upwards over compression spring and line up snap ring.

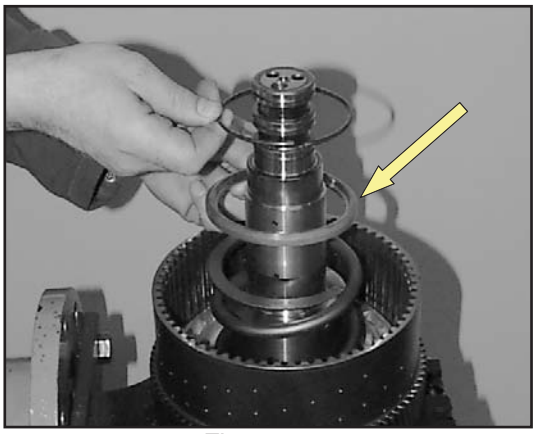


Figure 245

Lift plate carrier out of the clamping ring.

Pre-load compression spring by means of special device (S) and squeeze snap ring into the annular groove of the plate carrier (arrow)

(S) Special device 504211

Analogously install purge valve, spool and compression spring on the opposite side (clutch K4).

Now, lift plate carrier with the K4-side showing downwards into the clamping ring and fix it.

Tilt plate carrier by 180°.

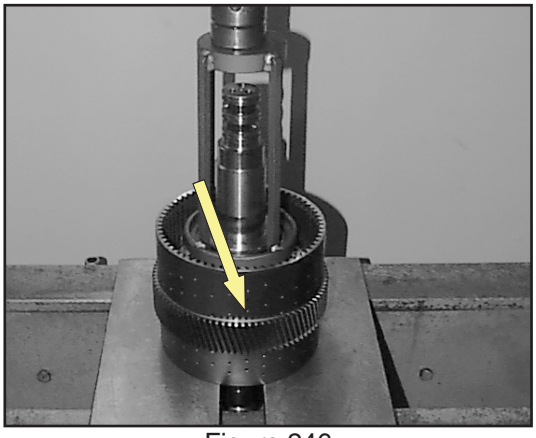


Figure 246

Multi-disc clutch-K4

The following sketch or table show plate stacking and installation position of the components.

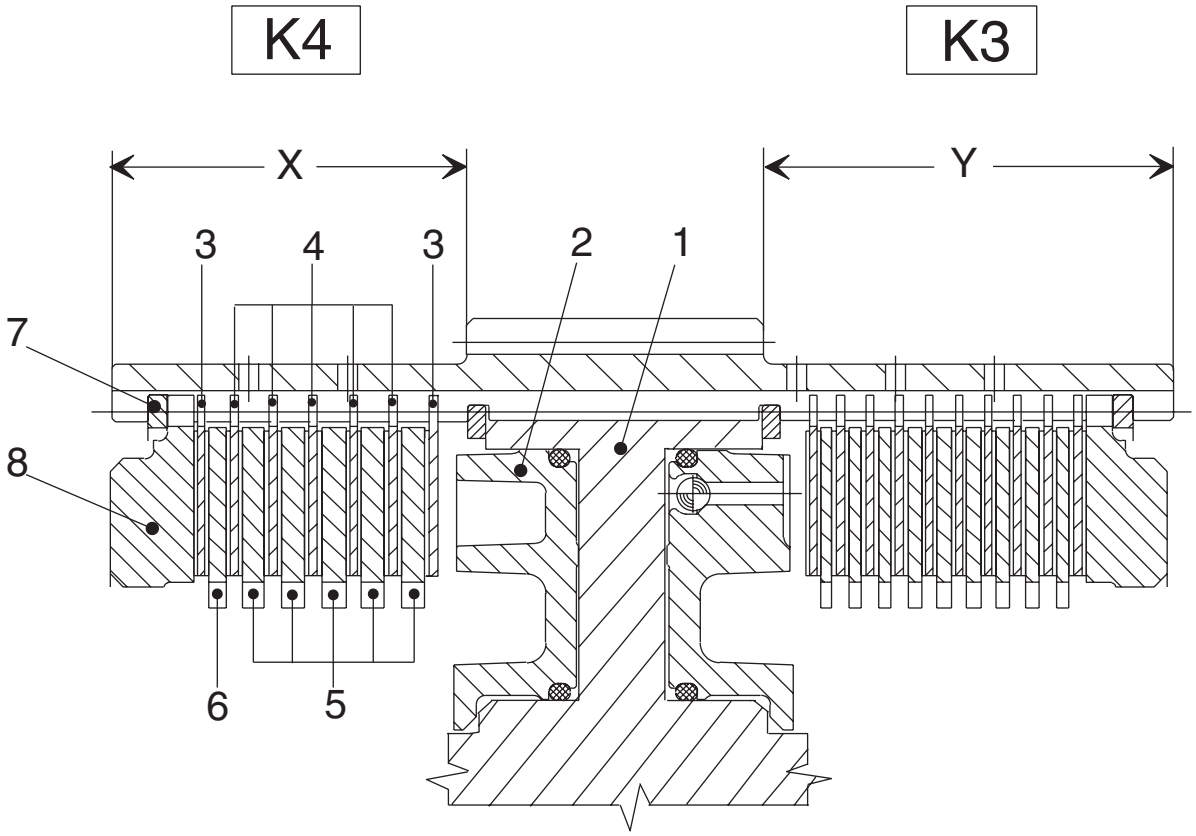


Figure 248

Item.	Designation	Quantity	s (mm)	Remark
1	Plate carrier	1		
2	Piston	1		
3	Outer plate	2	1,85	One-side coated
4	Outer plate	5	2,5	Coated on both sides
5	Inner plate	5	3,5	
6	Inner plate	1	2,5 ... 4,0	Optional
7	Snap ring	1	2,55 ... 3,10	Optional
8	End shim	1		
Number of friction surfaces: 12				
Plate clearance: 2,2 ... 2,4 mm				

Install outer plates Item 3 with the uncoated side facing the piston or the end shim!
The respective clutch side can be recognized by the length of the plate carrier, see sketch!
K4 = Measure X (short plate carrier side)
K3 = Measure Y (long plate carrier side)

Check plate clearance-K4 (Figure 249 ... 251)!

To ensure a correct measuring result, initially install plate pack without oil!

Install plate pack according to the sketch or table (page 3.31 or 3.32).

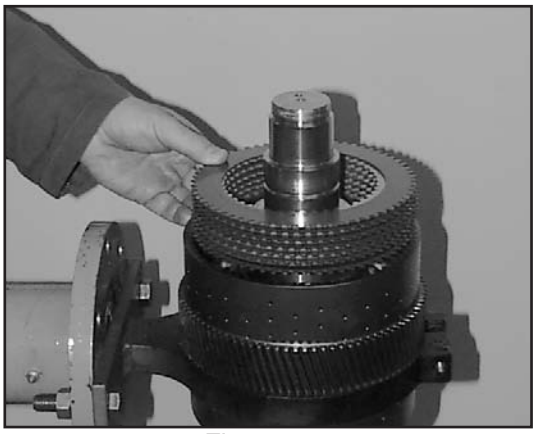


Figure 249

Insert end shim and fix it by means of snap ring.

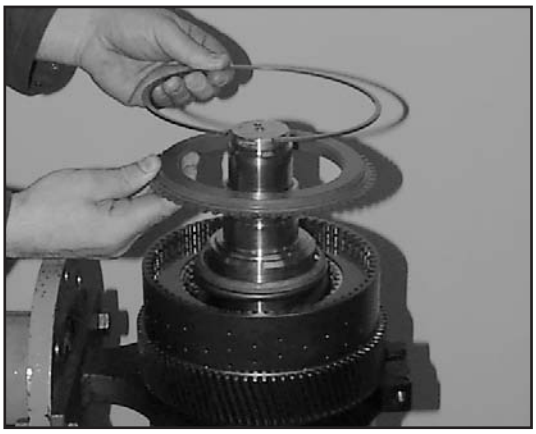


Figure 250

Press on end shim with about 100 N (10 kg) and set dial indicator to „Zero“ (Figure 251).

Now, press end shim against snap ring (upwards) and read plate clearance from dial indicator.

In case of a deviation from the required plate clearance (see table/page 3.31 or 3.32), correct with suitable inner plate Item 6 (optionally s = 2,5 to 4,0 mm) or and snap ring Item 7 (optionally)!

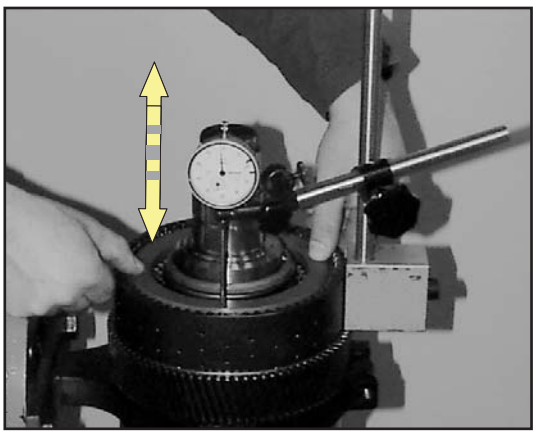


Figure 251

(S) Magnetic stand	504171
(S) Dial indicator	504172

After the performed adjustment of the plate clearance, disassemble plate pack. Oil plates according to ZF-list of lubricants TE-ML 03 and install them again.

Pre-assemble and install spur gear -K4 (Figure 252 ... 257):

The figure on the left shows the components of the spur gear-K4

1 = Bearing inner race
2 = Bearing outer race
3 = Shim (optional, empirical value s = 5,4 mm)
4 = Spur gear

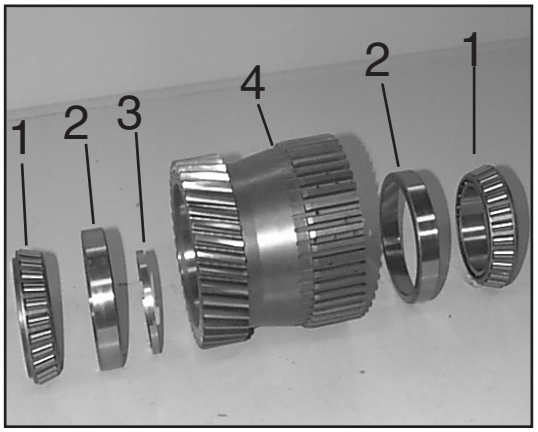


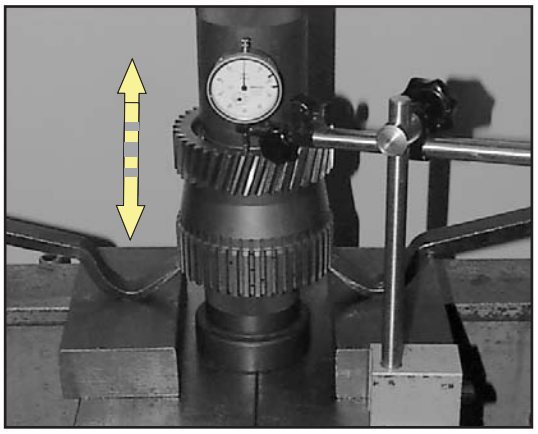
Figure 252

Check axial gap – spur gear bearing 0,0 ... 0,05 mm!

Install components according to Figure 252.
Pre-load tapered roller bearing with about 50.000 N (5 To.) and determine axial gap with dial indicator

In case of deviations from the required axial gap, correct with suitable shim (Item. 3/Figure 252)!

(S) Pry bar	504209
(S) dial indicator	504172
(S) Magnetic stand	504171


Figure 253

Heat bearing inner race and line it up until contact is obtained.


Figure 254

Line up the determined shim (see Figure 252 and 253) with the oil groove showing upwards.


Figure 255

Introduce spur gear until all inner plates are accommodated.

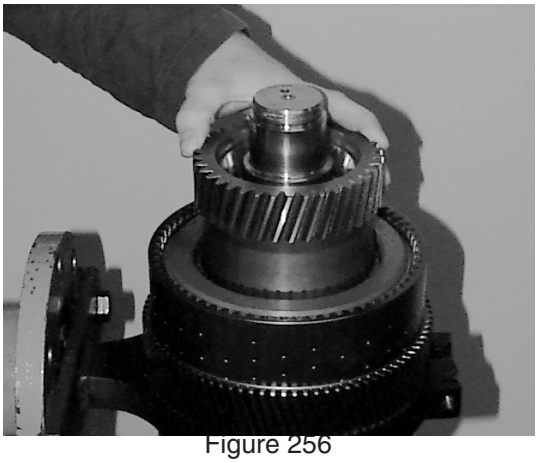


Figure 256

Heat up bearing inner race (spur gear bearing) and position it until contact is obtained

Use protective gloves!



Figure 257

Heat bearing inner race (clutch support) and line it up until contact is obtained

Use protective gloves!



Figure 258

Multi-disc clutch-K3

The following sketch or table show plate stacking and installation position of the components!

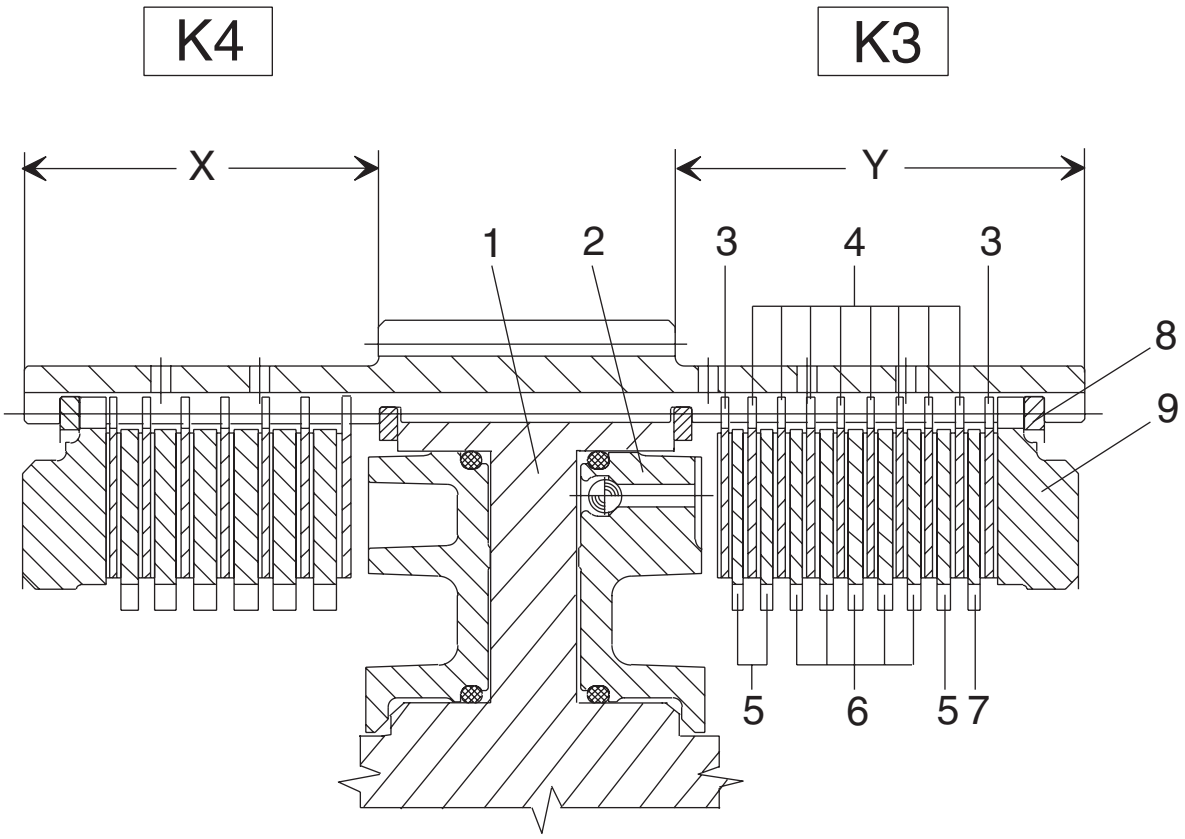


Figure 259

Item.	Designation	Quantity	s (mm)	Remark
1	Plate carrier	1		
2	Piston	1		
3	Outer plate	2	1,85	One-,side coated
4	Outer plate	8	2,5	Coated on both sides
5	Inner plate	3	2,5	
6	Inner plate	5	3,0	
7	Inner plate	1	2,5 ... 4,0	Optional
8	Snap ring	1	2,55 ... 3,10	Optional
9	End shims	1		
Number of friction surfaces: 18				
Plate clearance: 2,6 ... 2,8 mm				

Outer plates Item 3 with the uncoated side facing the piston or the end shim!
The respective clutch side can be recognized by the length of the plate carrier, see sketch!
K3 = Measure Y (long plate carrier side)
K4 = Measure X (short plate carrier side)

Check plate clearance-K3 (Figure 261 ... 263) !

To ensure a correct measuring result, initially install plates without oil!

Install plate pack according to the sketch or table (page 3.36 or 3.37).

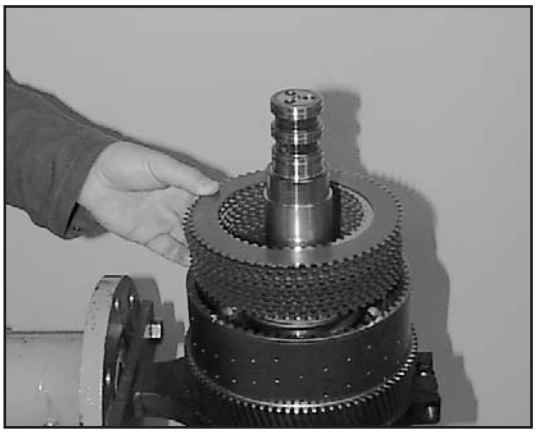


Figure 261

Introduce end shim and fix it by means of snap ring

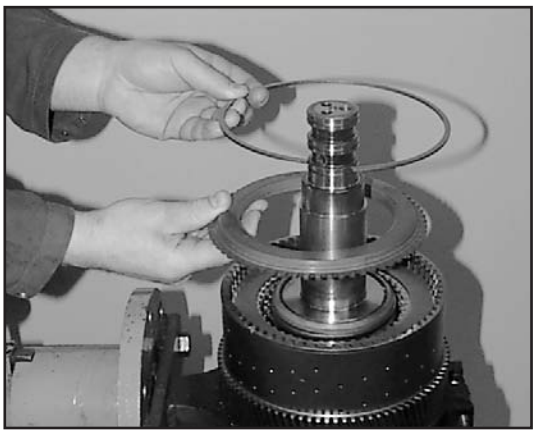


Figure 262

Press on end shim on with about 100 N (10 kg) and set dial indicator to „Zero“.
Now, press end shim against snap ring (upwards) and read plate clearance from dial indicator.

In case of deviations from the required plate clearance (see table/page 3.36 or 3.37),correct with suitable inner plate (optionally s = 2,5 ... 4,0 mm) or and snap ring (optionally)!

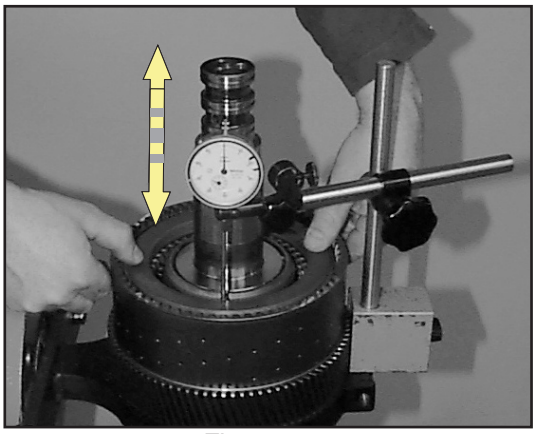


Figure 263

(S) Magnetic stand	504171
(S) Dial indicator	504172

After the performed adjustment of the plate clearance, disassemble plate pack. Oil plates according to ZF-list of lubricants TE-ML 03 and install them again.

Heat up bearing inner race and line it up until contact is obtained.



Use protective gloves!

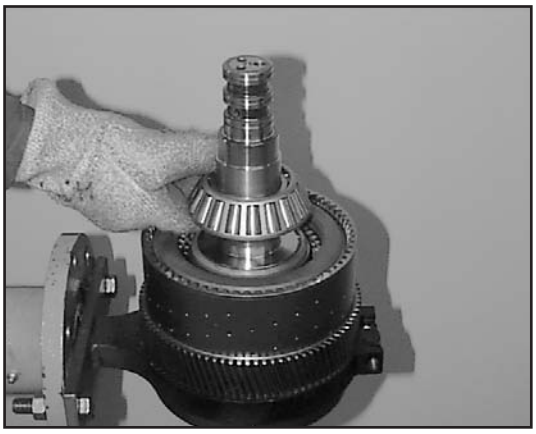


Figure 264

Lift plate carrier out of the clamping ring (S).

To ensure the exact contact of the components, pre-load the bearing with 100 000 N (10 To.) .



Support at the lower as well as at the upper bearing inner race!

Use pressure pieces (S)!

(S) Pressure piece 504218

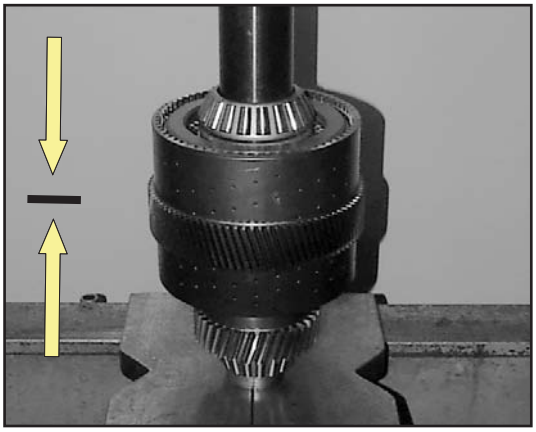


Figure 265

Lift plate carrier with the K-4 side showing downwards into clamping ring (S) and fix it.

Tilt plate carrier by 90°.

Wet thread nut with Loctite (type-no. 262) and install slotted nut (Figure 266).



Install slotted nut with the collar (60 mm dia.) facing the bearing inner race!

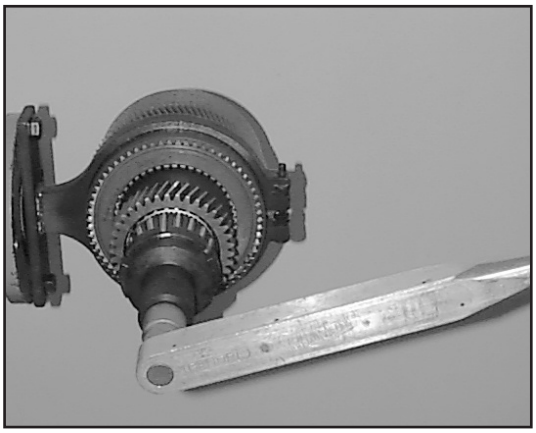


Figure 266

(S) Clamping ring 504226
or 504227
(S) Hook spanner 504217
(S) Hook spanner 504216

Insert bearing outer race into spur gear K3 until contact is obtained.

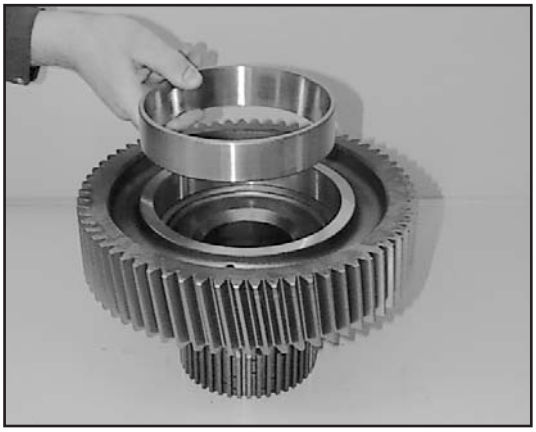


Figure 267

Introduce spur gear until all inner plates are accommodated.

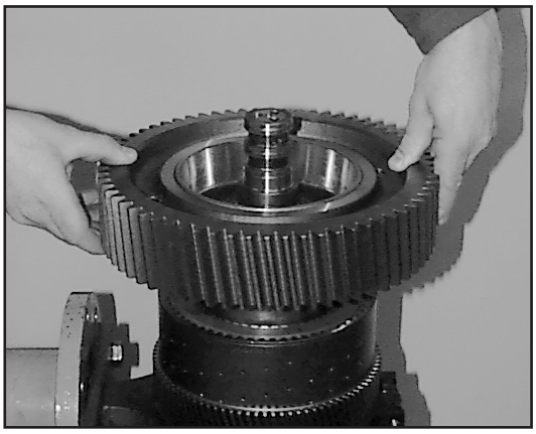


Figure 268

Heat roller bearing and position it until contact is obtained.



Figure 269

Use protective gloves!

Introduce bearing inner race.

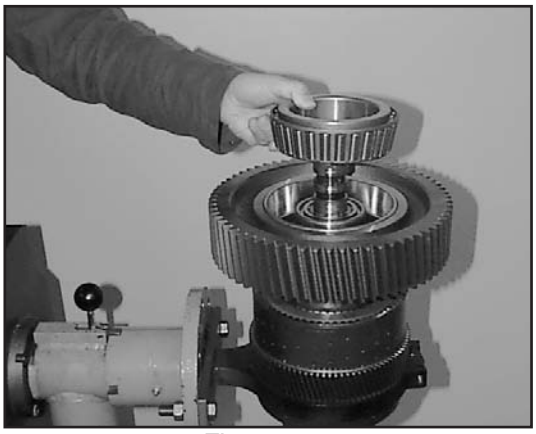


Figure 270

Check function of clutches K3 and K4 by means of compressed air.

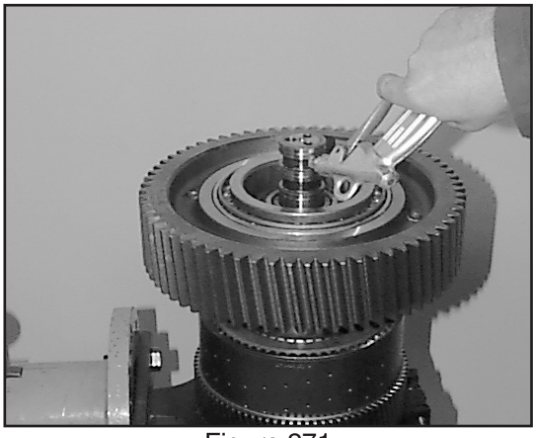


Figure 271

With correctly installed components, closing or opening of the clutches is clearly audible.

Squeeze in and engage rectangular rings (3x, see arrows).

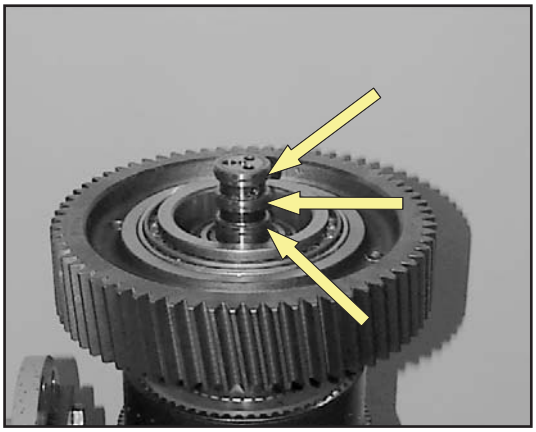


Figure 272

Reassemble multi-disc clutch-KR/K2

Lift plate carrier with the KR-side showing downward into clamping ring and fix it.

Tilt plate carrier 180°.

Insert both roll pins (6x24 and 3,5x24 mm) flush into the spur gear side bore of the plate carrier (arrow).

(S) Clamping ring	504226
or	504227

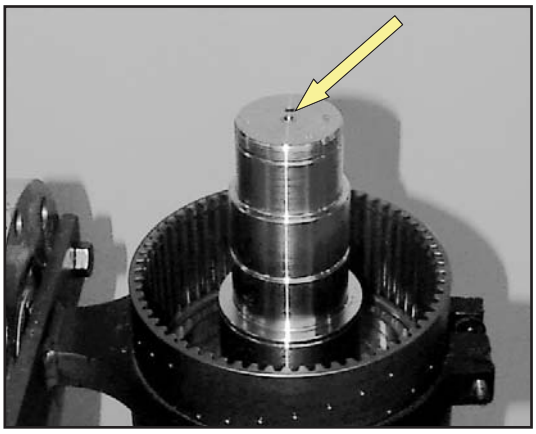


Figure 275

Tilt plate carrier by 180°.

Wet both set screws (arrows) with Loctite, type-no. 262 and install them

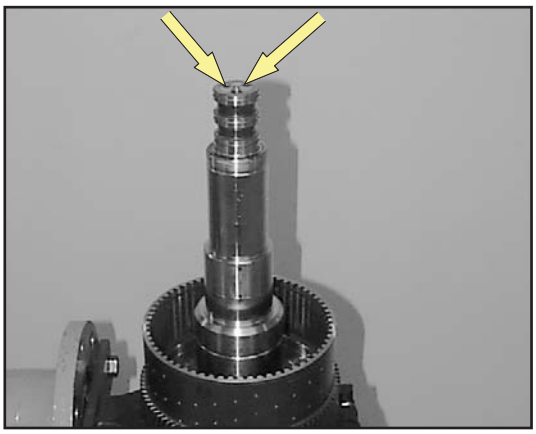


Figure 276

Insert purge valve (arrow) flush with the chamfer showing downwards.

(S) Settling tool	504207

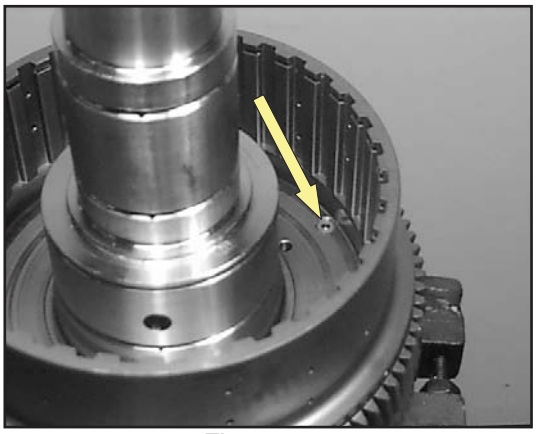


Figure 277

Lay both O-rings **scrollfree** into the ring grooves of the piston, see arrows!

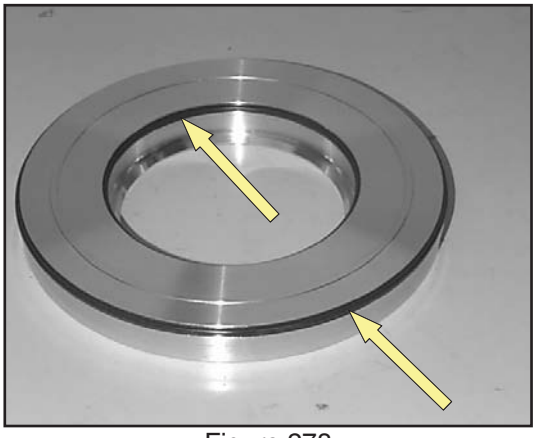


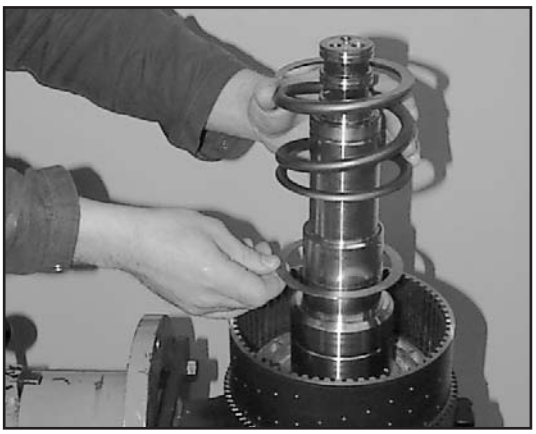
Figure 278

Oil O-rings and piston bearing surfaces.
Uniformly insert K2-piston until contact is obtained.

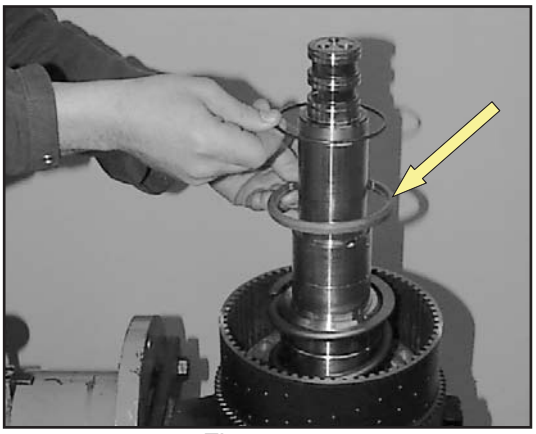
Pay attention to the installation position of the piston, see figure!


Figure 279

Introduce intermediate plate and compression spring.


Figure 280

Lay guide ring with the chamfer (arrow) showing upwards over the compression spring and line up snap ring.


Figure 281

Lift plate carrier out of the clamping ring (S).

Pre-load compression spring by means of special device (S) and squeeze snap ring into the annular groove of the plate carrier (arrow), see Figure 282!

(S) Pressure piece 504211

Analogously install purge valve, piston and compression spring on the opposite side (KR-clutch) (see Figure 277-282)!

Now, lift plate carrier with the KR-side showing downwards into the clamping ring (S) and fix it.

Tilt plate carrier by 180°.


Figure 282

Multi-disc clutch-KR

Multi-disc clutch-KR

The following sketch or table show plate stacking and installation position of the components!

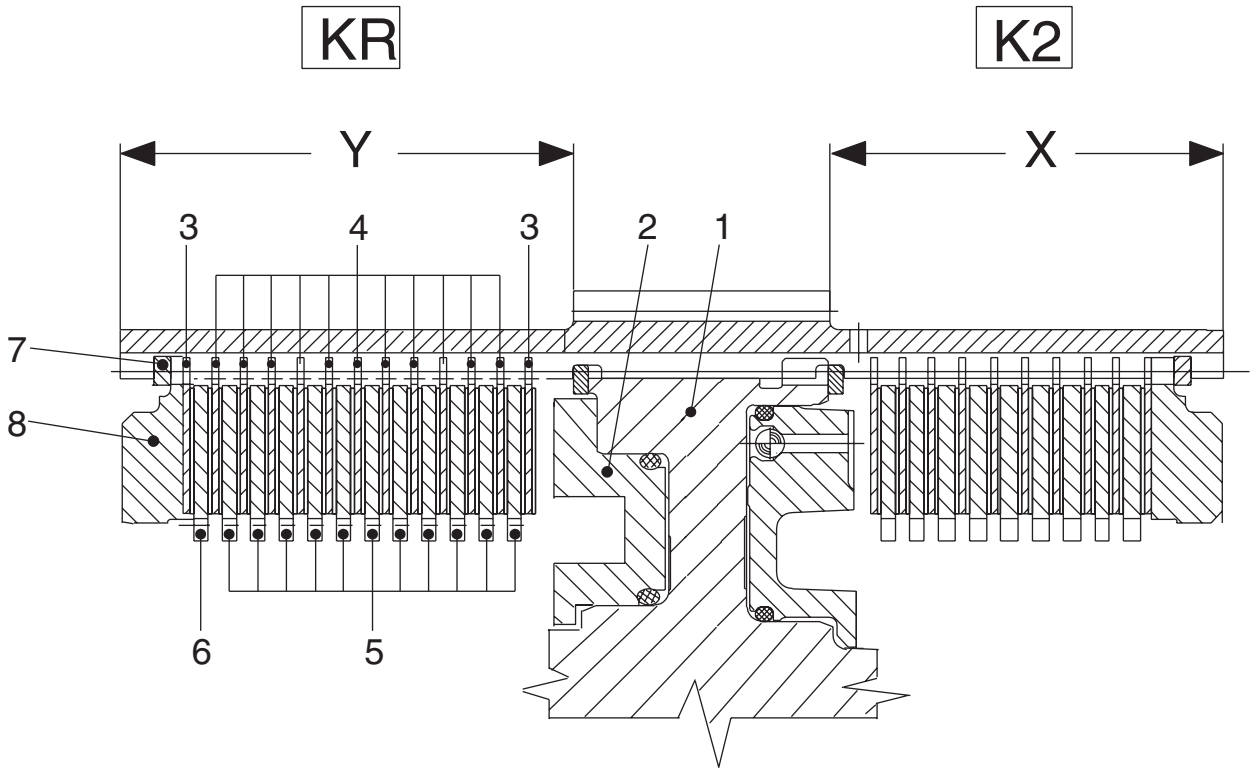


Figure 283

Item.	Designation	Quantity	s (mm)	Remark
1	Plate carrier	1		
2	Piston	1		
3	Outer plate	2	1,85	One-side coated
4	Outer plate	11	2,5	Coated on both sides
5	Inner plate	11	2,5	
6	Inner plate	1	2,5 ... 4,0	Optionally
7	Snap ring	1	2,55 ... 3,1	Optional
8	End shim	1		
Number of friction surfaces: 24				
Plate clearance: 2,8... 3,0 mm				

Install outer plates Item 3 with the uncoated side showing towards the piston or end shim.
The respective clutch side can be recognised by the length of the plate carrier, see sketch.
KR = Measure Y (long plate carrier side)
K2 = Measure X (short plate carrier side)

Check plate clearance-KR (Figure 285 ... 287) !

To ensure a correct measuring result, initially install plate pack without oil!

Install plate pack according to the sketch or table

(Figure 283).

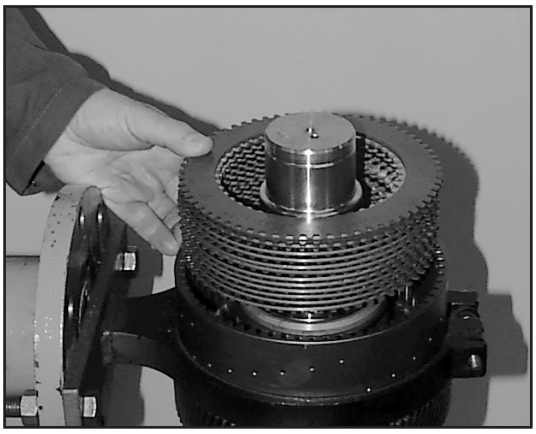


Figure 285

Insert end shim and fix it by means of snap ring.

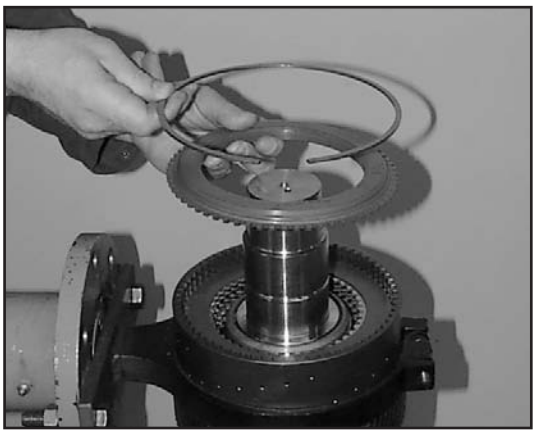


Figure 286

Press on end shim with about 100 N (10 kg) and set dial indicator to „Zero“.
Now, press end shim against snap ring (upwards) and read plate clearance from the dial indicator.

In case of deviations from the required plate clearance correct with suitable inner plate (optionally 2,5 to 4,0 mm) or and snap ring Item 7 (optionally).

(S) Magnetic stand	504171
(S) dial indicator	504172

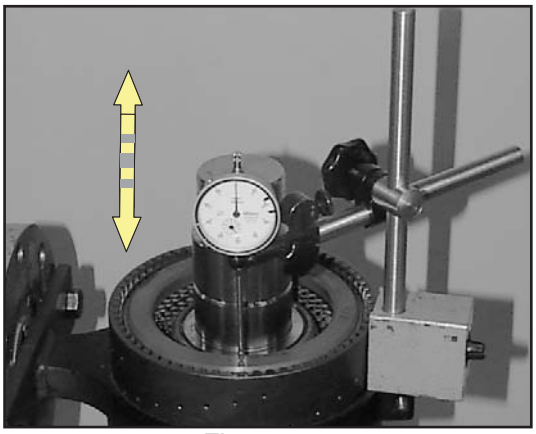


Figure 287

After the adjustment of the plate clearance, disassemble plate pack. Oil plates according to ZF-list of lubricants TE-ML 03 and install them again.

Pre-assemble and install spur gear KR (Figure 288 ... 296):

The figure on the left shows the components of the spur gear KR.

1 = Bearing inner race
2 = Shims , s = 3,0 and s = 3,10 mm
(Σ = 6,10 mm/empirical value)
3 = Spur gear
4 = Bearing inner race

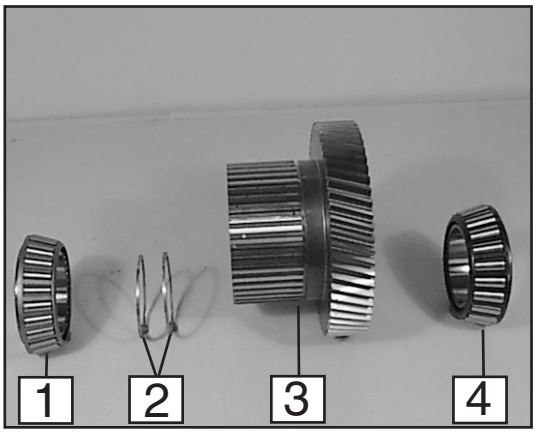


Figure 288

Check axial gap – spur gear support 0,0 ... 0,05 mm!

Place spur gear over the bearing inner race.

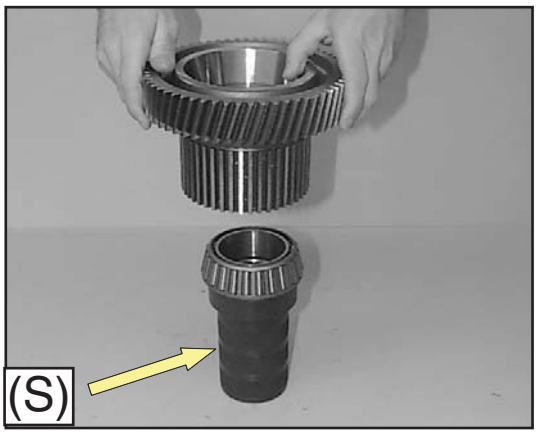


Figure 289

Introduce shims (2 units / s = 3,0 and s = 3,10 mm) .


Figure 290

Mount bearing inner race


Figure 291

Pre-load tapered roller bearing with about 50 000 N (5 t) and determine axial gap by means of dial indicator.

In case of deviations from the required axial gap, correct with suitable shims (Item. 2/Figure 288)!

(S) Pry bar	504209
(S) Dial indicator	504172
(s) Magnetic stand	504171

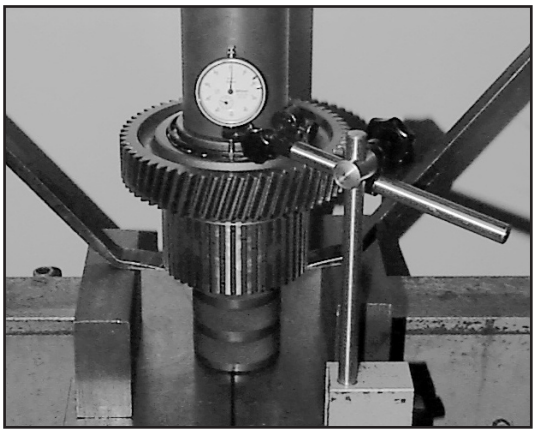


Figure 292

Heat bearing inner race and position it until contact is obtained.

Use protective gloves!

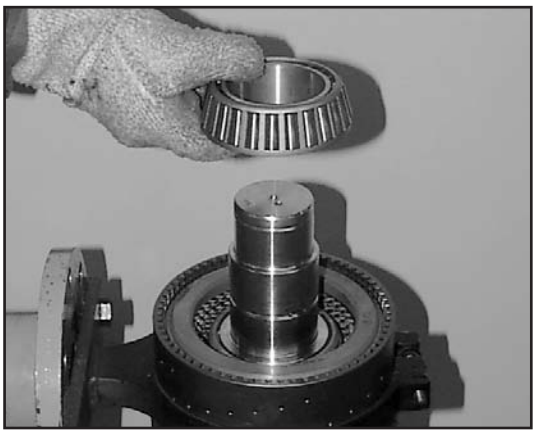


Figure 293

Introduce spur gear until all inner plates are accommodated

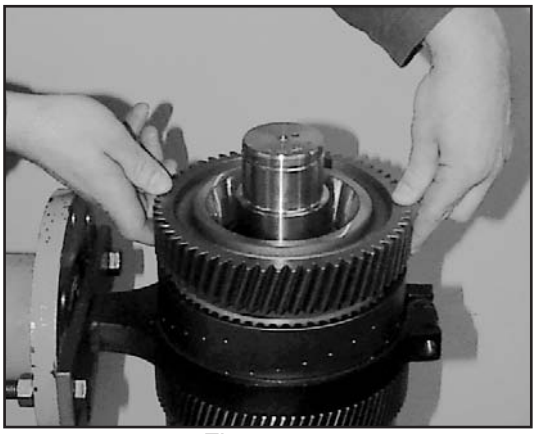


Figure 294

Introduce determined shims (see Figure 289 to 292).



Figure 295

Heat up bearing inner race (spur gear support) and position it until contact is obtained.

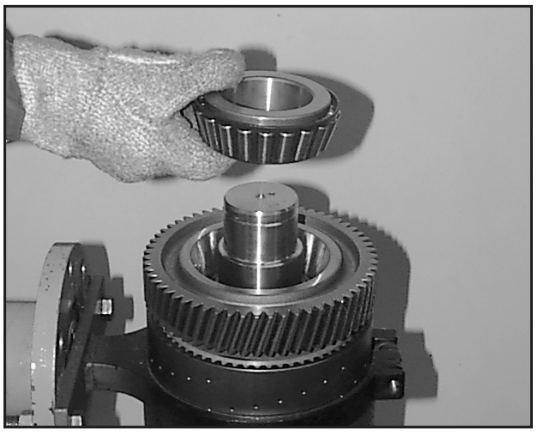


Figure 296

Use protective gloves!

Heat bearing inner race (clutch support)and position it until contact is obtained.

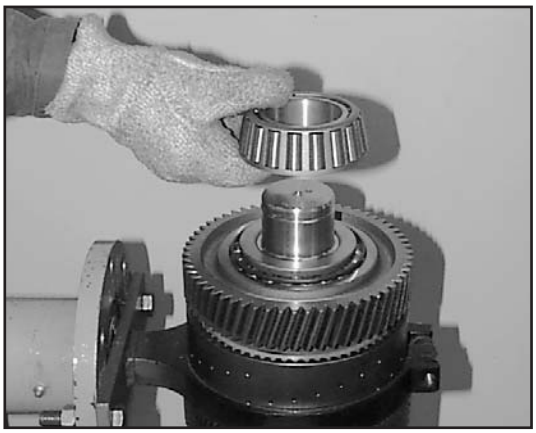


Figure 297

Use protective gloves!

Chapter 3 Drive Line

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3 Drive Line

3.1 Introduction

The Drive Line consists of the components transferring the power from the engine to the transmission, and from the transmission to each wheel, and also wheels, and brakes.

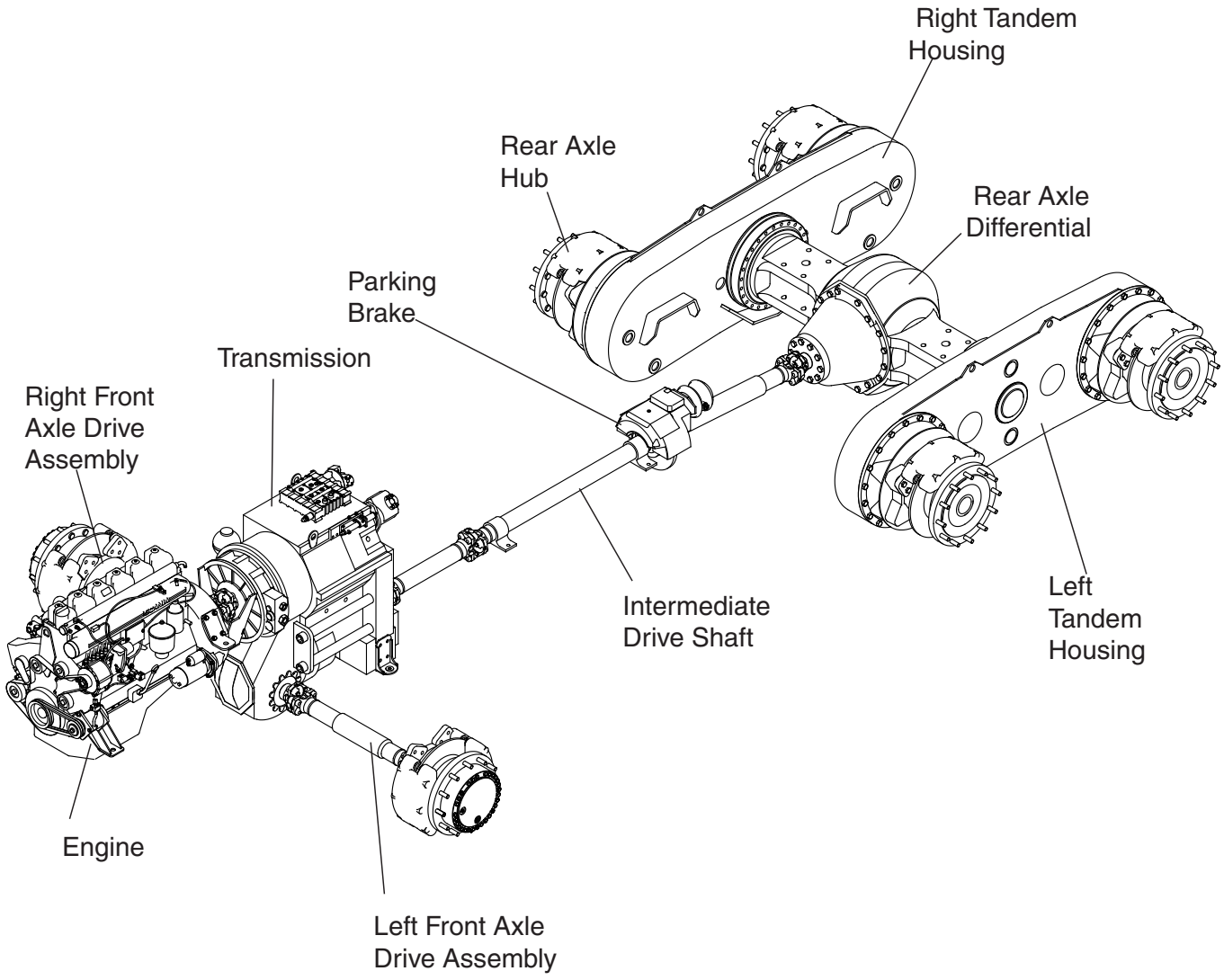


Fig 3.1 Drive Line Overview

3.2 Front Axle Drive Assembly

3.2.1 Front Axle Drive Unit

The Front Axle Drive Unit transfers the power from the transmission to each front wheel.

Removal
Rise both front wheels off the ground using a floor jack or a crane.

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

Place dumper on safety stands.
Thoroughly clean the front axle and the area around for any accumulated dirt.
Release the four bolts securing the actual drive shaft to the transmission output flange.
Turn the wheel to ease access to each bolt.
Remove actual wheel (Ref. 3.4.1)
Remove the brake calipers. (Ref. 3.6.1.3)
Loosen the 20 bolts securing the reduction drive assembly to the suspension arm, keep one of the upper bolts in place.
Fasten a lifting sling to the drive unit, and lift to release the weight. Remove the remaining bolt and lift/withdraw the unit from of the suspension arm, guiding the drive shaft through the opening.

Installation
Replace the drive assembly as removed.
Mount the 20 fastening bolts.
Replace the calipers. (Ref.3.6.1.3)
Replace wheel. (Ref. 3.4.1)
Connect the drive shaft to the transmission output flange, and tighten the four bolts.

Control
Check oil level in reduction drive. (Ref. Operation and Maintenance Manual)
Check that all connections are located as before removal, and rotate wheel to make sure there is no binding parts.
Lift dumper, remove stands, and lower to ground.
Check wheel nut torque. (Ref. 3.4.1)
Perform a test drive to see that maintained equipment is functioning as required.

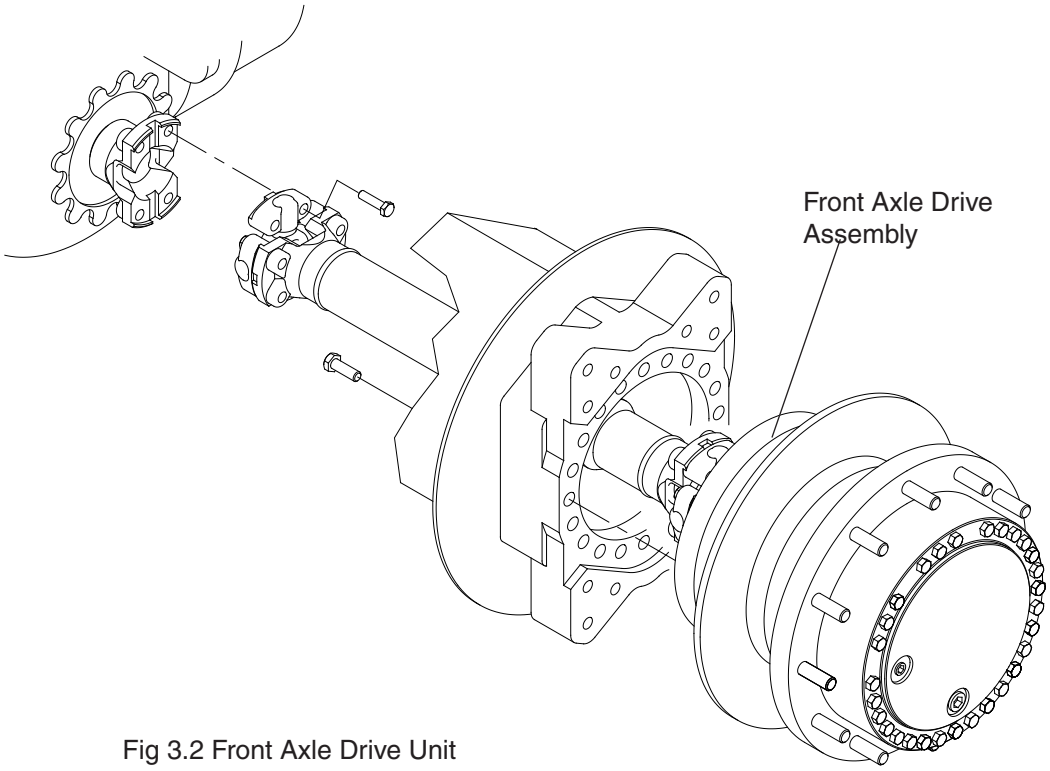


Fig 3.2 Front Axle Drive Unit

3.2.2 Front Wheel Hub Reduction Drive

The Front Wheel Hub Reduction Drive has a planetary drive, reducing axle speed, increasing torque to each front wheel.

Disassembly
Remove front axle drive assembly (Ref. 3.2.1)
Release the four bolts connecting the reduction gear to the drive shaft.

Assembly
Connect the reduction gear to the drive shaft and tighten the four bolts.
Replace front axle drive assembly (Ref. 3.2.1)

Control
Perform control as when replacing front axle drive assembly (Ref. 3.2.1)

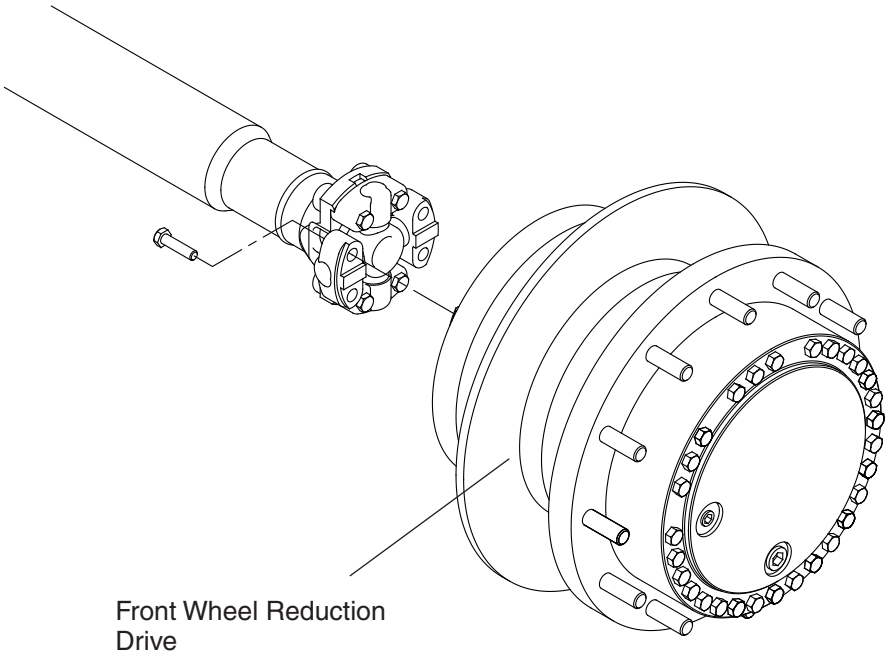


Fig 3.3 Front Wheel Hub Reduction Drive

3.3 Rear Axle Drive Assembly

3.3.1 Rear Axle Drive Unit

The Rear Axle Drive Unit transfers and distributes the power from the engine to the rear wheels, as well as being the main carrier of the dumper body loads.

Disassembly
Place dumper in a location where lifting capacity to rise the rear wagon from ground is available.
Thoroughly clean the rear axle drive assembly and the area around for any accumulated dirt.
Secure dumper from rolling, with wood blocks.
Disconnect the brake line hoses connected to drive assembly at the tandem housings.
Disconnect the drive shaft connected to the rear axle differential. (Ref. 3.5.3)
Secure the drive shaft from hanging down with a rope.
Unscrew the eight bolts connecting the rear axle drive assemby to the rear wagon frame.
Lift rear wagon to free the rear axle drive unit.
Roll drive unit slowly rearwards out from rear wagon.

WARNING!
If ground is not level, necessary precations to keep drive assembly from rolling out of control must be taken to avoid injurys to people and equipment.

Place rear axle drive unit in a safe position, and secure from rolling, with blocks.
Place rear wagon frame on safety stands.

Assembly
Rise the rear wagon high enough to roll the drive the unit slowly in position. Remove the safety stands, position drive assembly and lower rear wagon to enter the guide pins.
Replace the eight connecting bolts, and tighten.
Connect the drive shaft to the differential input flange. (Ref 3.5.3)
Connect the brake line hoses, and bleed the brake circuits. (Ref. 3.6.1.6)

Control
Check oil level in both tandem housings, and in the rear axle differential.
Check that parts are replaced as before removal.
Perform a test drive to check that rear
axle unit is functioning properly.

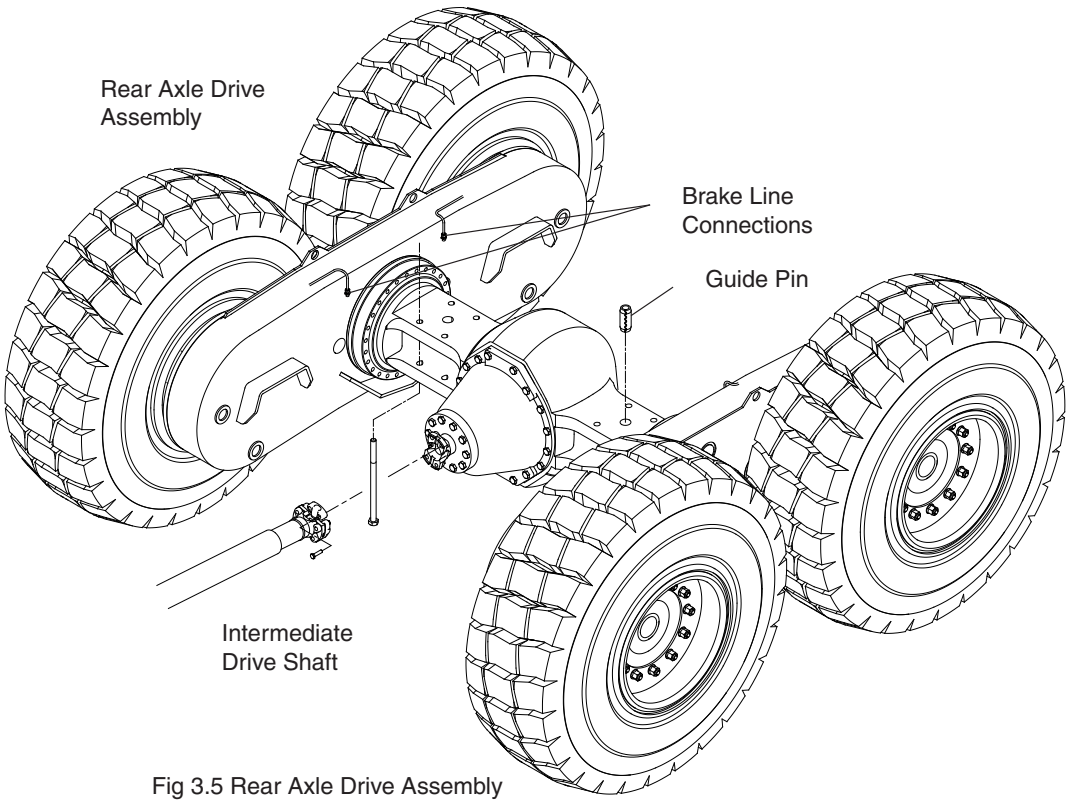


Fig 3.5 Rear Axle Drive Assembly

3.3.2 Rear Axle Differential

The Rear Axle Differential distributes the power between left and right rear wheel tandem housing.

Removal
Remove rear axle unit from dumper (Ref 3.3.1)
Release eight bolts, and remove pinion cover. Save the shims behind.
Remove circlip inside pinion, and withdraw seal plug, using a slide hammer equipped with an M16 adapter.
Withdraw drive shaft to disengage the differential, by using slide hammer equipped with an M16 adapter.
Pull shaft approx. 200 mm out. Repeat procedure on drive shaft on oposit side.
Rotate the rear axle housing until the differential input flange is in an upright position.
Support the rear axle housing from rotating by use of a floor jack.
Unscrew the 16 bolts securing the differential unit to the rear axle hosing.
Take note of where the different length of bolts are located.
Fasten a lifting device to the differential input flange, and lift the unit out of the housing.

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

Clean the rear axle housing mating flanges.

Installation
Apply a coat of sealing compound to the axle housing mating flange.
Lift the differential housing, and lower carefully into the rear axle hosing.
Enter the 16 bolts, with each length in the right locations.
Tighten the 16 bolts, advancing in a star pattern.
Push drive shafts back into position.
Rotate the differential input flange slightly from side to side to engage the differential, and the pinion.
Replace thrust washers and circlips, and replace pinion cover and shims as removed.
Rotate rear axle unit back into normal position with input axle horisontal.
Replace rear axle unit. (Ref.3.3.1)

Control
Check that all parts are located as when removed, and that the assembly can be rolled without binding.

WARNING!
If ground is not level, necessary precations to keep drive assembly from rolling out of control must be taken to avoid injurys to people and equipment.

Replace the rear axle drive assembly on dumper. (Ref. 3.3.1)

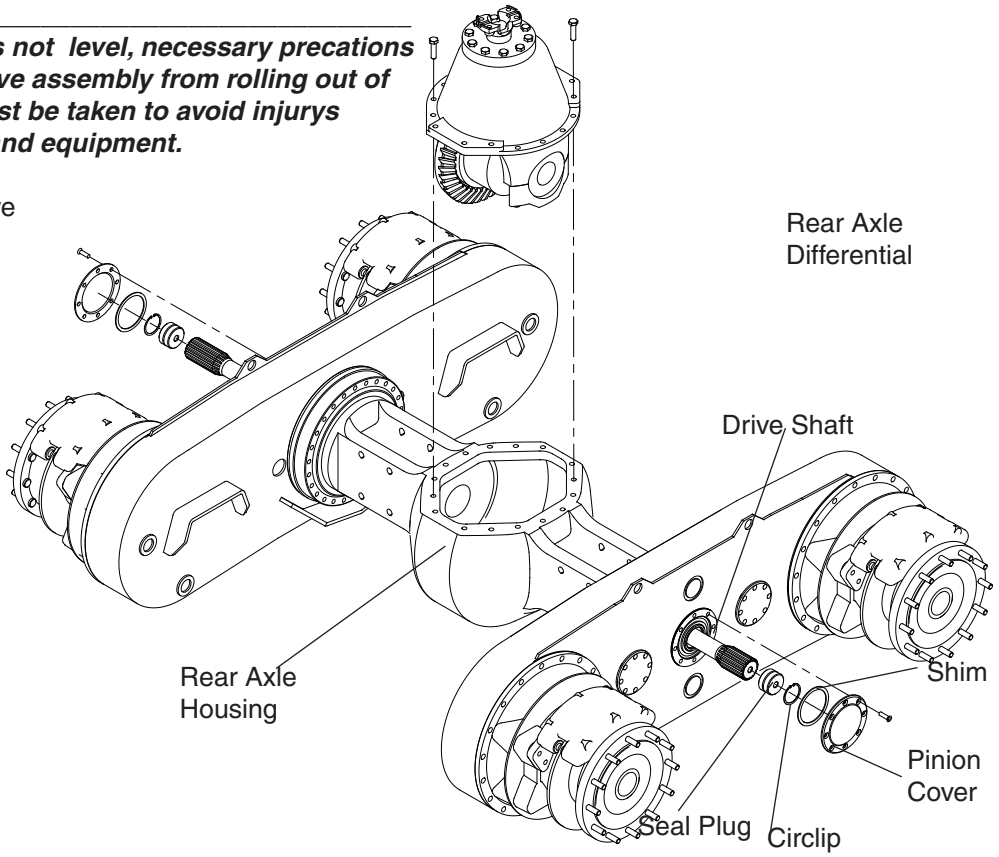


Fig 3.6 Rear Axle Differential

3.3.3 Rear Axle Hub Assembly

The four Rear Axle Hubs are carriers for the drive shafts for each rear wheel, and also act as brackets for the rear wheel brake calipers.

Removal
Rise wheel off the ground using a floor jack.
Remove actual wheel (Ref.3.4.1)
Thoroughly clean the rear axle hub assembly and the area around for any accumulated dirt.
Drain the actual tandem housing. (Approx. 70 litres)
Release the brake lines connected to the calipers, and remove the calipers. (Ref. 3.6.1.3)
Loosen the 18 bolts securing the hub assembly to the tandem housing. Unscrew the bolts, leaving one of the upper in place.
Fasten a lifting device to the hub assembly and lift to take the weight of the unit. Unscrew the remaining bolt, and slide the hub assembly slowly out of the tandem housing.

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

Place hub assembly safely resting on wood blocks to avoid damage to any parts.
Clean both mating flanges.

Installation
Apply a coat of sealing compound to the tandem housing mating flange.
Lift the rear axle hub, using a lifting device, and slide slowly into tandem housing.
Take care to get a proper gear mesh, and not damage the gear wheels.
Replace the 18 bolts, and tighten.
Replace brake calipers, an connect the brake lines. (Ref. 3.6.1.3)
Bleed the brake circuits.(Ref. 3.6.1.6)
Replace wheel. (Ref. 3.4.1)
Refill tandem housing with oil. (Ref. Operators Manual Chapter 6 - Lubricants, and Chapter 7 - Maintenance)

Control
Check that all parts are located as when removed.
Make a test drive to see that the operation of the actual wheel is functioning properly.

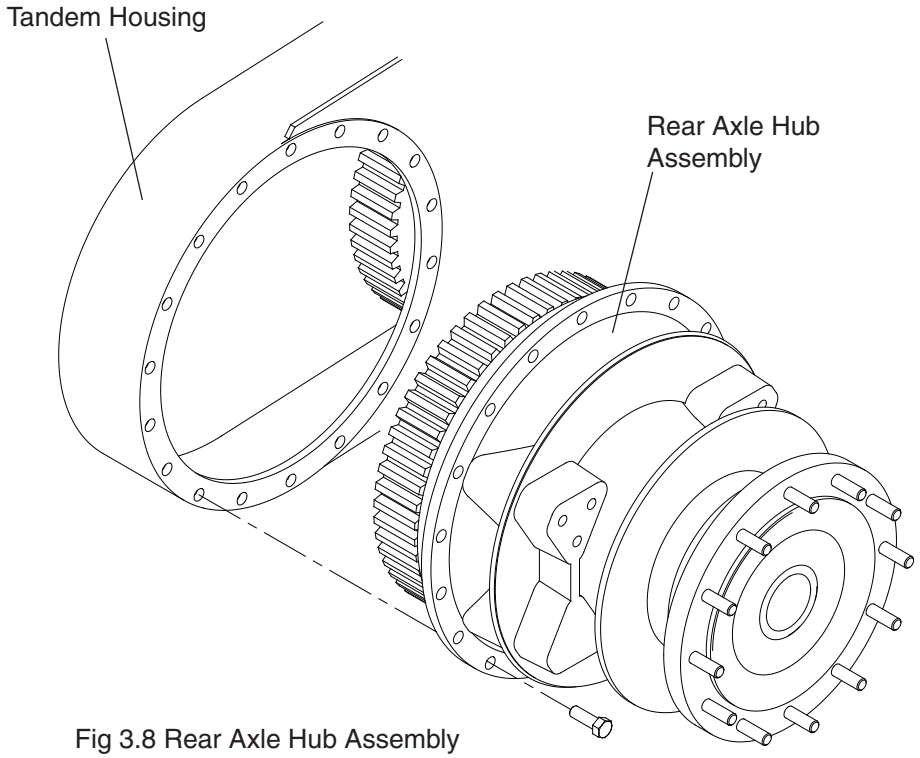


Fig 3.8 Rear Axle Hub Assembly

3.3.4 Tandem Housing Internal Parts

All internal parts in the tandem housing can be changed without removing the housing from the rear axle.

Removal
Remove both actual axle hub assemblies from actual housing (Ref. 3.3.5).
Brake callipers can be left in place on hubs.
Place a piece of hard wood or other suitable material, under each intermediate gear to maintain the vertical position. (Approx. 20 x 100 x 500mm)
Remove the retainer plate behind each intermediate shaft. Keep the shims and the O-rings.
Remove the two intermediate gear shafts by removing eight bolts on each and withdraw.
Roll each intermediate gear away from pinion, or lift completely out of housing for replacement of bearings and races.
Remove the pinion drive cover, by unscrewing eight bolts. Keep the shims.
Withdraw the pinion unit
This can be accomplished by using a slide hammer with an M16 adapter. Removal of intermediate gears and pinion give access to the inner pinion bearing, bearing race and seal ring, removal of pinion and outher bearing can be accomplished without moving the intermediate gears.
Clean the mating flanges for traces of sealing compound etc.
Installation
Replace the pinion unit using the same procedure as when removed. Apply a light coate of oil to the pinion splines.
Tap the pinion carefully into position using a soft mallet. At the same time rotate the pinion slightly to make sure the splines enter the the drive shaft.
Apply sealing compound to the mating flanges, and replace the pinion cover using the same amount of shims as when removed.
Tighten the eight bolts.
Position the intermediate gears, and replace the bearing units, using sealing compound on mounting flanges.
Tighten the eight mounting bolts, and put back O-ring shim and retainer plate from back.
Remove wood blocks.
Replace rear axle hub assemblies (Ref. 3.3.5)

Control
Check that all parts are located as when removed.
Make a test drive to see that the operation of the actual tandem unit is functioning properly.

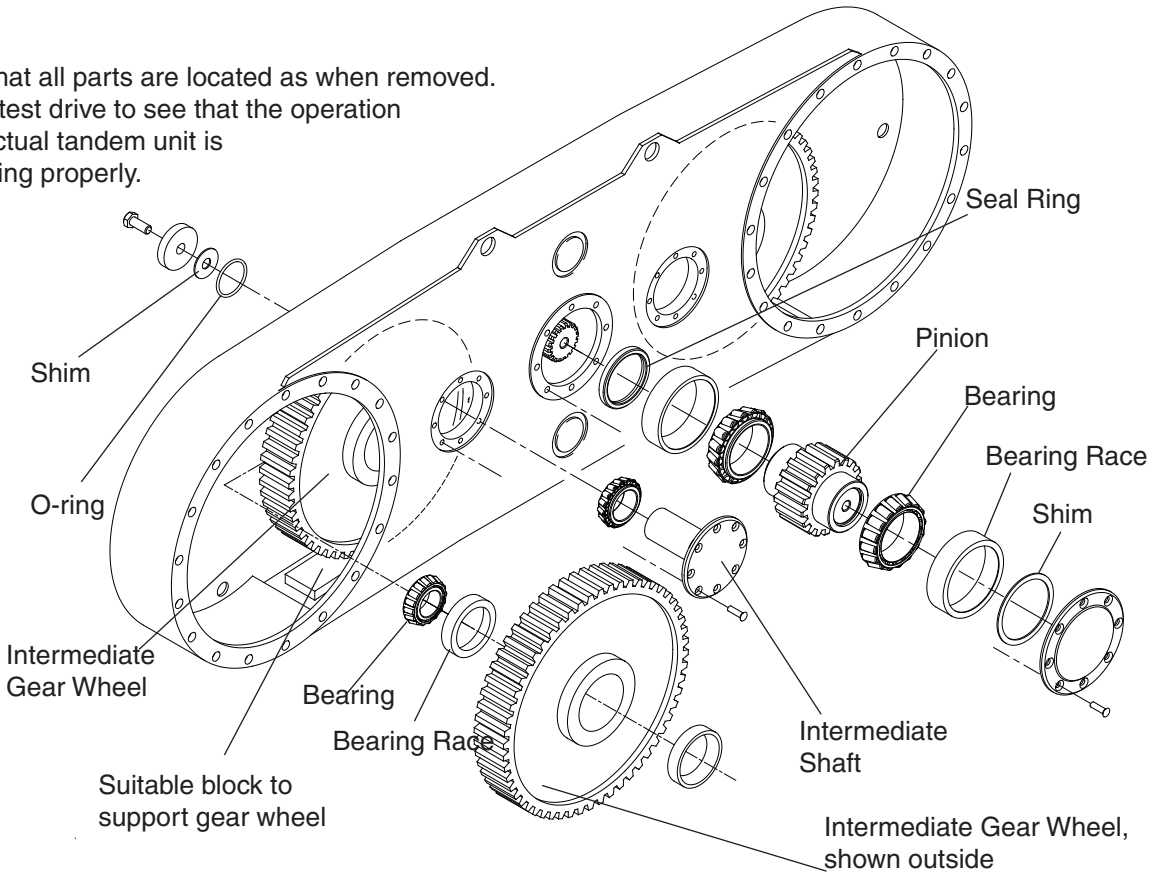
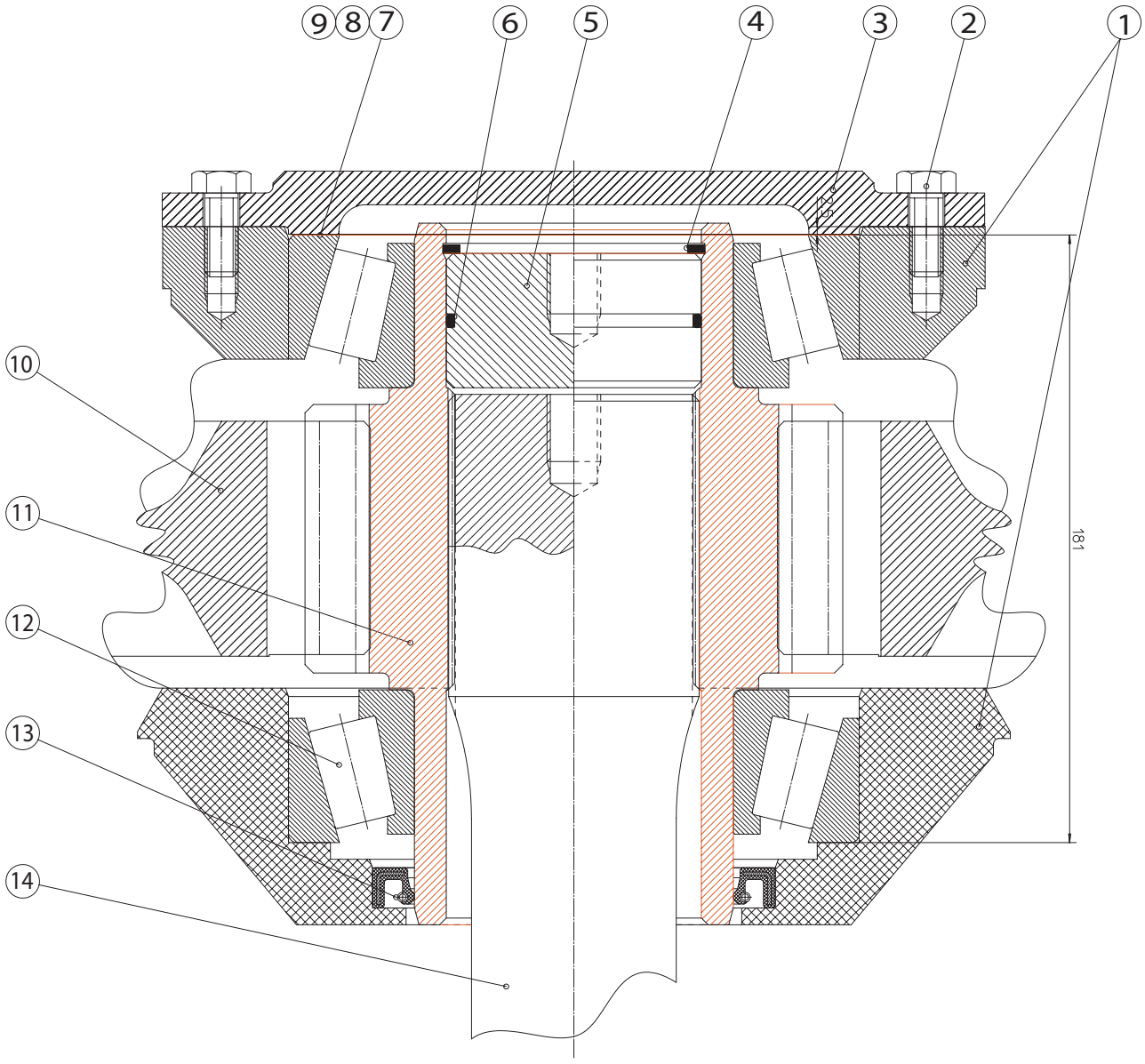


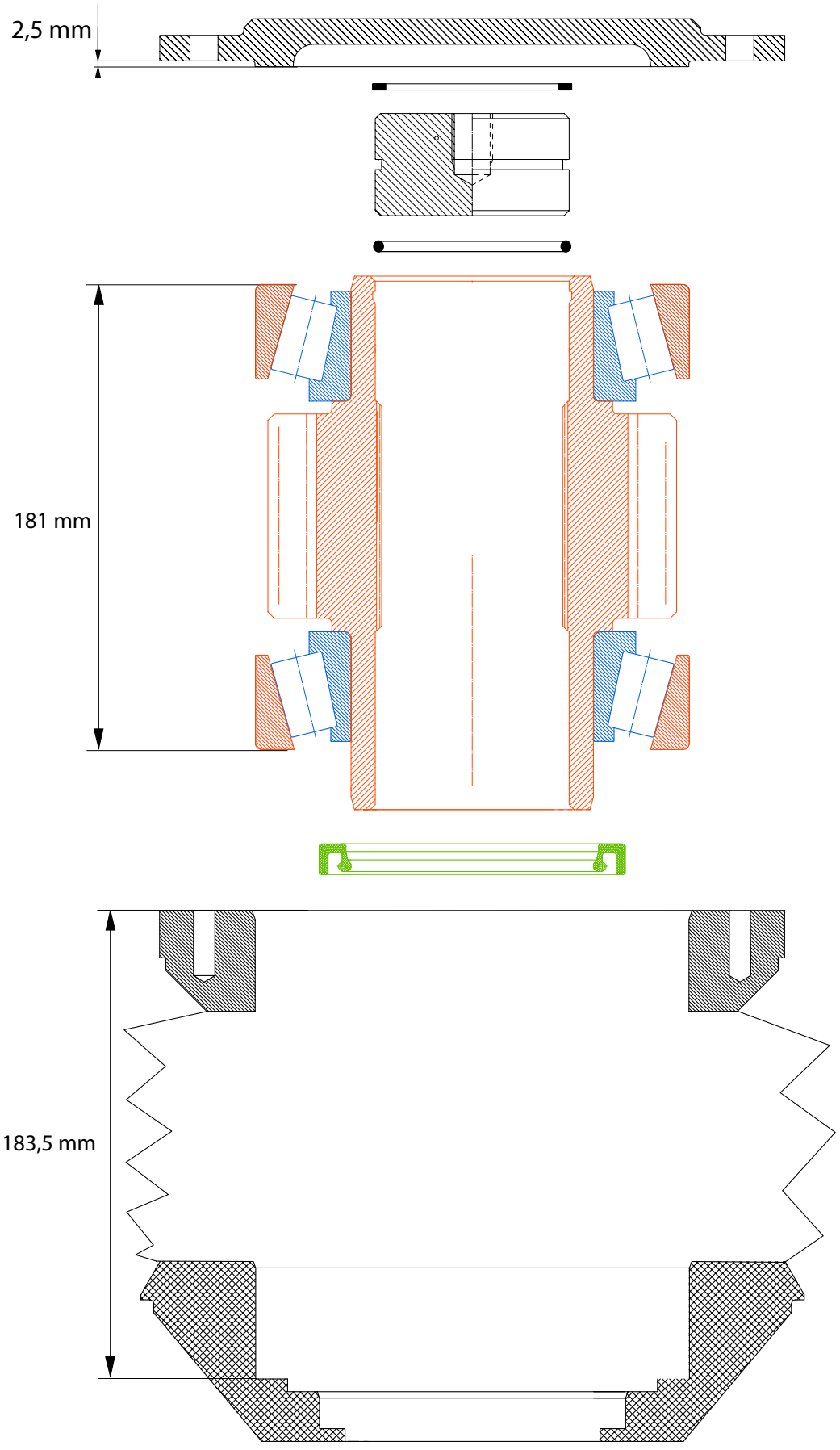
Fig 3.9 Rear Axle Pinion Drive

View of the pinion in the tandem housing.



1 Tandem housing
2 Screw M10 x 25
3 Cover
4 Snap ring
5 Thrust washer
6 O-ring
7 Shim cover pinion bearing (0.1mm)
8 Shim cover pinion bearing (0.3mm)
9 Shim cover pinion bearing (0.5mm)
10 Wheel
11 Pinion
12 Roller bearing
13 Seal ring
14 Shaft

Pinion basic dimensions



Calculation

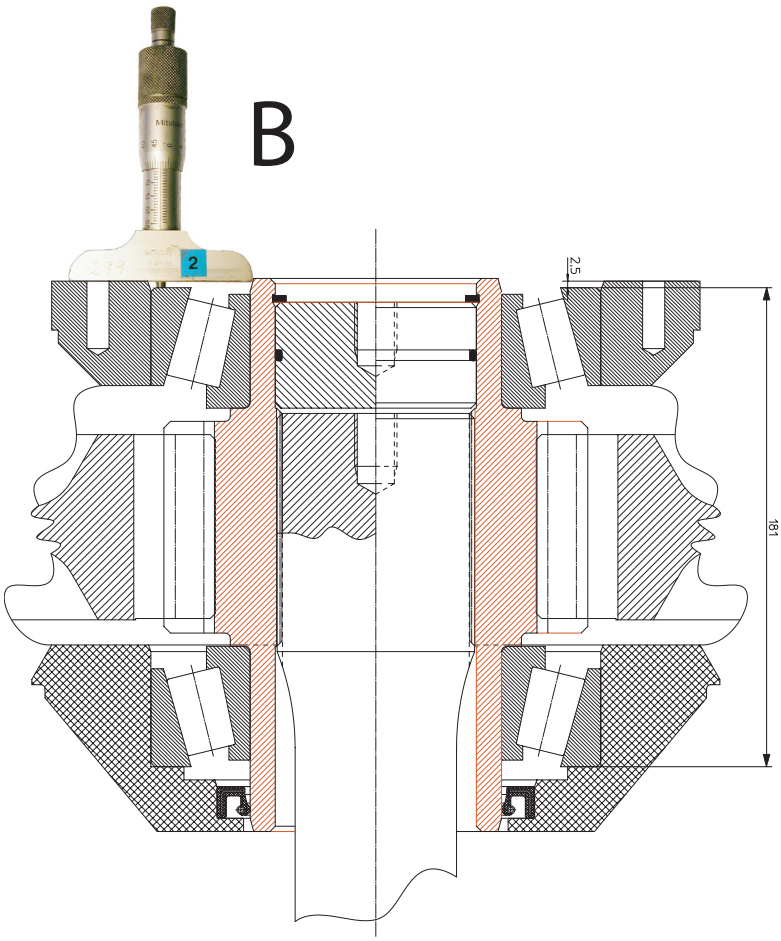


Calculation example:

Measure B	2,65 mm
Measure A	2,45 mm
Differance	0,20 mm

Give shims 0,10 mm.

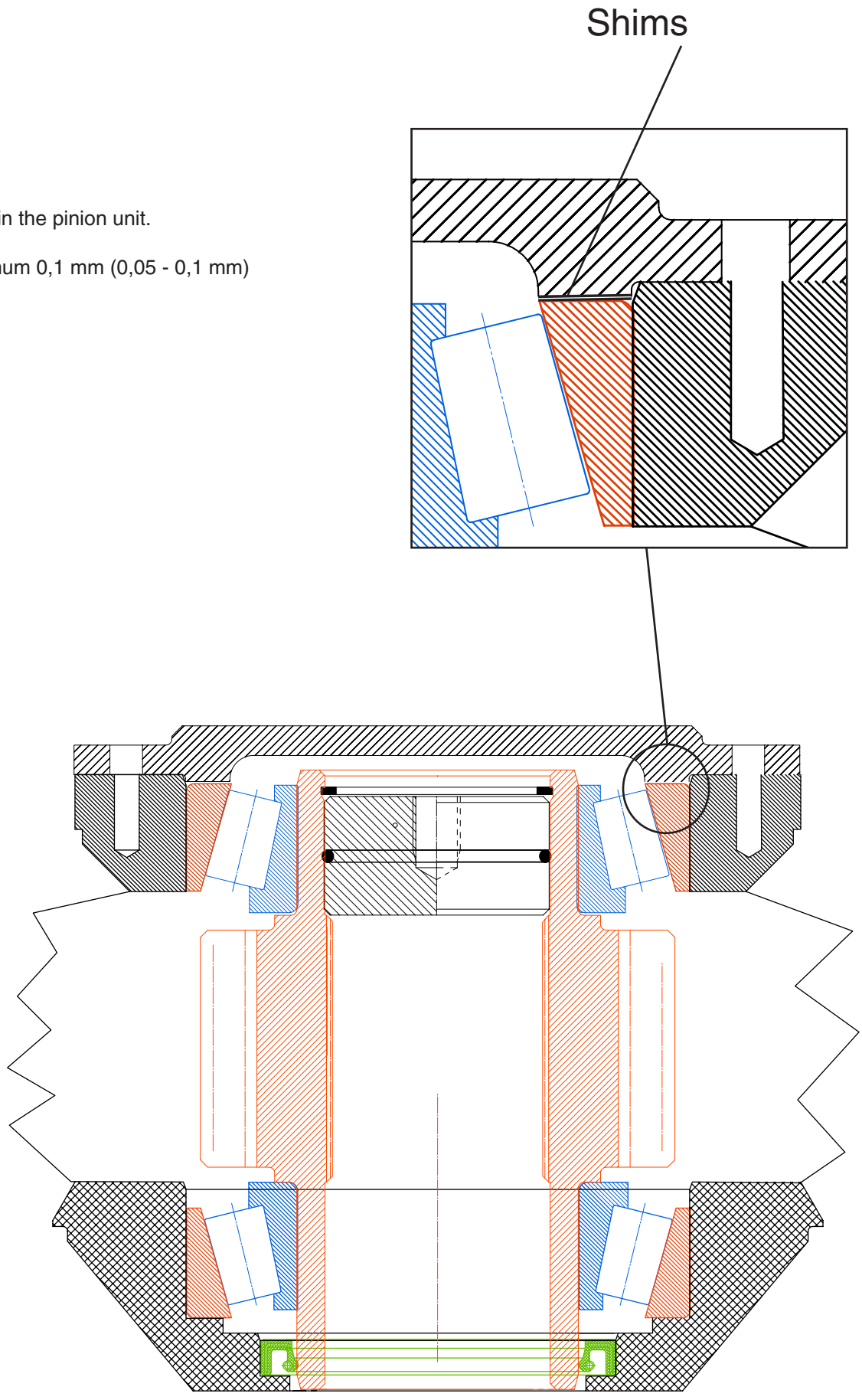
See also the SPI 03/2004



Note:

It is no pre-tension in the pinion unit.

Clearance is maximum 0,1 mm (0,05 - 0,1 mm)



3.3.5 Tandem Housing

Each Tandem Housing is a main part of the rear wheel suspension, as well as containing the rear wheel reduction drive, distributing the power from the rear axle to each rear wheel.

Removal
Remove rear axle drive assembly from dumper.
(Ref. 3.3 1)
Place the drive assembly in a safe position where lifting capacity is available. Secure unit from rolling, with blocks.
Drain actual tandem housing. (Approx. 70 litres)
Drain the rear axle housing. (approx. 30 litres)
Replace the drain plugs.
Place rear axle on safety stand.
Remove actual wheels (Ref.3.4.1)
Thoroughly clean the tandem housing and the area around for any accumulated dirt.
Fasten lifting device to the two tandem hosing lifting lugs.
Lift to take the weight off the tandem housing.
Unscrew the 26 bolts securing the tandem housing to the rear axle, and move tandem housing straight out from rear axle to disengage the drive shaft splines.

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

Move tandem housing away from rear axle unit, and lower safely to ground.
Clean the mating flanges for traces of sealing compound.

Installation
Apply sealing compound to the mating flanges, and apply a light coat of oil in the pinion splines. Lift the tandem housing. Check that the mating flanges are parallel to each other, and move the housing towards the rear axle unit to enter the drive shaft splines in the pinion.
Replace the 26 bolts, and tighten the bolts advancing in a star pattern.
Replace wheels (Ref. 3.4.1)
Remove safety stand, and lower rear axle drive unit to the ground.
Refill oil in tandem housing and the rear axle housing.
(Ref. Operators an Maintenance Manual, Chapter 6 - Lubricants, and Chapter 7 - Maintenance)
Replace rear axle drive
unit on dumper.
(Ref. 3.3.1)

Control
Check that all parts are located as when removed.
Make a test drive to see that actual tandem unit is functioning properly.

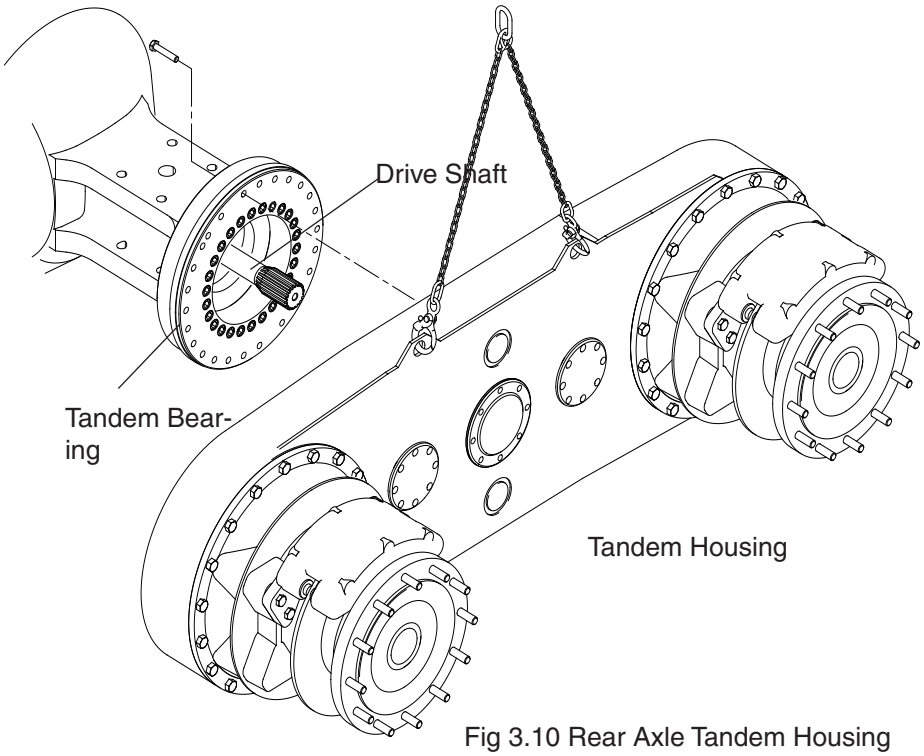


Fig 3.10 Rear Axle Tandem Housing

3.3.6 Tandem Bearing

The Tandem Bearings are the suspension for the tandem housing. The bearings are mounted to the rear axle, and carries all the loads on the rear wheels.

Removal
Remove actual tandem housing. (Ref. 3.3.6)
Draining of oil is not necessary if removal takes place just for work on the tandem bearing.

Fasten a lifting device in outer mounting holes, and lift to take the weight of the tandem bearing.
Unscrew the 26 bolts attaching the tandem bearing to the rear axle housing.
Disconnect lubrication line.
Lift bearing out from the rear axle unit, and lower to the ground.
Clean the mating flanges.

Installation
Attach lifting divice to the tandem bearing, and lift to vertical position.
Apply sealing compound to the mating flanges.
Guide the bearing in position on the rear axle unit, and install the 26 bolts.
Tighten the bolts advancing in a star pattern.
Remove lifting device.
Connect lubrication line.
Lubricate the tandem bearing.
Install the tandem housing. (Ref. 3.3.6)

Control
Check that all parts are located as when removed.
Make a test drive to see that the operation of the actual tandem unit is functioning properly.

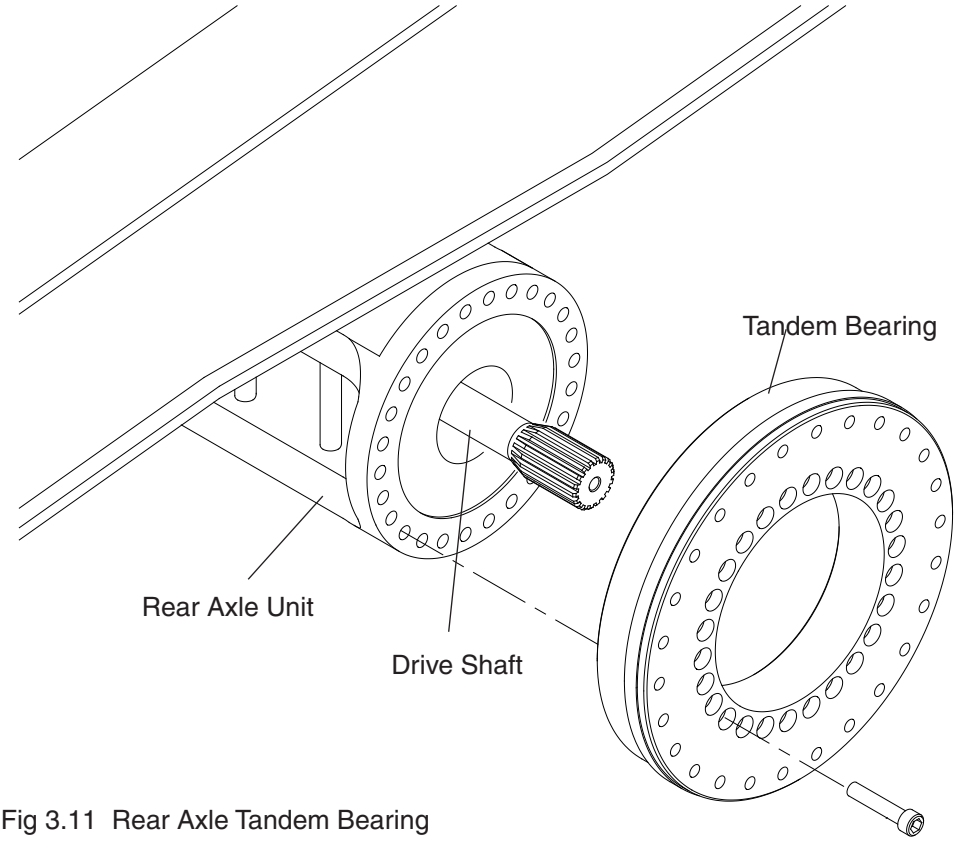


Fig 3.11 Rear Axle Tandem Bearing

3.4 Wheels

3.4.1 Wheel

Removal
Use a floor jack or a crane to lift the dumper to rise the actual wheel off the ground.
Place on safety stand.
Remove all wheel nuts except one of the upper.
Place a wheel handling tool under the wheel and lift to take the weight of the wheel. Remove the remaining nut, and withdraw the wheel.
Place wheel safely aside.

Installation
Position wheel using wheel handling tool.
Tighten the12 wheel nuts temporary.
Lift dumper, remove stand, and lower to ground.

Control
Tighten wheel nuts to 450 Nm advancing in a star pattern.
Check tyre pressure (See Operators Manual Chapter 5 - Operating Instructions, and Chapter 8 - Technical Data, for recommendations)

3.4.2 Tyre and Rim Replacement

Handling of tyres and rims demands special equipment and trained personnel, if such not present on the premises, leave this to tyre shops.

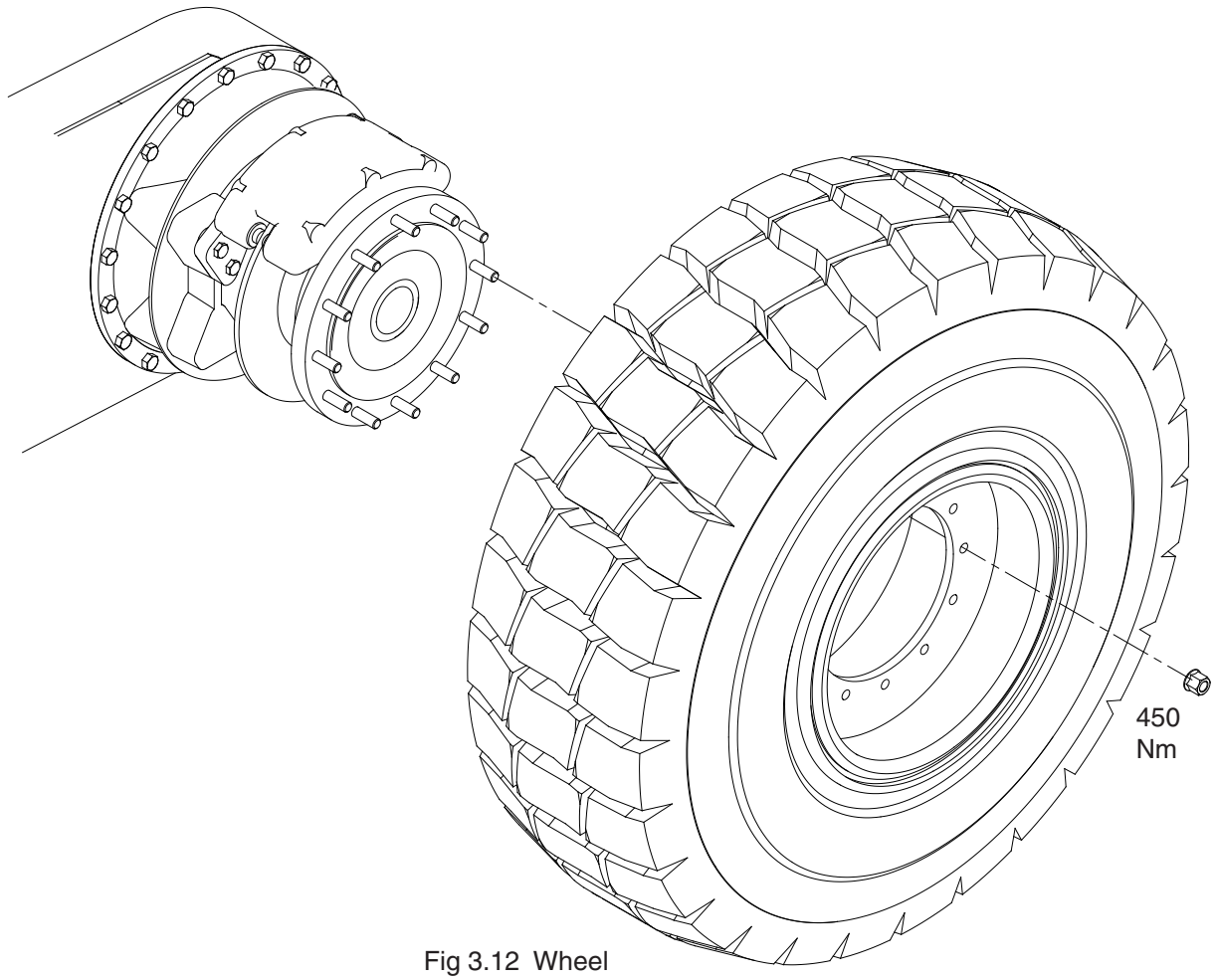


Fig 3.12 Wheel

3.5 Propeller Shafts

The Propeller Shafts connects the engine, transmission and the wheel axles, and transfer the torque to the different axle drives.

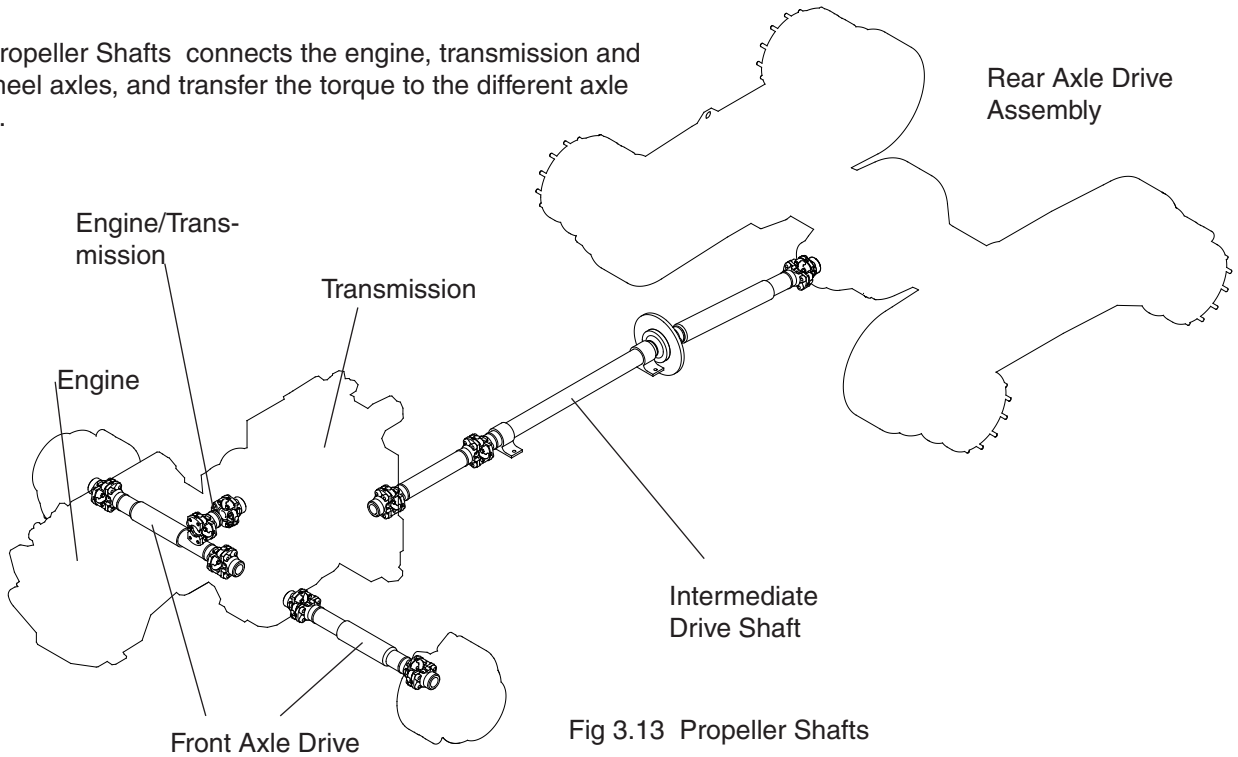


Fig 3.13 Propeller Shafts

3.5.1 Engine/Transmission Propeller Shaft

The Engine/Transmission Propeller Shaft connects the engine to the transmission.

Removal
Tilt the cab. (Ref.Operation and Maintenance Manual)
Thoroughly clean the prop shaft and the area around for any accumulated dirt.
Remove the upper half of the safety catcher, by releasing the two bolts.
Remove the four bolts securing the shaft to the engine, and remove the four bolts securing the shaft to the transmission. Lift the shaft out.

WARNING!
The shaft is telescopic, and possible pressure inside can force the two halves to move apart. Keep fingers clear!
If the two shaft halves are separated in the splines, they must be put back in the same orientation as before

Installation
Check the alignment of engine/transmission by using alignment tool.
If out of specification, adjust by changing the number of engine mount shims.
Push the shaft halves together to reduce the length, and position between the engine and transmission flanges.
Replace the four mounting bolts, and tighten.
Replace the drive shaft safety catcher, and tighten the two bolts.

Control
Check that all parts are located as when removed.
Lower the cab. (Ref. Operation and Maintaenance Manual)
Start the engine to check for normal operation of drive shaft.

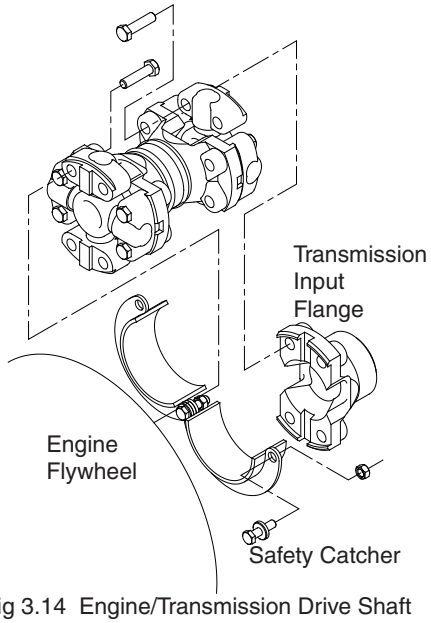


Fig 3.14 Engine/Transmission Drive Shaft

3.5.2 Front Axle Drive Shaft

The Front Axle Drive Shafts transfer the power from the transmission to the front axle reduction drives.

Removal
Rise both front wheels off the ground using a floor jack or a crane.

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

Place dumper on safety stands.
To gain access, remove the front differential protection cover.
Thoroughly clean the front axle and the area around for any accumulated dirt.
Release the four bolts securing the actual drive shaft to the transmission front output flange.
Turn the wheel to ease access to each bolt.

WARNING!
The shaft is telescopic, and possible pressure inside can force the two halves to move apart. Keep fingers clear!

If the two shaft halves are separated in the splines, they must be put back in the same orientation as before

Release the four bolts securing the drive shaft to the front wheel reduction drive, and withdraw axel.

Installation
Position the drive shaft on the front wheel reduction drive flange, replace the four bolts and tighten.
Push the shaft halves together to reduce the length, and position the inner shaft coupling on the transmission output flange, and replace the four bolts and tighten.

Control
Check that all parts are located as when removed.
Make a test drive to see that the operation of the actual drive shaft is functioning properly.

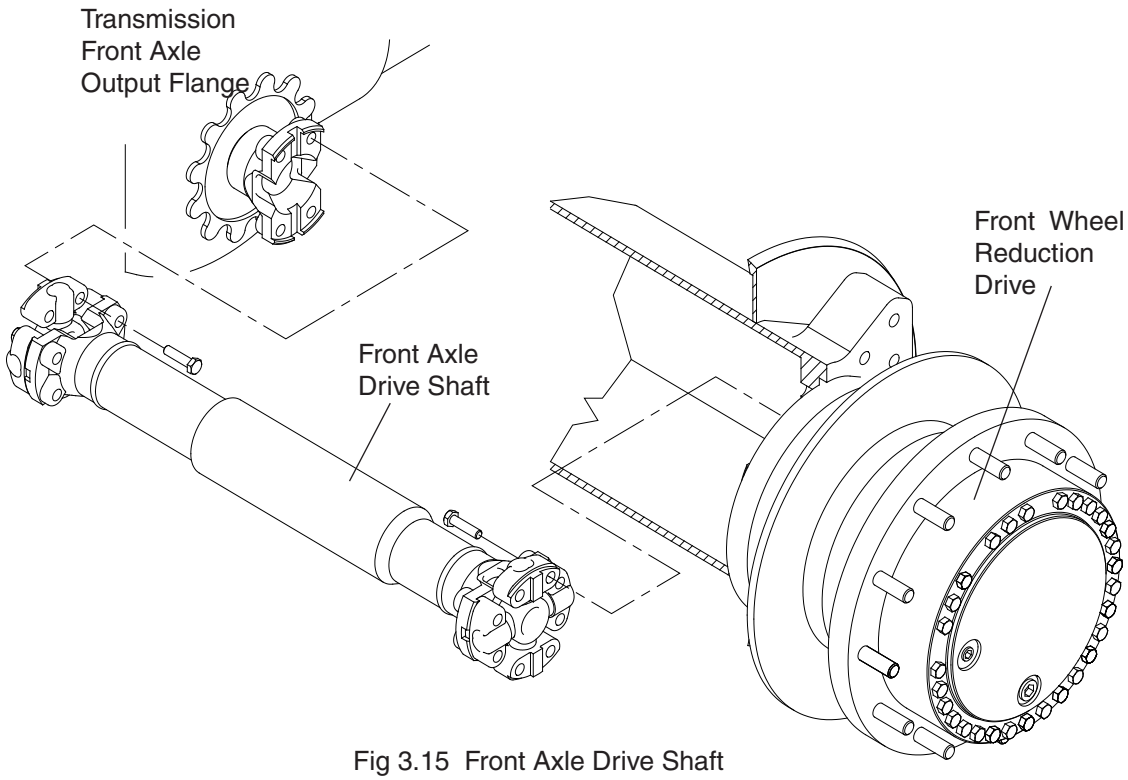


Fig 3.15 Front Axle Drive Shaft

3.5.3 Intermediate Drive Shaft Assembly

The Intermediate Drive Shaft Assembly transfers the power from the transmission to the rear axle drive assembly, and consists of three main parts
The front part of the drive shaft connects the transmission trough the articulation bearing to the center part of the drive shaft which is supported in the rear frame.
The rear end of the center drive shaft is the location of the parking brake. This is also the connection to the rear part of the drive shaft assembly, which again is connected to the rear axle input flange.
Access is obtained by lifting the dumper body, and putting the body on the safety stand.

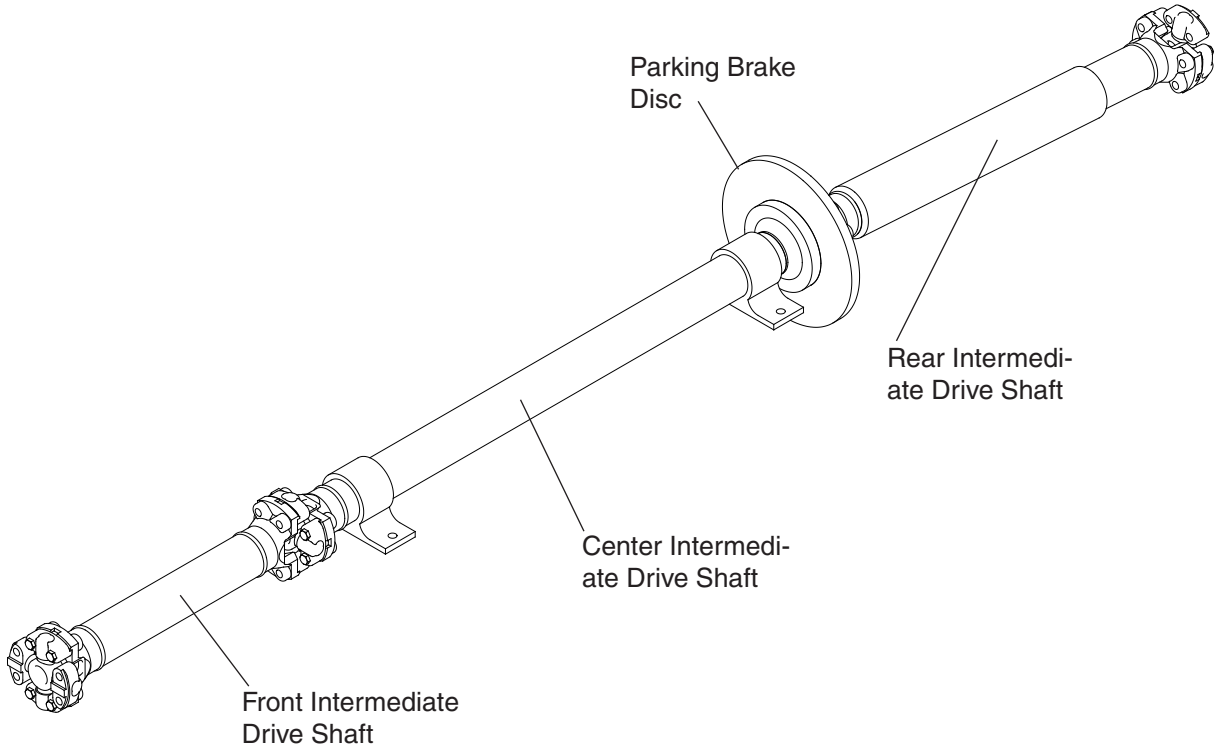


Fig 3.16 Intermediate Drive Shaft

3.5.3.1 Front Intermediate Drive Shaft

Removal
Rise the dumper body, and place on safety stand.
Thoroughly clean the shaft and the area around for any accumulated dirt.
The front drive shaft is removed through the shaft tunnel in the articulation bearing. Release the four bolts securing the shaft to the transmission rear output flange.

WARNING!
The shaft is telescopic, and possible pressure inside can force the two halves to move apart. Keep fingers clear!

If the two shaft halves are separated in the splines, they must be put back in the same orientation as before

Release the four bolts securing the drive shaft to the center rear axle drive shaft, and withdraw the drive shaft.
Installation
Position the drive shaft on the center shaft flange, replace the four bolts and tighten.
Push the shaft halves together to reduce the length, and position the front flange on the transmission flange.
Replace the four bolts and tighten.

Control
Check that all parts are located as when removed.
Make a test drive to see that the operation of the actual drive shaft is functioning properly.

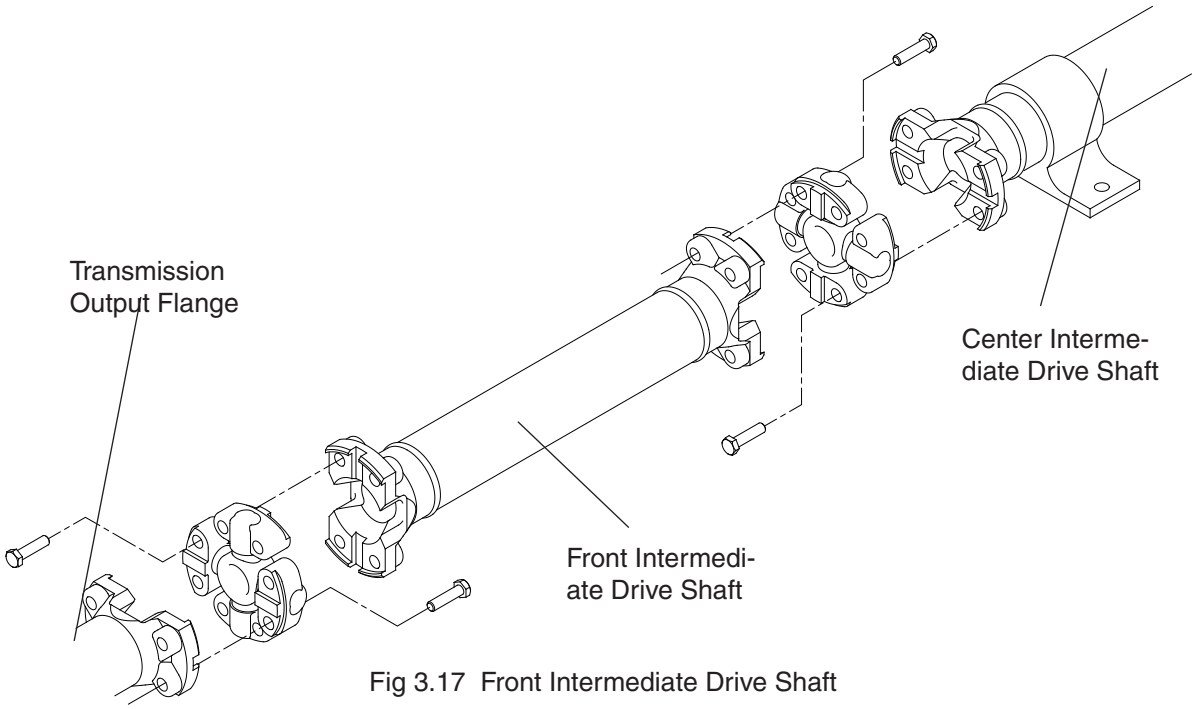


Fig 3.17 Front Intermediate Drive Shaft

3.5.3.2 Center Intermediate Drive Shaft

Removal
Rise the dumper body, and place on safety stand.
Thoroughly clean the shaft and the area around for any accumulated dirt.
Remove the parking brake unit (Ref.3.6.1)
Unscrew the four bolts securing the center shaft to the front intermediate drive shaft. (Ref. 3.5.3.1)
Unscrew the four bolts securing the center shaft to the rear intermediate drive shaft. (Ref. 3.5.3.3)
Release the four bolts securing the two bearing supports to the rear frame.
Note number of shims under bearing supports.
Lift center shaft out of rear frame.

Installation
Position the center shaft in the rear frame using the same amount of shims as when removed, replace the four bolts and tighten.
Push the front drive shaft together to reduce the length, and position the rear flange on the center shaft front flange. Replace the four bolts and tighten.
Push the rear shaft together to reduce the length, and position the front flange on the center shaft rear flange. Replace the four bolts and tighten.
Replace the parking brake unit. (Ref. 3.6.1)

Control
Check that all parts are located as when removed.
Make a test drive to see that the actual drive shaft is functioning properly.

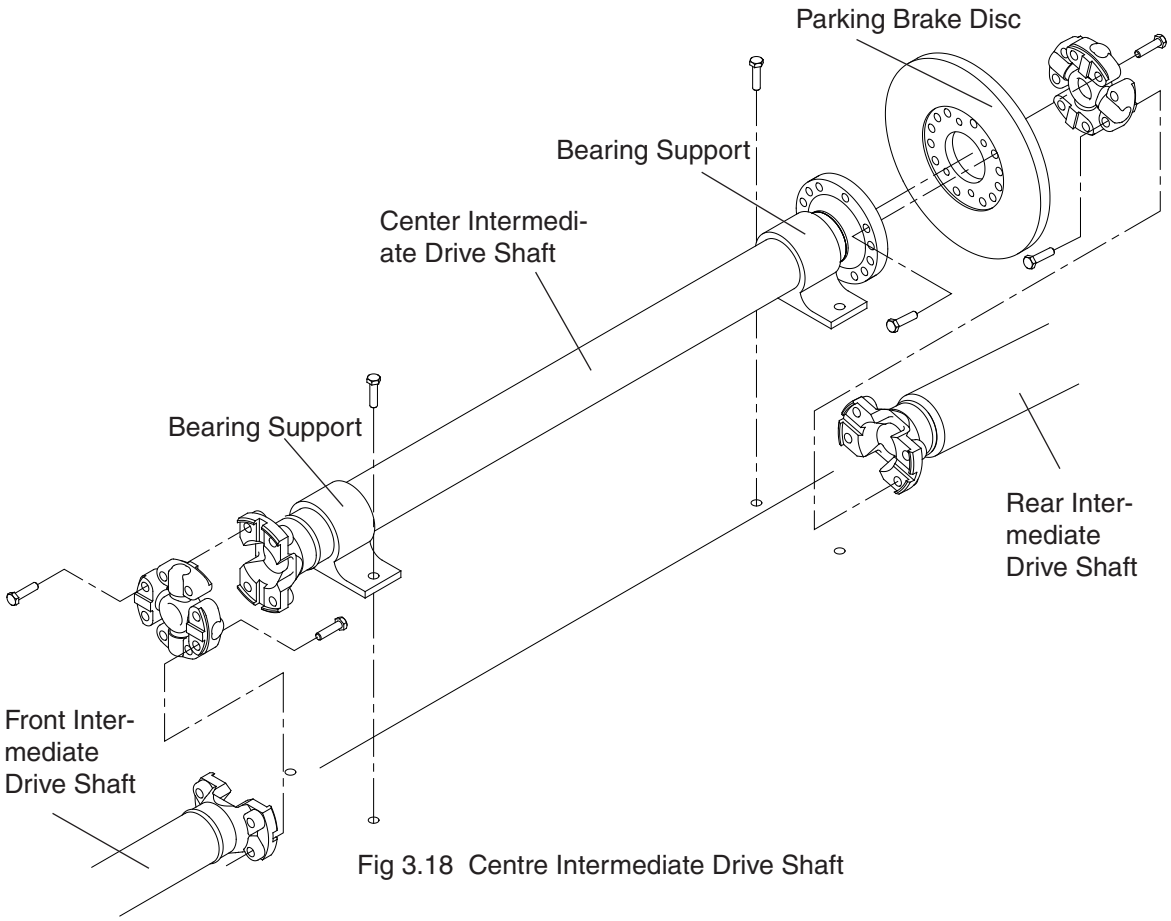


Fig 3.18 Centre Intermediate Drive Shaft

3.5.3.3 Rear Intermediate Drive Shaft

Removal
Secure dumper from rolling with wheel blocks, as removing this shaft unables parking brake to lock the rear wheels.
Rise the dumper body, and place on safety stand.
Thoroughly clean the shaft and the area around for any accumulated dirt.
Release the four bolts securing the drive shaft to the center rear axle drive shaft.

WARNING!
The shaft is telescopic, and possible pressure inside can force the two halves to move apart. Keep fingers clear!

If the two shaft halves are separated in the splines, they must be put back in the same orientation as before

Release the four bolts securing the drive shaft to the rear axle input flange, and withdraw the drive axle.

Installation
Position the drive shaft on the rear axle input flange, replace the four bolts and tighten.
Push the shaft halves together to reduce the length, and position the front flange on the center shaft rear flange. Replace the four bolts and tighten.

Control
Check that all parts are located as when removed.
Make a test drive to see that the actual drive shaft is functioning properly.

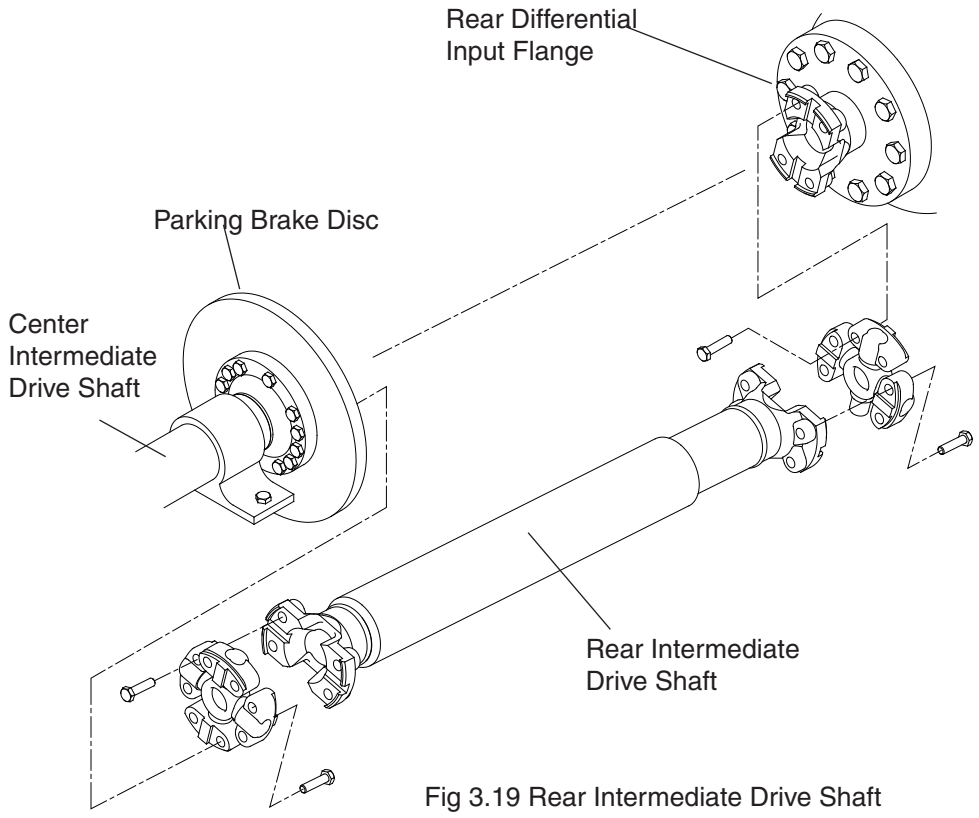


Fig 3.19 Rear Intermediate Drive Shaft

3.5.4 Engine Output Flange Flexible Coupling

The Engine Output Flange Flexible Coupling is located inside the engine flywheel, and absorbs engine vibrations, thereby reducing vibration and sound created by the engine.

Disassembly
Remove the engine/transmission drive shaft.
(Ref. 3.5.1)
Unscrew the eight bolts and washers securing the coupling mounting flange to the flywheel and remove from dumper.
Separate the coupling flange from coupling by unscrewing 16 bolts. Withdraw the coupling and the inside rubber bearings.

Assembly
Position the rubber bearings and the coupling flange on the coupling. Replace the 16 bolts and tighten.
Position the coupling on the engine flywheel flange, and replace the eight bolts and washers using.
Tighten the bolts, advancing in a star pattern.
Replace the engine/transmission drive shaft.
(Ref. 3.5.1)

Control
Check that all parts are located as when removed.
Lower the cab. (Ref. Operation and Maintenance Manual)
Start the engine to check for normal operation of coupling.

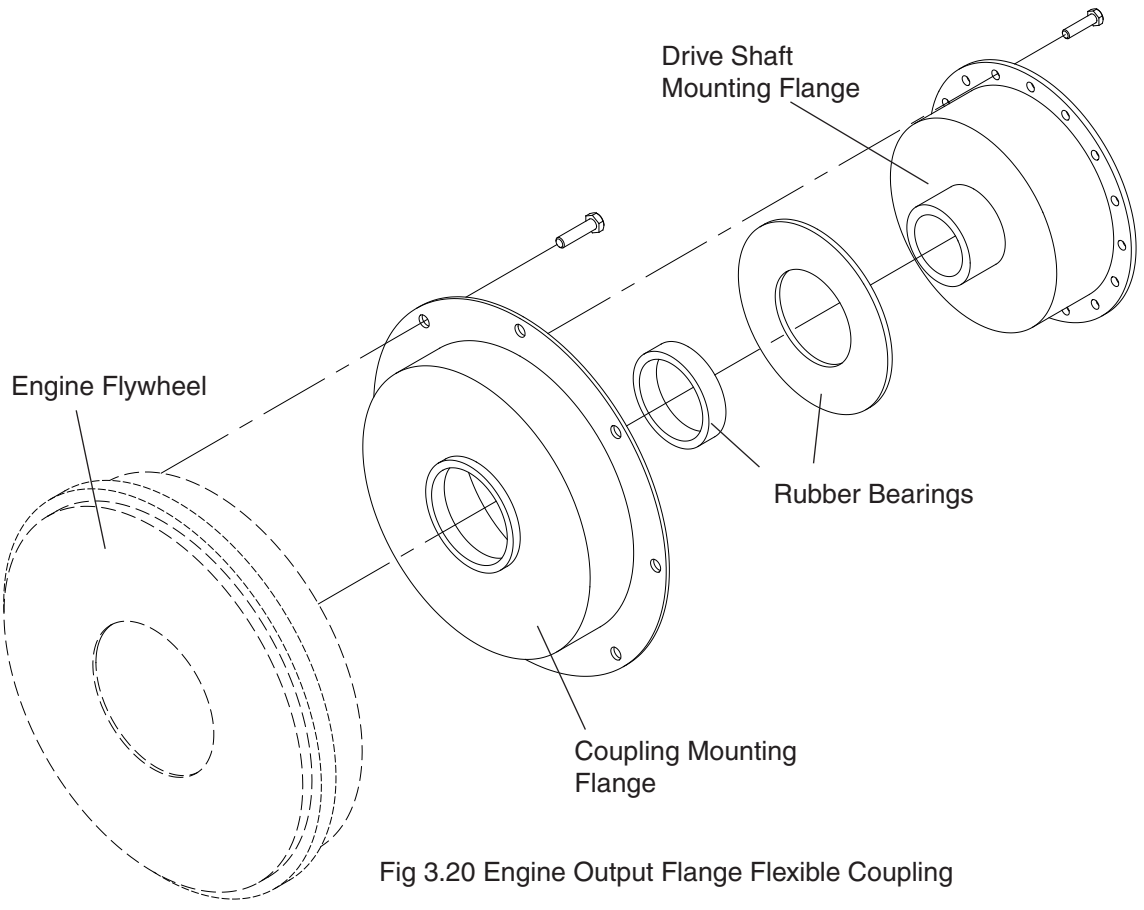


Fig 3.20 Engine Output Flange Flexible Coupling

3.6 Brakes

3.6.1Service Brakes

The Service Brakes are controlled by the brake pedal, and is acting on all six wheels, devided into two separat brake circuits.
The disc brake units are hydraulically operated, assisted by pressurized air.

3.6.1.2 Disc Brake Pads

The Service Brakes are equipped with totally eight brake calipers, and each caliper has two brake pads. New pads for service brakes have a lining thickness of 22 mm.(Measured between brake disc and brake pad steel ends) Pads should be replaced with new ones if linings thickness are under 3.5 mm.

Removal
Rise actual wheel off the ground using a floor jack or a crane.
Remove actual wheel (Ref. 3.4.1)

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

Place dumper on safety stands.
Thoroughly clean the wheel hub and the area around for any accumulated dirt.
On the front hubs align the slot in the hub with the pad securing pin located in the “closed end” of brake pads in actual caliper. See figure below for orientation.
Remove the two bolts locking the securing pins in place, and remove the pins.
Push old pads back from disc to give space for new, and remove the old pads.
Be aware that overflow can occure in the fluid reservoir as pistons are forced back in the cylinders.
To avoid this, open the bleeder plug as old pads are pushed back.

Installation
Enter the brake pads open end in the securing pin in oposit side of caliper and orient the closed end to insert the removed pins. Rotate pins to line up with locking bolt mounting hole. Lock the pins in place by inserting and tightening the locking bolts.
Replace wheel. (Ref. 3.4.1)

Control
Check that all parts are located as before removal, and rotate wheel to make sure there is no binding parts.
Lift dumper, remove stands, and lower to ground.
Check wheel nut torque. (Ref. 3.4.1)
Depress the brake pedal a few times, and check the fluid level in the actual reservoir.
Perform a test drive to see that the brakes is functioning as required.

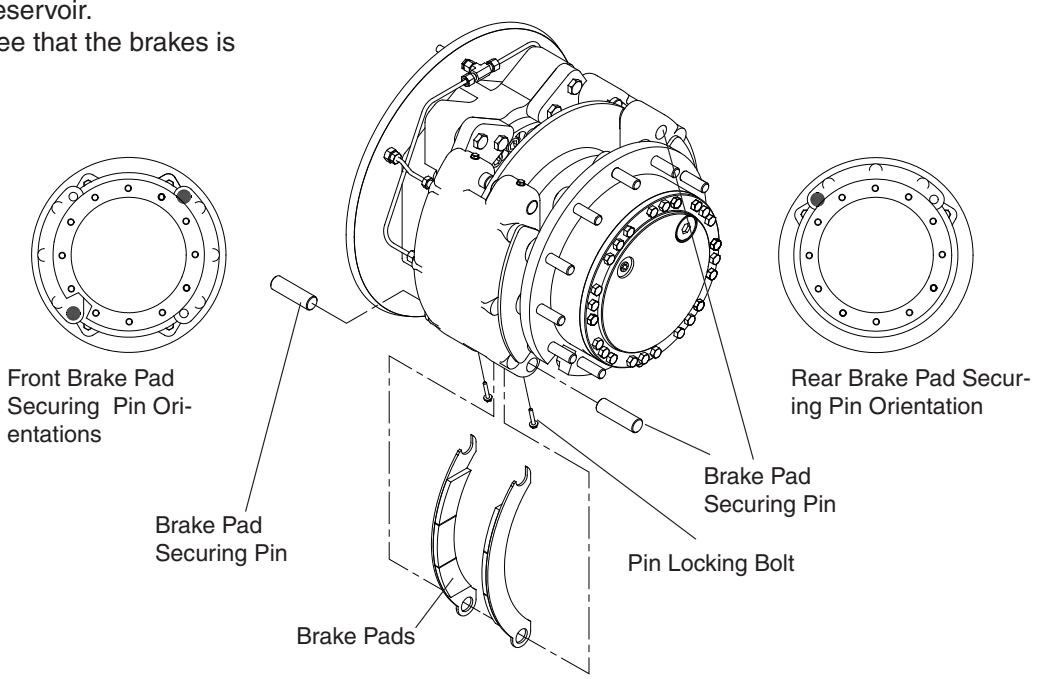


Fig 3.18 Brake Pads (Front Brakes Illustrated)

3.6.1.3 Front Brake Calipers

The two front wheel brake units are equipped with two calipers on each hub.

Removal
Rise both front wheels off the ground using a floor jack or a crane.
Place dumper on safety stands.
Remove actual wheel (Ref. 3.4.1)

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

Thoroughly clean the front axle and the area around for any accumulated dirt.
Disconnect the brake lines connected to each caliper. Plug lines as they are disconnected.
Unscrew the six bolts securing each caliper to the front axle drive assembly.
If caliper is going to be replaced with another unit, keep the line connectors.

Installation
Replace brake and bleeding line connectors if missing.
Position the caliper on the front axle drive assembly and tighten the four bolts.
Connect the brake lines to each caliper.
Bleed the brake circuit. (Ref. 3.6.1.6)
Replace wheel. (Ref. 3.4.1)

Control
Check that all connections are located as before removal, and rotate wheel to make sure there is no binding parts.
Lift dumper, remove stands, and lower to ground.
Check wheel nut torque. (Ref. 3.4.1)
Perform a test drive to see that maintained equipment is functioning as required.

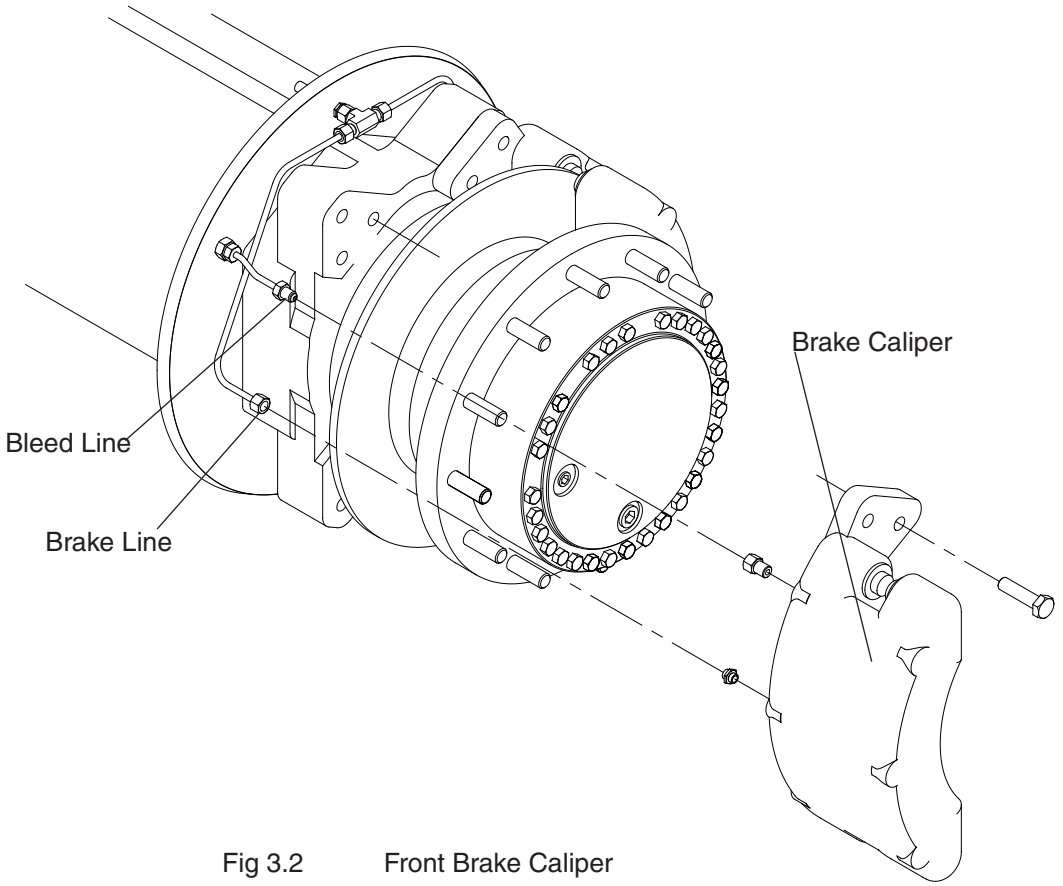


Fig 3.2 Front Brake Caliper

3.6.1.4 Rear Brake Calipers

The rear wheels are equipped with one brake caliper on each hub.

Disassembly
Rise wheel off the ground using a floor jack or a crane.

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

Place dumper on safety stand.
Remove wheel. (Ref. 3.4.1)
Thoroughly clean the axle hub and the area around for any accumulated dirt.
Disconnect the brake lines connected to caliper. Plug lines as they are disconnected.
Unscrew the six bolts securing caliper to the hub assembly.
If caliper is going to be replaced with another unit, keep the line connectors.

Assembly
Replace brake and bleeding line connectors if missing.
Position the caliper on the hub assembly and tighten the four bolts.
Connect the brake lines to caliper.
Bleed the brake circuit. (Ref. 3.6.1.6)
Replace wheel. (Ref. 3.4.1)

Control
Check that all connections are located as before removal, and rotate wheel to make sure there is no binding parts.
Lift dumper, remove stands, and lower to ground.
Check wheel nut torque. (Ref. 3.4.1)
Perform a test drive to see that maintained equipment is functioning as required.

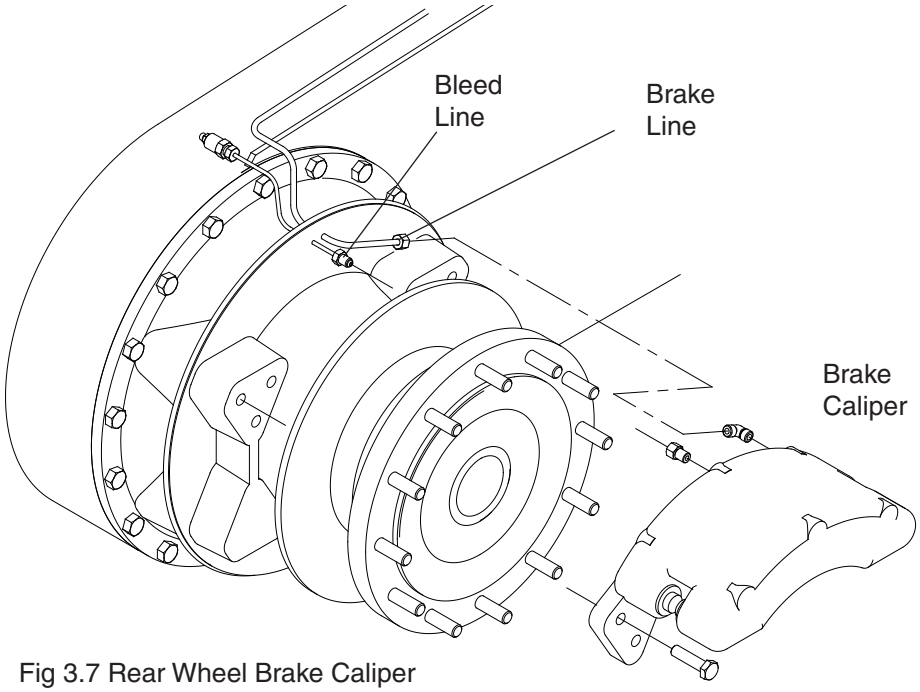


Fig 3.7 Rear Wheel Brake Caliper

3.6.1.5 Front Brake Discs

Disassembly
Remove both brake calipers on actual wheel hub. (Ref. 3.6.1.3)
Drain the oil from the reduction gear. Mark the location of the planetary drive carrier relative to the hub.
Remove the 24 bolts securing the planetary drive carrier to the wheel hub. Separate the carrier from the hub.
Retrieve the trust washer.
Remove the two bolts locking the shaft nut securing plate, and remove shaft nut.
The shaft nut is locked with Loctite. To avoid damage of threads heat the nut before loosening. (120°C) Retrieve the shim.
Pull out ring gear. Pull hub off the shaft.

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

Remove the 12 bolts fastening the brake disc to the hub, and tap loose the disc.
Remove the four alignment pins.
Thoroughly clean all removed parts.

Note:
If any defects are discovered making installation of new parts necessary, contact Moxy representative for assistance as a major overhaul involves use of special tools.

Assembly
Position the brake disc on the hub. Tighten the 12 bolts securing the disc to the wheel hub loosely.
Drive in the four alignment pins. Tighten the bolts to 300Nm.
Enter the wheel hub on the spindle. Check that the shaft seal and the bearings are properly seated.
Enter the ring gear on the drive shaft splines.
Lock the ring gear in position with the shaft nut, using the same shim as removed.
Apply Loctite 243, and tighten shaft nut to 1000 Nm. During tightening rotate the hub several times in both directions, and tap the hub with a soft mallet to relaxe the bearing.
Apply grease to both contact faces of the thrust washer, and position in center of planetary gear carrier.
Apply sealing compound to the mating flanges, and position carrier on wheel hub according to markings made when disassembled.
Tighten the 24 bolts to 185 Nm.
Replace brake calipers, and perform control. (Ref. 3.6.1.3)

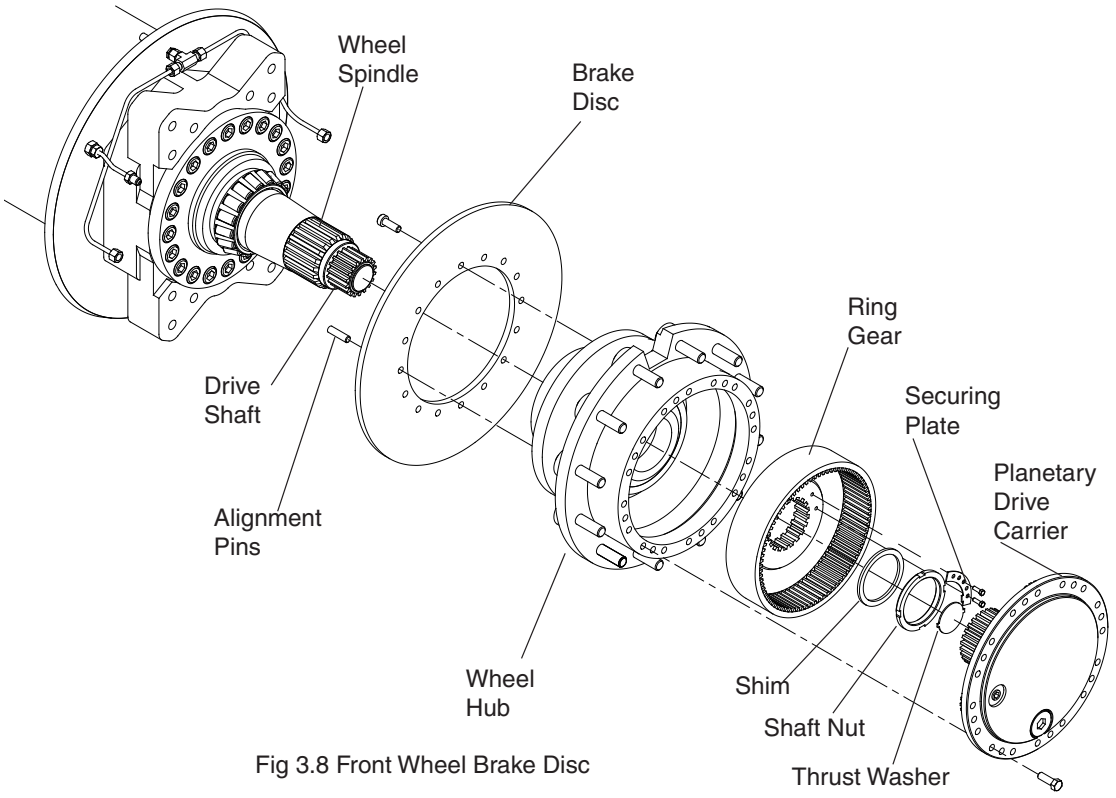


Fig 3.8 Front Wheel Brake Disc

3.6.1.5 Rear Brake Discs

Disassembly
Remove the brake caliper on actual wheel hub. (Ref. 3.6.1.4)
Drain the oil from the actual tandem housring.
Remove the actual rear axle hub assembly. (Ref. 3.3.3)

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

Place hub assembly on on wheel shaft flange.
Remove thrust washer secured with four bolts.
Pull off the gear wheel.
Lift off the hub carrier.
Loosen the 16 bolts securing the brake disc to the wheel axle, and tap off the disc.
Remove the alignment pins.

Assembly
Position the brake disc on the wheel shaft. Tighten the 12 bolts securing the disc to the wheel hub loosely.
Drive in the four alignment pins. Tighten the bolts to 300Nm.
Enter the hub carrier on the wheel shaft. Check that the shaft seal and the bearings are properly seated.
Enter the gear wheel on the wheel shaft, and slide into position.
Position the thrust washer on the end of the wheel shaft. Apply Loctite 242 on the bolts, and tighten to 333 Nm.
Place rear axle hub assembly on tandem housing.(Ref. 3.3.3)
Replace brake caliper, and finnish task.
(Ref. 3.6.1.4)

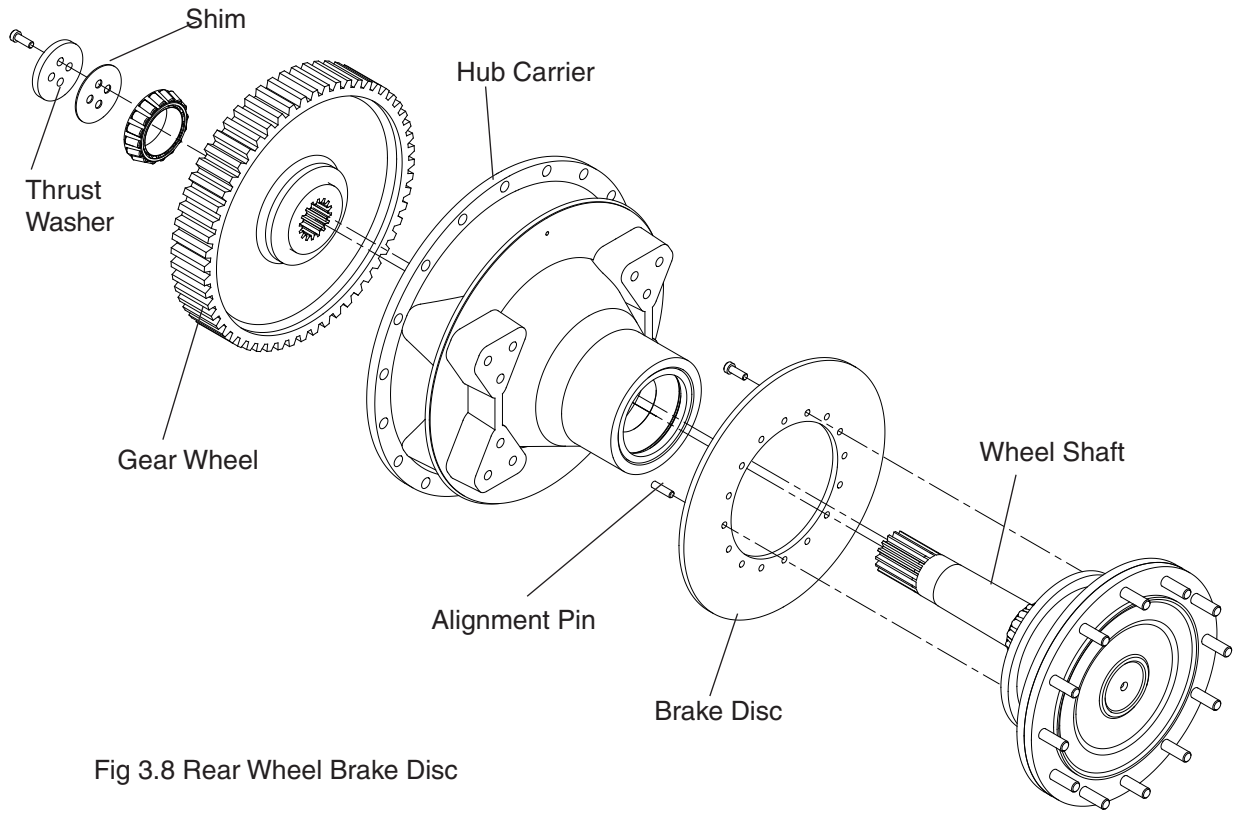


Fig 3.8 Rear Wheel Brake Disc

3.6.1.6 Bleeding Brake System Circuits

Any maintenance performed on the brake system involving opening of a circuits, shall always be followed up with bleeding the circuit.

Note:
Before bleeding, and during the process, keep reservoir topped with brake fluid.
Use fresh fluid according to Operation and Maintenance Manual.

Never fill fluid drained during bleeding back into the system!

Start the engine to keep air pressure on a normal level.

Start bleeding process at the master cylinder.
Remove bleeding valve cap. Fit a transparent plastic hose to the bleeding valve, leading into a reservoir to recieve the fluid.
First depress the brake pedal several times, and then hold steady depressed.
Open the bleeding valve. When fluid flow stops, close the bleeding valve, and release the brake pedal.

Repeat until no air bubbles is observed in fluid coming from the bleeding valve. Tighten bleeding valve to 2.9 Nm. Replace cap.

Proceed with the calipers. Repeat the process, starting with the one closest to the master cylinder, and bleed one at the time until the hole circuit is finnished.
Control
Check function f brakes.

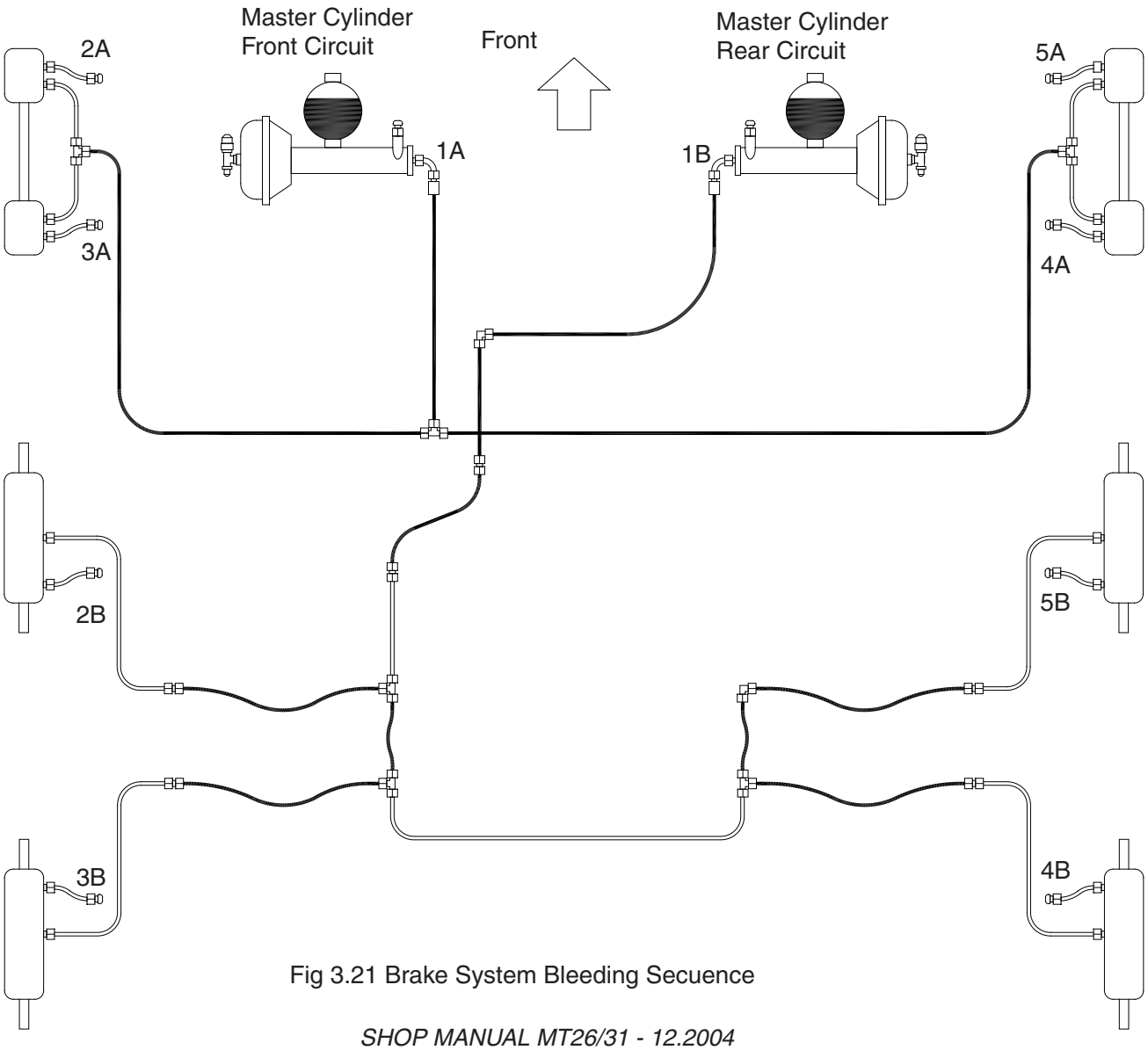


Fig 3.21 Brake System Bleeding Secuence

3.6.2 Parking Brake

3.6.2.1 Parking Brake Unit

The Parking Brake is the dumper secondary braking system.
The system consists of a spring operated, air released, disc brake, mounted on the intermediate shaft.
The Parking Brake Unit operates the disc brake, and is mounted on a bracket located between the rear frame members.

Disassembly
Secure dumper from rolling with wheel blocks.
Rise the dumper body, and place on safety stand.
Thoroughly clean the parking brake unit and the area around for any accumulated dirt.
Release the air system pressure. (Ref. Operation and Maintenance Manual 7.2.6)
Disconnect the air hose connected to the quick release valve.
Manually release the parking brake. (Ref. Operators Manual , Chapter 5 - Operating Instructions)
Remove the six bolts securing the parking brake bracket to the rear frame, and lift brake unit out from rear frame.

WARNING!
Take care not to put fingers between brake linings when handling the released brake unit

If the unit is going to be stored out of dumper for more than one day, for safety reasons engage the brake manually to release the spring pressure.

Replacement
Manually release the parking brake, if engaged.
Position the parking brake unit in the rear frame.
Install the six mounting bolts with norlock washers and tighten. Engage the parking brake manually.
Connect the air hose to the quick release valve.

Control
Check that all parts are located as when removed
Start the engine to pressurize the air system, and check the operation of the parking brake, as follows:
Make sure the the system pressure is at 6.8 to 7.8 bar.
On level ground apply the parking brake (indicator lamp ON).
Set the gear selector in 1st gear.
Increase engine speed slowly.
The parking brake should prevent the dumper from moving up to 1,400 rpm.

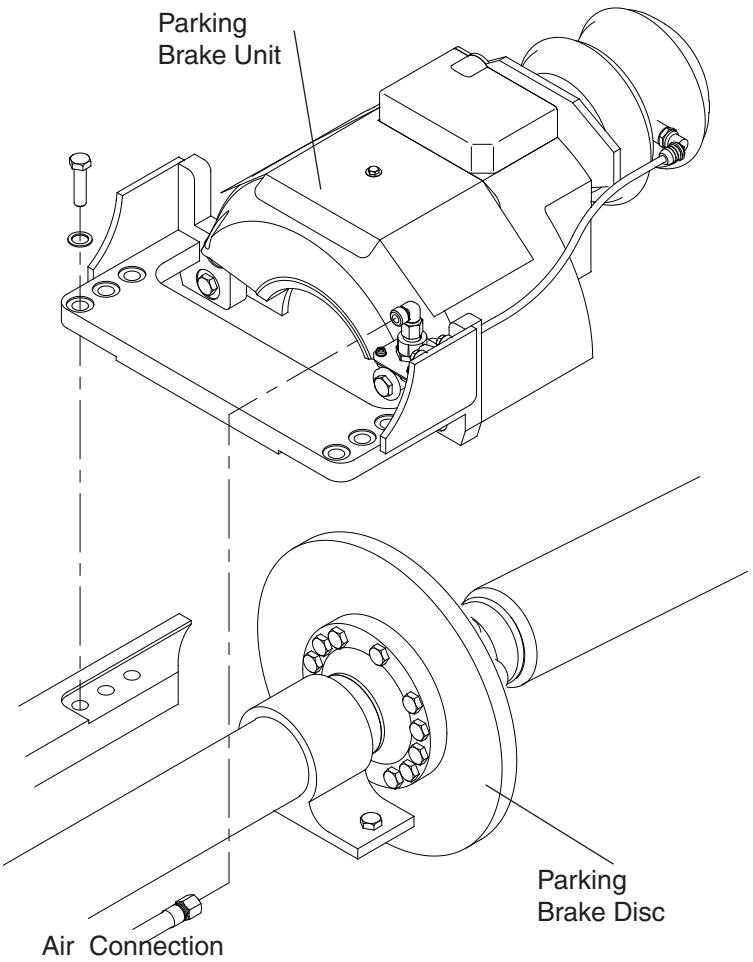


Fig 3.22 Parking Brake Unit

3.6.2.2 Parking Brake Release Air Cylinder

The Parking Brake Release Air Cylinder disengages the parking brake by compressed air.

Disassmbly
Remove the parking brake unit (Ref. 3.6.2.1)
Place unit on work bench.
Remove parking brake covers.
Engage the parking brake manually to remove the clevis pin from the operating arm. (Ref. Operators Manual , Chapter 5 - Operating Instructions)
Disconnect the air hose connected to the air cylinder.
Remove the air cylinder from brake unit by unscrewing two nuts.
If air cylinder is replaced with a new unit, save the hose connector.

Assembly
Install the the hose connector, if missing.
Position the the air cylinder on the brake unit, tighten the two nuts.
Install the air hose.
Install the clevis pin to connect the air cylinder to the operating arm. Secure with cotter pin.
Install parking brake covers.
Install parking brake unit in dumper. (Ref. 3.6.2.1)

Control
Perform control as when replacing
parking brake unit (Ref. 3.6.2.1)

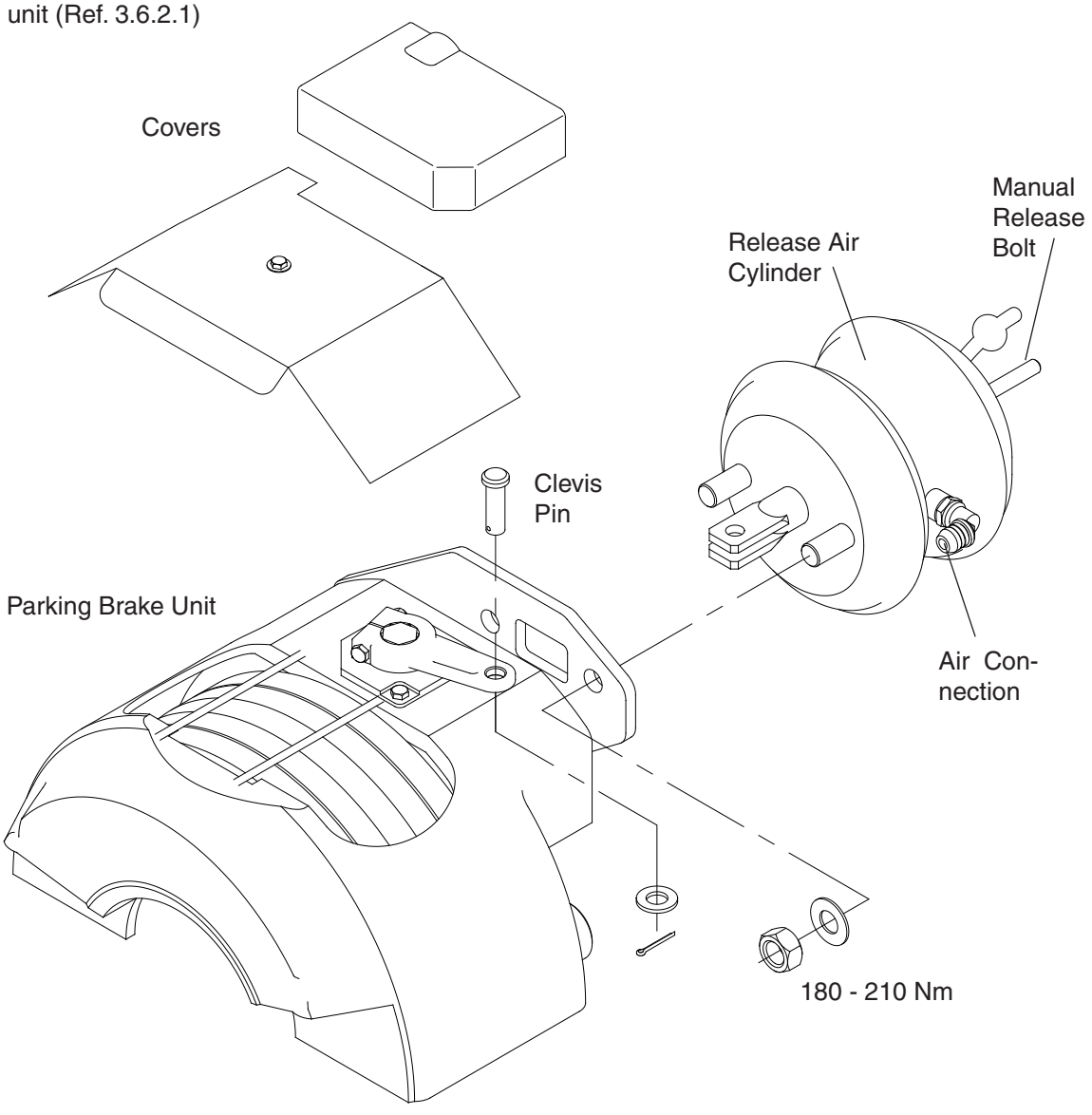


Fig 3.23 Parking Brake Release Air Cylinder

3.6.2.3 Parking Brake Caliper Replacement

The Parking Brake Caliper is spring loaded to locked position.

Removal
Remove the parking brake unit (Ref. 3.6.2.1)
Remove the parking brake release air cylinder
(Ref. 3.6.2.2)
Remove caliper from mounting bracket by unscrewing four bolts.

Replacement
Position caliper on bracket. Replace the four bolts and tighten.
Install the parking brake release air cylinder
(Ref. 3.6.2.2)
Install parking brake unit in dumper. (Ref. 3.6.2.1)

Control
Perform control as when replacing parking brake unit (Ref. 3.6.2.1)

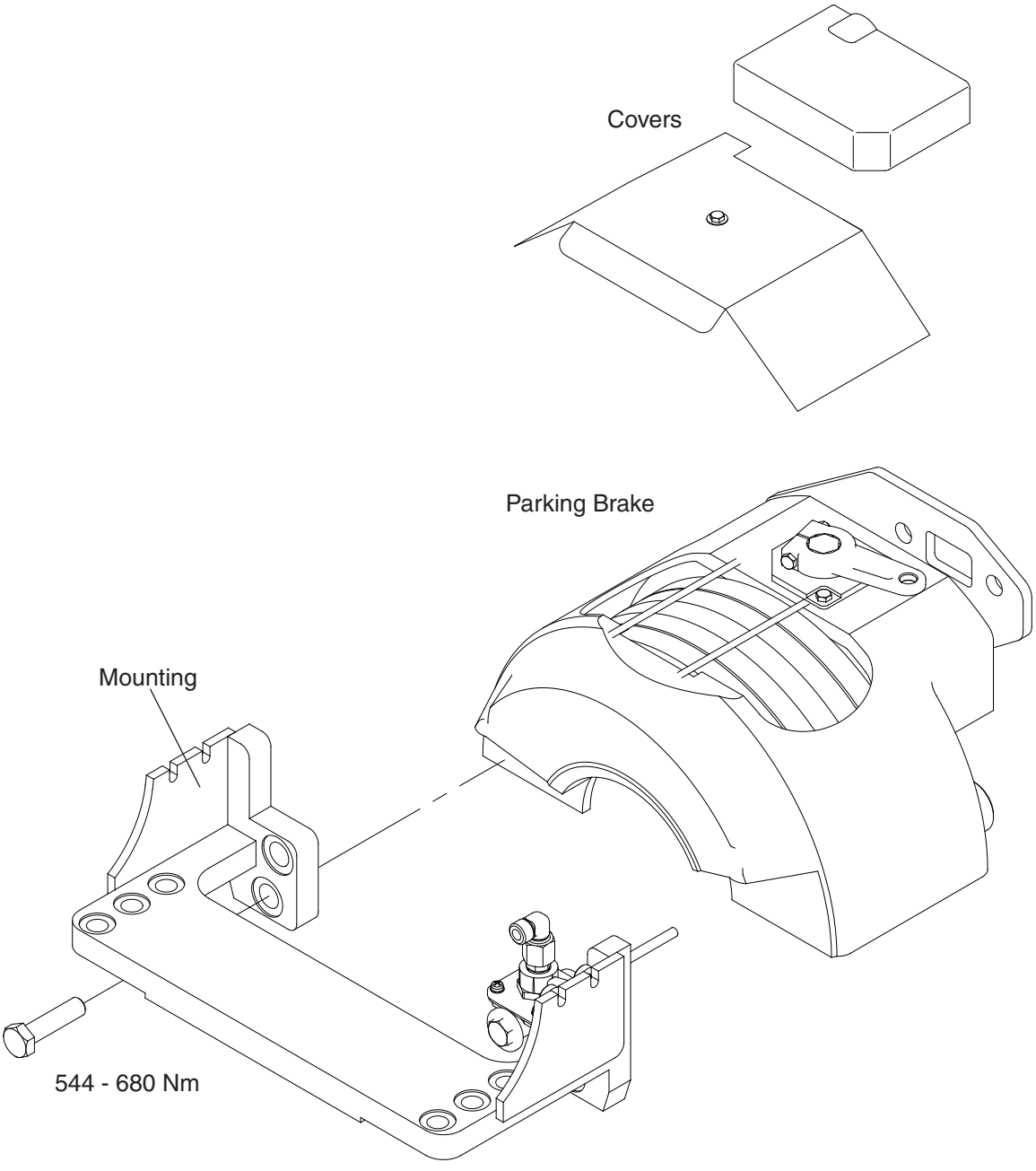


Fig 3.24 Parking Brake Caliper

3.6.2.4 Parking Brake Disc Replacement

The Parking Brake Disk is mounted on rear end of center intermediate shaft.

Disassembly
Remove the parking brake unit (Ref. 3.6.2.1)
Remove rear intermediate drive shaft (Ref. 3.5.6)
Remove the 12 bolts securing the brake disc to the center intermediate drive shaft.

Assembly
Position the brake disc on the center intermediate drive shaft rear flange. Tighten the bolts.
Install rear intermediate drive shaft (Ref. 3.5.6)
Install the parking brake unit (Ref. 3.6.2.1)

Control
Perform control as when replacing parking brake unit (Ref. 3.6.2.1)

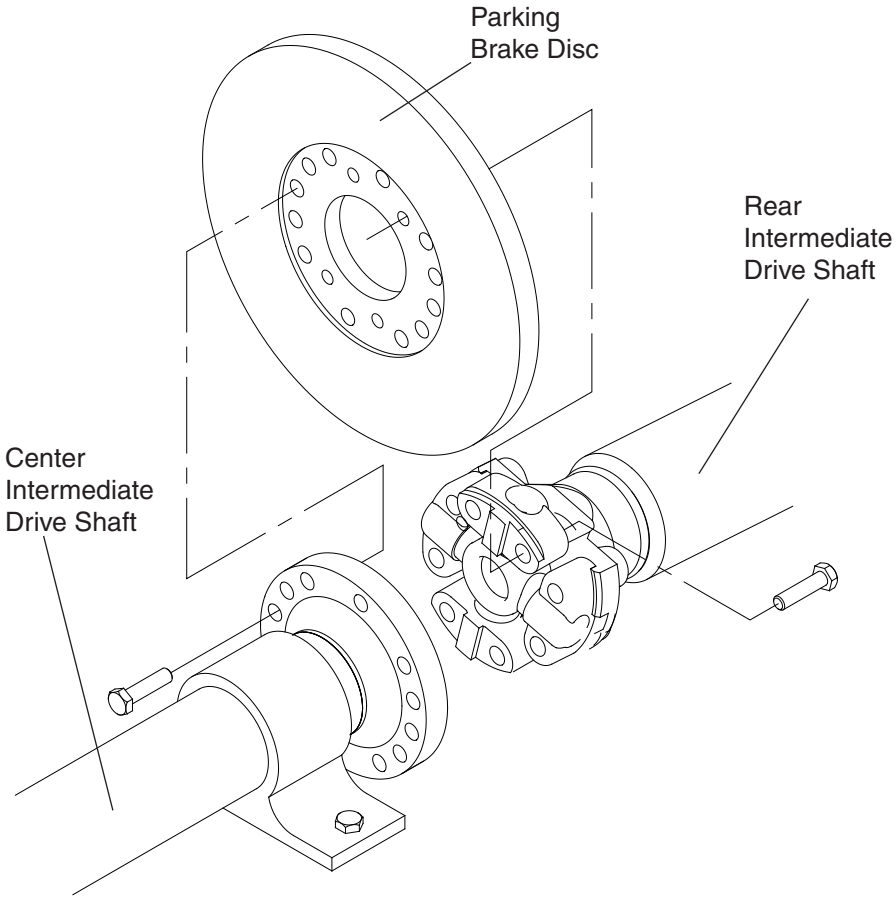
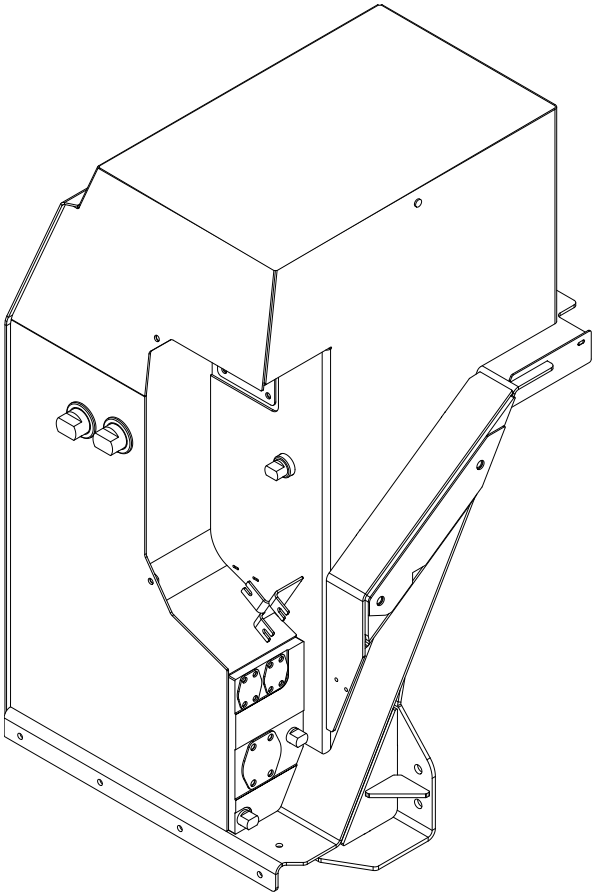
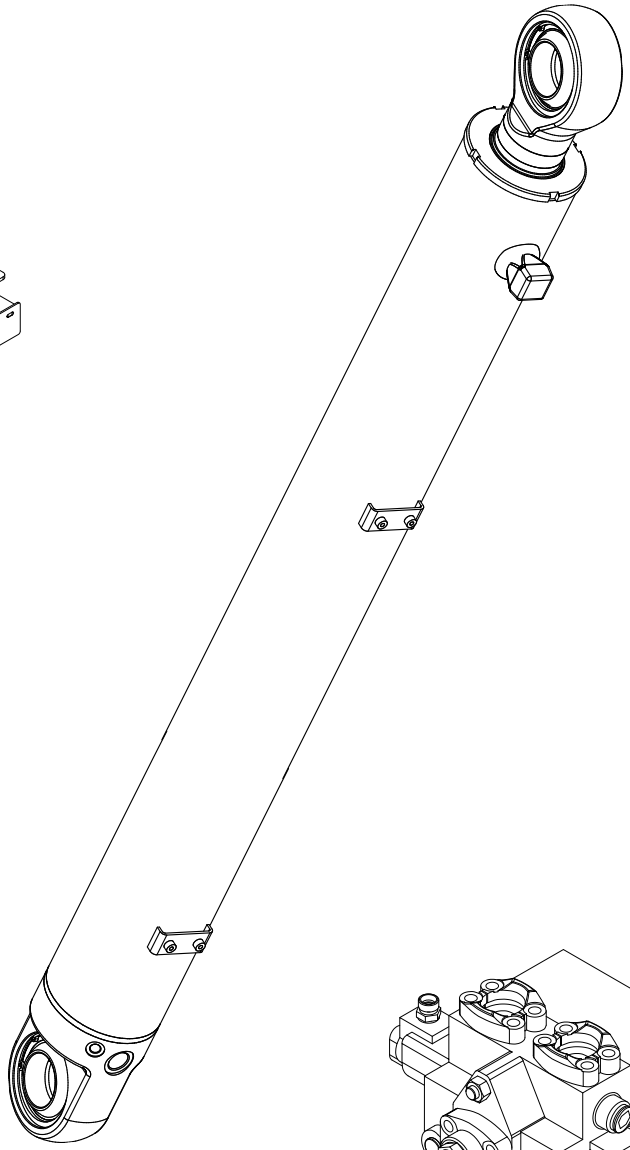


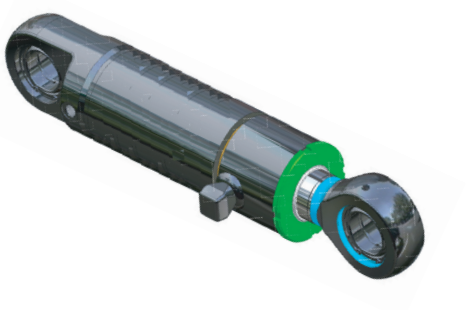
Fig 3.26 Parking Brake Disc

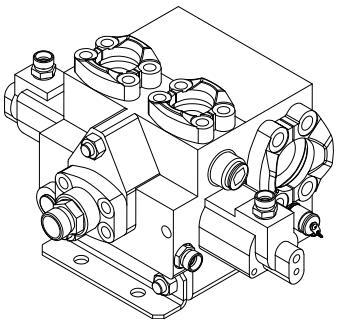
Chapter 5

Hydraulic system









Hydraulic system

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Components, capacities and oil types

Oil type:

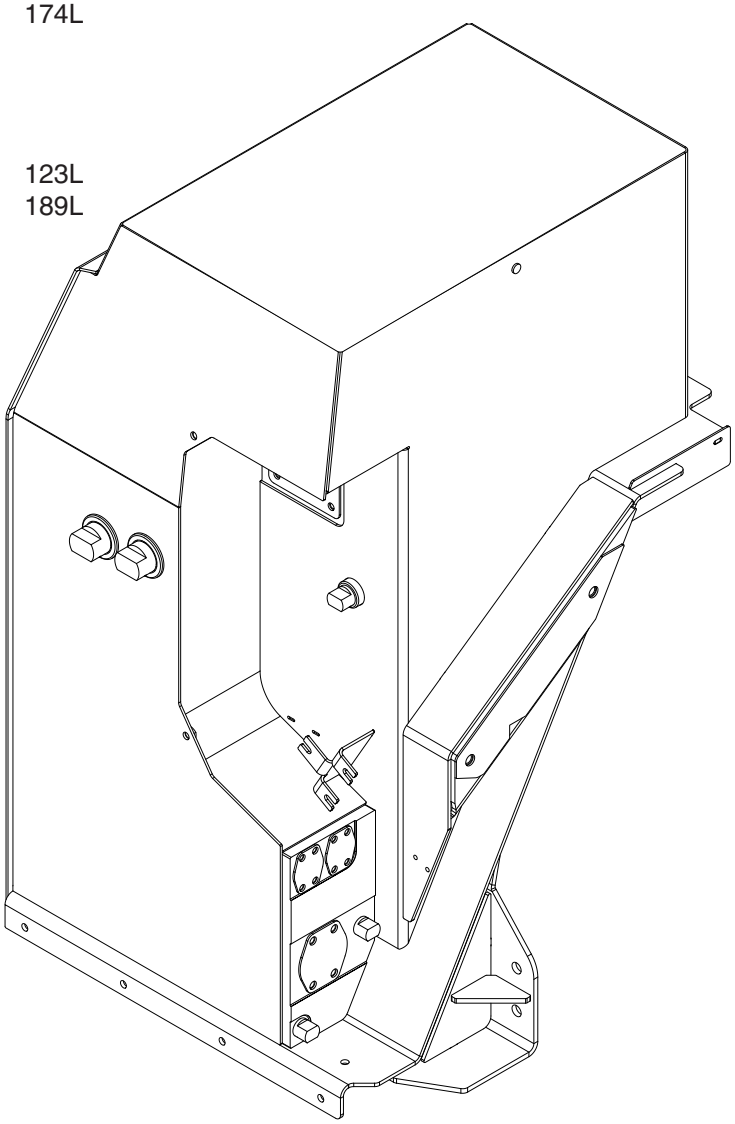
- Hydraulic oil: ISO VG 46 (Shell Tellus T46)
- BIO oil can be used
- BIO oil cannot be mixed with hydraulic oil and system need to be flushed
- Type of BIO oil to be accepted by Moxy

Hydraulic tank MT26:

- Two chamber tank
- Volume total
- Volume oil 111L
- Volume system 174L

Hydraulic tank MT31:

- Two chamber tank
- Volume total
- Volume oil 123L
- Volume system 189L



Breather filter:

- Spin on type

Hydraulic system main function.

The system has three pumps. The steering and tilting functions are fed by the main hydraulic pump, (1) and the cooling fan drive motor and the accumulators are fed by the fan drive pump, (2) both driven by the engine. The emergency steering is fed by the emergency steering pump, (3) (max. 50 l/min) which is driven by the truck's rolling motion either forwards or backwards.

All three hydraulic pumps are located at the rear end of the transmission, and are delivering oil from the hydraulic tank.

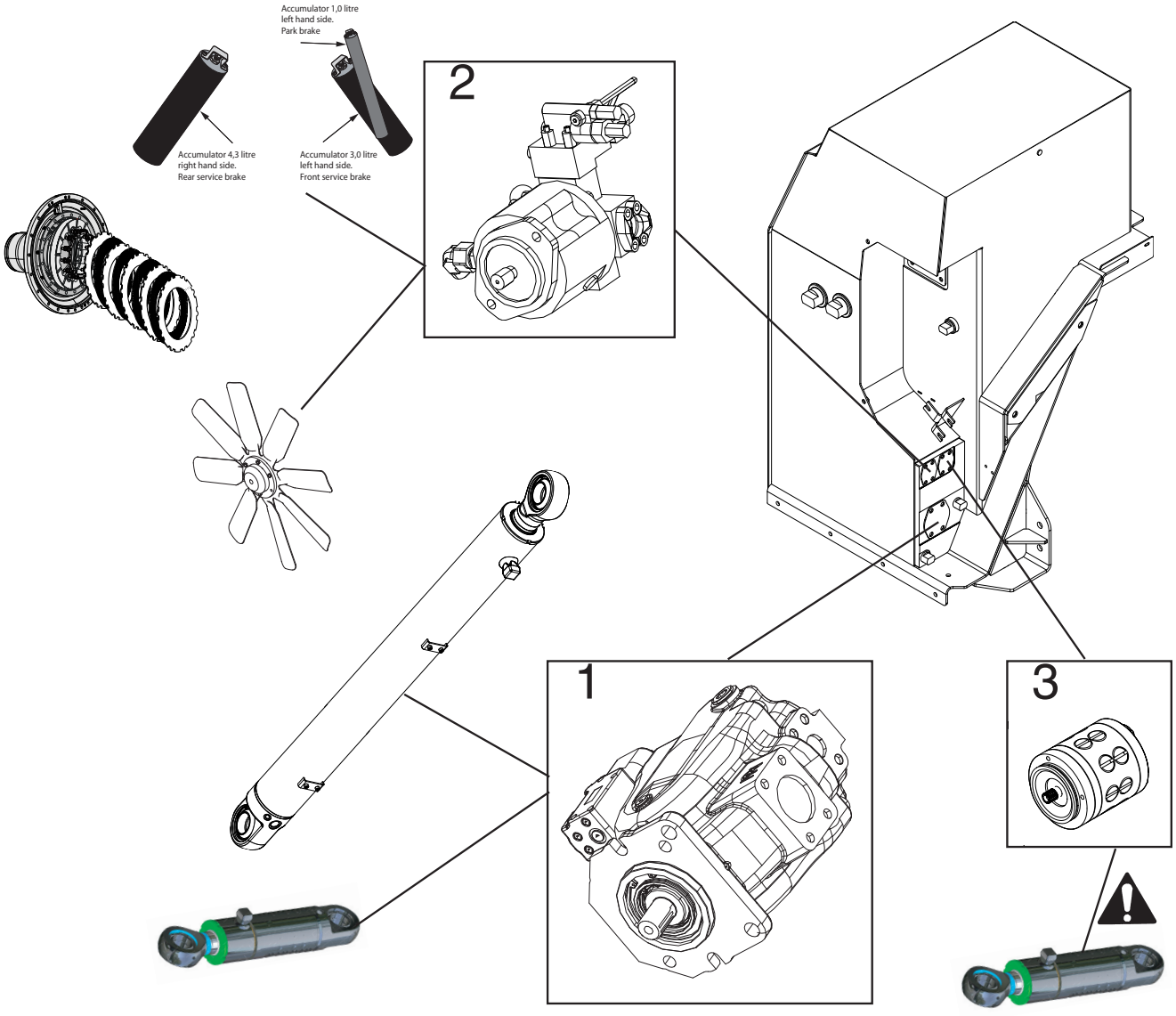
The hydraulic system has three primary functions:

The first primary function is to supply steering power and transmit the drivers steering motion from the steering wheel to the steering cylinders, (1) and maintain safe steering function also when engine fails. (3)

The second primary function is to serve the brake accumulators with pressure in the accumulator chamber and feeds the cooling fan motor which provides sufficient fan speed to maintain engine operating temperature within given limits. (2)

The third primary function is to supply power to the tilting cylinders to manage unloading the dumper body (1).

The hydraulic system also has a secondary function.
A separate pump (2) feeds the cooling fan motor which provides sufficient fan speed to maintain engine operating temperature within given limits.



System pressure

Brake system pressure:

- Front brake circuit 131 ±8,6 bar
- Rear brake circuit 131 ±7,0 bar

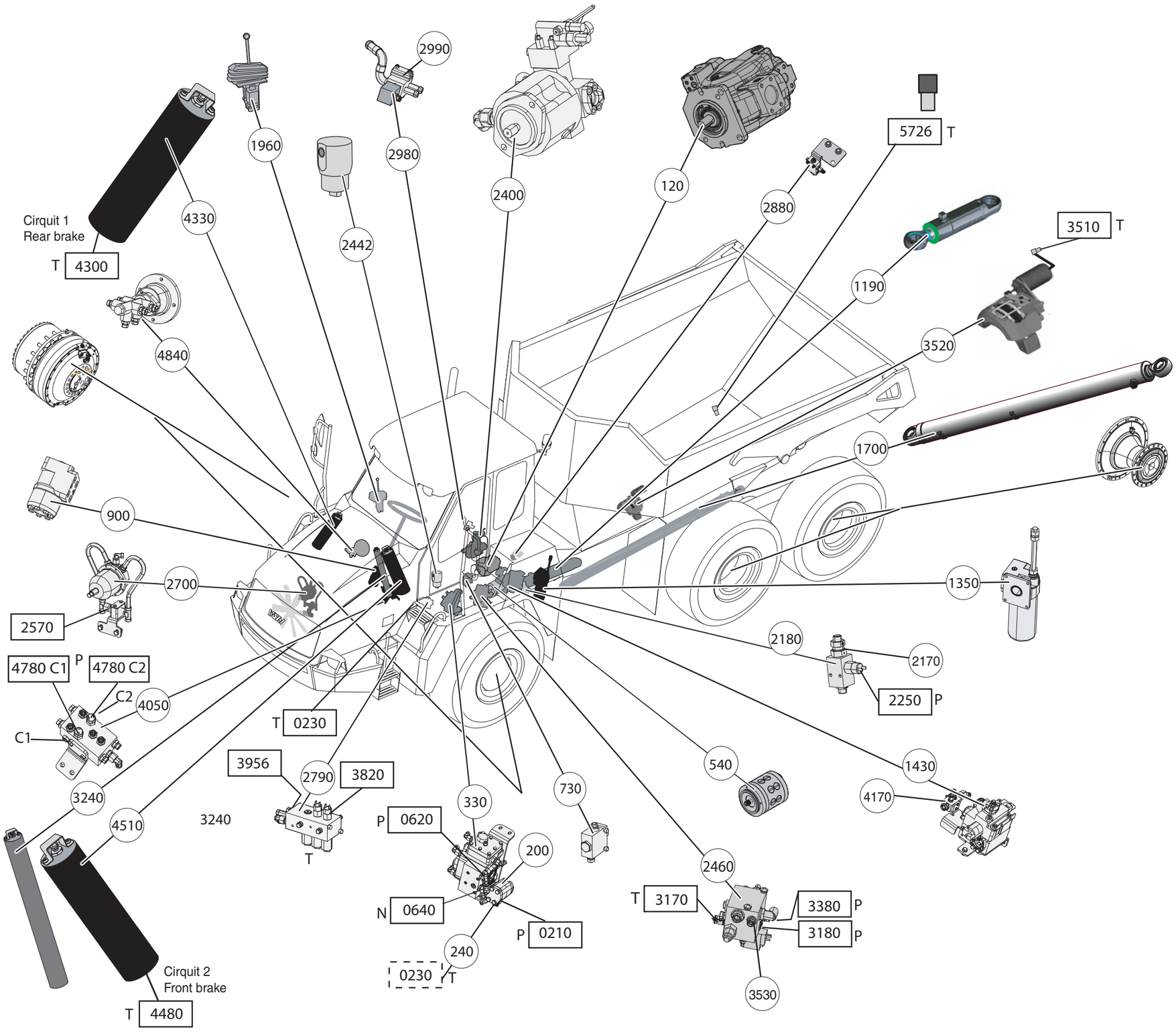
Pressure monitoring switches:

- Main pump (1) 5.0 ± 0.1 bar N/C
- Emergency steering pump (1) 3.2 ±0.1 bar N/C
- Main brake accumulators (2) 110 0/+5 bar N/C
- Park brake accumulator (1) 110 0/+5 bar N/C
- Park brake monitoring (1) 5 bar ±0.1N/C
- Engine brake monitoring (1) 3.0 ±0.1bar N/O
- Retarder brake monitoring (1) 3.0 ±0.1bar N/O
- Tilt lever hold (down) (1) 4.5 ±0.1bar N/O

Operating pressure:

- Diff. lock 7,0 ±0.1bar
- Engine brake 10,2 ±0.1bar
- Retarder 6,0 ±0.1bar
- Retarder - emergency 6,0 ±0.1bar

Hydraulic parts view



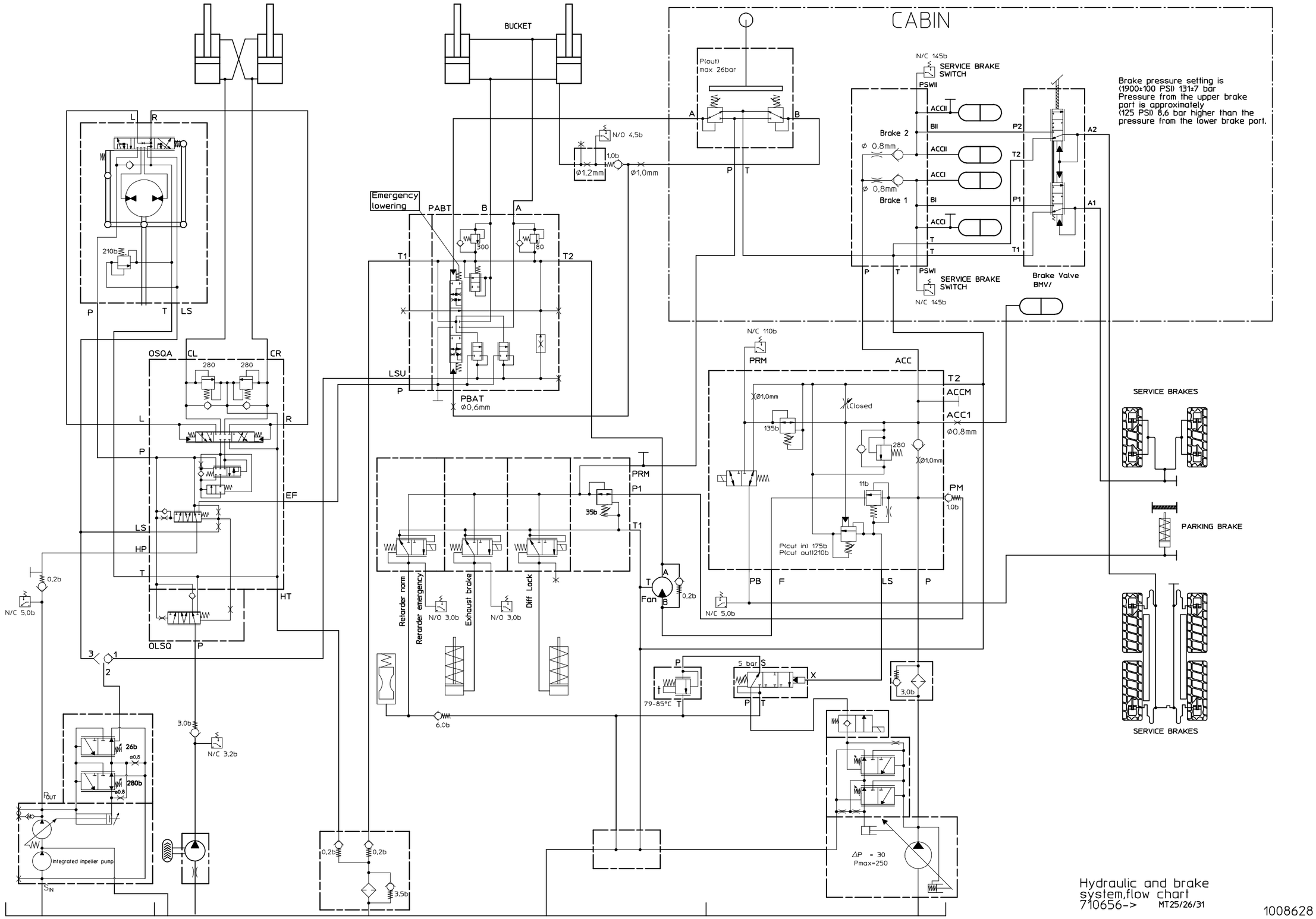
0120 Hydraulic Main pump
0200 Valve housing w/check valve
0250 Passage measuring tap ema3/sh
0330 Steering valve
0540 Emergency steering pump ass'y mod
0640 Non Return Valve
0730 Shuttle valve
0900 Orbitrol
1190 Steering cylinder
1350 Moxy return filter
1430 Tilting valve
1700 Tilt cylinder
1960 Tilt control valve
2030 Passage no 2
2170 Non Return Valve
2180 Block
2400 Pump Fan motor - Accumulators
2442 In-line filter Accumulator and fan motor
2460 Accumulator valve block
2570 Non Return Valve
2700 Motor f/fan
2790 Solenoid valve kit
2880 Auxiliary valve
2980 Thermopressure valve
2990 Block f/ther.pressure valve ass'y
3520 Parking brake
3530 Non Return Valve
3900 Non Return Valve
4050 Accumulator connector block
4170 Block f/gathering return hoses
4840 Footbrake valve hydraulic 180bar
5120 Brake caliper HH-6, modyfied
5480 Brake caliper HH6(mineral-oil)

3240 Accumulator Park brake
4330 Accumulator (4,3 litre) Brake cirquit 1
4510 Accumulator (3,0 litre) Brake cirquit 2

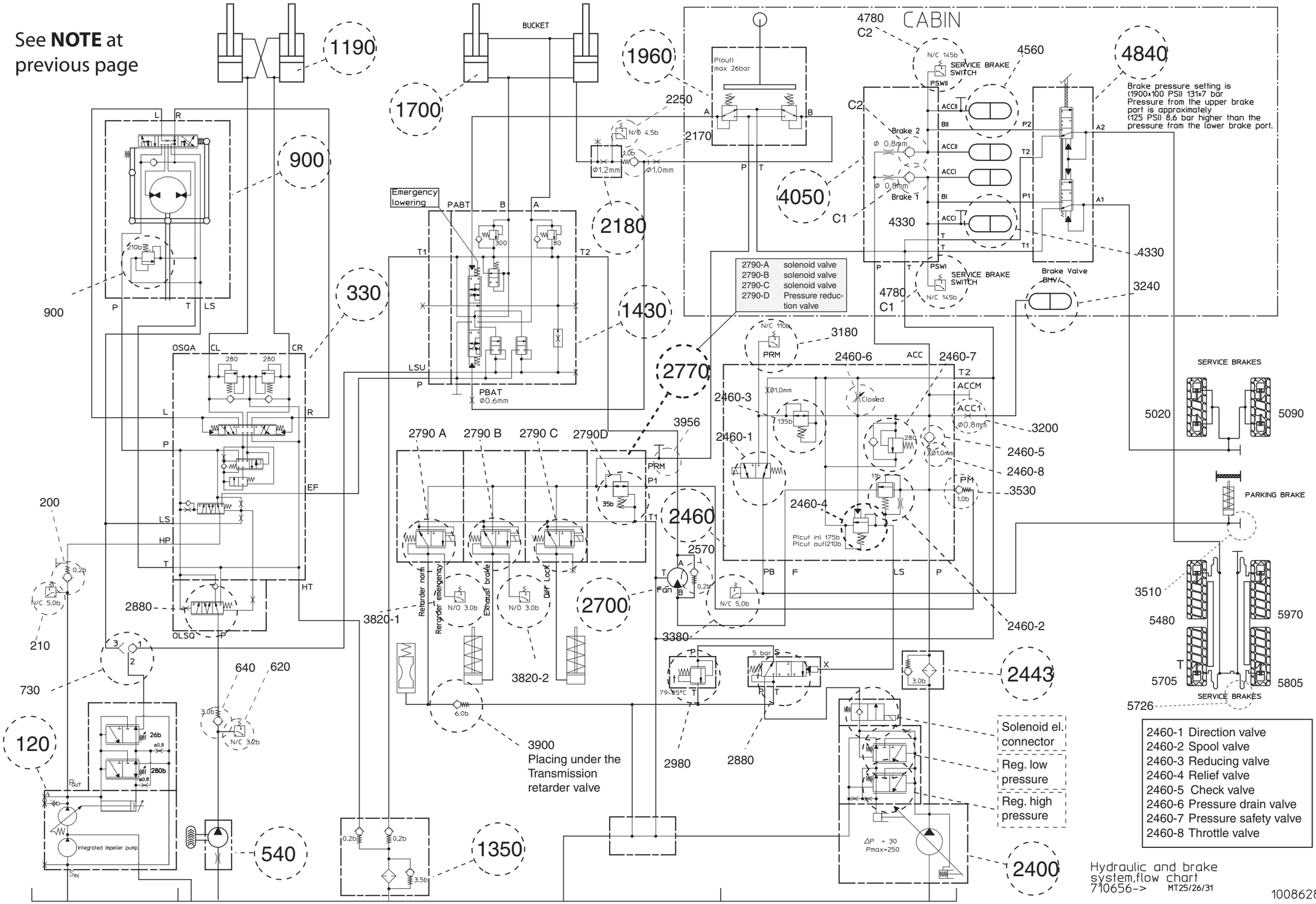
0230 Test point Main pump
3170 Test point Accumulator charging
3510 Test point Park brake
3956 Test point Tilting control valve
4480 Test point Accumulator cirquit 1
4300 Test point Accumulator cirquit 2
5726 Test point Main brake

0210 Pr.switch N/C- 5.0b
Low pressure pump cirquit
0620 Pr.switch N/C- 3.2b
Emergency steering pump lamp ?
2250 Pr.switch N/O- 4.5b
Tilting handle down release
3180 Pr.switch N/C- 110.0b
Park brake emergency on
3380 Pr.switch N/C- 5.0b
Park brake on
3820 Pr.switch N/O- 3.5b
Retarder and exhaust brake on
4780 Pr.switch N/C- 145.0b
Low prssure warning,
accumulator cirquit 1 and 2

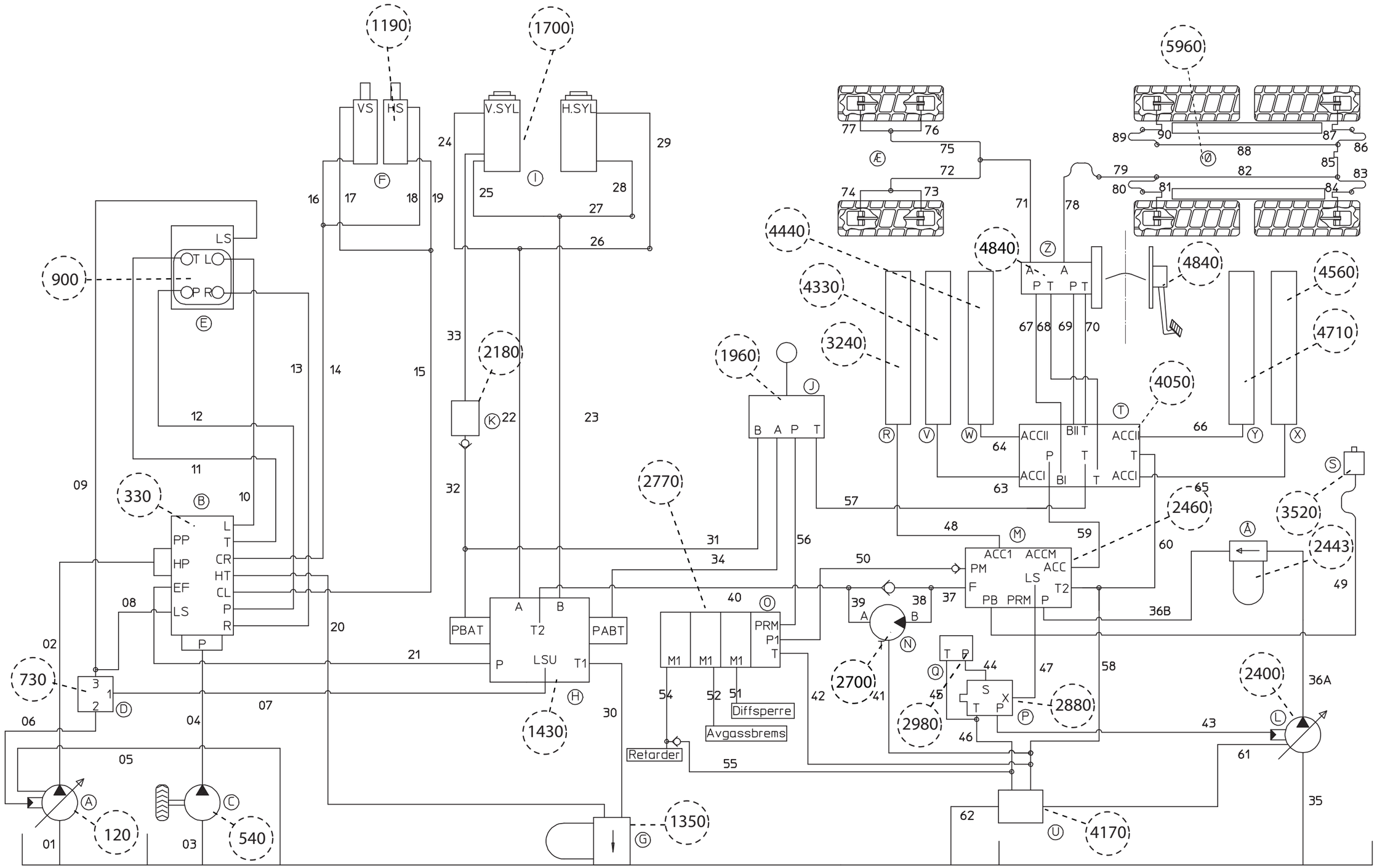
Hydraulic circuits



Hydraulic cirquit with item numbers



Hydraulic cirquit with hoses item number



Hydraulic and brake
system 710656-> MT25/26/31 1008695

Startup test procedure

Check oil level in hydraulic tank.

If necessary refill with Shell Tellus T46, or equivalent.

NOTE ! Check level glass on the hydraulic tank.

Hydraulic oil is preferred, but ATF oil or engine oil can be used.
(Ref. Operators Manual, Chapter 6 - Lubricants, and Chapter 7 - Maintenance)

Start engine, and let it run until hydraulic oil temperature exceeds 40° C.
Oil temperature increases faster by tilting dumper body several times, and/or frequently moving steering wheel from lock to lock.
During warm-up check for any leaks in the hydraulic system.
Any leaks must be repaired before proceeding the warm-up.
After warm-up, re-check hydraulic oil level, and perform an operational check of all functions as follows:

Check 1

Steering function.

Turn steering wheel from side to side, lock to lock, engine speed 650 rpm. (low idle). Count the number of turns. Approx. 5 turns is acceptable.
Open the bonnet and connect pressure gauge to the quick connector at the left side of the engine.

Check 2

Steering pressure.

Engine at 2000 rpm, hold steering wheel towards either end lock position. Hydraulic pressure: 210 bar±5.
Adjusting procedure.

Check 3

Tilting pressure, lowering.

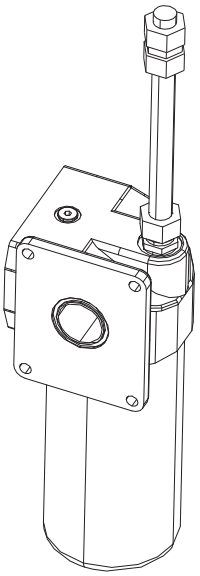
Engine at 650 rpm, lower dumper body.
Lowering time should be approx. 18 sec. / 10 sec. at max rpm
Hydraulic pressure: 100 bar ± 5.

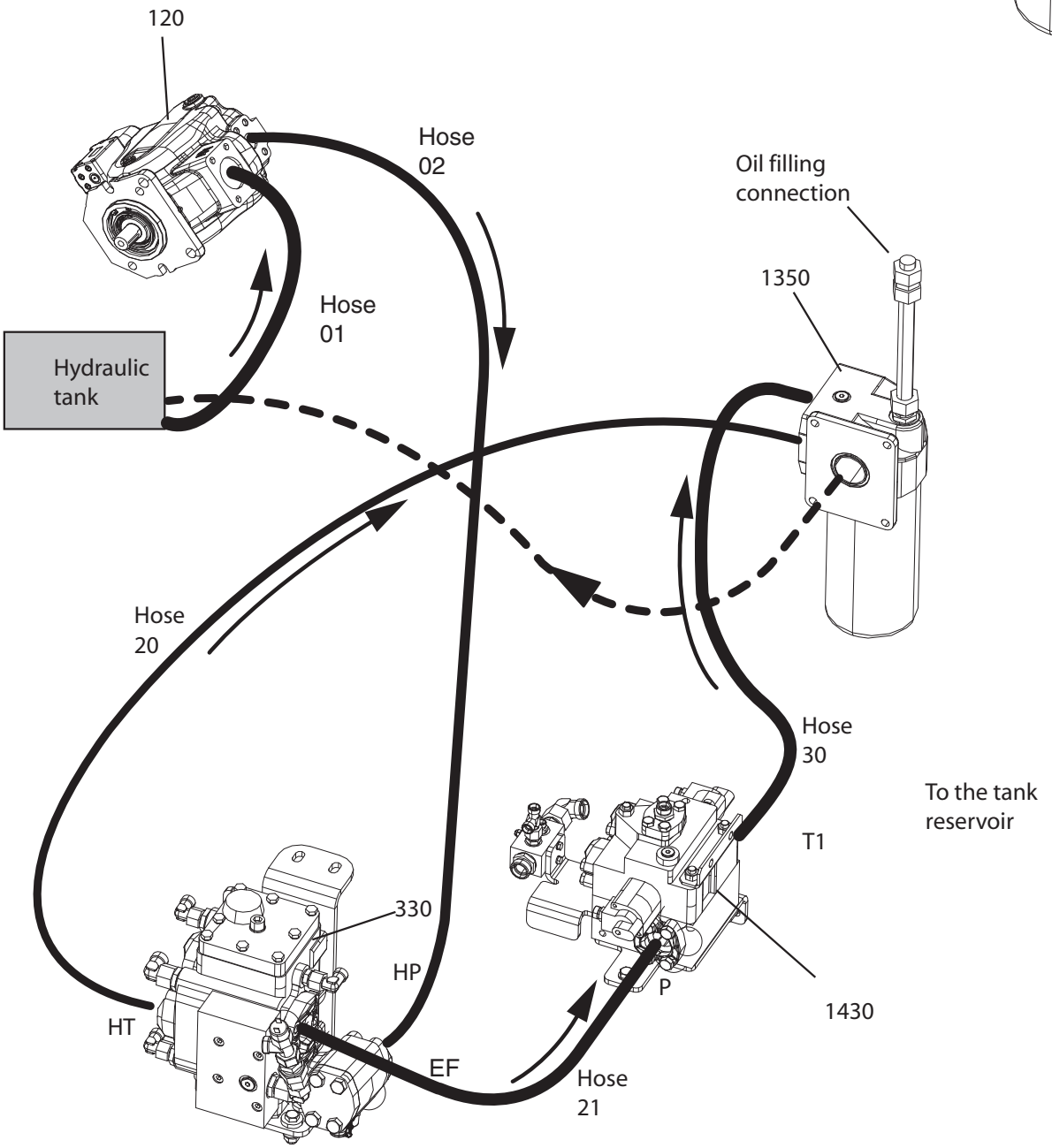
Main pump

Hydraulic filter cirquit

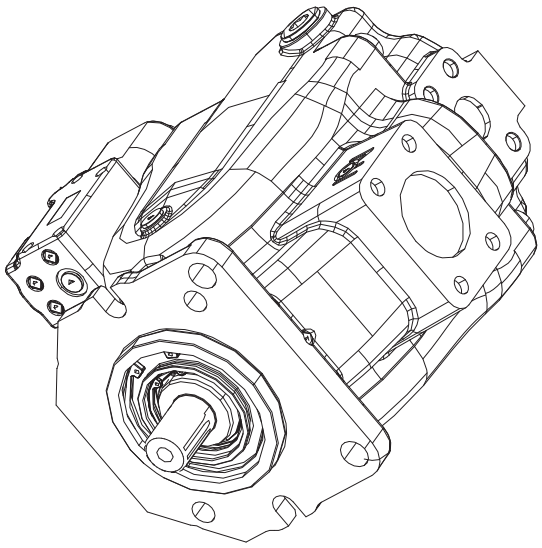
Hydraulic filter:

- Filter head w/by-pass valve and separate return inlets (with check valves) for tilt/fan and steering
- Oil refill through filter head
- Pressure test point (optional)
- Return filter (spin on)





Pump description



- Variable axial piston pump
- LS – operated
- Mounted at rear of transmission
- Driven by the engine
- Ratio 1:1
- Maximum volume 105 ccm

- Stand – by pressure 25 ±2.0bar (idle)
- Maximum (tilt) pressure 280 ±5.0bar (1000 rpm)

The Main Hydraulic Pump is located at the rear end of the transmission. Pump is accessed from rear, under the cab.

Removal
Thoroughly clean the main pump and the area around for any accumulated dirt.
Place a container below the pump to catch any hydraulic fluid spilt during removal.
Mark both hydraulic lines for proper location and plug lines as they are removed from pump.
To ease removal of pump, also disconnect the hoses connected to the top of the returnline manifold. Also disconnect the flange coupling at the right side of the fan drive pump (Ref.3.6)
Unscrew the bolt and the nut securing the pump to the transmission.
Lift the pump out from the truck for exchange or overhaul.

Installation
Apply a light coat of lubrication on the axle splines. Check that the o-ring is installed to seal the mating flange, and position the pump onto the transmission.
Check that the pump is properly seated, and thighten bolt and nut.
Clean the flange couplings, and install new o-rings.
Connect the flange couplings, ensure that the hoses are positioned in correct angle, and tighten the bolts.

Control
Before startup - Check that all connections are located in the same positions as before removal, and that all hoses are correctly routed.

Perform startup test procedure. Ref. section: Startup test procedure.

Main pump pressure adjusting

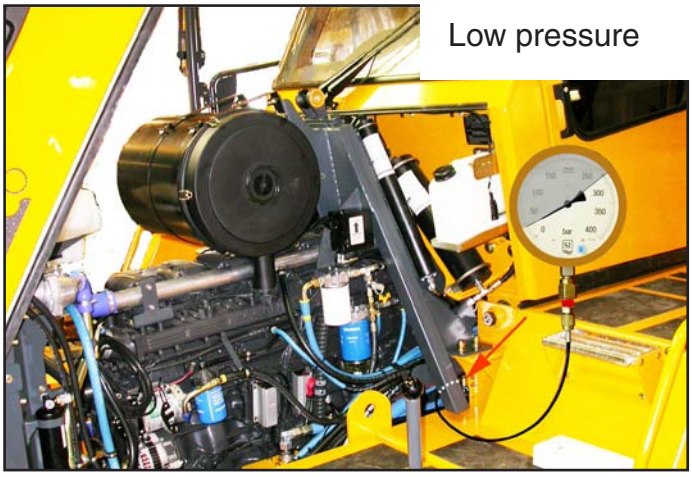
Connect the manometer to the test point 0230 underneath the filter rack left hand side.

Test the high pressure 280 bar with to run the engine 1000 rpm and turn the steering cylinder to end stop.

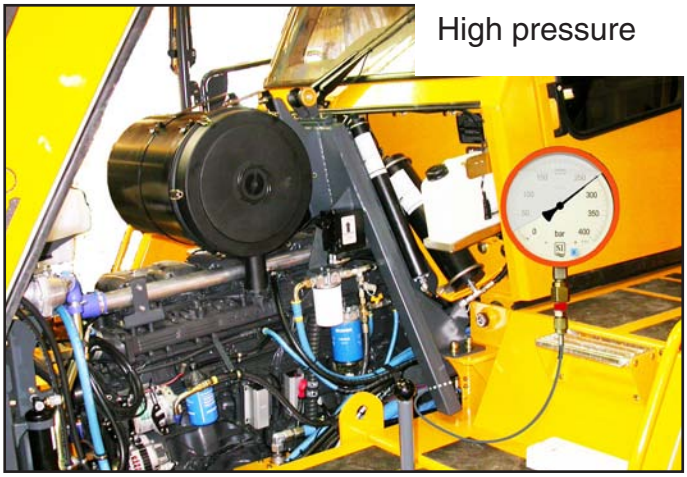
Adjust the pump to the correct value 280 bar

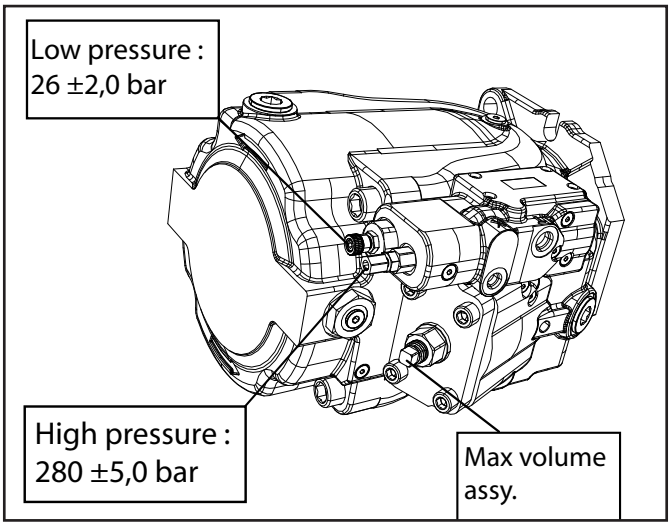
Test the low pressure.
Engine idle, pressure 26 bar.
If mor or less, adjust the pump to correct value.

Low pressure

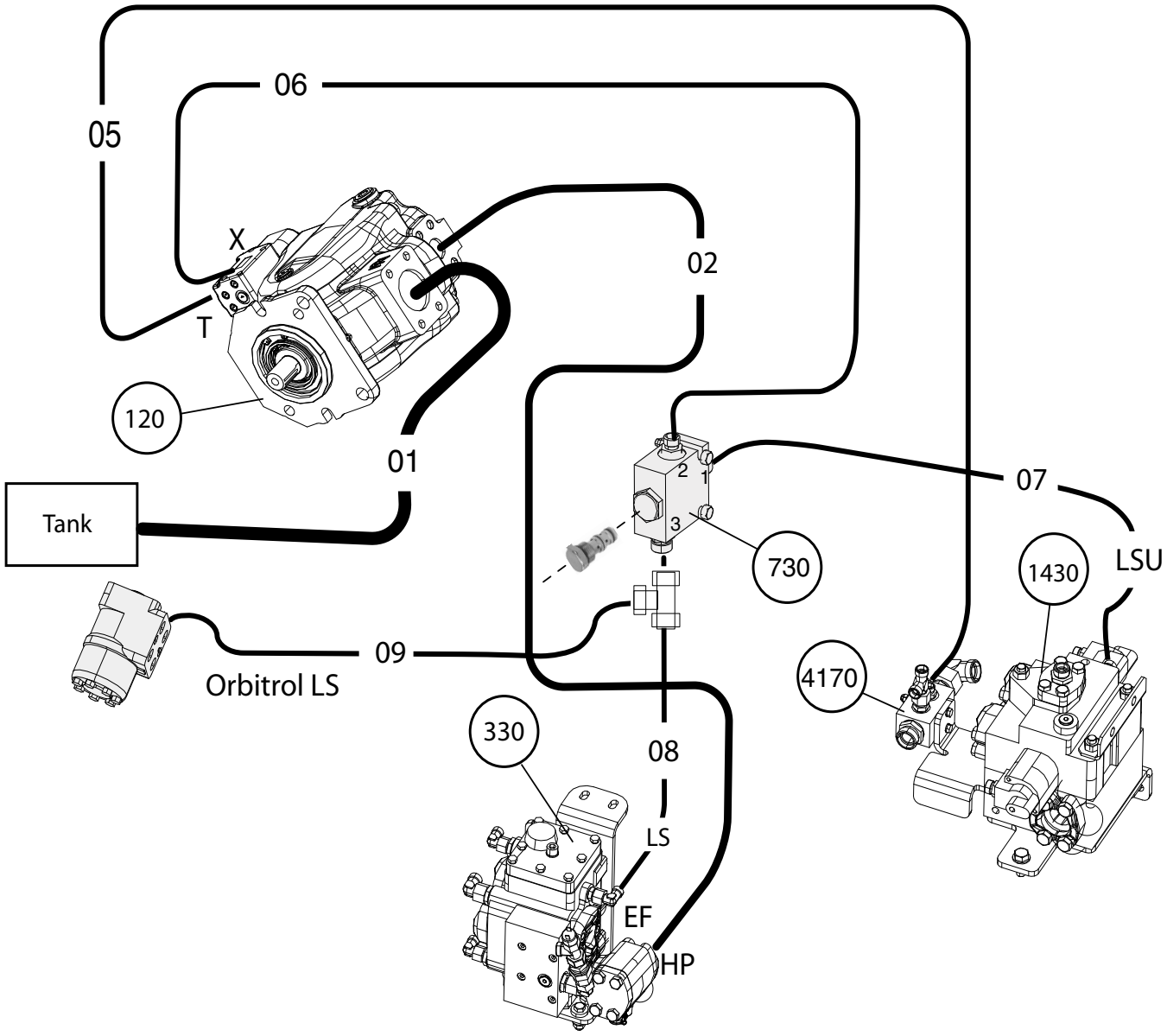


High pressure





Main pump circuit

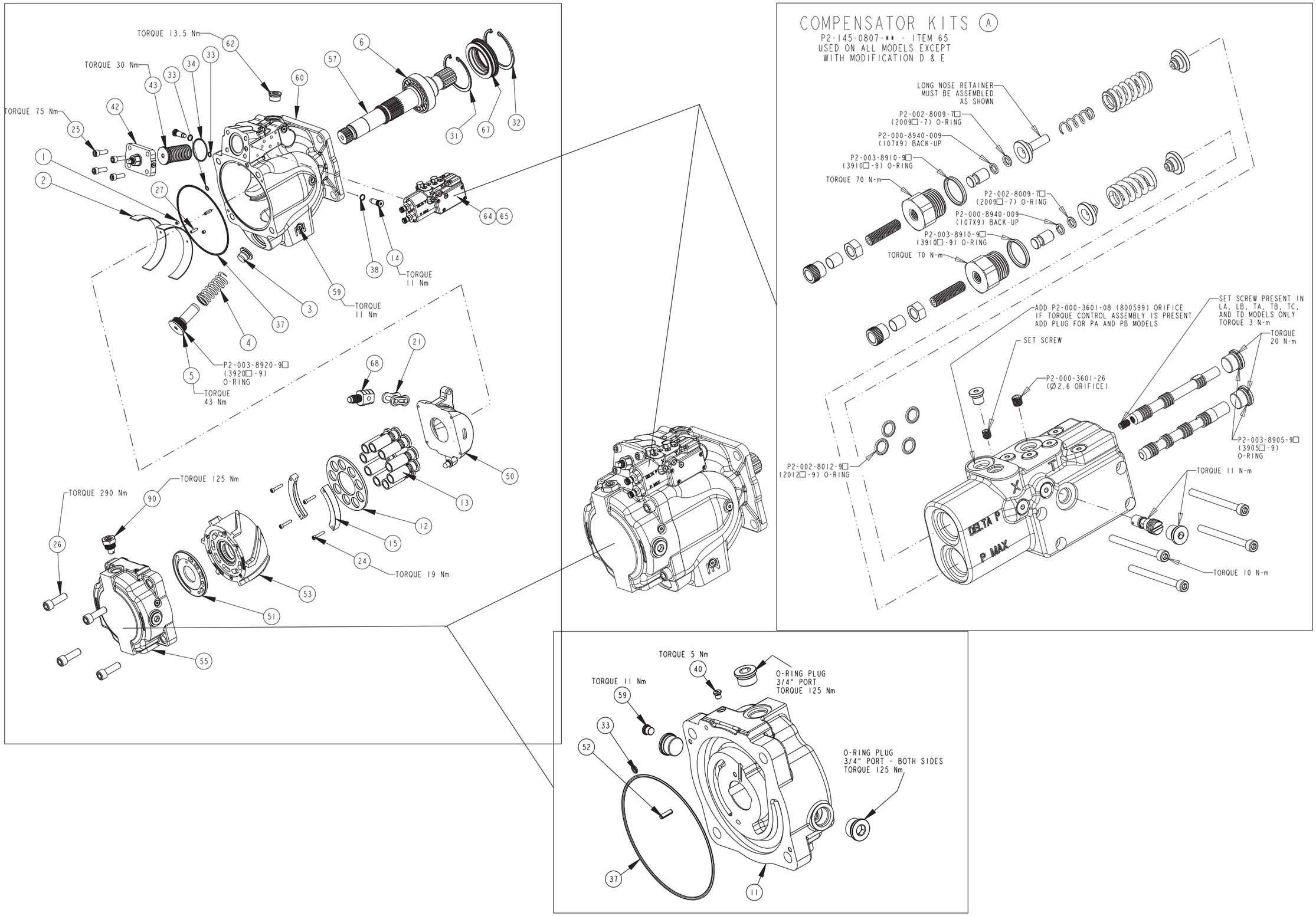


Main pump parts list

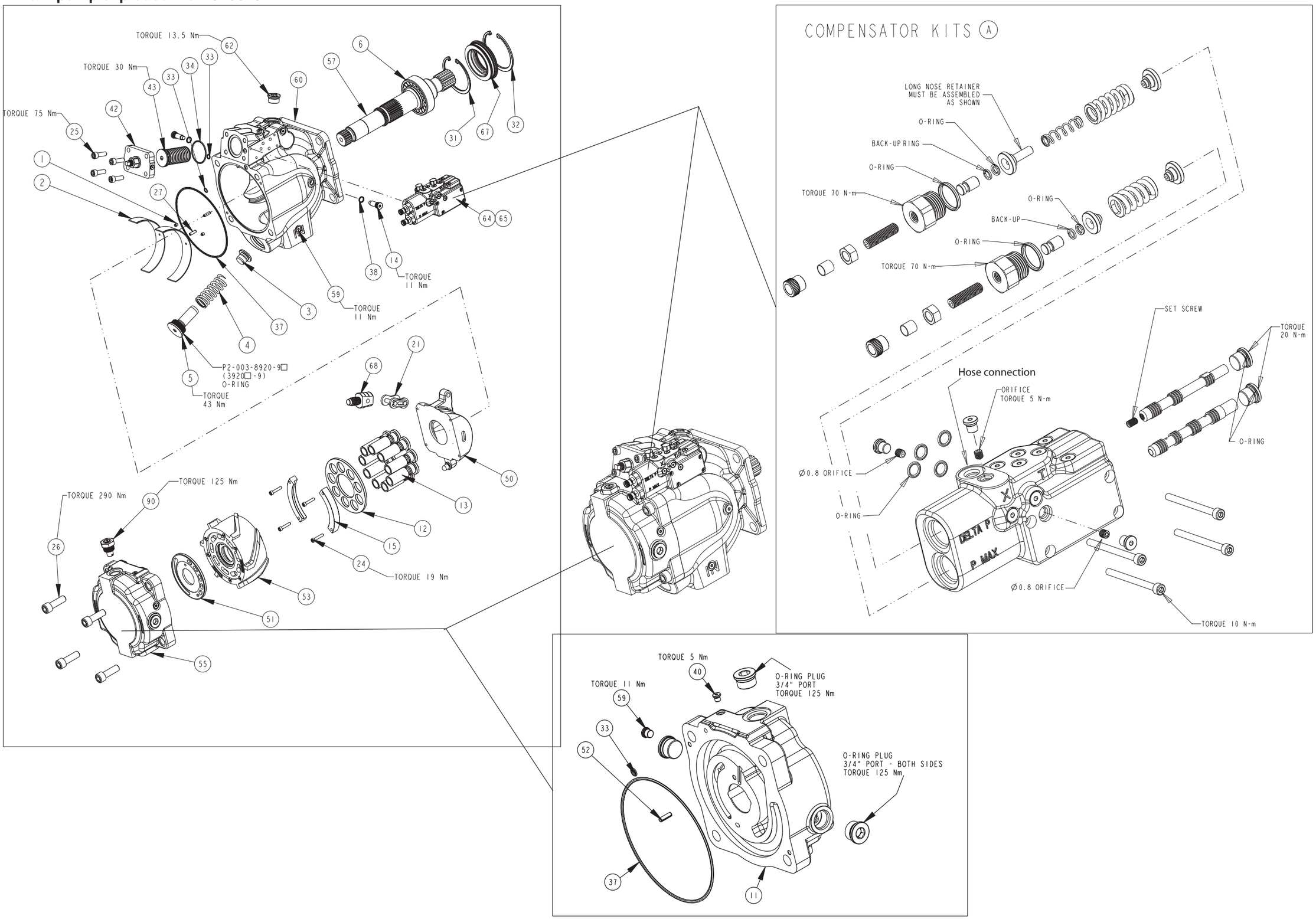
Item	Qty	Description
1	2	STEPPED PIN
2	2	SADDLE BEARING
3	1	SPRING GUIDE
4	1	SERVO SPRING
5	1	SPRING PLUG ASSY
6	1	SPHERICAL BEARING
7	1	BEARING RING
8	1	BARREL
9	2	WASHER
10	1	BARREL SPRING
11	1	BUSHING
12	1	SLIPPER RETAINER
13	9	PISTON ASSY
14	2	SWASHPLATE RETAINING PIN
15	2	FIXED CLEARANCE HOLD DOWN
16	1	SERVO PISTON COVER
17	1	SEAL LOCKNUT - M16
18	1	MAX VOL STOP
19	1	SERVO PISTON
20	3	PISTON RINGS
21	1	CHAIN LINK
22	1	NAMEPLATE
23	4	DRIVE SCREW
24	4	SHCS M6X30
25	4	SHCS M10X30
26	4	SHCS M16X50
27	2	ROLL PIN - 6X20
28	1	SNAP RING - EXT 55MM
29	1	SNAP RING - INT 65MM
30	1	SNAP RING - INT 72MM
31	1	SNAP RING - INT 100MM
32	1	SNAP RING - INT 108MM
33	2	O-RING
34	1	O-RING
35	1	O-RING
36	1	O-RING
37	1	O-RING
38	2	O-RING
39	1	O-RING

Item	Qty	Description
40	3	SAE-2 PLUG
41	1	SHAFT SEAL - NITRILE
41	1	SHAFT SEAL - FLOUROCARBON
42	1	MAX. VOLUME ASSY
43	1	SERVO PISTON ASSY
44	1	SAE-4 PLUG
45	6	M5 SHOULDER BOLT
50	1	SWASHPLATE ASSY - CW
51	1	PORT PLATE CW
52	1	ROLL PIN - 6X20
53	1	BARREL ASSEMBLY - CW
54	1	IMPELLER RING - CW
55	1	REAR COVER ASSY
57	1	SHAFT ASSY - CC KEY
58	1	SQUARE KEY
59	1	SAE-4 PLUG
60	1	HOUSING
61	1	M6X6 SET SCREW
62	1	SAE-12 PLUG
63	1	TORQUE CONTROL ASSY
64	1	COMPENSATOR ASS'Y
65	1	COMPENSATOR ASS'Y
67	1	SEAL
68	1	LINK PISTON
80	1	P3 SPACER RING - METRIC
81	4	CAP SCREW - M6X16
82	1	O-RING
83	1	O-RING
90	1	AIRBLEED ASSY

Main pump exploded view

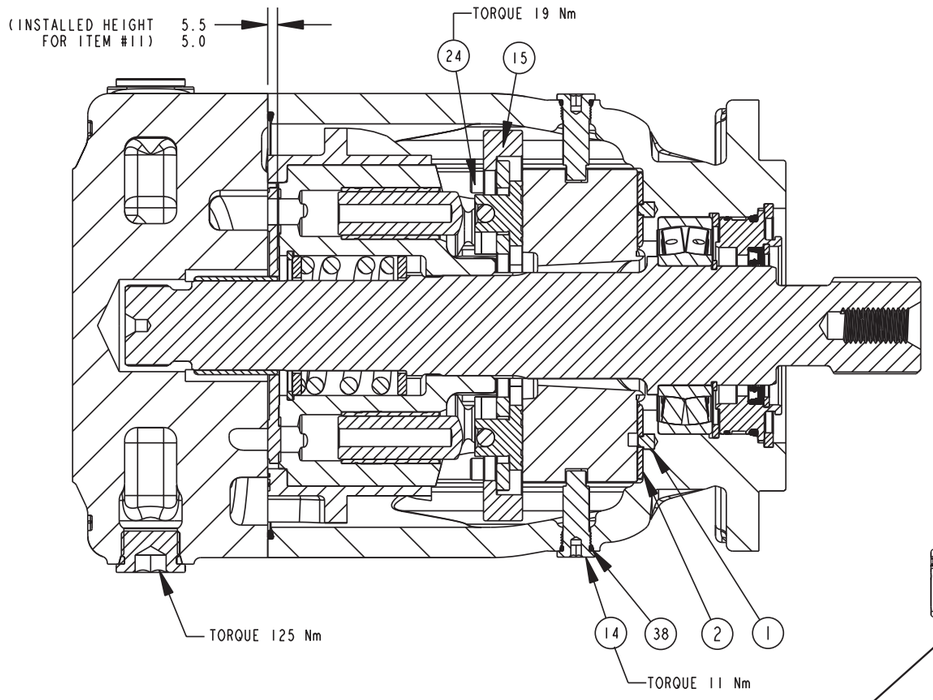


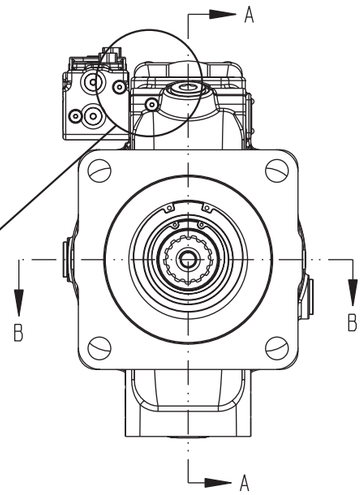
Main pump exploded view 810073-



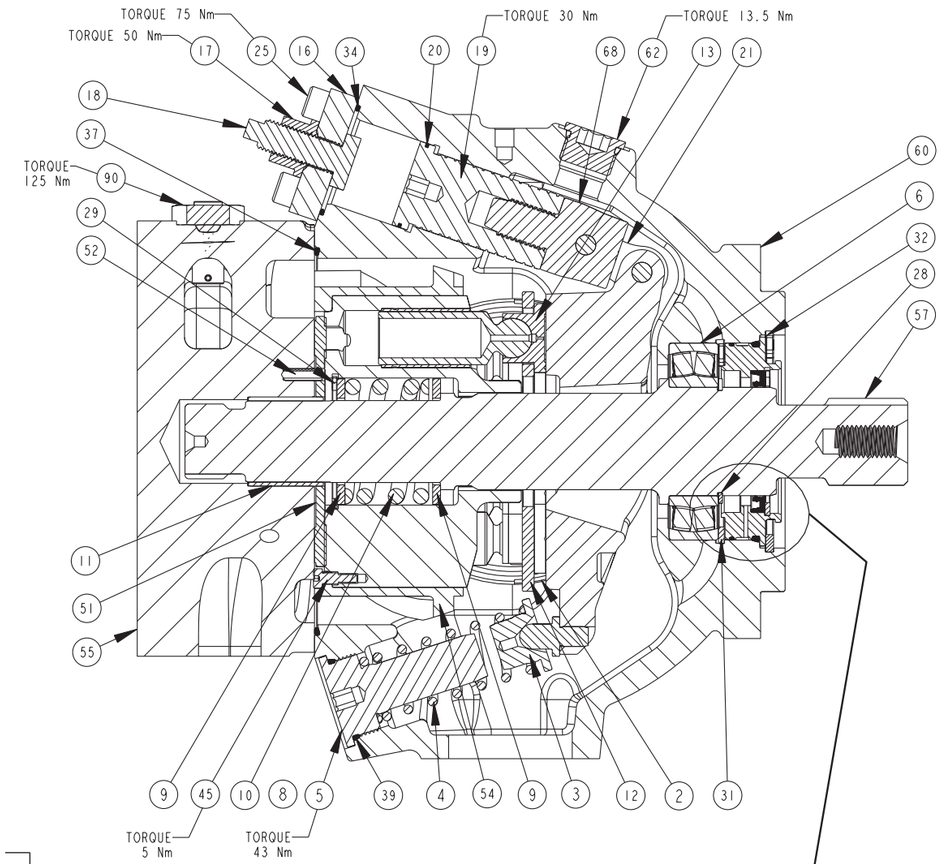
Main pump section draving

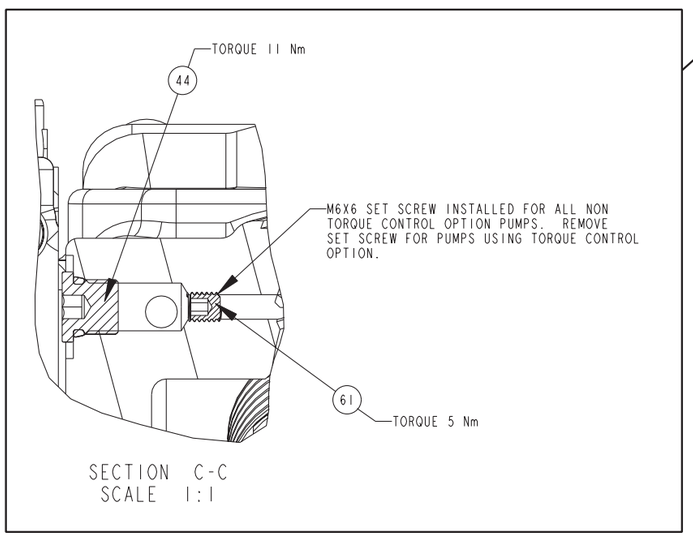
Section B - B

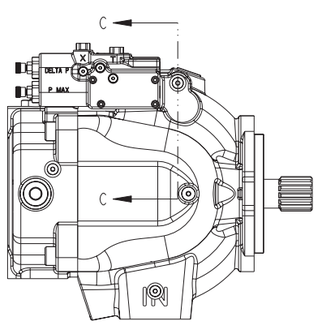


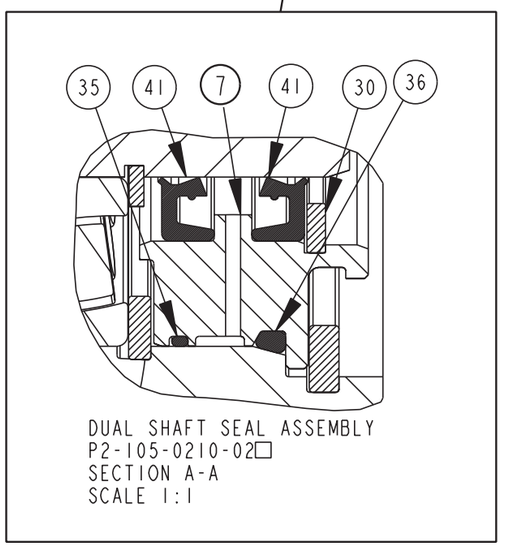


Section A - A









Main pump, disassemble - assemble the shaft

Disassemble of the pump in the warranty period is not allowed. In these instance the period of guarantee is not valid.

1.
Take the dimension A – top of max. volume stop screw to servo cover.

2.
Screw in the max. volume screw 4 as far as possible.

3.
Loosen the rear cover bolts 1 so that there is approximately 5 mm between rear cover 2 and housing 3.

4.
Disassemble snap ring 5 and pull shaft seal carrier 6 with two screw drivers.
(do not dam-age the shaft seal)

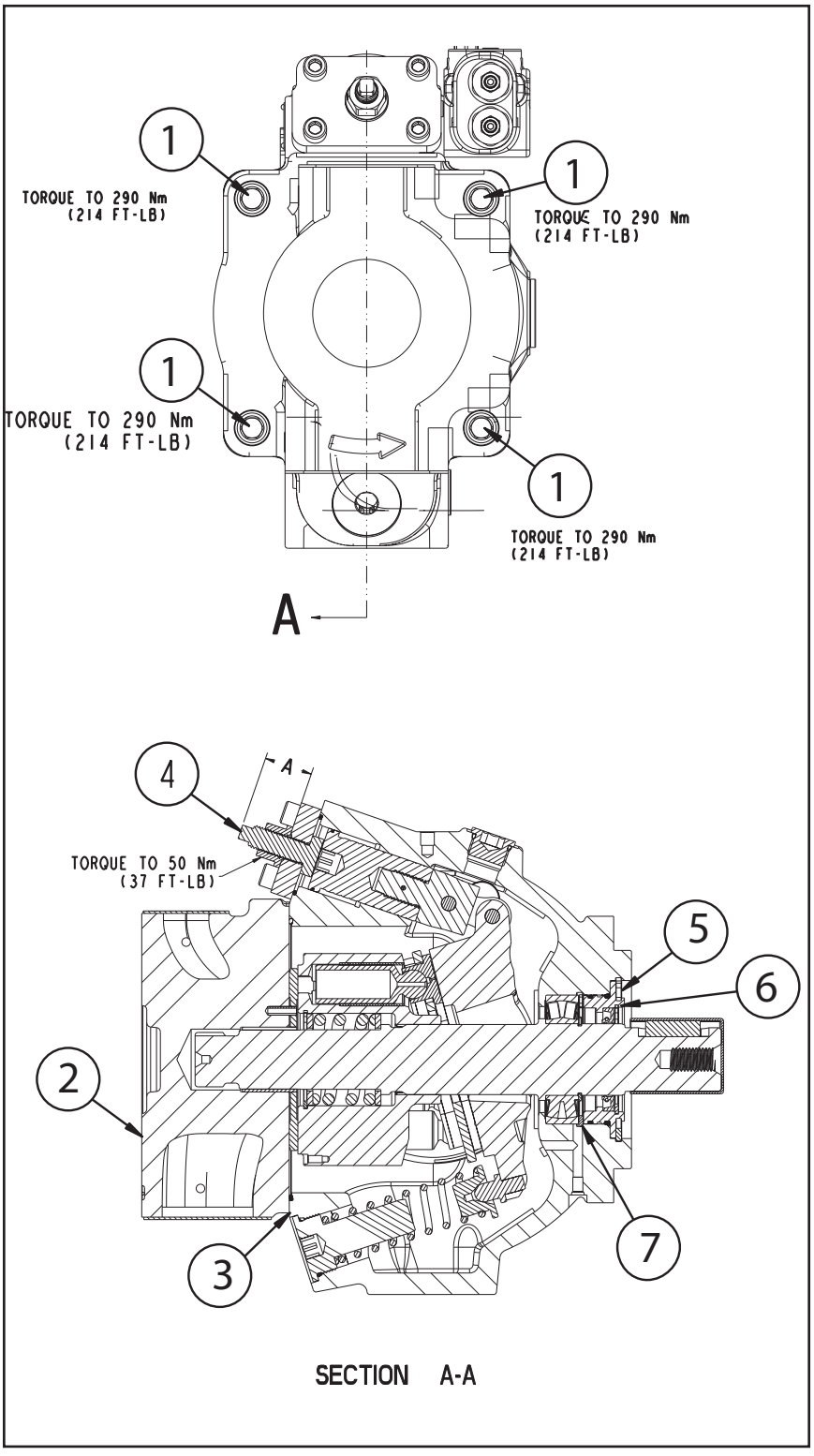
5.
Disassemble snap ring 7 and pull out the shaft with the bearing.

6.
Put in the new shaft assembly and the snap ring 7.

7.
Put in seal carrier 6 and snap ring 5. (Carefully, do not damage the shaft seal)

8.
Readjust the max. volume screw 4 with dimension A and fasten the nut (torque 50 Nm).

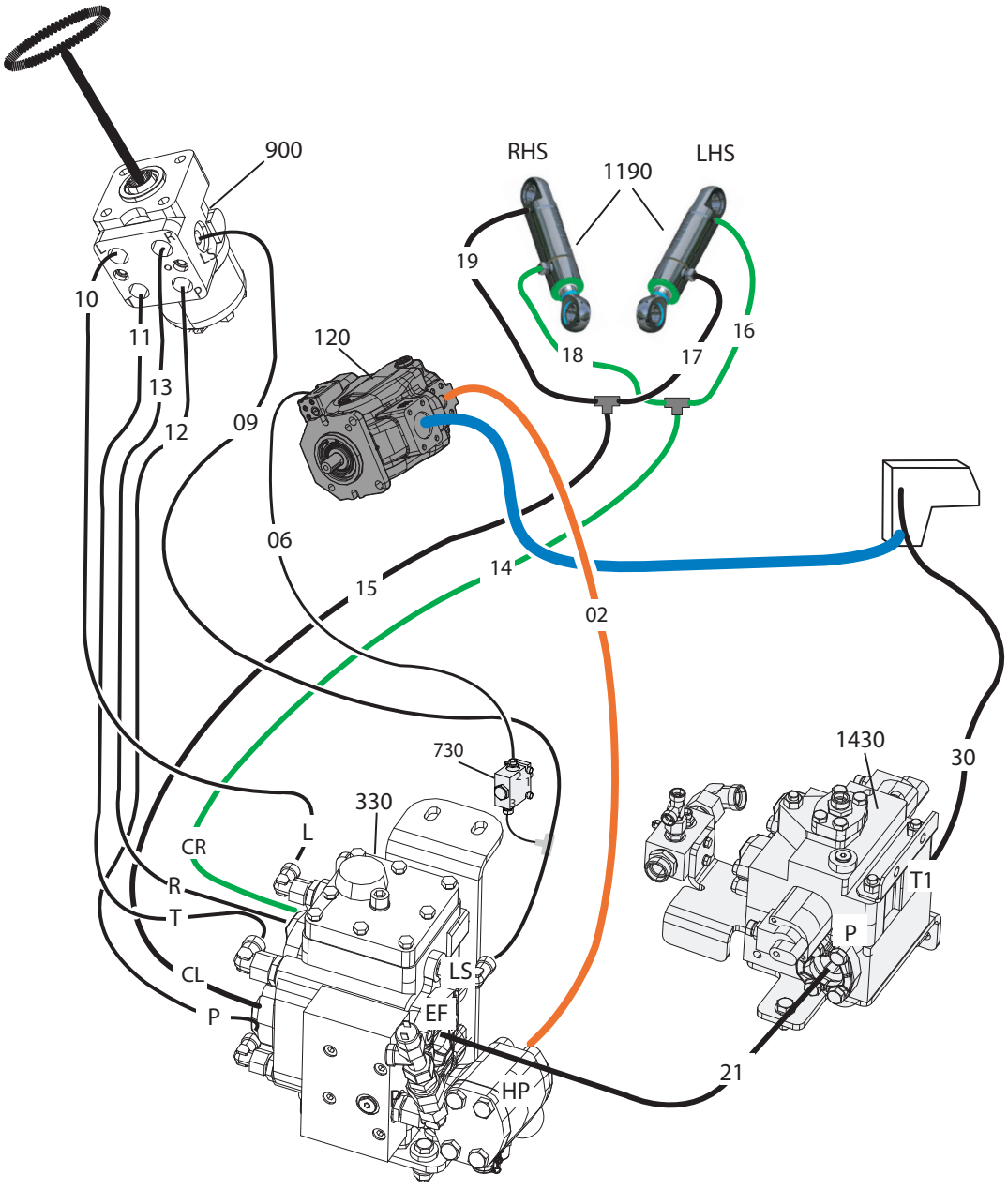
9.
Fasten rear cover bolts 1 with 290 Nm.



Steering system

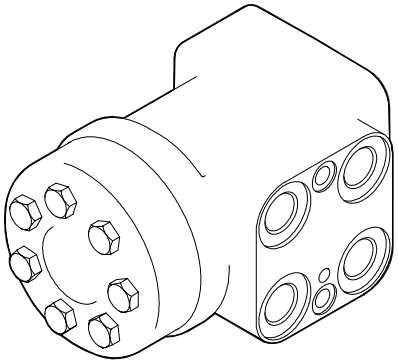
Description:

The steering system is built up of a Danfoss orbitrol steering unit (900), a Danfoss flow amplifier (330), and two steering cylinders (1190).
When the orbitrol is activated, a controlled oil flow is directed to the flow amplifier.
This oil flow is amplified in the flow amplifier and the total oil flow is directed to the steering cylinders.
The orbitrol has a displacement of 250 cm3/rev. and the amplification factor is 8. This means that total displacement is 160 cm3 x 8 = 1280 cm3 per steering wheel revolution.
In the flow amplifier system, it is a combination between steering and working hydraulics.
A priority valve is built into the flow amplifier. The priority valve ensures that the steering system has first priority on oil flow from the hydraulic pumps, which enters the flow amplifier.
The oil flow which is not used for steering, are sent via the “EF” line to the tipping valve.
If the steering wheel is not turned, the entire oil flow is directed to the tipping valve.
The principle applied to the controlled operation of the flow amplifier, called “load sensing”. As name suggest , it is a system in which the load is used in this system, to control the priority valve in the flow amplifier, so that oil flow and pressure precisely matches momentary demands.



Steering Master Valve (Orbitrol)

Orbitrol:
- Danfoss OSPCX 160LS
- 160ccm delivery per turn



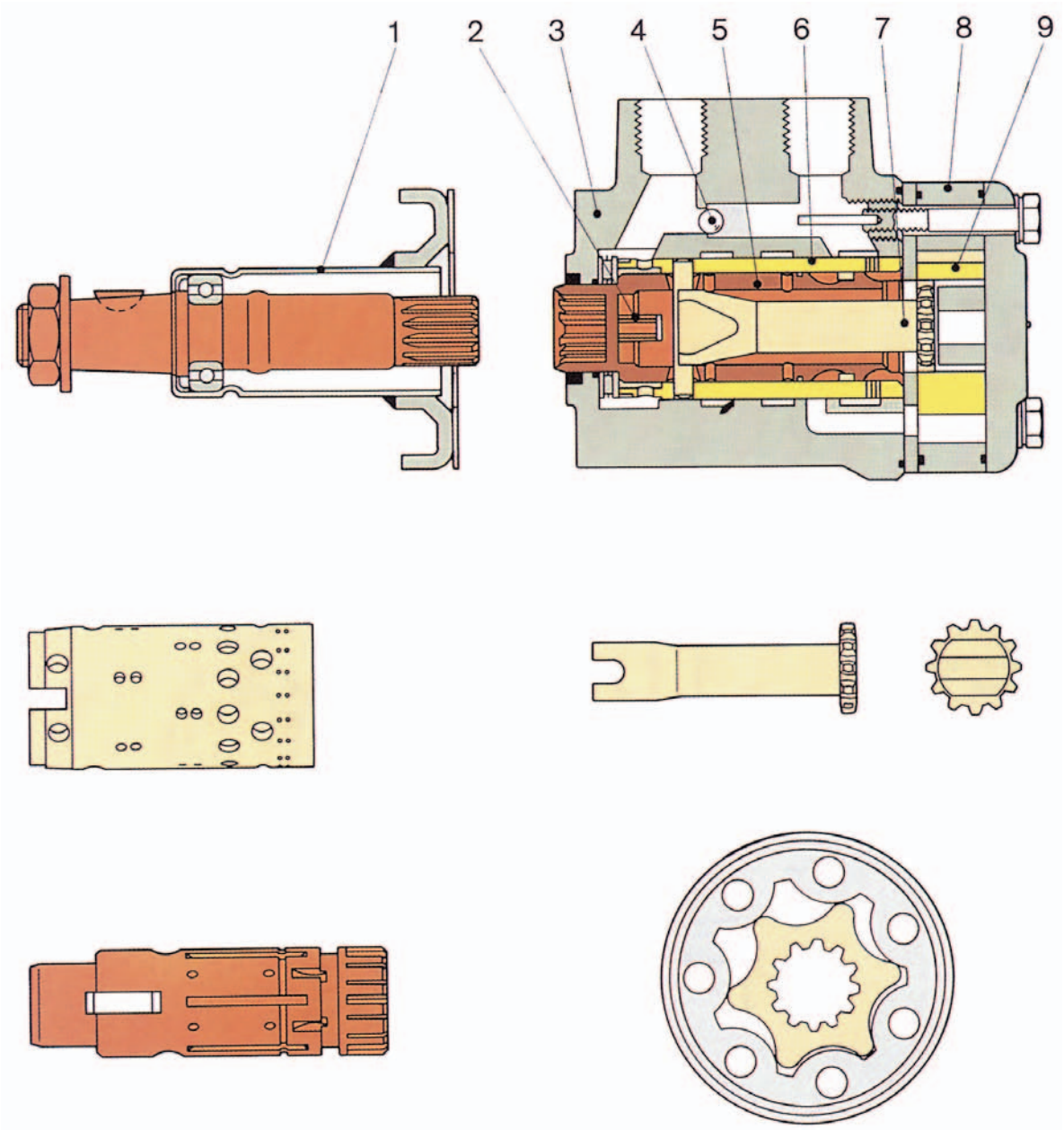
The Steering Master Valve is located on the cab front wall (firewall). Access is obtained by tilting the cab. (Ref. Operation and Maintenance Handbook)

Removal
Thoroughly clean the steering servo valve and the area around for any accumulated dirt.
Place a container below the valve to catch any hydraulic fluid spilt during removal.
Mark each hydraulic line for proper location and plug lines as they are removed from valve.
From inside the cab unscrew the four bolts securing the valve to the cab floor
Lift the steering master valve out from the truck for exchange or overhaul. If the valve is exchanged, save the connectors attached to the valve body.

Installation
Check the condition of the connector seals, replace if neccessary. Install the connectors in the valve body. Apply a light coat of oil to the connector seals, and tighten.
Apply a light coat of oil on the axle splines, and position the valve on the cab, and insert the fastening bolts.
Check that the valve is properly seated, and thighten the four bolts.
Install the hoses.

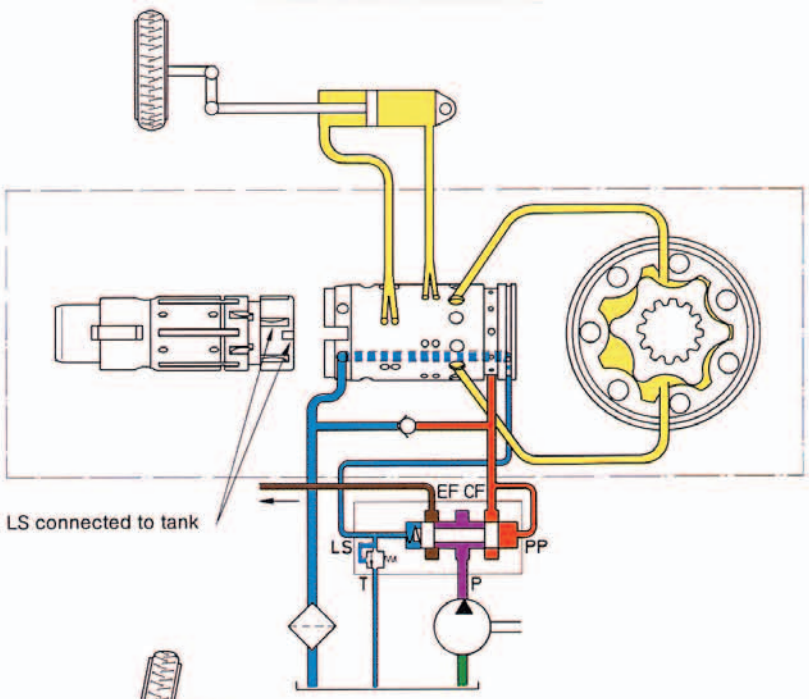
Control
Before startup - Check that all connections are located in the same positions as before removal, and that all hoses are correctly routed.

Perform startup test procedure. Ref. section: Startup test procedure.

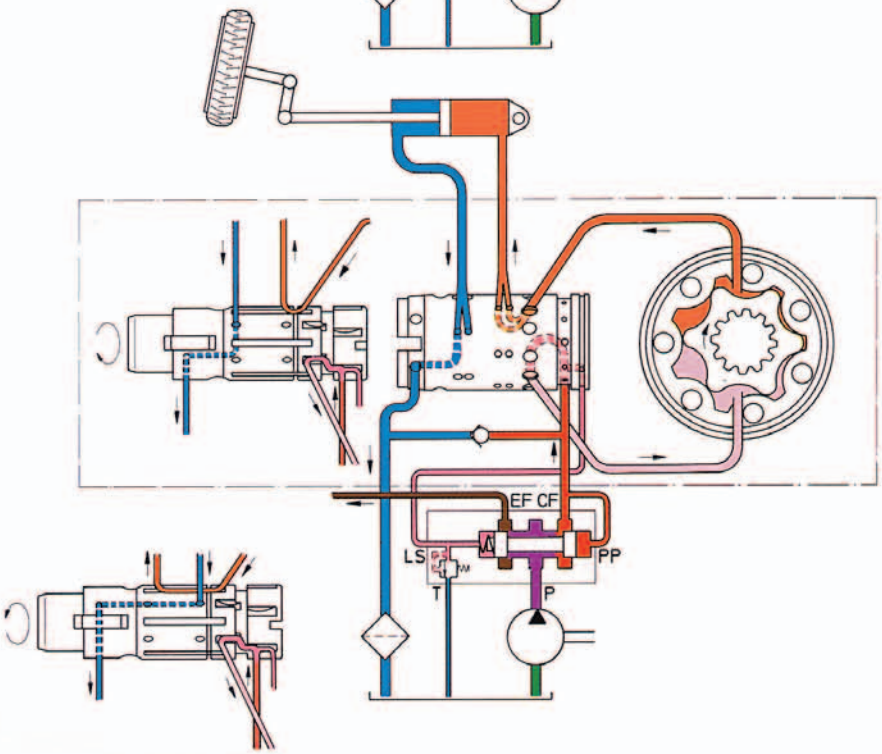

1
2
3
4
5
6
7
8
9

Load sensing

Neutral position



Right turn



- Oil to priority valve
- Oil to steering unit
- Oil in load sensing line
- Oil to gear wheel set
- Oil to steering cylinder
- Lock-up oil
- Oil to working hydraulics
- Oil in return line
- Oil in suction line

Steering Pressure Adjustment

Steering pressure:

See the section “Main pump pressure adjusting”

Loosen steering master valve (Orbitrol)
Remove hose supports to pull valve down to access adjusting port.

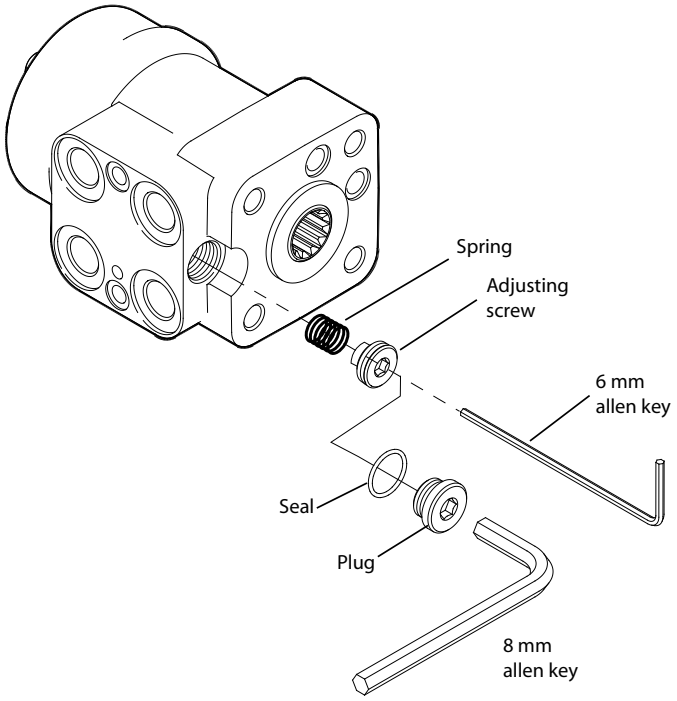
Remove plug next to master valve mounting flange 8mm Allen /Unbrako key.

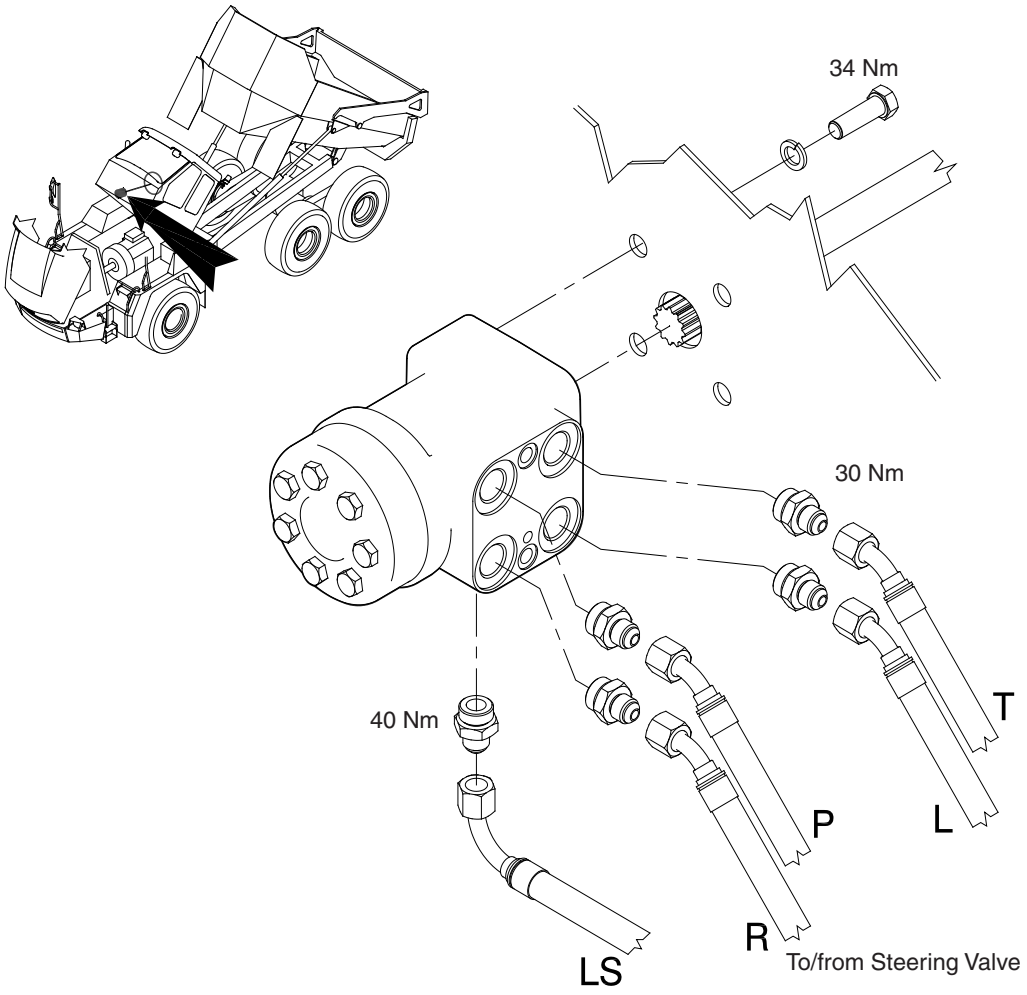
Insert allen key 6mm into the adjusting screw.

Adjust pressure by turning key, turn key clockwise to increase pressure, or anticlockwise to reduce pressure.

Replace plug.

Steering Pressure Adjustment





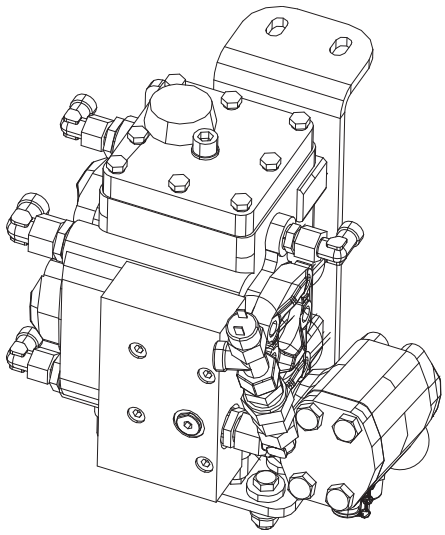
Steering valve

Steering system:

- Relief valve (orbitrol) 210 0/-10bar (at 1500 rpm)
- Shock valves (OSQ) 280 +20/0 bar

Steering valve:

- Danfoss OSQ A8
- Amplification value 8



The Main Steering Valve is located on the front wagon, left frame-member. Access is obtained by removing left front wheel and removing the cover behind the wheel. The cover is secured with four bolts.

Removal
Thoroughly clean the steering valve and the area around for any accumulated dirt.

Place a container below the valve to catch any hydraulic fluid spilt during removal.
Mark each hydraulic line for proper location and plug lines as they are removed from valve.
Unscrew the three bolts securing the valve to the bracket.
Observe that each bolt has a washer between the bracket and the valve body, as well as under the head.
Lift the steering valve out from the truck for exchange or overhaul. If the valve is exchanged, save the connectors attached to the valve body.

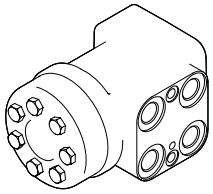
Installation
Check the condition of the connector seals, replace if necessary. Apply a light coat of oil to the hose fitting seals. Install the connectors in valve body, and tighten.
Position the main steering valve on its bracket. Install three securing bolts with washers both under each head and between the bracket and the valve body. Tighten the bolts.
Clean the flange couplings, and install new o-rings.
Connect the flange couplings, ensure that the hoses are positioned in correct angle, and tighten the bolts.
Install the remaining smaller hoses.
Replace cover, and install wheel.

Control
Check that all connections are located in the same positions as before removal, and that all hoses are correctly routed.
Install cover, and fit the four bolts. Tighten the bolts.

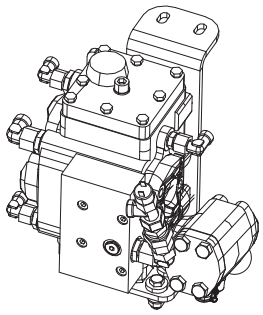
Perform startup test procedure. Ref. section: Startup test procedure.

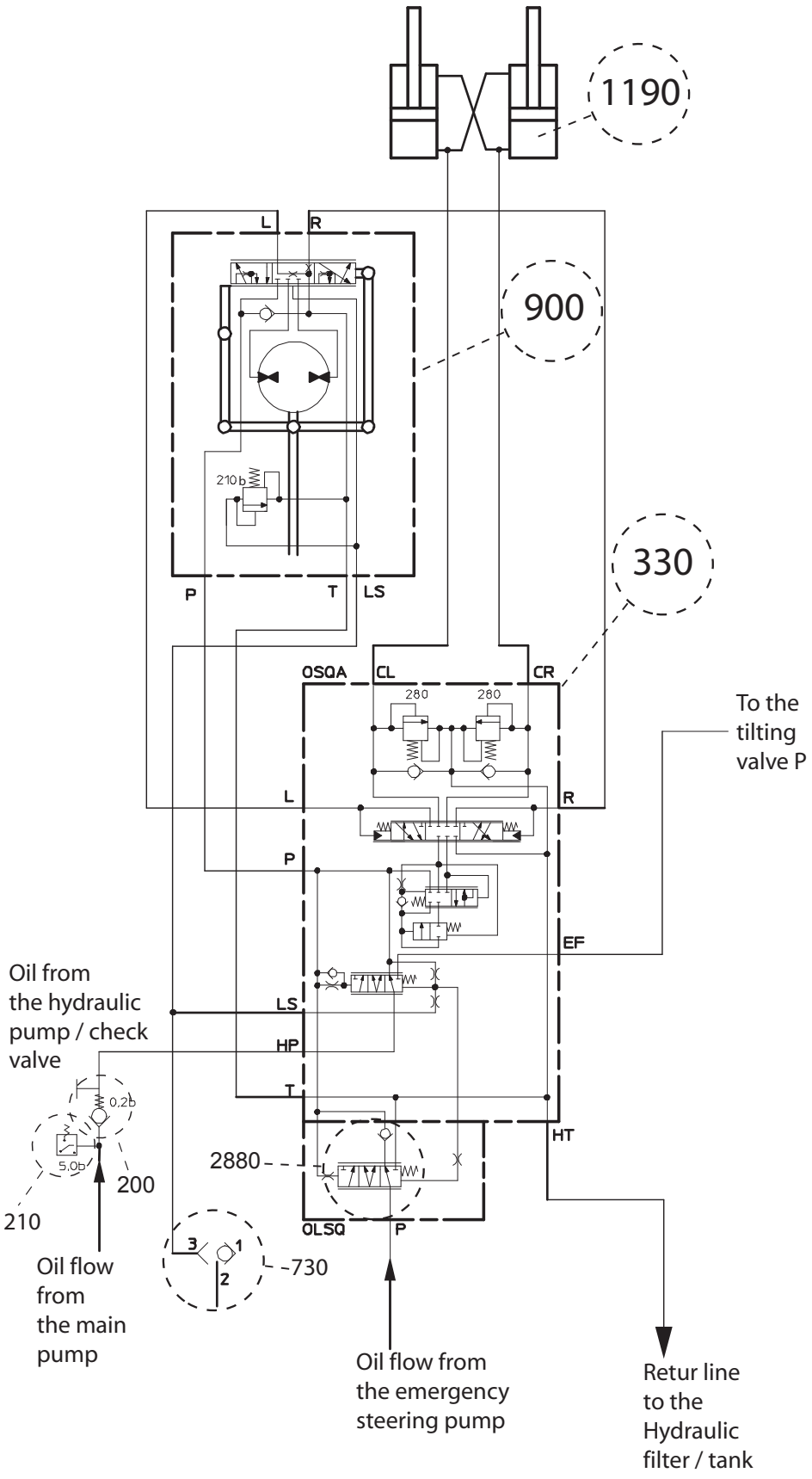
Steering cirquit

Orbitrol



Steering valve

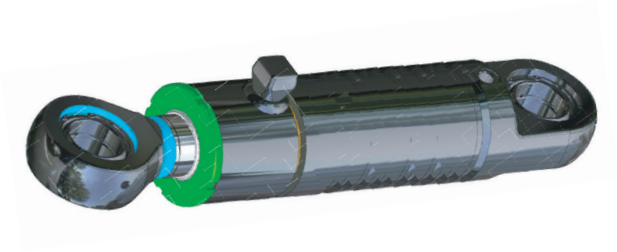




Steering Cylinder

Steering cylinders:

- Double acting
- Qty 2
- Cylinder diameter 100mm
- Piston diameter 63mm
- Stroke 515mm
- End cushion



The Steering Cylinders are located on each side of the articulation hinge.

Removal
Thoroughly clean the steering cylinder and the area around for any accumulated dirt.
Make sure that the steering lock is in position (Ref. Operation and Maintenance Handbook)
Place a container below the cylinder to catch any hydraulic fluid spilt during removal.
Mark each hydraulic line for proper location and plug lines as they are removed from cylinder.
Remove the screws and washers securing the cylinders pivot bolts. Disconnect lubrication lines if fitted.
Drive the pivot bolts down.
Carefully lift the steering cylinder out from the truck for exchange or overhaul. If the cylinder is exchanged, save the connectors attached to the valve body.

WARNING!_____
Be aware of the risk of injury to people and equipment when handling heavy objects!

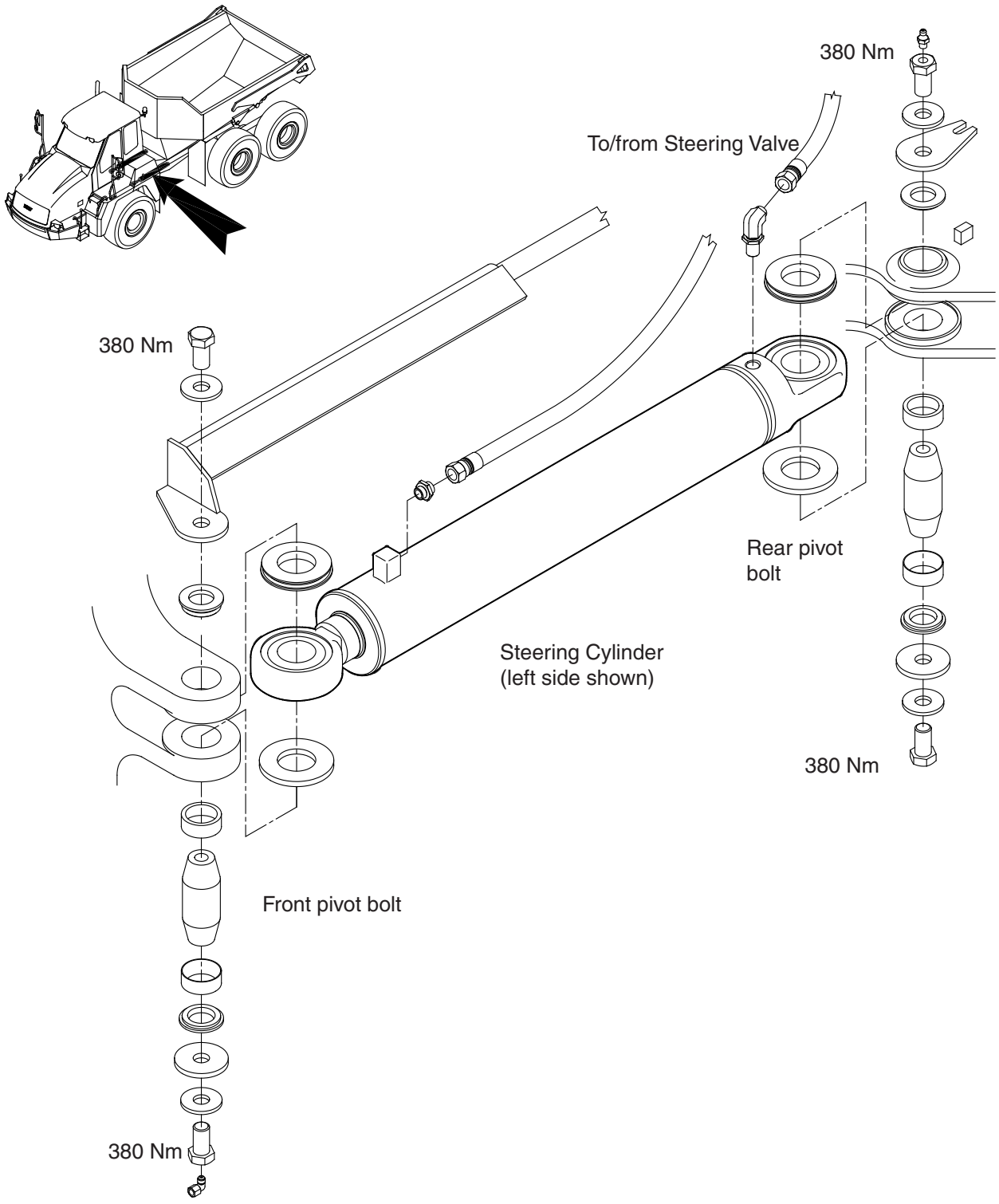
Installation
Check the condition of the connector seals, replace if necessary. Apply a light coat of oil to the hose fitting seals. Install the connectors in cylinder body, and tighten.

Position the steering cylinder in the mounting brackets. Install the pivot bolts, with lubrication bore pointing down, by driving down from the top with a soft mallet.. Install expansion rings, securing screws and washers etc. Make sure the assembly is centred. Tighten the screws to 380 Nm.
Connect lubrication lines if fitted.

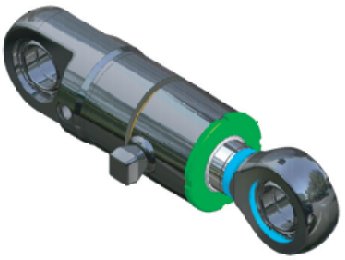
Fill cylinder with hydraulic oil, and install hydraulic hoses.

Control
Check that all connections are located in the same positions as before removal, and that all hoses are correctly routed.

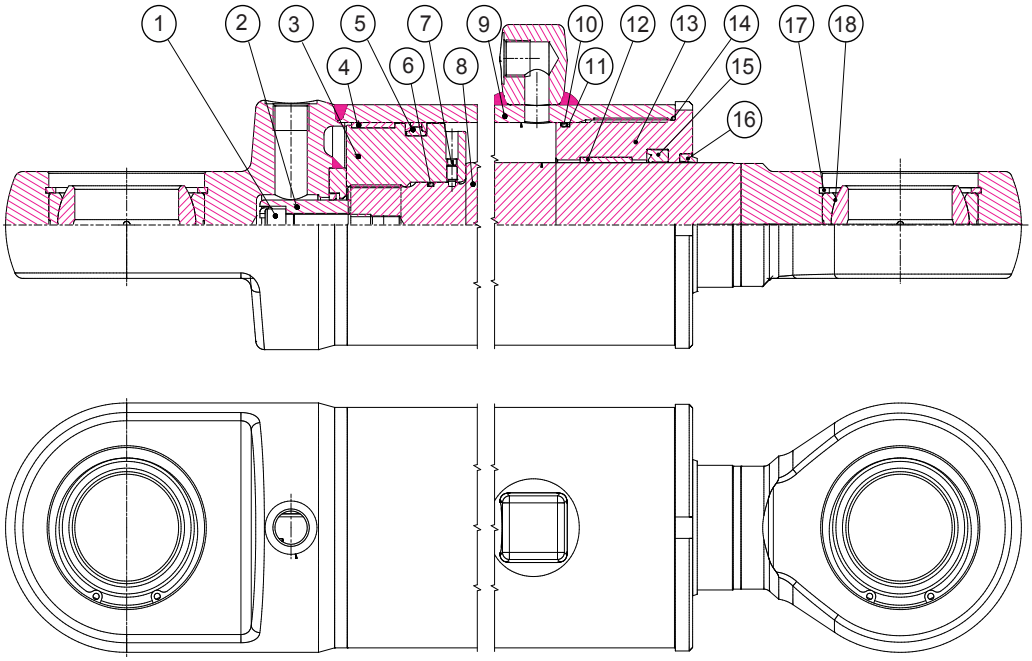
Perform startup test procedure. Ref. section: Startup test procedure.


380 Nm
To/from Steering Valve
380 Nm
Rear pivot bolt
Steering Cylinder (left side shown)
380 Nm
Front pivot bolt
380 Nm

Steering cylinder, sectional drawing.



Torque limit:
Pos. 3: 1370 Nm
Pos. 7: 5 Nm
Pos. 13: 450 Nm

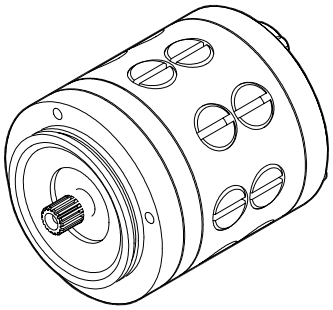


Steering cylinder ass'y

Pos	Qt'y	Description
1	1	Screw
2	1	Bushing
3	1	Piston
4	1	Steering
5	1	Piston seal
6	1	O-ring
7	1	Locking screw
9	1	Casing
10	1	O-ring
11	1	Backup ring
12	1	Steering
13	1	Cover
14	1	O-ring
15	1	Seal
16	1	Stripper
17	4	Retaining ring
18	2	Bearing
		Seal kit

Emergency steering pump

- Variable radial piston pump
- Mounted on rear of transmission
- Driven by output shaft (Ground driven)
- Maximum volume: 32 ccm
- Maximum delivery: 50 l/min



The dump truck is equipped with a ground driven radial piston pump fitted at the transmission.
This pump makes the truck steerable if the engine stops or main pump drive fall out.
The radial piston pump is very convenience due to the same flow direction either rotation of the pump. This ensures emergency steering function when driving either forwards or backwards.
The pump displacement is 32 cm3/rev, and the oil flow is maximum 50 l/min.

If the main hydraulic pump should fail during driving (or engine stops), the connecting valve in steering valve will direct the oil flow from the emergency steering pump to the steering circuit.
At the same time the flow indicator valve will meter low or no oil flow and thereby connect the warning light at the instrument panel.

The Emergency Steering Pump is located at the rear end of the transmission, just above the rear output shaft.
Access is from rear of front wagon, through the drive shaft tunnel.

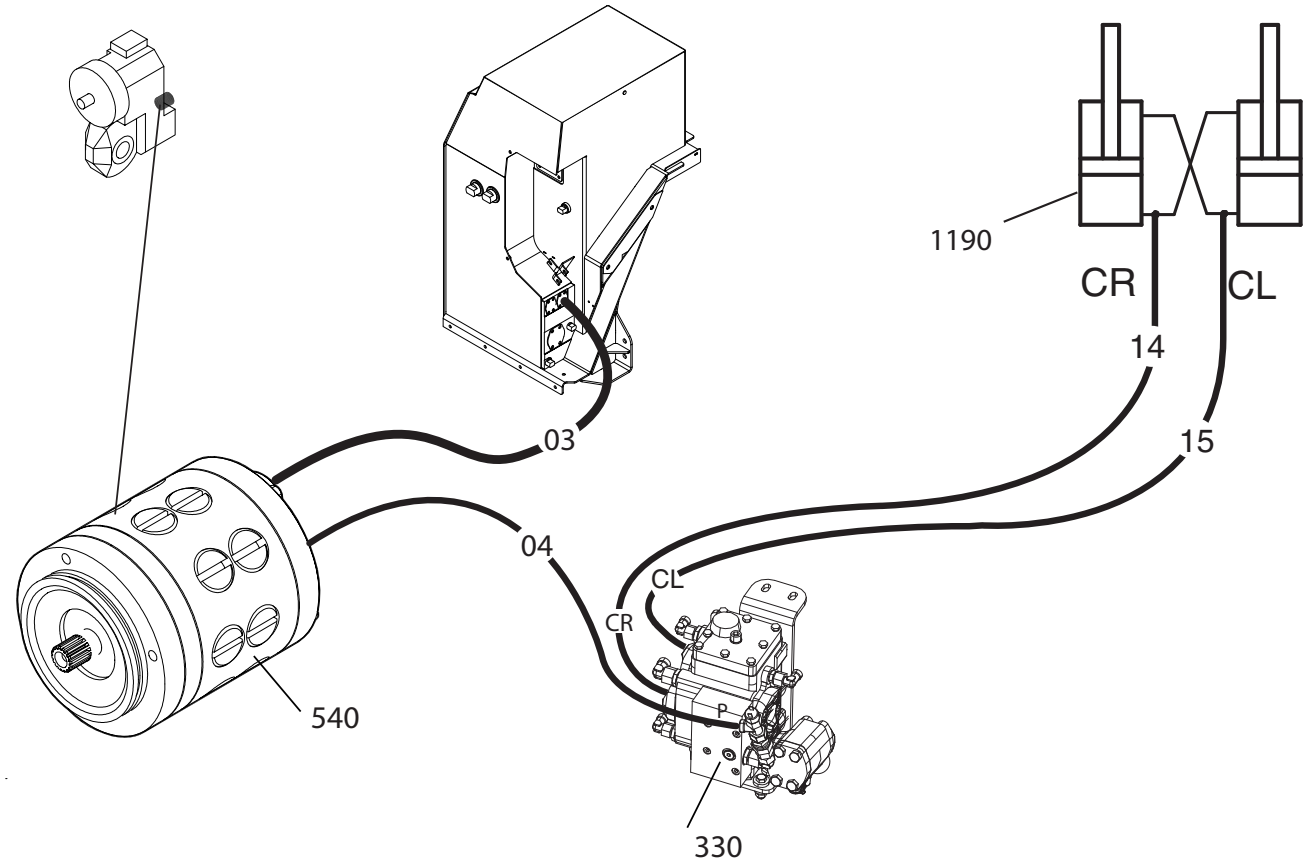
Removal
Thoroughly clean the emergency pump and the area around for any accumulated dirt.
Place a container below the pump to catch any hydraulic fluid spilt during removal.
Mark both hydraulic lines for proper location and plug lines as they are removed from pump.
Unscrew the 4 Allen screws securing the pump to the transmission.

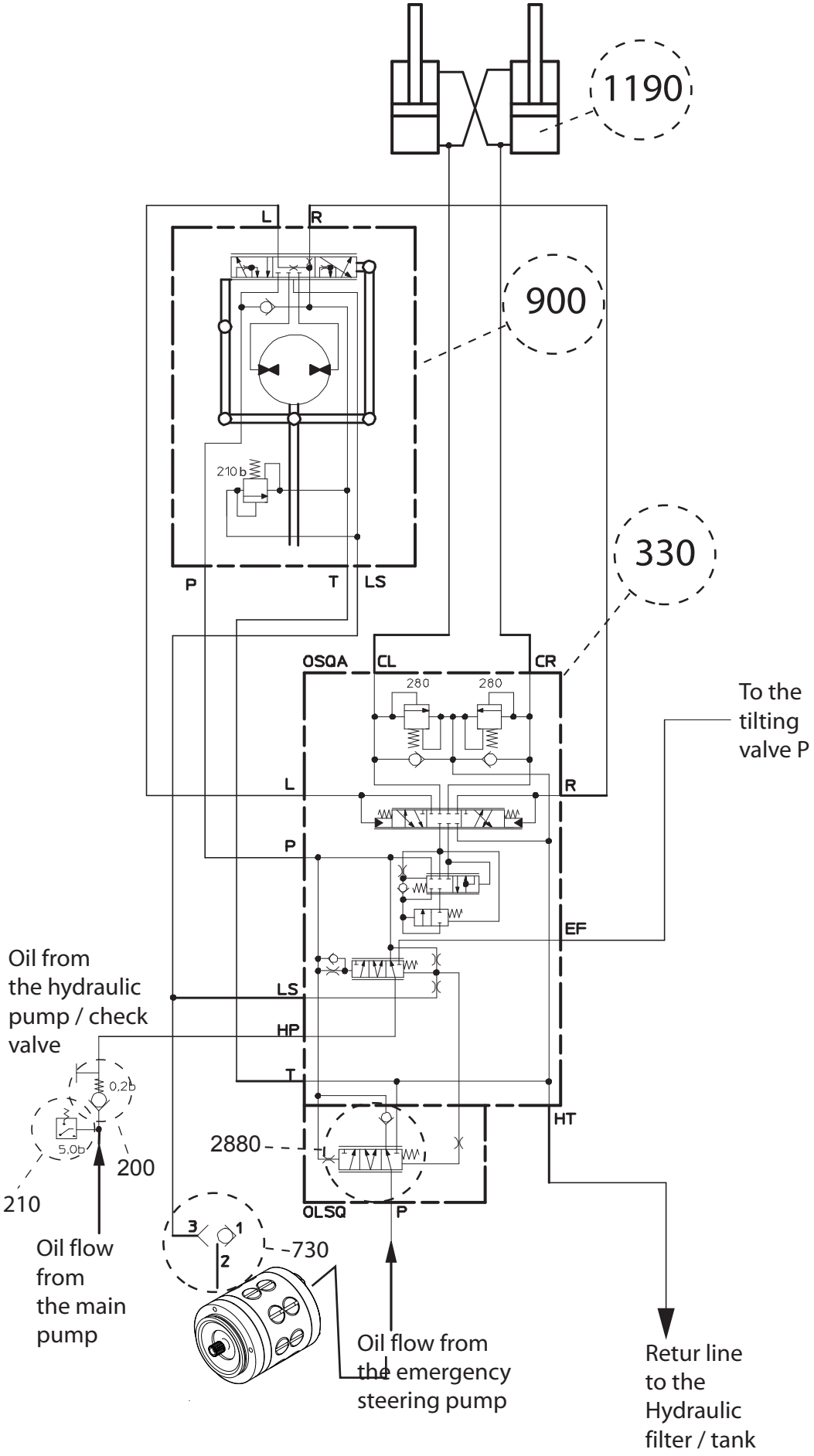
Lift the pump out from the truck for exchange or overhaul. If the pump is exchanged, save the hose fittings attached to the valve body.

Installation
Check the condition of the connector seals, replace if necessary. Install the connectors in the valve body, using a light coat of oil on the seals, and tighten.
Check that the o-ring is installed in groove in pump mating flange.
Apply a light coat of oil on the axle splines, and position the pump onto the transmission.
Check that the pump is properly seated, and thighten the 4 Allen screws.
Install the hydraulic line hoses.

Control
Before startup - Check that all connections are located in the same positions as before removal, and that all hoses are correctly routed.

Perform startup test procedure. Ref. section: Startup test procedure.

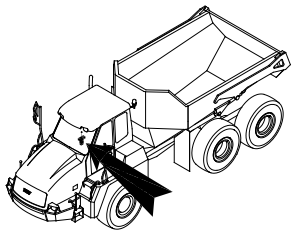

1190
CR
CL
14
15
03
04
CL
CR
P
540
330


1190
900
330
L
R
210b
P
T
LS
OSQA
CL
CR
280
280
To the tilting valve P
L
R
P
EF
LS
HP
T
HT
2880
OLSQ
P
Oil from the hydraulic pump / check valve
0,2b
5,0b
200
210
Oil flow from the main pump
3
1
2
730
Oil flow from the emergency steering pump
Retur line to the Hydraulic filter / tank

Tilting system

Tilt Servo Valve

The Tilt Servo Valve is located in the cab in console on drivers right hand side. Access is obtained by removing console side cover.



Removal
Thoroughly clean the tilt servo valve and the area around for any accumulated dirt.

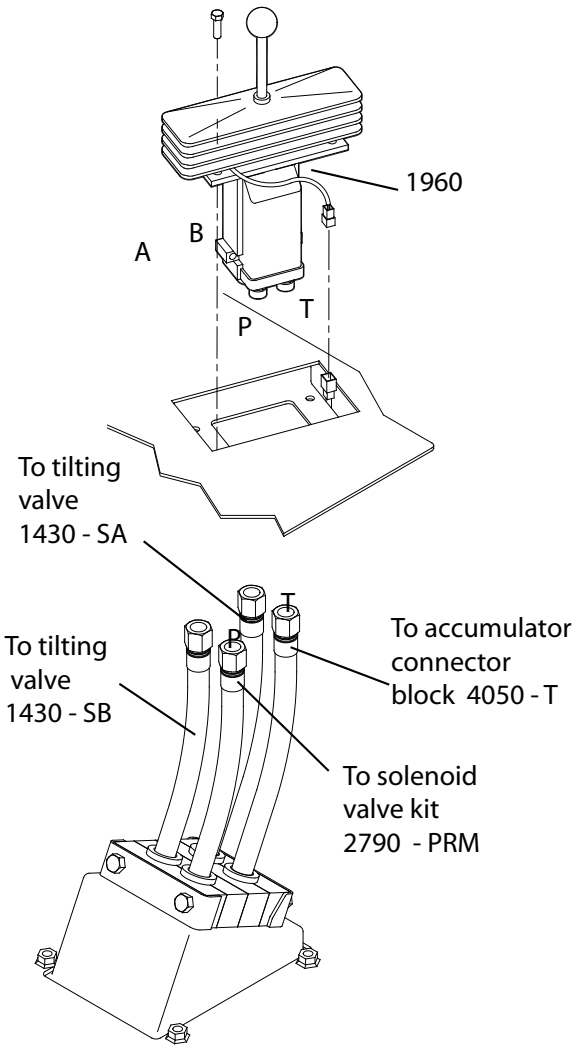
Use rags to catch any hydraulic fluid spilt during removal.
Mark each hydraulic line for proper location and plug lines as they are removed from valve.
Unplug the electrical connector.
Unscrew the four bolts securing the valve to the console.
Lift the tilt servo valve out from the truck for exchange or overhaul.

Installation
Position the tilt servo valve in console. Install four securing bolts.
Tighten the bolts to.
Install the hydraulic line hoses.

Control
Before startup - Check that all connections are located in the same positions as before removal, and that all hoses are correctly routed.

Perform startup test procedure.

Ref. section: Startup test procedure.



Tilt / auxiliary operation servo
(diff. lock, engine and retarder brake):

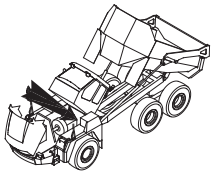
- Pressure reduction valve 35 ±0.5bar

(fan pump at maximum pressure engine at idle)

Operating pressure:

- Diff. lock 10 ±0.1bar
- Engine brake 10 ±0.1bar
- Retarder 4 ±0.1bar
- Retarder emergency 6 ±0.1bar

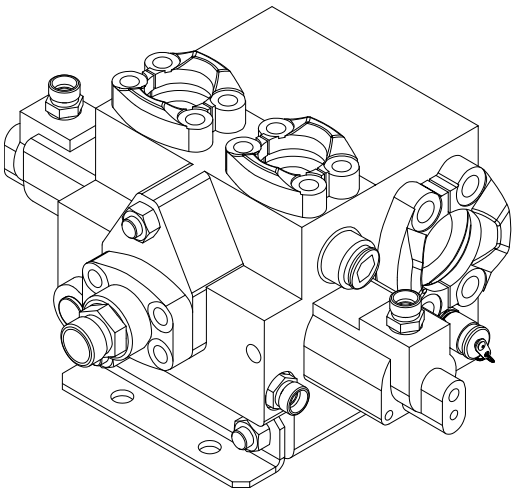
Tilt valve



- Single spool of LS – type
- Hydraulic operated
- Shock / suction valves on cylinder side for tilt – up and tilt – down
- Manual override for body lowering

- Shock valve tilt – up 300 ±5.0bar
- Shock valve tilt – down 80 ±2.0bar

Tilting up pressure is equivality of the setting of the main pump maximum pressure.
Se in the section: Main pump.



The Tilt Control Valve is located on the front wagon, left frame-member.
Access is obtained by removing left front tire, and removing the cover behind the tire.
The cover is secured with four bolts.
Some of the connection are accessed from behind under the cab.

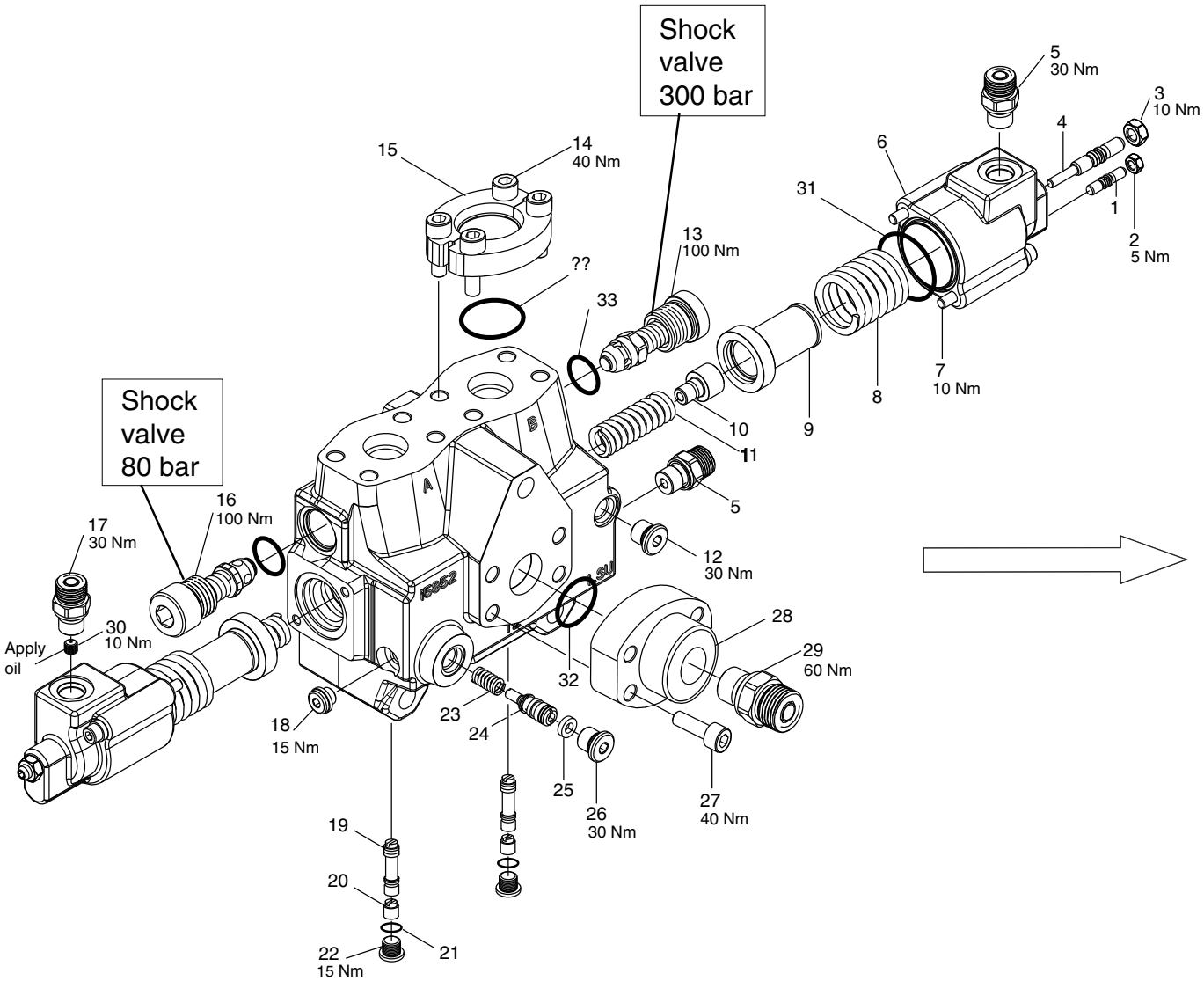
Tilt valve exploded, assemble view

Removal
Thoroughly clean the tilting valve and the area around for any accumulated dirt.
Place a container below the valve to catch any hydraulic fluid spilt during removal.
Mark each hydraulic line for proper location and plug lines as they are removed from valve.
Unscrew the three bolts securing the valve to the bracket.
Observe that each bolt has a washer between the bracket and the valve body, as well as under head and nut.
Lift the tilt control valve out from the truck for exchange or overhaul.

Installation
Position the tilt control valve on its bracket. Install the three securing bolts with washers both under each head, nut and between the bracket and the valve body.
Observe that the longer bolt is used in the upper right location securing the brake line support.
Tighten the nuts.
Install the hydraulic hoses.

Control
Check that all connections are located in the same positions as before removal, and that all hoses are correctly routed.

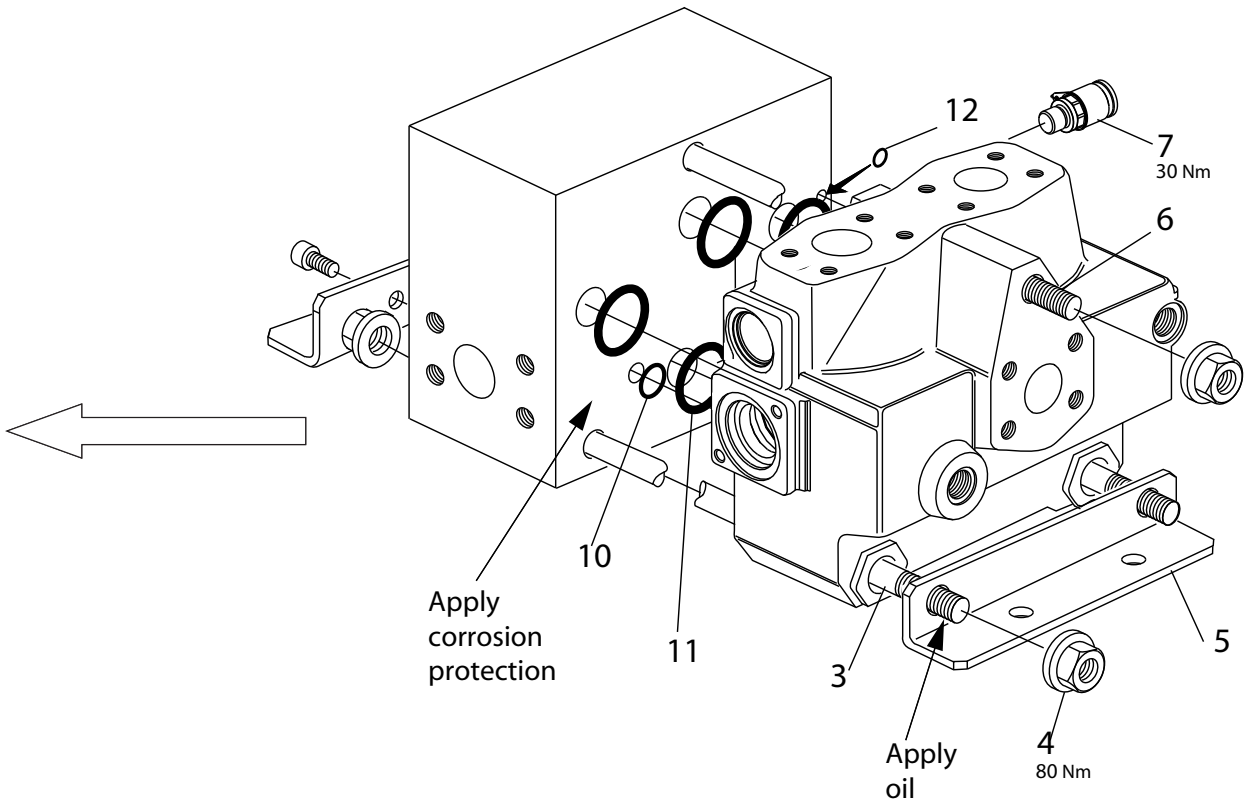
Parts list, see next page



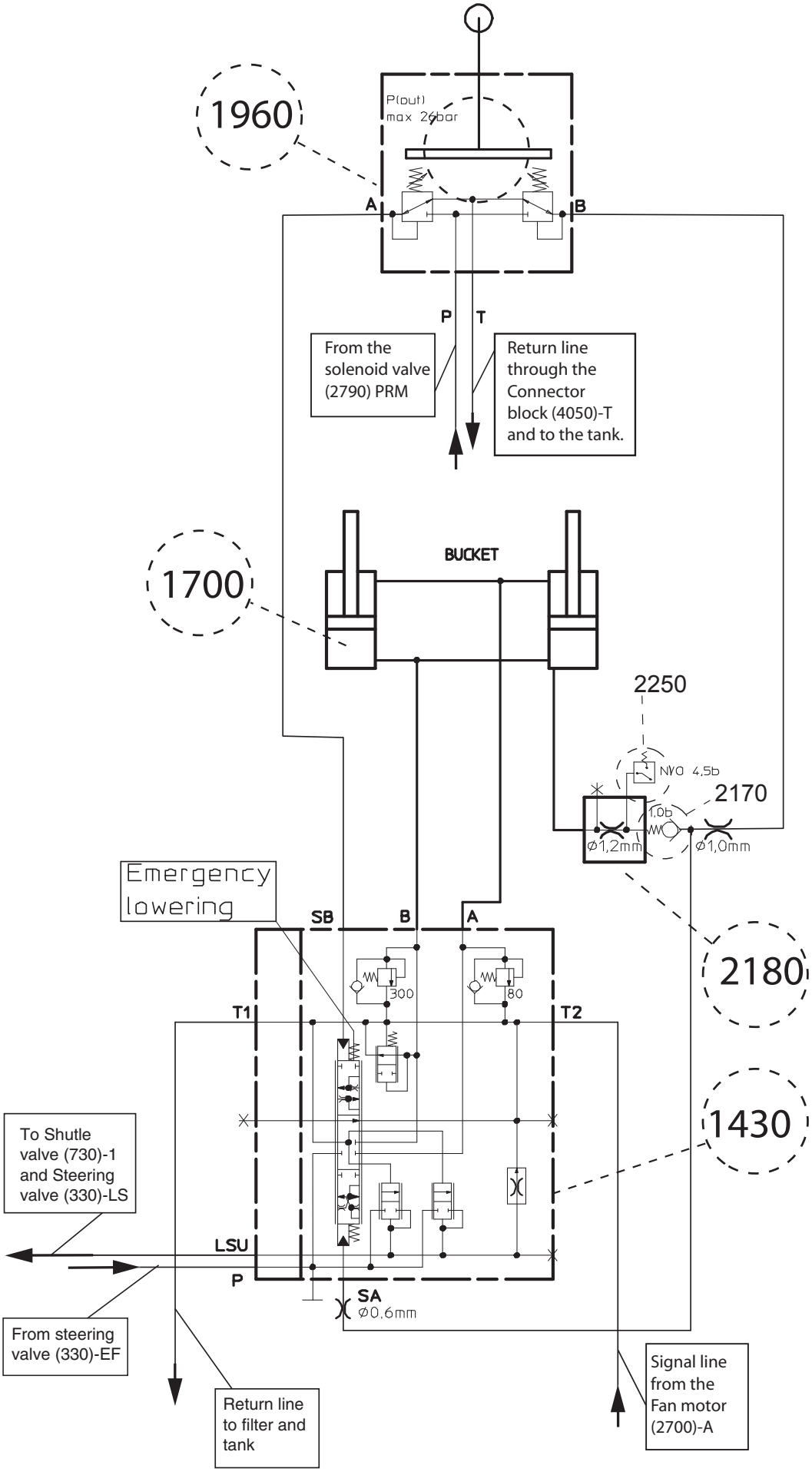
Tilt valve parts list

Tilting valve ass'y

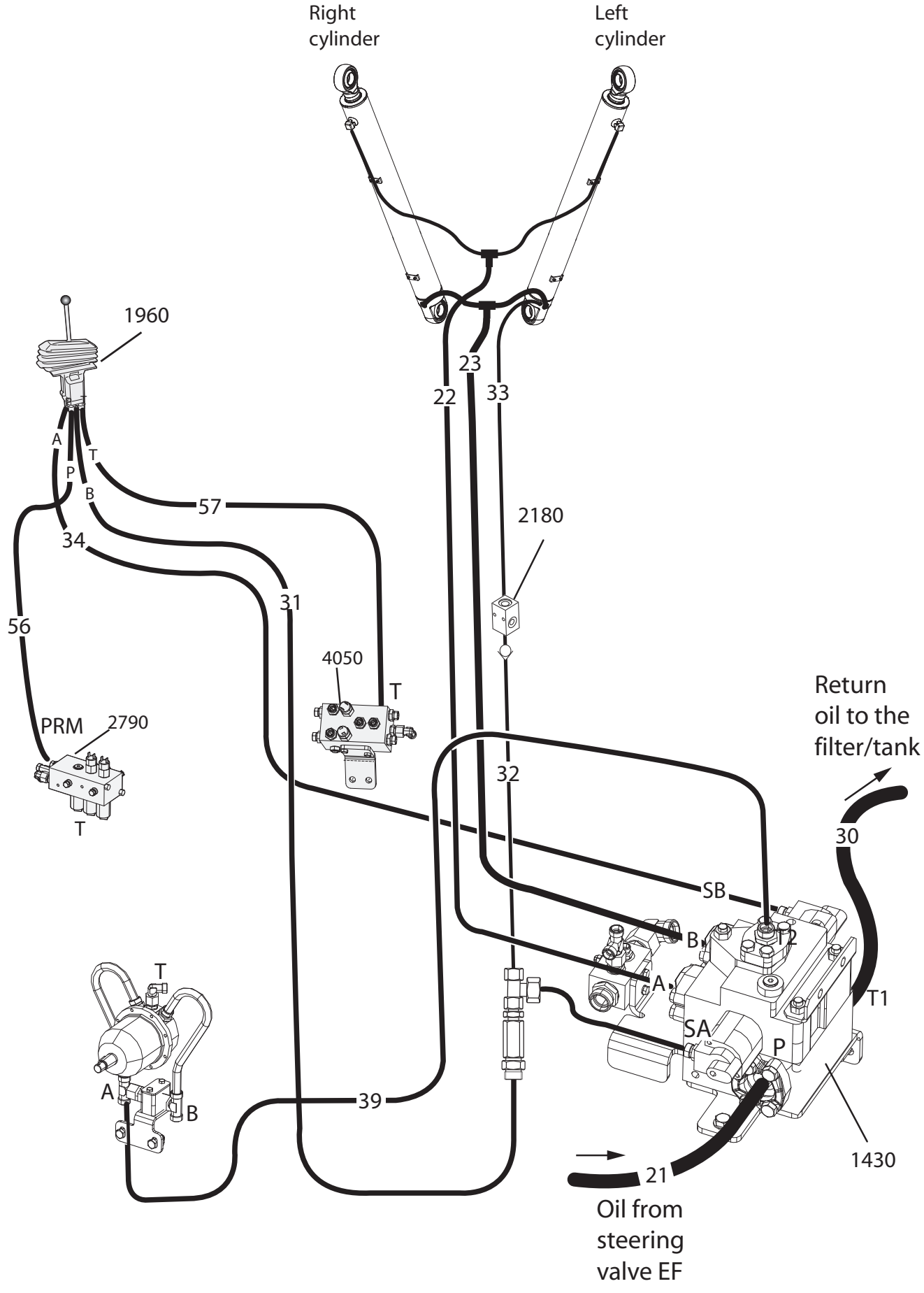
1	Flange kit	Item	27,28,32
1	Connector	Item	29
1	Connector	Item	5
1	Connector	Item	17,30
1	Cap kit	Item	1,2,3,4,6,7
1	Seal kit	Item	31(2x) seals on 1 and4(2x)
1	Spring kit	Item	8,9,10,11
1	Relief valve	Item	16
1	Relief valve	Item	13
1	Seal kit	Item	33(2x)
1	Spool	Item	19,20,21,22
1	Drain valve	Item	23,24,25,26
1	Plug	Item	12,18
1	Seal kit	Item	21(2x)25,32, seals on 12 and 18
1	Tie-rod kit	Item	3,4,5,6
1	Measuring plug	Item	7
1	Seal kit	Item	10,11,12



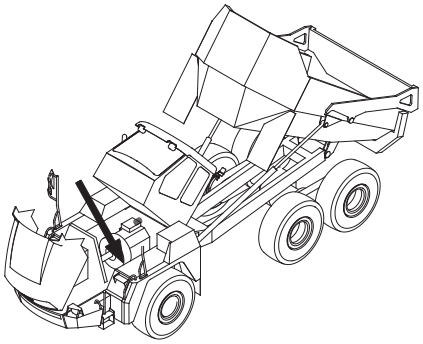
Tilting circuit

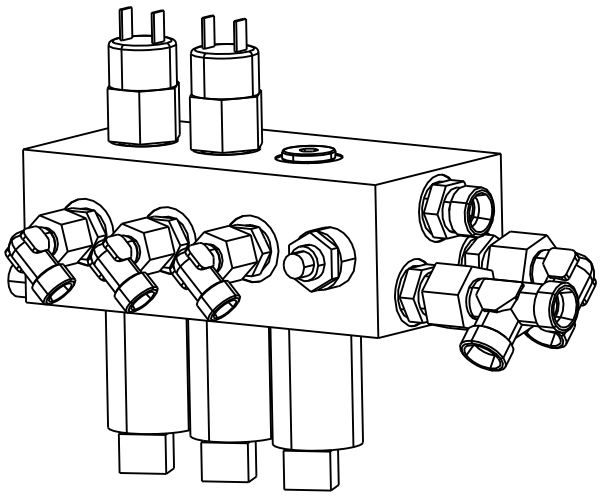


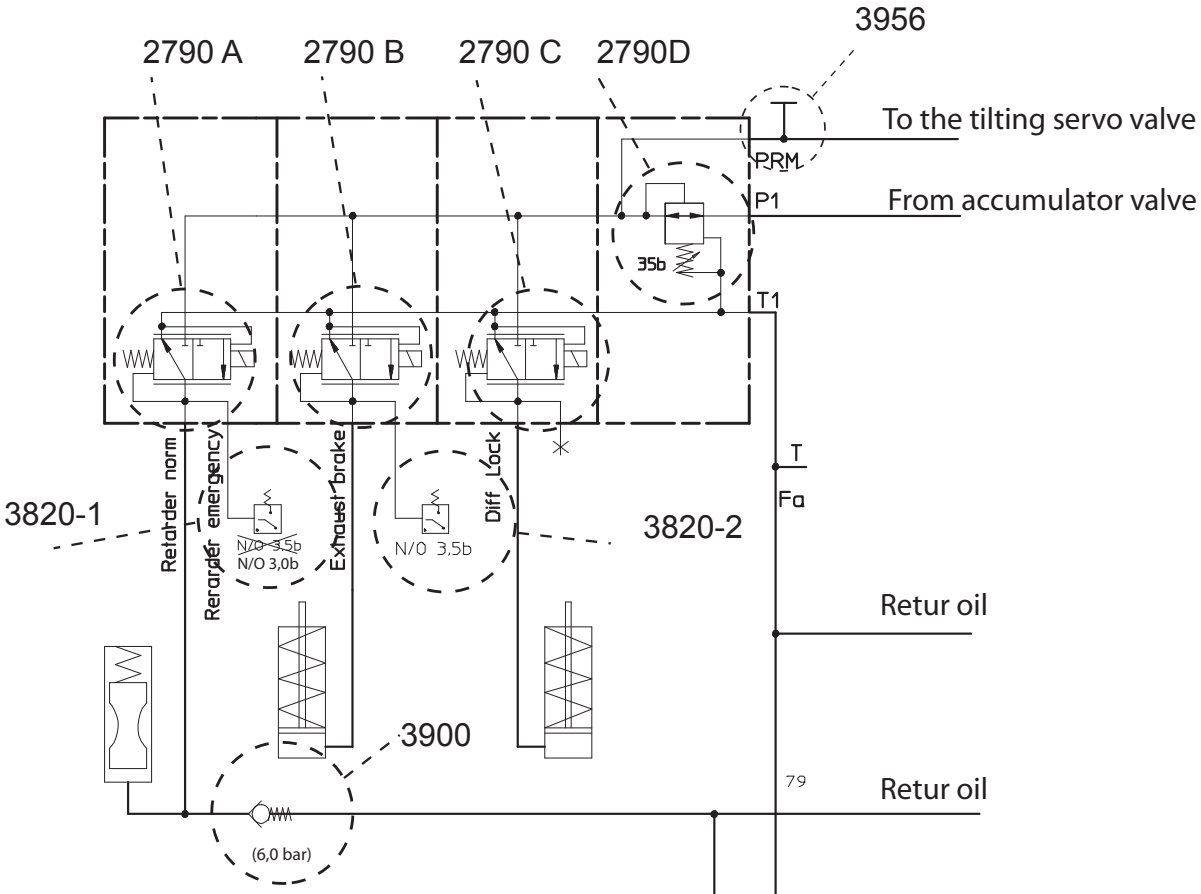
View of the tilting system



Solenoid valve cirquit



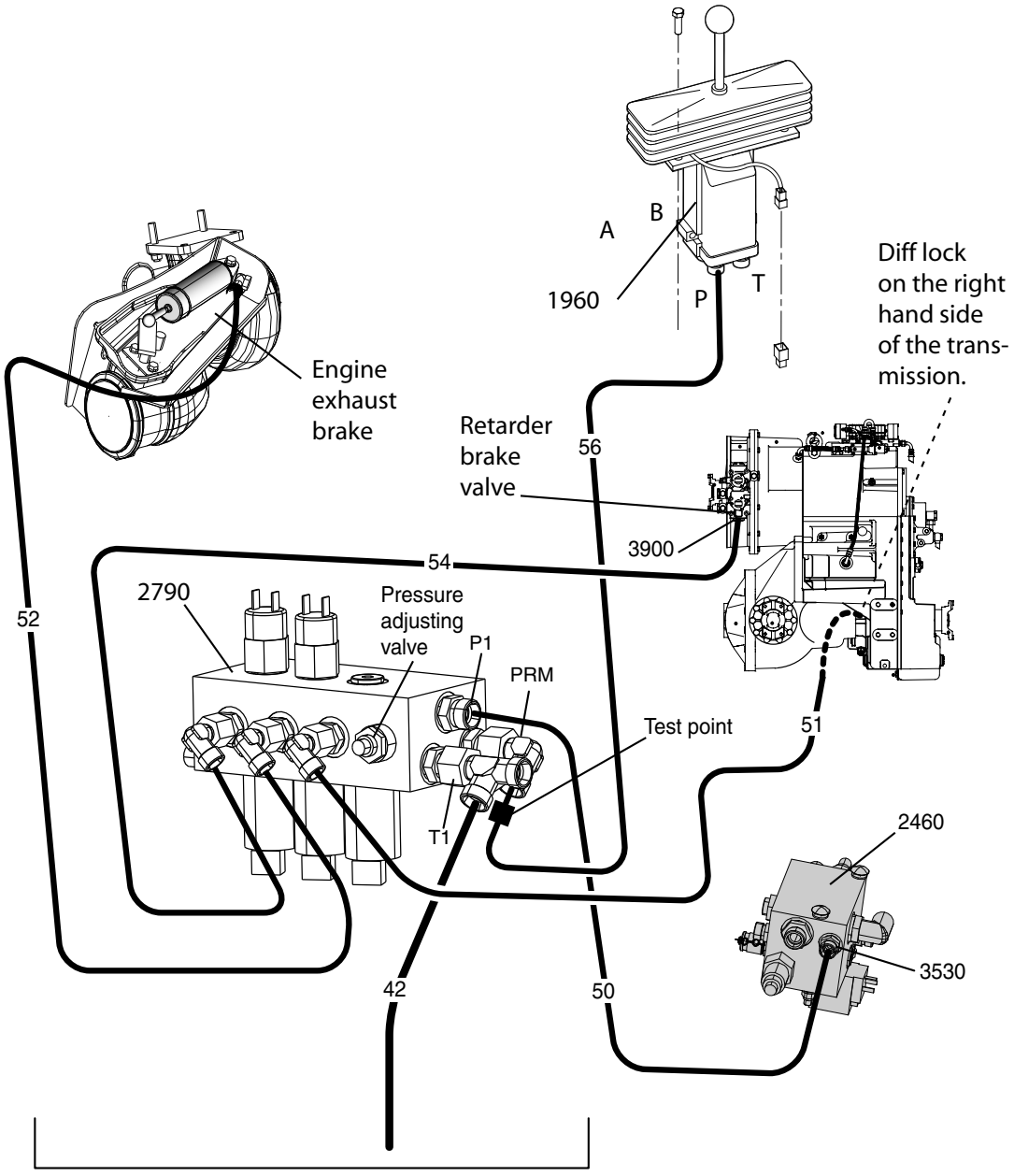




3820-1 Pressure switch
3820-2 Pressure switch
3956 Test point
2790A Solenoid valve Retarder
2790B Solenoid valve Exhaost brale
2790C Solenoid valve Diff lock
2790D Pressure reduction valve

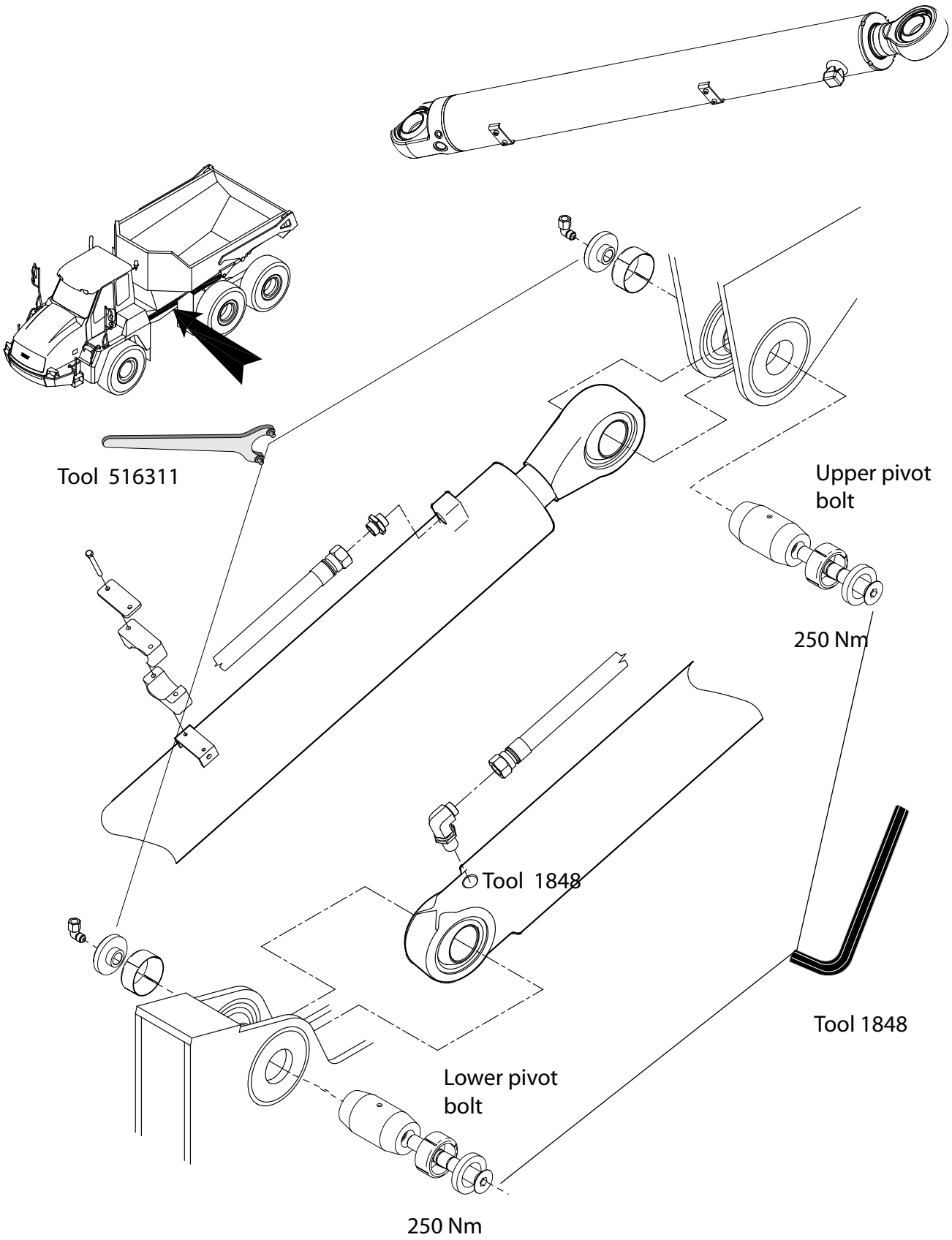
Tilting servo pressure, control / adjusting



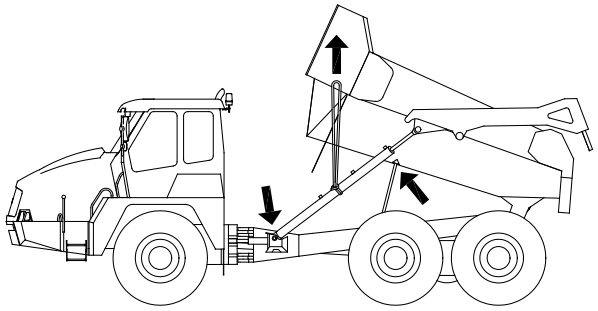


Tilt cylinders:

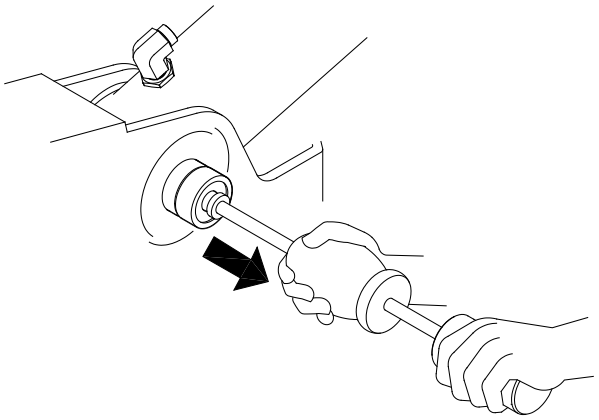
- Double acting
- Qty 2
- Cylinder diameter 115mm
- Piston diameter 70mm
- Stroke 2290mm



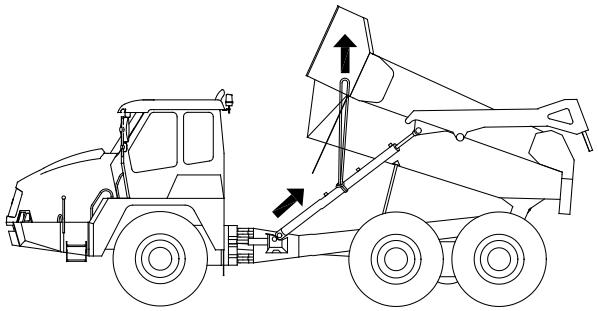
The Tilt Cylinders are located on the rear wagon on each side of the dumper body.
To remove the cylinders, rise the dumper body, and place body on safety stand.



Removal
Thoroughly clean the tilt cylinder and the area around for any accumulated dirt.
Place a container below the cylinder to catch any hydraulic fluid spilt during removal.
Mark each hydraulic line for proper location and plug lines as they are disconnected from cylinder.
Fasten a lifting sling between the two hose clamps on tilting cylinder.
Lift the cylinder slightly to remove the weight on the lower pivot bolt.
To remove the upper pivot bolt, unscrew securing screws and washers. Disconnect lubrication lines if fitted.
Remove the pivot bolt and expansion rings using a slide hammer to withdraw the bolt. Slide hammer must be equipped with a M20 adapter to fit the bolt.
When bolt is free, lower cylinder to get clear of bracket.
Remove lower pivot bolt as described for upper.

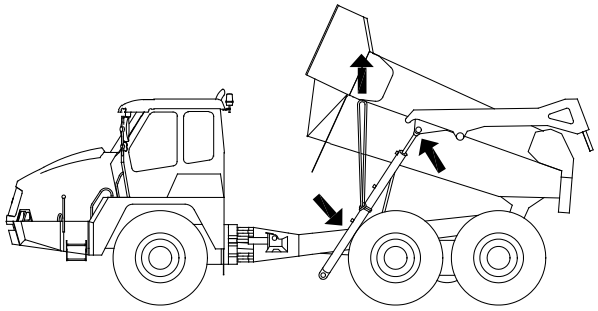


WARNING!_____
Be aware of the risk of injury to people and equipment when handling heavy objects!

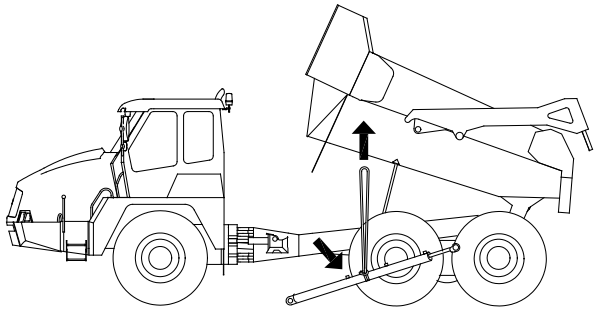


Carefully lift and push cylinder rearwards out of bracket, and swing front end of cylinder out, then lower to ground level.
If the cylinder is removed for exchange, unscrew the hose fittings attached for possible reuse.

Installation
Check the condition of the connector seals, replace if necessary. Apply a light coat of oil to the connector seals.
Install the connectors in cylinder body, and tighten.
Install cylinder in opposite order as described for removal.
Pivot bolts are installed with the lubrication supply bore facing in, and lubrication cross bore pointing perpendicularly to cylinder center line.
Pivot bolts are driven in using a soft mallet. Make sure pivot bolts and attaching parts are centred before securing screws are tightened. Install lubrication lines. Reconnect hydraulic hoses.



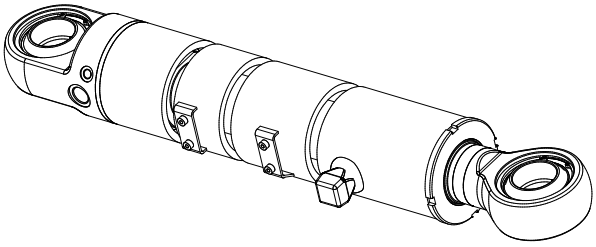
Control
Check that all connections are located in the same positions as before removal, and that all hoses are correctly routed.

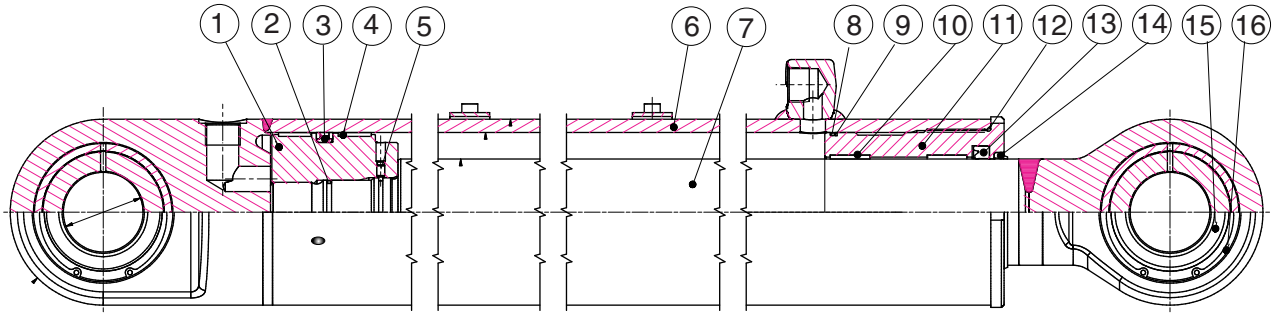


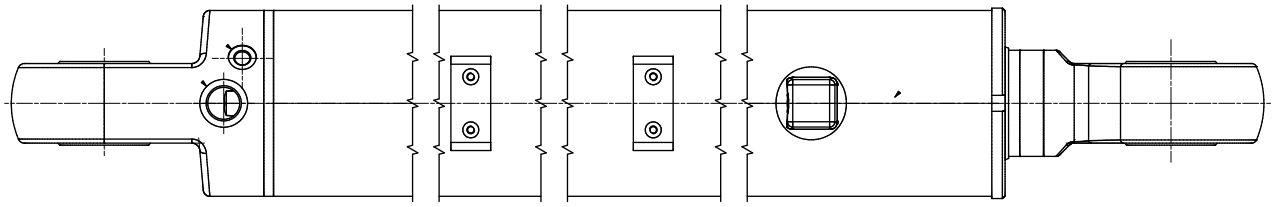
Perform startup test procedure.
Ref. section: Startup test procedure.

Tilt cylinder, sectional drawing.

Torque limit:
Pos 1: 1370 Nm
Pos 5: 5 Nm
Pos 11: 500 Nm







Tilting cylinder ass'y

Pos	Qt'y	Description
1	1	Piston
2	1	O-ring
3	1	Piston seal
4	2	Steering
5	1	Locking screw
6	1	Casing
7	1	Piston rod
8	1	O-ring
9	1	Backup ring
10	2	Steering
11	1	Cover
12	1	O-ring
13	1	Piston rod seal
14	1	Stripper
15	1	Bearing
16	4	Retaining ring
		Seal kit

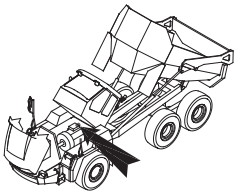
xx

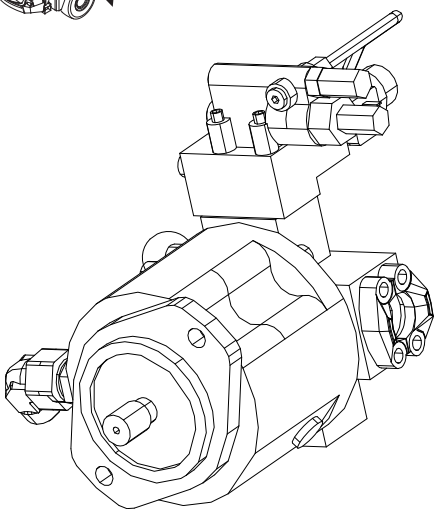
Fan system

Fan and accumulator pump.

- Variable axial piston pump
- LS – operated
- Mounted at rear of transmission
- Driven by the engine

• Ratio	1.05 : 1
• Maximum volume	28 ccm
• Stand – by pressure	30 ±2.0bar (idle)
• Maximum (fan) pressure	250 ±3.0 bar (1500 rpm. Will start dropping at approx. 1200 rpm)





The Fan Drive Pump is located at the rear end of the transmission.
Pump is accessed from rear, under the cab. Can also be accessed by tilting the cab. (Ref. Operation and Maintenance Handbook)

Removal
Thoroughly clean the Fan Drive Pump and the area around for any accumulated dirt.
Remove electrical connector from the solenoid valve, by unscrewing one screw.
Place a container below the pump to catch any hydraulic fluid spilt during removal.
Mark each hydraulic line for proper location and plug lines as they are removed from valve.
Unscrew the two bolts securing the pump to the transmission.

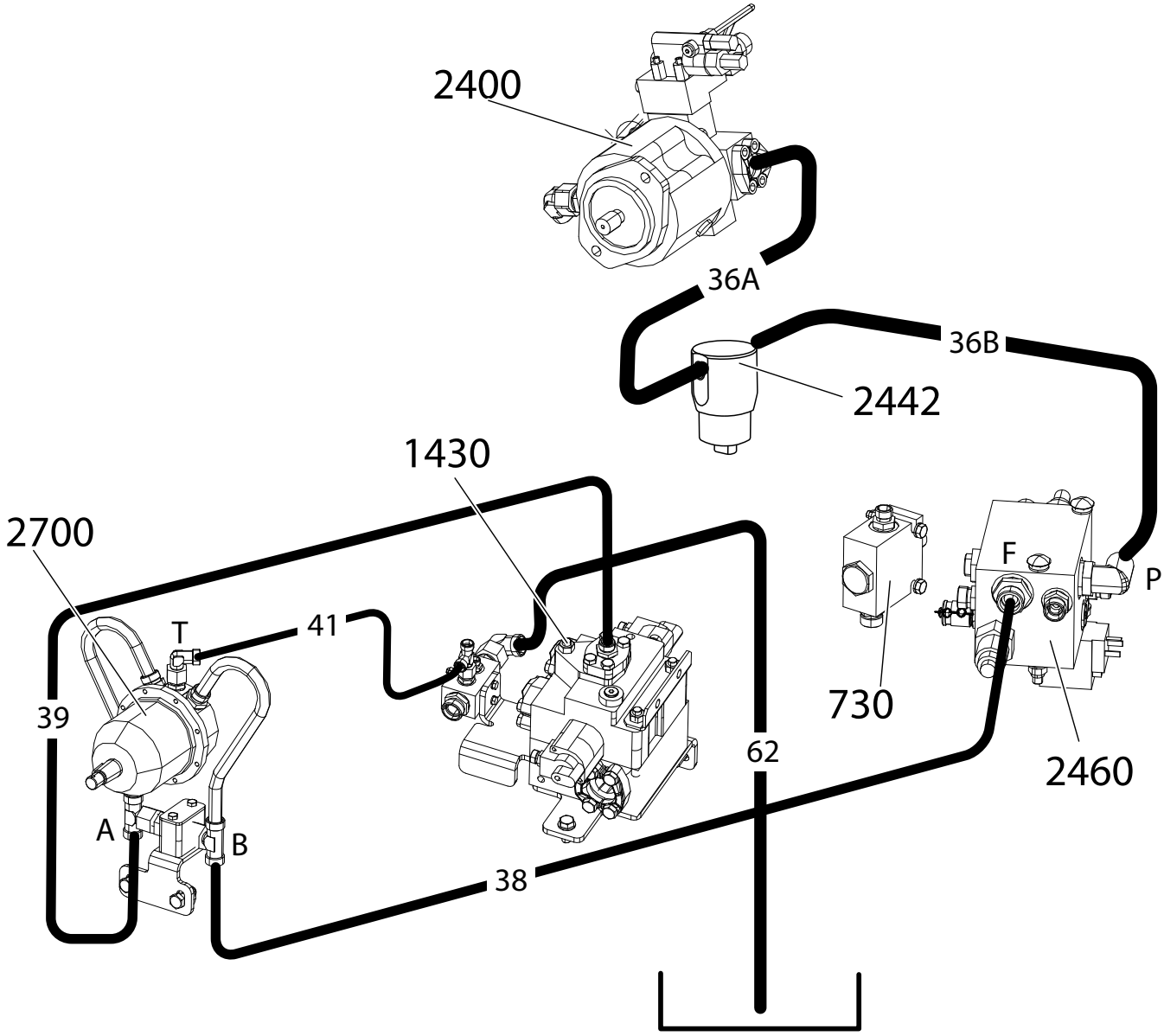
Lift the Fan Drive Pump out from the truck for exchange or overhaul. Observe the O-ring on the mating flange.
If the valve is exchanged, save the connectors attached to the valve body.

Installation
Check the condition of the connector seals, replace if necessary. Apply a light cote of oil to the connector seals.
Install the hose fittings in the valve body, and tighten.
Apply a light coat of lubrication on the axle splines. Check that the o-ring is installed to seal the mating flange, and position the pump onto the transmission..
Check that the pump is properly seated, and thighten the two bolts.
Clean the flange couplings, and install new o-rings, ensure that the hoses are positioned in correct angle, and tighten the bolts.
Install the remaining smaller hoses.
Replace the electrical connector on the solenoid valve.

Control
Before startup - Check that all connections are located in the same positions as before removal, and that all hoses are correctly routed.

Perform startup test procedure. Ref. section: Startup test procedure.

Fan cirquit



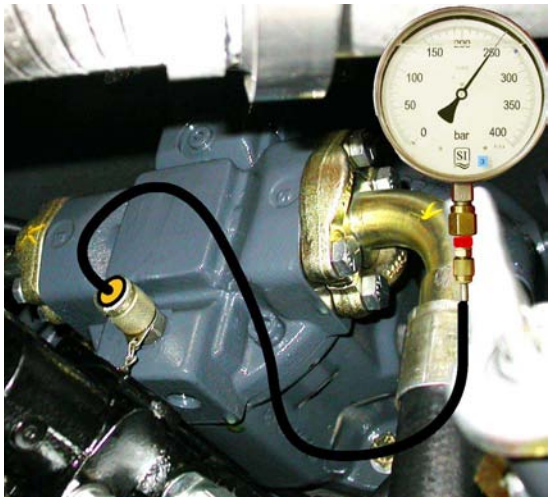
Pump pressure adjustment

Controll main pressure.

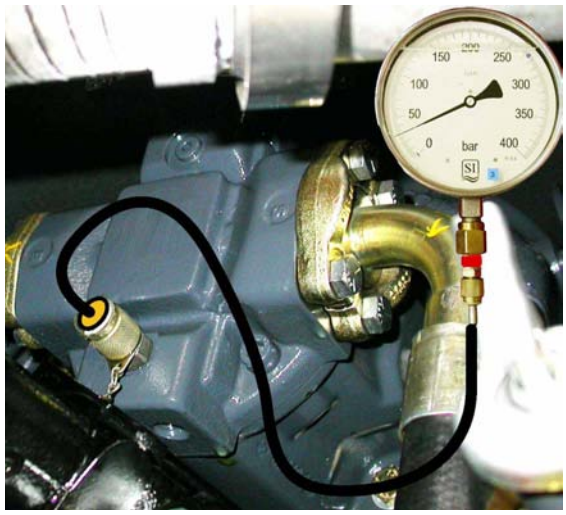
Remove the plug and assemble to the pump housing the test connector.

Connecting the manometer connection to the pump.

Release the electrical connector from the solenoid valve.

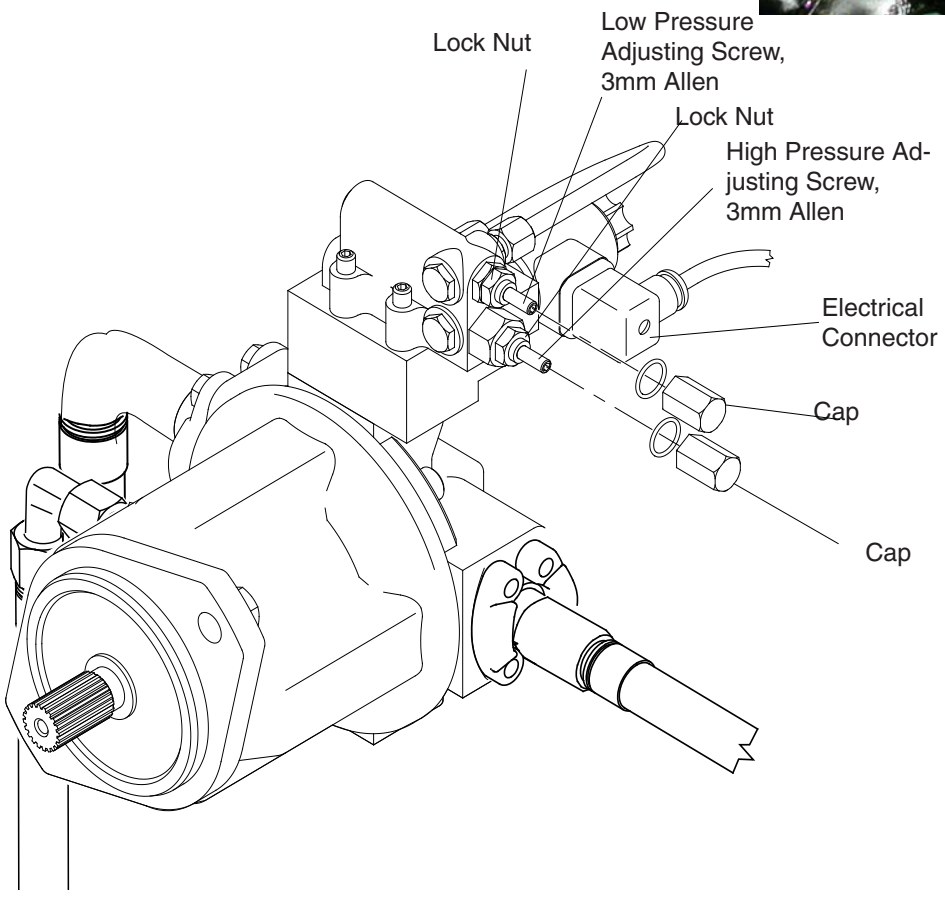


Run the engine with 1500 O/min , read the manometer, the high pressure shall now be adjusted to 250 ±3.0 bar

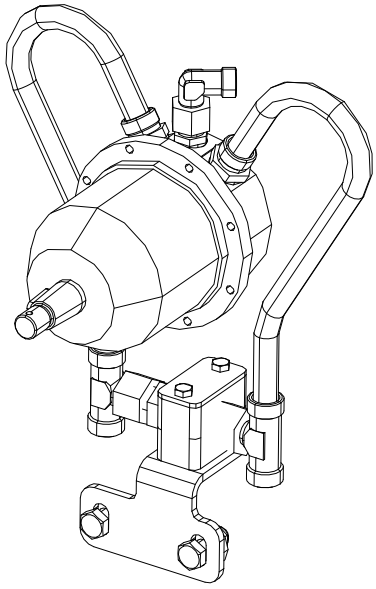


Adjust the low pressure to 30 ±2.0bar (idle)

See the figure below



Fan Drive Motor



The Fan Drive Motor is located at the front end of the engine, just behind the cooler package
Access is obtained by removing the bonnet.

Removal:
Drain the cooling system.
Remove the upper coolant and charge air hoses from cooler package.
Remove the two bolts securing the cooler package to the dumper frame.
Remove the bracket securing the cooler package to the engine by unscrewing the bolts.
Unscrew the two upper bolts, and loosen the two lower bolts securing the fan unit support bracket to cooler package.
Cooler package can now be tilted forwards, and the fan unit support bracket tilted rearwards to give more space for further removal of parts.
Thoroughly clean the fan drive motor and the area around for any accumulated dirt.

Remove fan.

When removing the fan drive motor the fan can be left standing inside the radiator shell assembly, using rags to protect radiators.
Otherwise the fan can be lifted out from cooler package.
Place a container below the motor to catch any hydraulic fluid spilt during removal.
Mark hydraulic lines for proper location and plug as they are removed from motor.

Remove the hydraulic tubing attached to the motor.
Unscrew the eight bolts securing the motor to the support bracket, and the motor can be removed for exchange or overhaul. Pull cooler package and fan unit support bracket forwards, and pull fan drive motor backwards If the motor is exchanged, save the connectors attached to the valve body.

Installation
Check the condition of the connector seals, replace if necessary. Install the connectors in motor body, using a light coat of oil on the seals and tighten.

Install fan drive motor in support bracket, and tighten the eight bolts.
Attach the hydraulic tubing to the motor.
Position key in motor shaft slot, and slide fan in position on shaft. Tighten axle nut, and secure with cotter pin.
Replace fan unit support bracket on cooler package, and tighten the four bolts.
Replace the cooler package securing bolts, and tighten.
Install the coolant and air hoses between engine and cooler package.

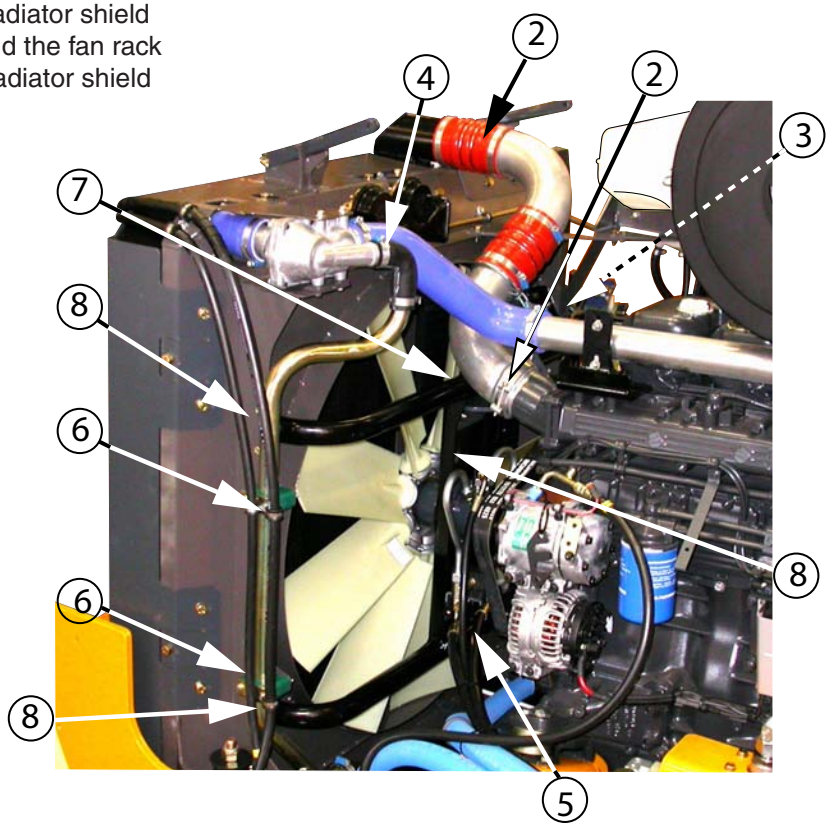
Control
Before startup - Check that all connections are located in the same positions as before removal, and that all hoses and tubes are correctly routed.

Perform startup test procedure. Ref. section: Startup test procedure.

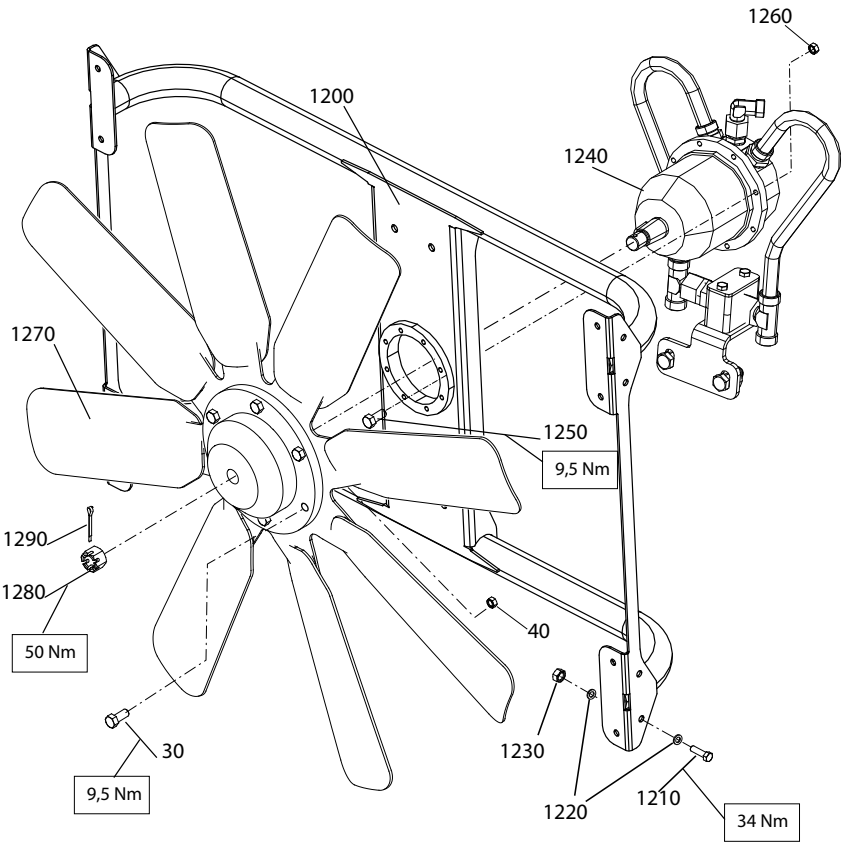
Disassemble the fan and fan motor

1 Drain the cooling system.

2 Remove the pipeline between the engine and the air cooler.
3 Remove clamping band for the hose and wiring
4 Disassemble the inlet cooling hoses from the thermostat housing
5 Disassemble the hydraulic hoses from the fan motor
6 Disassemble the pipe clamps from the radiator shield
7 Disassemble bracket between engine and the fan rack
8 Disassemble the fan unit rack from the radiator shield



Pos	Qty	Description
1200	1	Fan beam
1210	16	Screw
1220	32	Washer
1230	16	Nut
1240	1	Motor
1250	8	Screw
1260	8	Nut
1270	1	Fan
1280	1	Nut
1290	1	Cotter pin

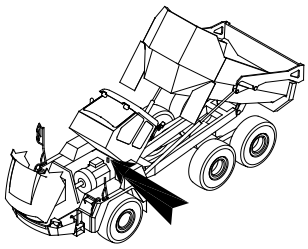


9. Disassemble cotter pin (1290) and the nut (1280) from the fan motor.
10. Disassemble the fan motor from the rack.

Assemble in reverse order.

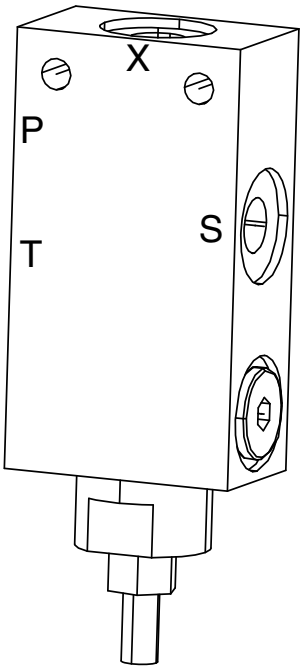
Note:
Be aware the conical shaft end have clearance to the nut surface when assembling.

Auxilary Valve



The Auxilary Valve is located on the front wagon, rear frame-member. Access is from rear of front wagon.

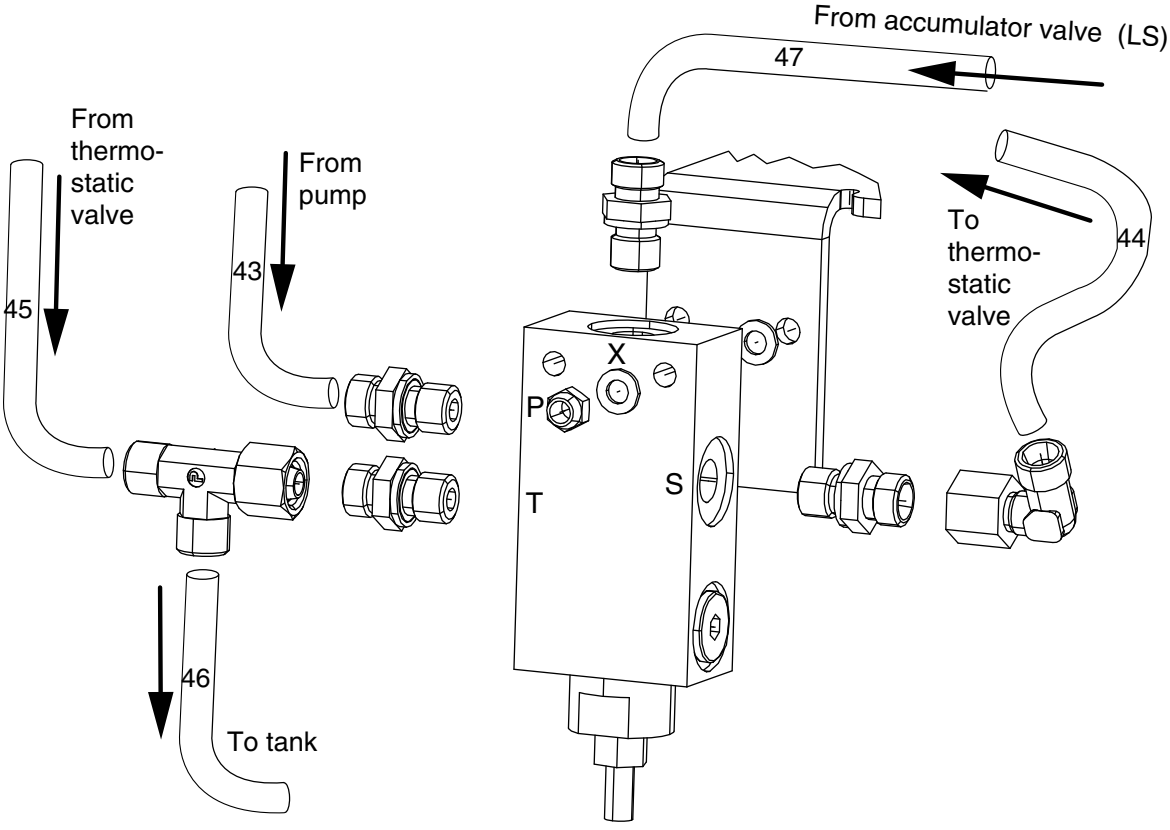
Removal
Thoroughly clean the pressure reduction valve and the area around for any accumulated dirt.
Place a container below the valve to catch any hydraulic fluid spilt during removal.
Mark each hydraulic line for proper location and plug lines as they are removed from valve.
Unscrew the two bolts securing the valve to the bracket. Observe that each bolt has a washer between the bracket and the valve body, as well as under the head and nut.
Lift the pressure reduction valve out from the truck for exchange or overhaul. If the valve is exchanged, save the connectors attached to the valve body.



Installation
Check the condition of the connector seals, replace if necessary. Apply a light coat of oil to the hose fitting seals. Install the connectors in valve body, and tighten.

Position the Auxilary valve on its bracket. Install two securing bolts with washers both under each head, nut and between the bracket and the valve body. Tighten the bolts.
Install the hydraulic lines.

Control
Check that all connections are located in the same position as before removal, and that all hoses are correctly routed.



Tilt / auxiliary operation servo

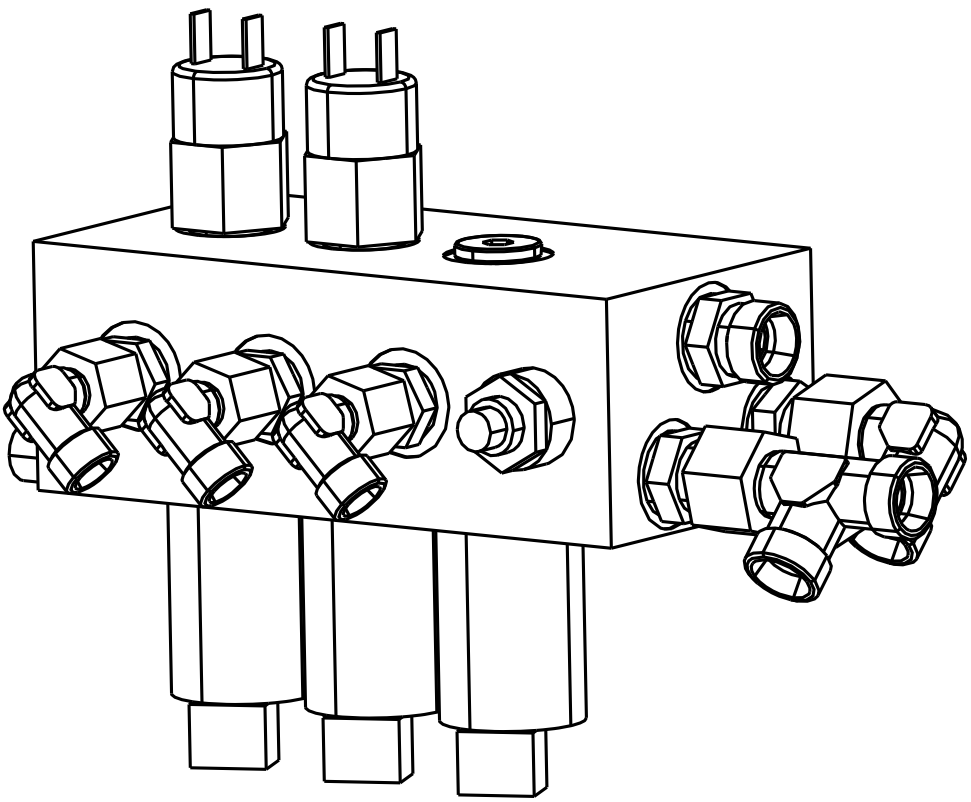
(diff. lock, engine and retarder brake):

- Pressure reduction valve 35 ±0.5bar

(fan pump at maximum pressure engine at idle)

Operating pressure:

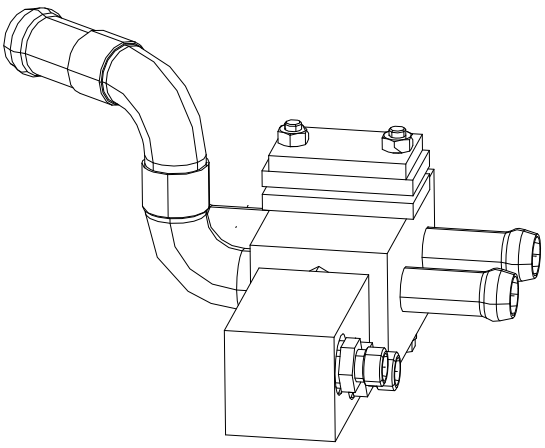
- Diff. lock 10 ±0.1bar
- Engine brake 10 ±0.1bar
- Retarder 4 ±0.1bar



Thermostatic Valve

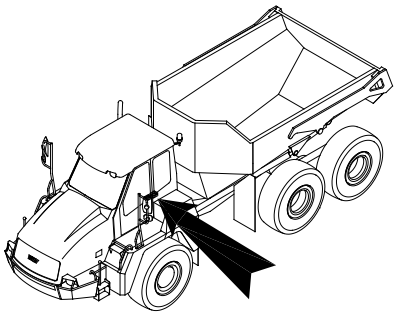
The Thermostatic Valve is located underneath cab floor. Access is from rear of front wagon.
The thermostatic valve is inserted into the cooling system, to monitor the temperature to control the delivery rate of the fan drive pump.
When the engine temperature is rising (79 - 85°C), the thermostatic valve open the oil line and send signal to the Auxiliary valve.

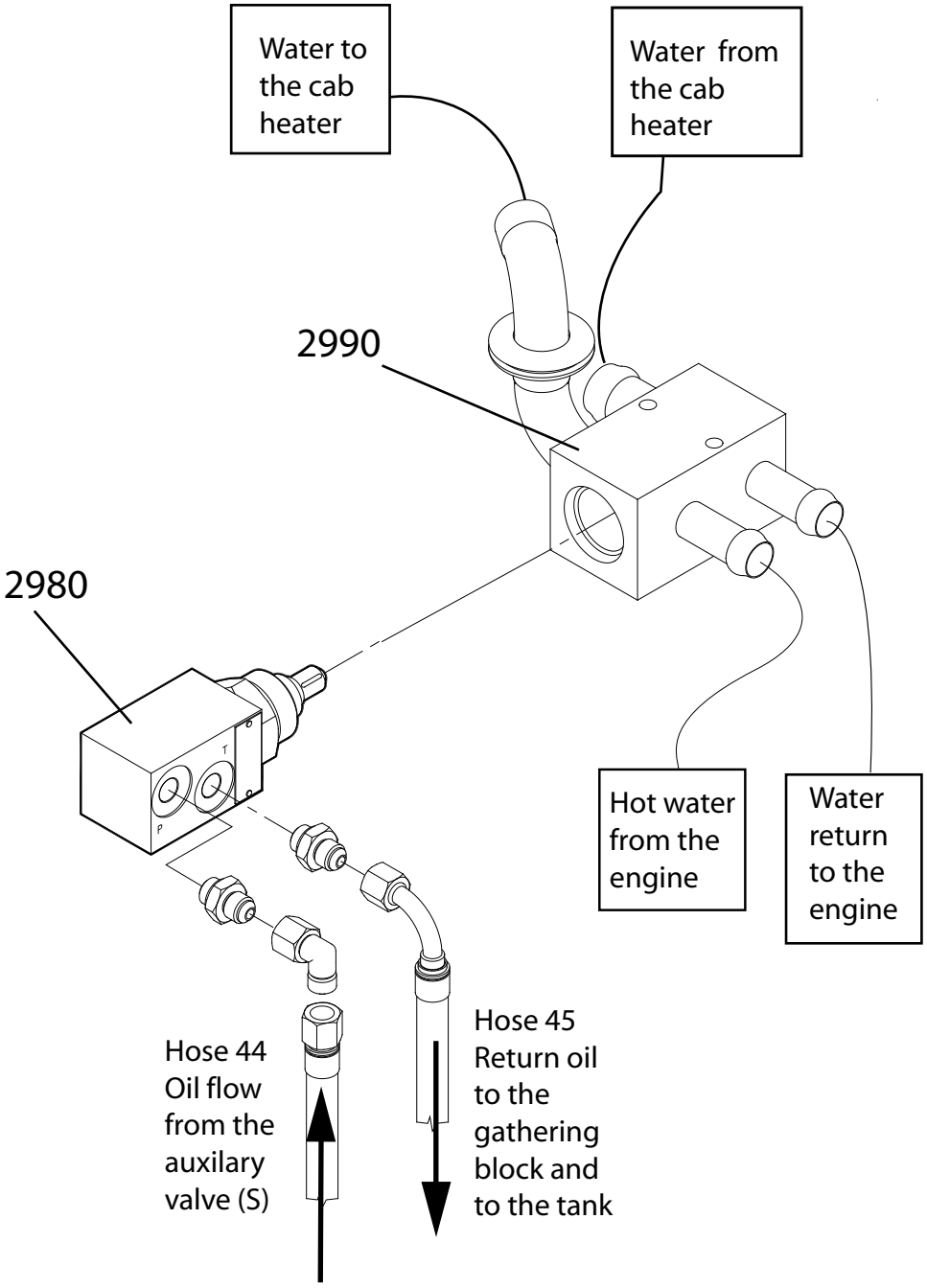
Removal
Drain the cooling system (Ref. 1.3.2)
Thoroughly clean the thermostatic valve and the area around for any accumulated dirt.
Place a container below the valve to catch any fluid spilt during removal.
Mark each hydraulic line for proper location, and plug lines as they are removed from valve.
Remove the connectors attached to the valve body.
Unscrew the valve from the cooling system interface block.
It may be necessary to loosen the two bolts securing the interface block to the cab floor to accomplish the removal of the valve.
Remove the thermostatic valve out from the truck for exchange or overhaul.



Installation
Insert the thermostatic valve in the cooling system interface block, using sealing compound.
Thighten the two bolts securing the interface block if loosened.
Check the condition of the connector seals, replace if necessary. Apply a light coat of oil to the hose fitting seals. Install the connectors in valve body, and tighten.
Install the hydraulic lines.

Control
Check that all connections are located in the same position as before removal, and that all hoses are correctly routed.




Water to the cab heater
Water from the cab heater
2990
2980
Hot water from the engine
Water return to the engine
Hose 44 Oil flow from the auxilary valve (S)
Hose 45 Return oil to the gathering block and to the tank

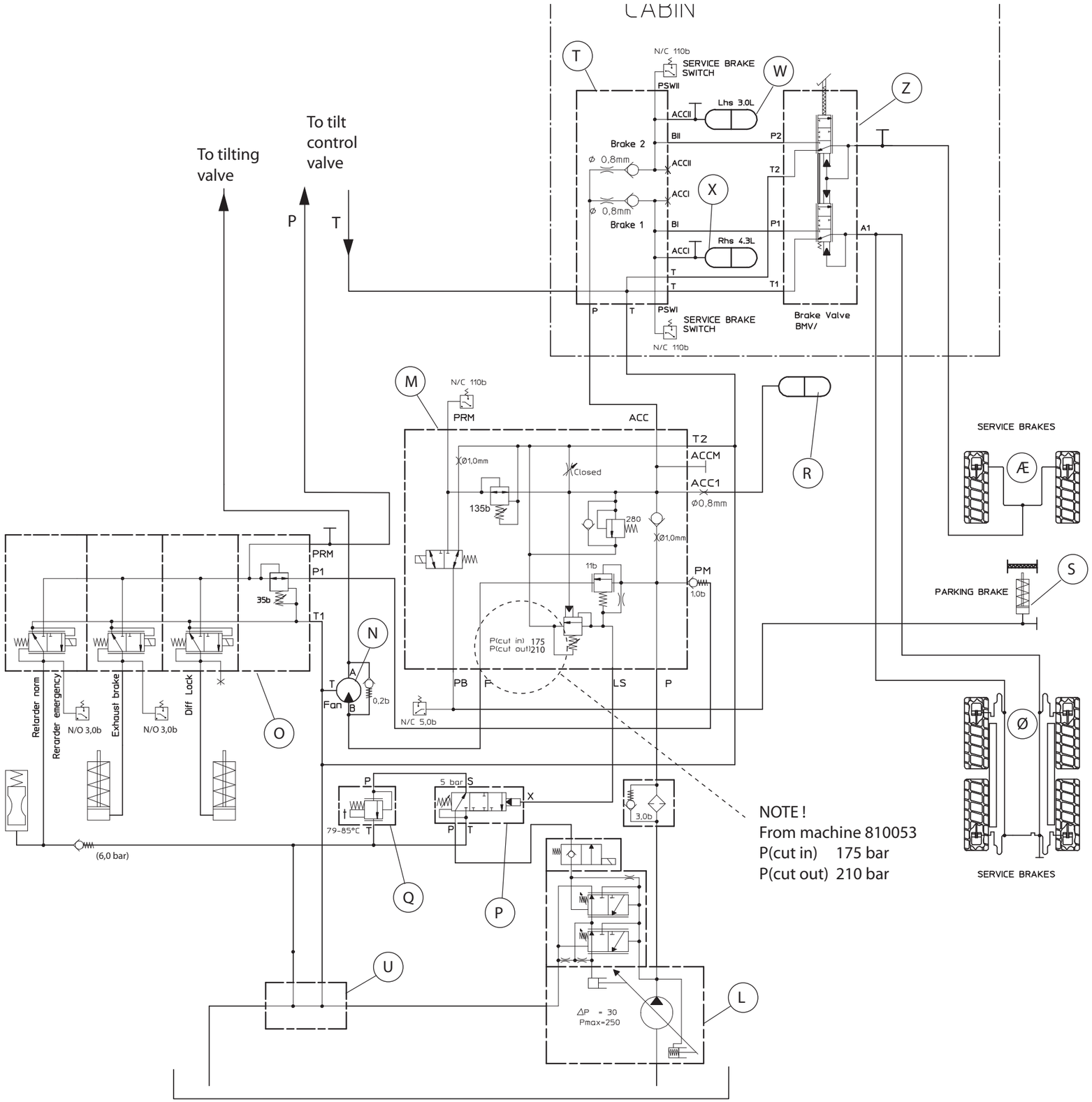
Brakes

Brake cirquit

MT26/31

Brake system flow chart

Pos	Description.
L	Fan pump variable
M	Accumulator valve block
N	Fan motor
O	Solenoid valve kit
P	Auxiliary valve
Q	Thermo
R	Accumulator park brake
S	Park brake unit w/hyd. cyl.
T	Accumulator connector block
U	Block f/gathering return hoses
W	Accumulator cirquit 2
X	Accumulator cirquit 1
Z	Foot brake valve
Æ	VDB Service brake front
Ø	VDB Service brake rear



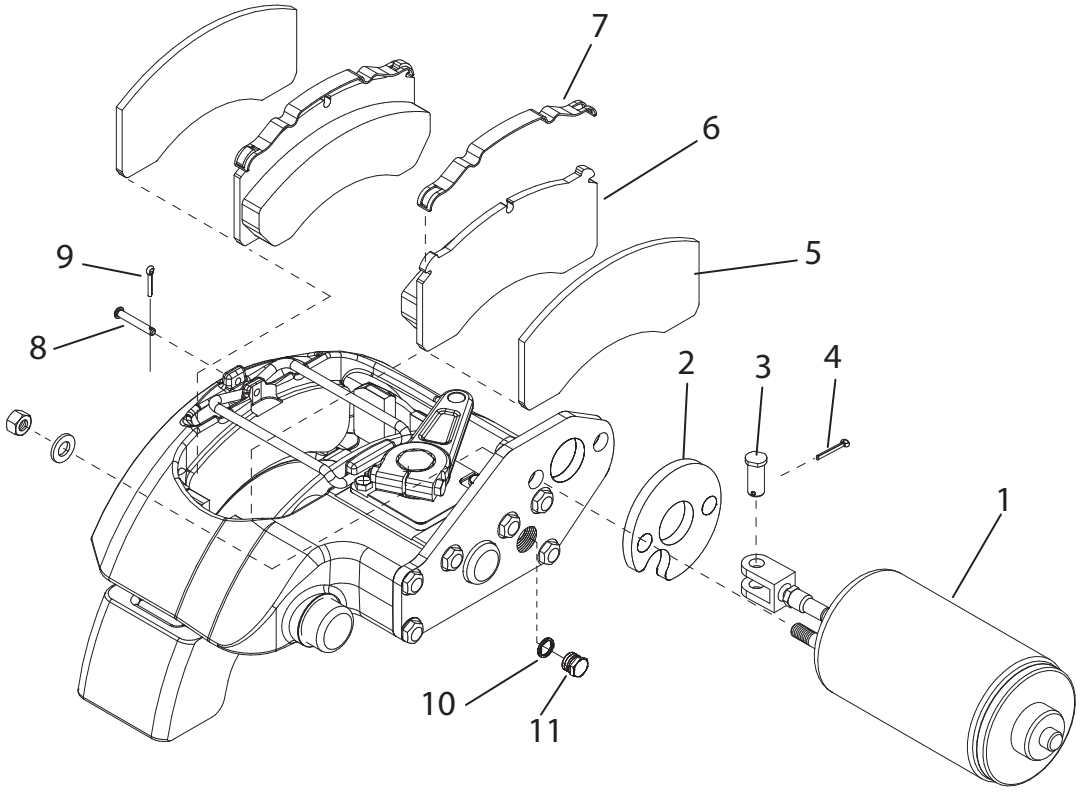
Parking brake, description

The parking brake is spring actuated, hydraulic released, self adjusting, single disc brake mounted at the fixed propeller shaft in rear chassis.

Operation
When the parking brake switch, is switched to the “on” - position, the parking brake accumulator, charged by the hydraulic pump is closed by the solenoid valve and park brake oil is returned to tank.
When the parking brake oil is drained, the park brake light switch is disconnected and park brake light on dashboard disconnects.

With the Park Brake Switch in the off position, the solenoid valve allow pressuriezed oil to compress the spring in the brake chamber to keep Park Brake in the off position.

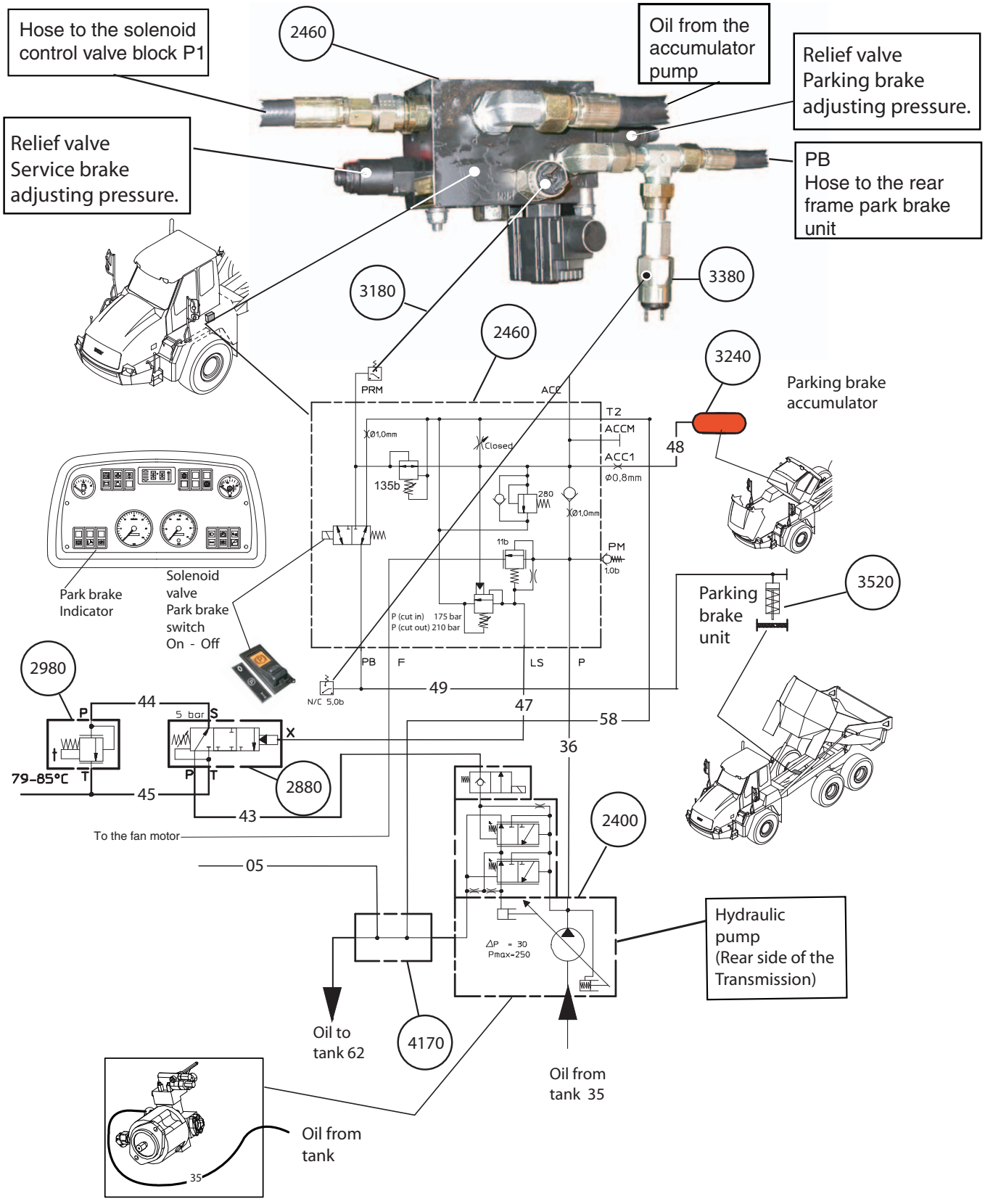
If for some reason the Park Brake oil pressure drops below approx 108 bar the spring force will apply the Parking Brake as an emergency brake. The warning light come on at 110 bar.



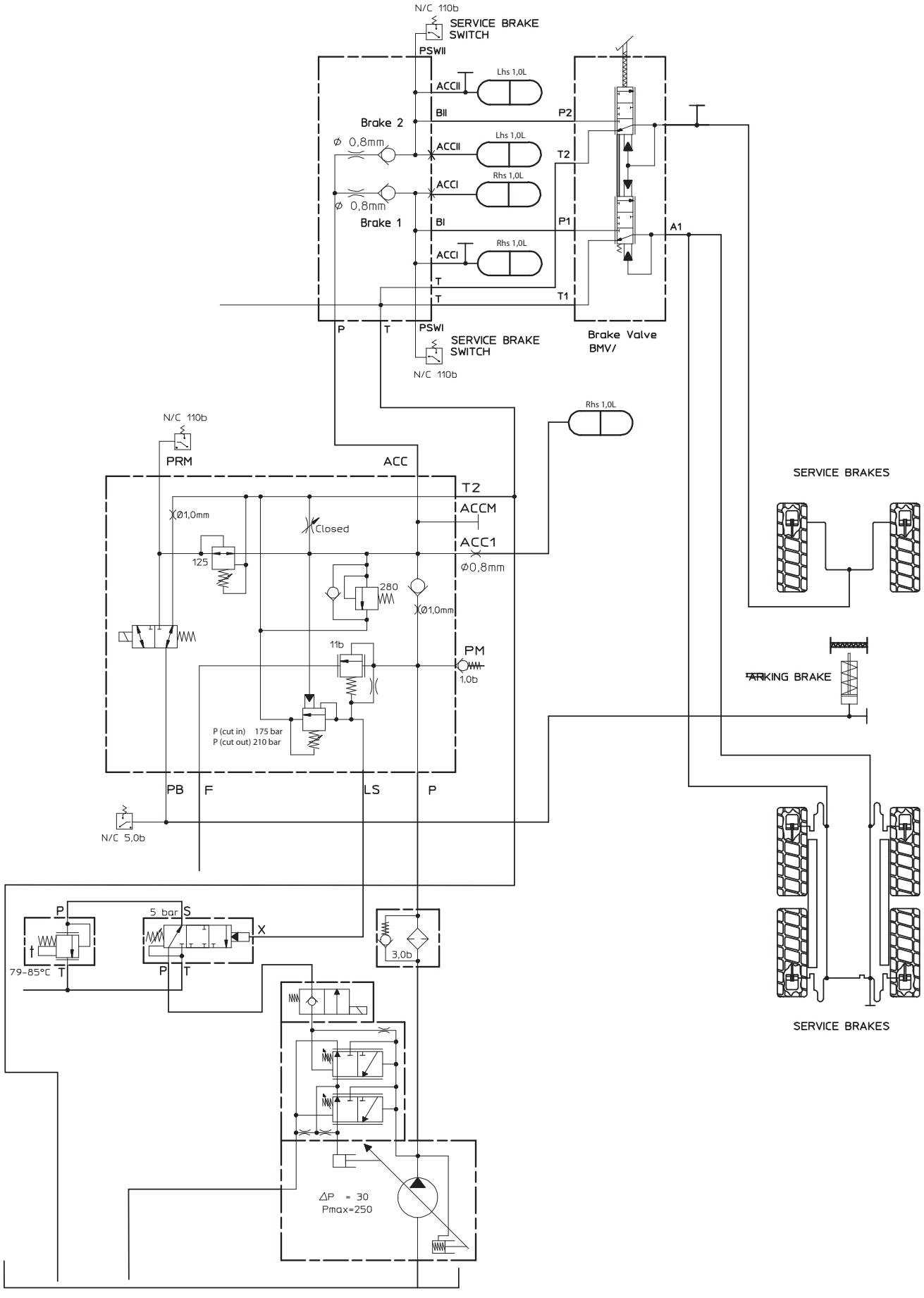
1	Chamber	7	Spring
2	Spacer	8	Retaining ring
3	Pin	9	Cotter pin
4	Cotter pin	10	Washer
5	Spacer	11	Adjuster plug
6	Lining assembly		



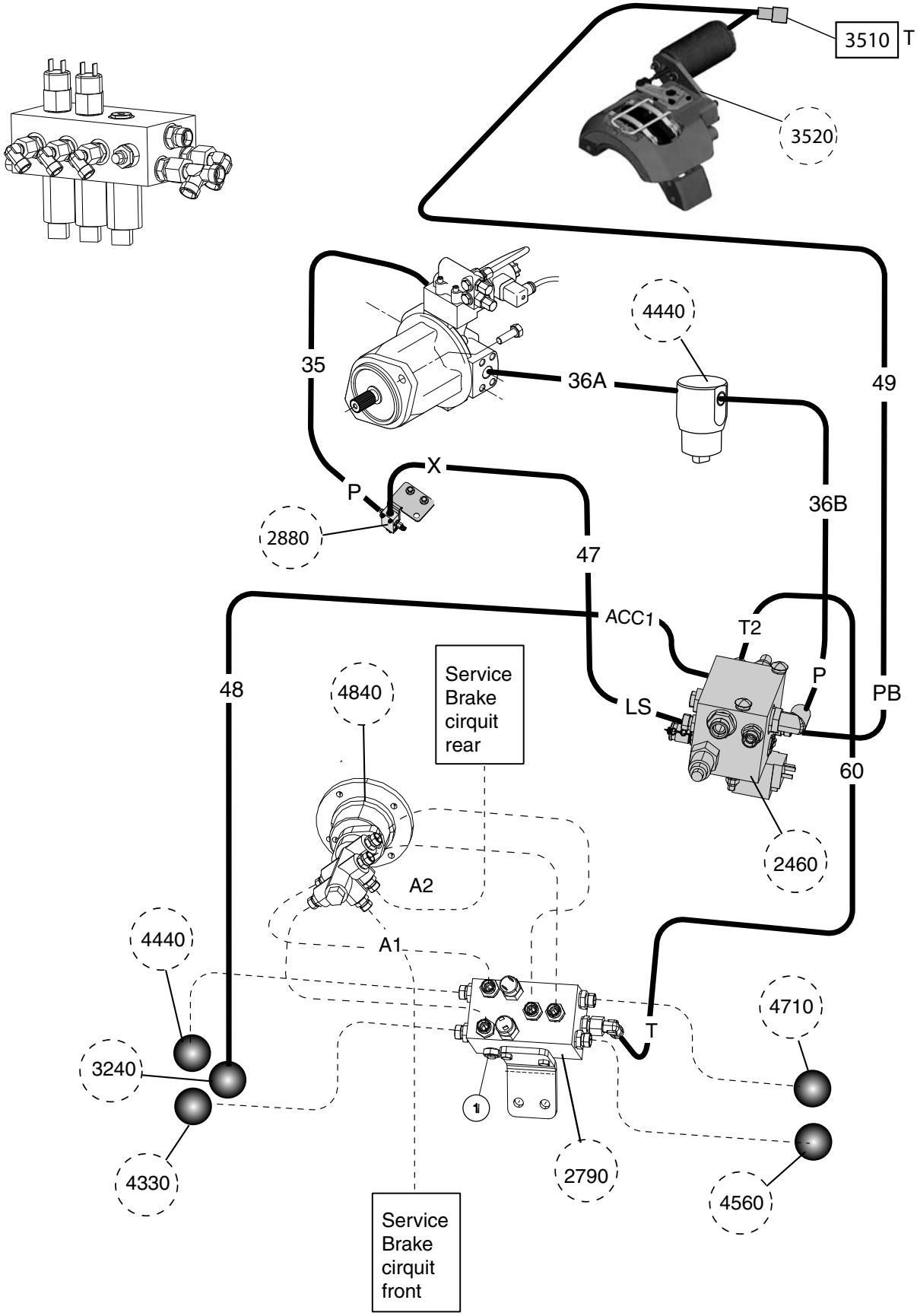
Parking brake cirquit veiw



Parking brake cirquit



Parking brake view



Park brake pressure control / adjusting



Secure the wheel with blocks.
Stop the engine and check the function:
Turn of the main circuit switch.
The park brake is now activated.

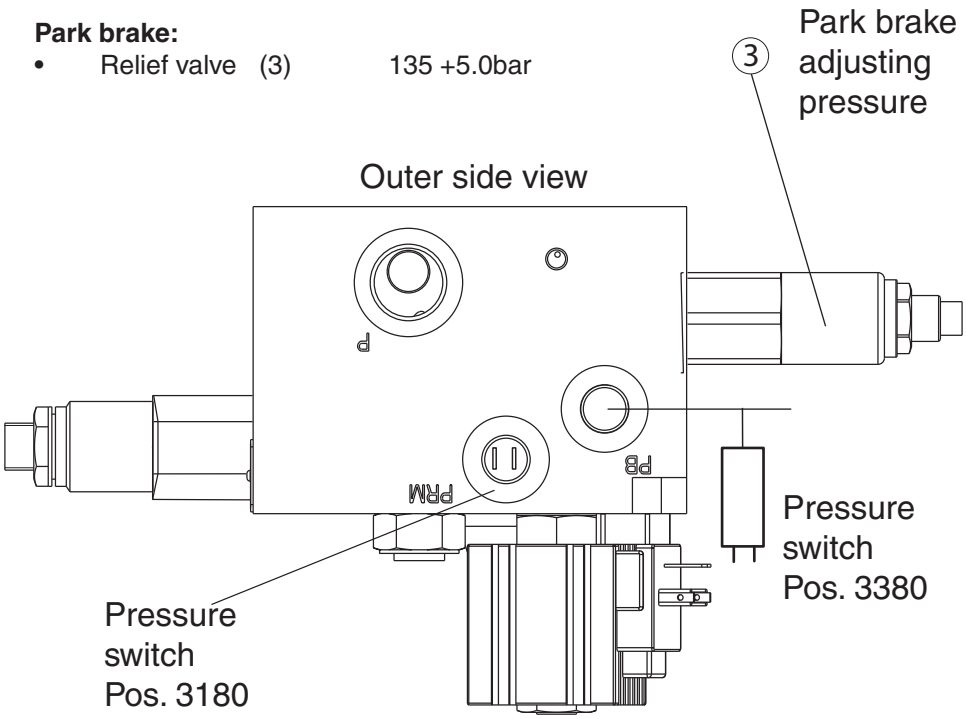
NOTE
The park brake switch is now in off-position.

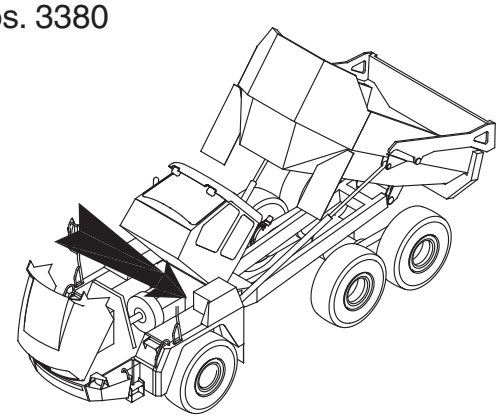
Start the engine, activate and deativate the park brake with the switch.
Connect the manometer and read the pressure on the manometer when the brake switch are in off position.

Correct value is 135 bar
If lower, adjust on the accumulator valve park brake adjusting pressure (135 +5.0 bar) (3)

The warning light coming on when pressure is lower than 110 bar.

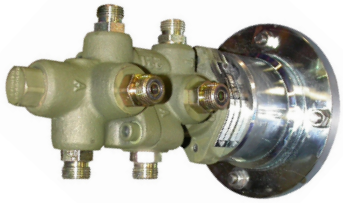
Park brake:
- Relief valve (3) 135 +5.0bar



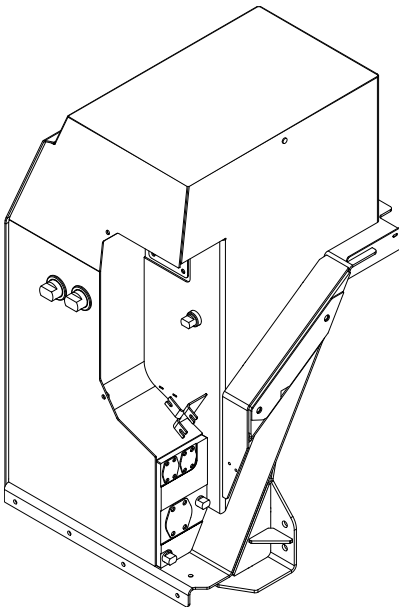


Service brake parts

The service brake consist of:
Hydraulic pump, Accumulators, Accumulator valve, Brake valve, Control valve, and calippers.



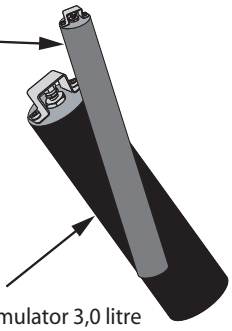




Accumulator 1,0 litre
left hand side.
Park brake

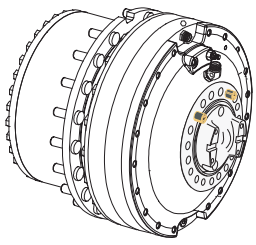


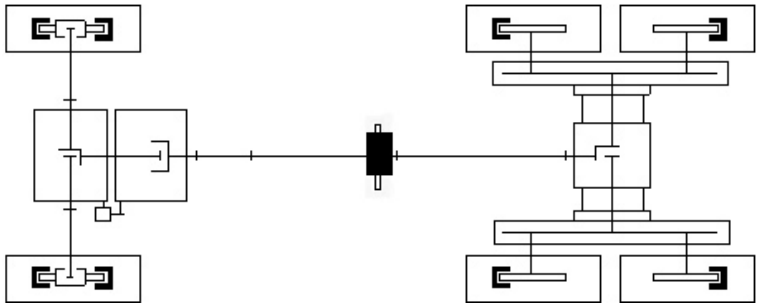
Accumulator 4,3 litre
right hand side.
Rear service brake

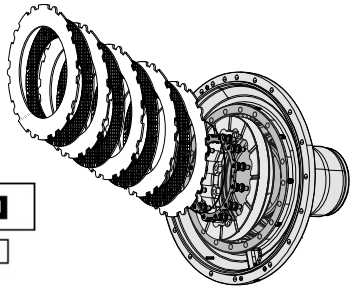


Accumulator 3,0 litre
left hand side.
Front service brake

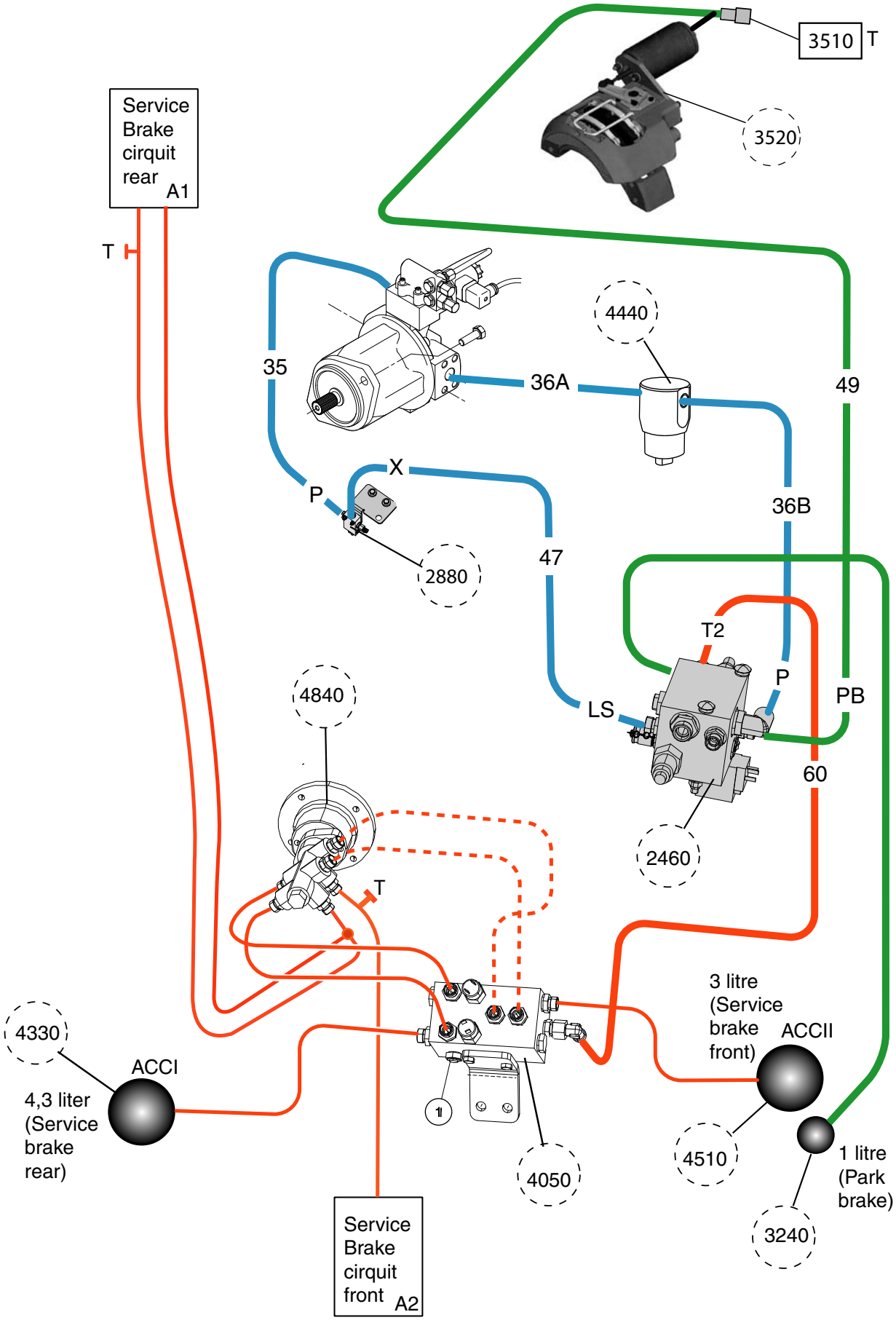








Service and park brake cirquit view



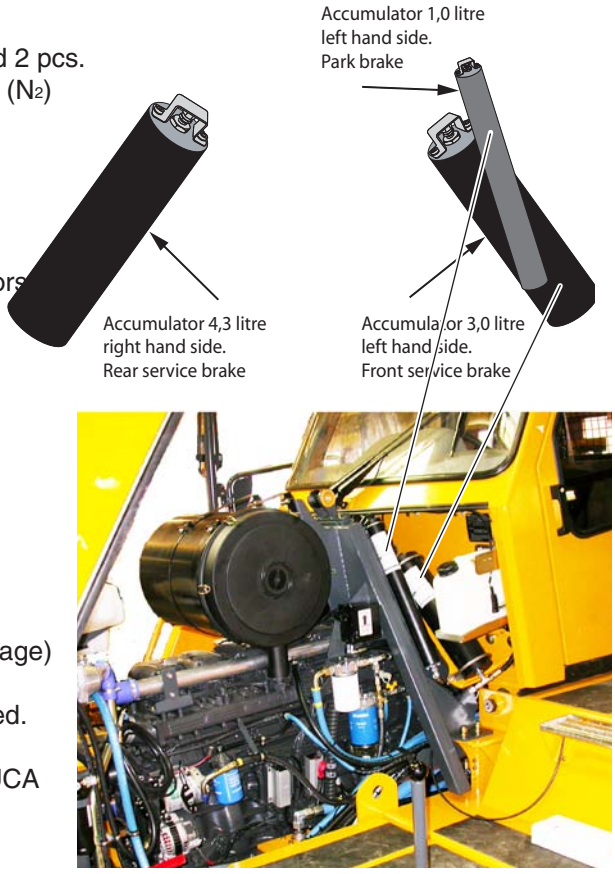
Accumulators

Description of the Accumulators

The accumulators for the parking brake are placed left and right hand side of the cab front wall.
On the right side are placed 3 pcs and at the leftside are placed 2 pcs.
The accumulators are from MOXY factory loaded with Nitrogen (N_2)

NOTE:
Wet disc brake: Pressure: 60,0 bar
Park brake: Pressure: 112,5 bar:

Read the loading instruction marked on each of the accumulators



Checking and Adjusting Precharge Pressure

The precharge pressure of the accumulator may be checked, and nitrogen filled or vented, using the UCA Universal Charging & Gauging kit. (See view of the kit at next page)
The UCA assembly is screwed onto the accumulator's gas valve, allowing the precharge pressure to be checked or reduced.
If the precharge pressure is to be increased, the UCA can be connected to the nitrogen source with the hose supplied. The UCA kit is supplied with two pressure gauges, reading 0-25 bar and 0-250 bar; where a different pressure range is required, a commercially-available pressure gauge may be used.

Safety

Charging must be carried out by qualified personnel.
Before taking any readings or pressurizing with nitrogen, the accumulator must be isolated from the hydraulic system and the fluid side discharged in order to depressurize it.

Use only nitrogen (N2) to pressurize the accumulator.

Danger of Explosion – Never Charge with Oxygen

The types of nitrogen permitted are: type S (99.8% pure); type R (99.99% pure); type U (99.993% pure).
If the pressure of the gas contained in the nitrogen bottle is greater than the maximum permissible operating pressure of the accumulator, a pressure regulator must be fitted to the nitrogen bottle.

Moxy recommends that the precharge should be checked during the first week following commissioning of the system.
Thereafter, it should be checked every three months, or at intervals determined by the system builder.

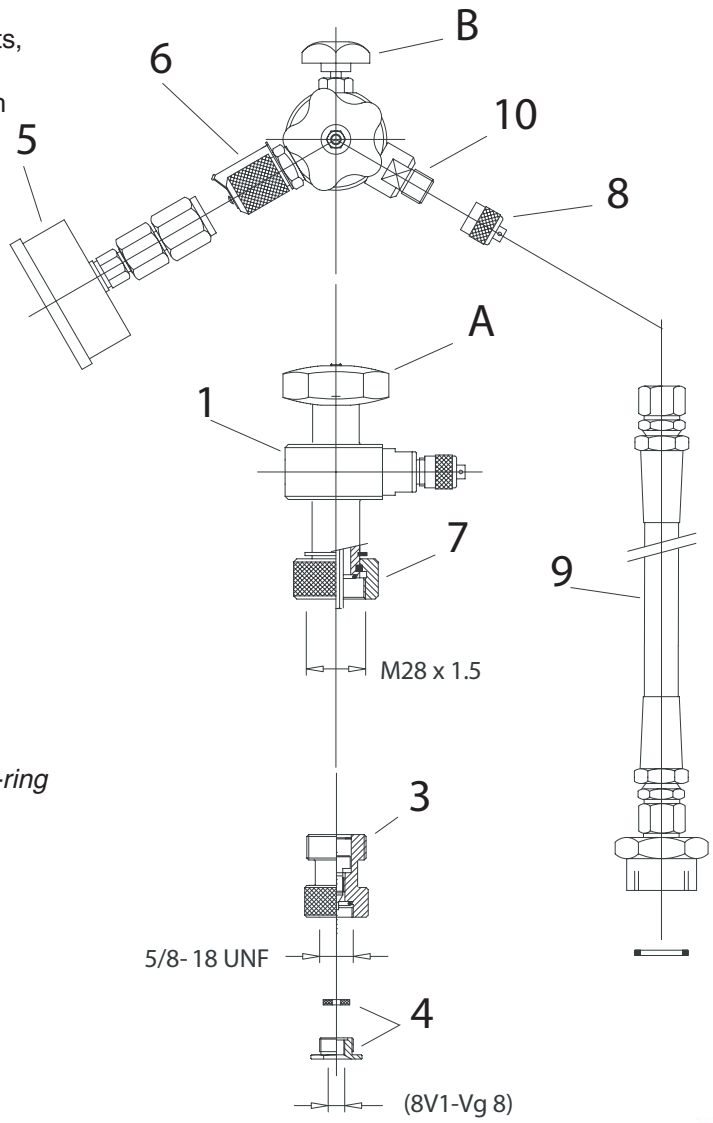
The Effect of Temperature on Precharge Pressure

In order to compensate for the difference in pressure at ambient and operating temperatures, it is recommended that the precharge pressure po should be adjusted to reflect the operating temperature of the system, using the correction factor equations and table on page 11.

Warning – Stabilization

The process of charging or discharging an accumulator with nitrogen causes a temperature change which is transmitted to the surrounding air as the temperature of the accumulator stabilizes.
To allow for the effects of temperature transfer, the accumulator should be allowed to stand for a minimum of 15 minutes before a final reading of the precharge pressure is taken.

Gas Bottle Fittings and Part Numbers
To meet the requirements of different markets, Parker's UCA
Charging and Gauging Kits are supplied with an adapter to
suit the appropriate gas bottle fitting.



Controls

A Inflation valve
B Bleed valve

Key

1 UCA
3 Adapter (short)
4 Adapter (insert) with fibre washer
5 Pressure gauge
6 Knurled protective cap – gauge port
7 Knurled collar – gas port
8 Knurled protective cap – filling port
9 Filling hose (G1/4 fitting, 60° cone) with O-ring
10 Filling port valve

Pos 9 spare hose Moxy No. 515642

Pre - charging (Nitrogene N2)

NOTE:

Wet disc brake: Pressure: 60,0 ±0.5bar
Park brake: Pressure: 112,5 ±0.5bar:



UCA Universal Charging & Gauging kit. No. 515148
Pos No 9 is special for the different country. See the list below:

Country	Gas Bottle Fitting	Moxy part No
UK	5/8 BSP (male)	Moxy No. 515149
France	W 21,7 x 1/ 14" (female)	Moxy No. 515151
Germany	W 24,32 x 1/ 14" (female)	Moxy No. (Incl. 515148)
Italy	W 21,7 x 1/ 14" (male)	Moxy No. 515152
US	0,960 x 1/ 14" (male)	Moxy No. 515150

Operating Instructions

Only fluids in Group 2 as defined by the Pressure Equipment
Directive 97/23/EC are permitted for use in A and AP Series accumulators – see Piston Accumulator Operating Instructions, bulletin 1240-T1.
Before installation, refer to the pressure and temperature limits shown on the nameplate.
For cyclic loading, consult Parker regarding the fatigue-free working pressure range or limiting of the number of cycles for finite life applications.

Maintenance

Accumulators must be regularly examined, checked for general condition, and maintained on a periodic basis. The frequency and extent of inspection required will depend on experience with the particular application. It is the responsibility of the accumulator installer to set the frequency of maintenance appropriate to the application, but a period of one year between inspections is considered to be an acceptable maximum.

In the case of finite life applications, Parker recommends inspection of the accumulator when one half of the allowable load cycles has been completed or after a period of one year – whichever occurs first.
If the user is not competent to make the necessary assessment of reliability, then expert advice must be obtained. Examination shall consist of visual inspection of the physical integrity of the equipment and, where applicable, a functional test.

Maintenance routines shall be performed by authorised personnel only and shall include the verification of settings and operational testing where applicable.
Maintenance shall also include routine testing of individual devices after specified service cycles and the exchange of components before the end of the projected lifetime.

Maintenance programs and work, results of examinations and any resulting remedial measures taken shall be documented and retained for 10 years or the lifetime of the installation (if shorter). Replacement of components shall be documented and retained in the same way.

Repair Kits are available for all accumulator models; replacement of the piston seals is generally the only maintenance required.
When ordering repair kits, state the complete model number from the nameplate and specify the type of fluid and operating temperature. Replacement of other seals on end caps and the gas valve is also recommended (for A Series kit numbers, see page 4; for AP Series kit numbers, see page 6).

Periodic checking of the pre-charge pressure, see page 8, will provide early warning of deteriorating piston seal performance.
If pre-charge pressure is low, check also for gas valve and/or end cap seal leakage. Allowing for temperature difference, if any, the pre-charge pressure will rise if oil collects in the gas side and will fall if gas leaks into the oil side or past gas end cap seals. It is suggested that a check be made a week after installation, and thereafter once every three months or at intervals determined by the system builder.

Filling table of Correction Factors

Precharge Temperature t_0 °C

Operating Temperature t_2 °C	-20	-10	0	5	10	15	20	25	30	35	40	50	60	70	80	90	100
-20	1.00	1.04	1.08	1.10	1.12	1.14	1.16	1.18	1.20	1.22	1.24	1.28	1.32	1.36	1.40	1.43	1.47
-10	0.96	1.00	1.04	1.06	1.08	1.10	1.11	1.13	1.15	1.17	1.19	1.23	1.27	1.30	1.34	1.38	1.42
0	0.93	0.96	1.00	1.02	1.04	1.05	1.07	1.09	1.11	1.13	1.15	1.18	1.22	1.26	1.29	1.33	1.37
10	0.89	0.93	0.96	0.98	1.00	1.02	1.04	1.05	1.07	1.09	1.11	1.14	1.18	1.21	1.25	1.28	1.32
20	0.86	0.90	0.93	0.95	0.97	0.98	1.00	1.02	1.03	1.05	1.07	1.10	1.14	1.17	1.20	1.24	1.27
30	0.84	0.87	0.90	0.92	0.93	0.95	0.97	0.98	1.00	1.02	1.03	1.07	1.10	1.13	1.16	1.20	1.23
40	0.81	0.84	0.87	0.89	0.90	0.92	0.94	0.95	0.97	0.98	1.00	1.03	1.06	1.10	1.13	1.16	1.19
50	0.78	0.81	0.85	0.86	0.88	0.89	0.91	0.92	0.94	0.95	0.97	1.00	1.03	1.06	1.09	1.12	1.15
60	0.76	0.79	0.82	0.83	0.85	0.86	0.88	0.89	0.91	0.92	0.94	0.97	1.00	1.03	1.06	1.09	1.12
70	0.74	0.77	0.80	0.81	0.83	0.84	0.85	0.87	0.88	0.90	0.91	0.94	0.97	1.00	1.03	1.06	1.09
80	0.72	0.75	0.77	0.79	0.80	0.82	0.83	0.84	0.86	0.87	0.89	0.92	0.94	0.97	1.00	1.03	1.06
90	0.70	0.72	0.75	0.77	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.89	0.92	0.94	0.97	1.00	1.03
100	0.68	0.71	0.73	0.75	0.76	0.77	0.79	0.80	0.81	0.83	0.84	0.87	0.89	0.92	0.95	0.97	1.00
110	0.66	0.69	0.71	0.73	0.74	0.75	0.77	0.78	0.79	0.80	0.82	0.84	0.87	0.90	0.92	0.95	0.97
120	0.64	0.67	0.69	0.71	0.72	0.73	0.75	0.76	0.77	0.78	0.80	0.82	0.85	0.87	0.90	0.92	0.95

Example

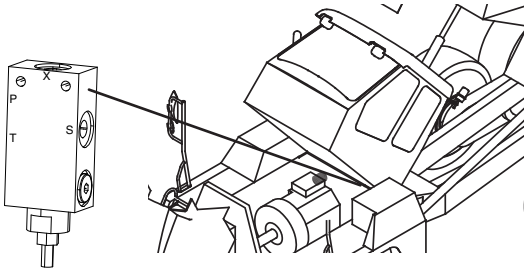
The satisfactory operation of a hydraulic system requires a precharge pressure of 100 bar. The operating temperature t_2 is 50°C and the temperature at precharging t0 is 20°C. From the table, a correction factor of 0.91 should be applied, giving a precharge pressure at 20°C of 91 bar.

Warning – Stabilization

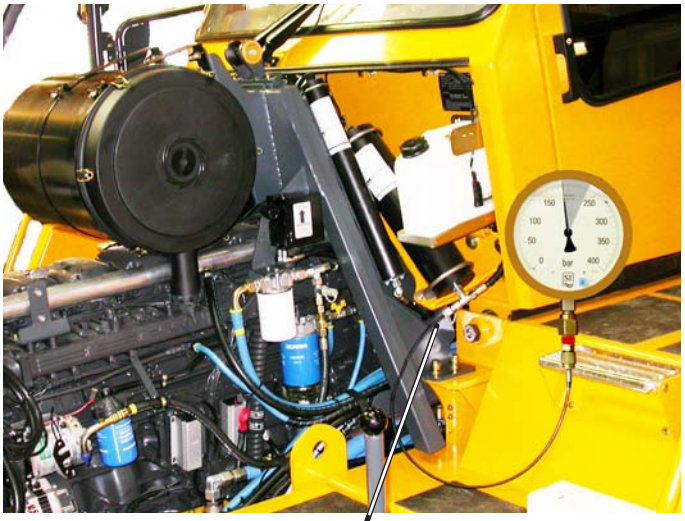
The process of filling or discharging an accumulator with nitrogen causes a temperature change which is transmitted to the surrounding air as the temperature of the accumulator stabilizes. To allow for the effects of temperature transfer, the accumulator should be allowed to stand for a minimum of 15 minutes to allow the temperature to stabilize before a final reading of the precharge pressure is taken.

Accumulator charging:

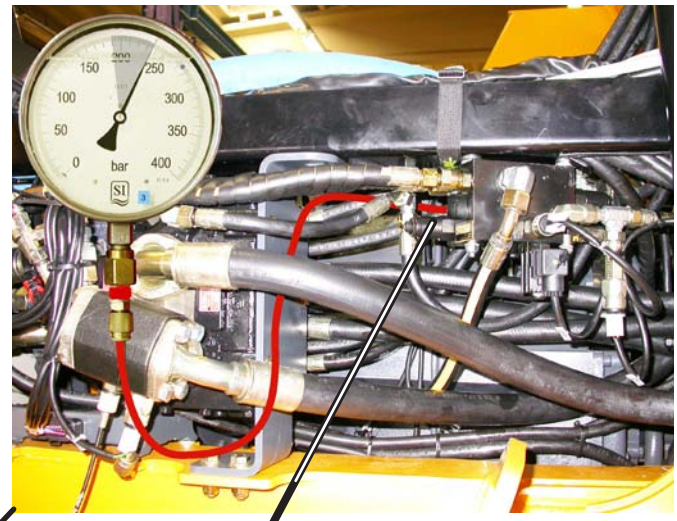
- Minimum charging (start) 175 ± 2 bar
- Maximum charging (relief) 210 bar
  (there should be a difference of min. 15 bar from this value and maximum fan pressure of 250 bar)
- (charging to 250 bar with activated retarder or fan at maximum pressure)
- Auxiliary valve 4 +1.0/0 bar

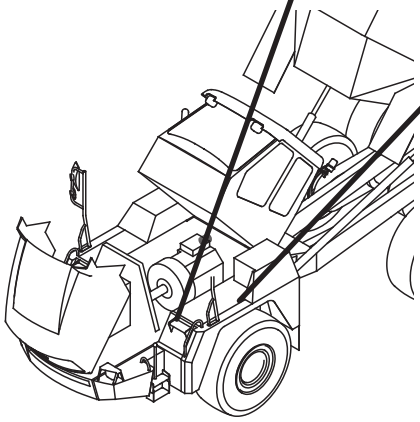


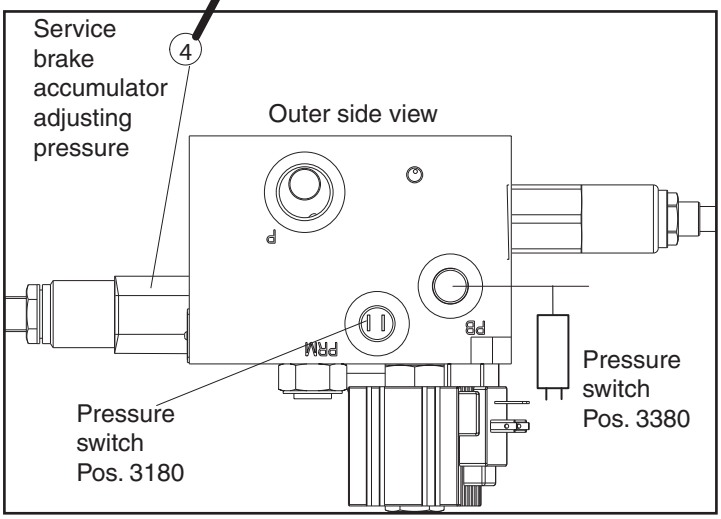
Control



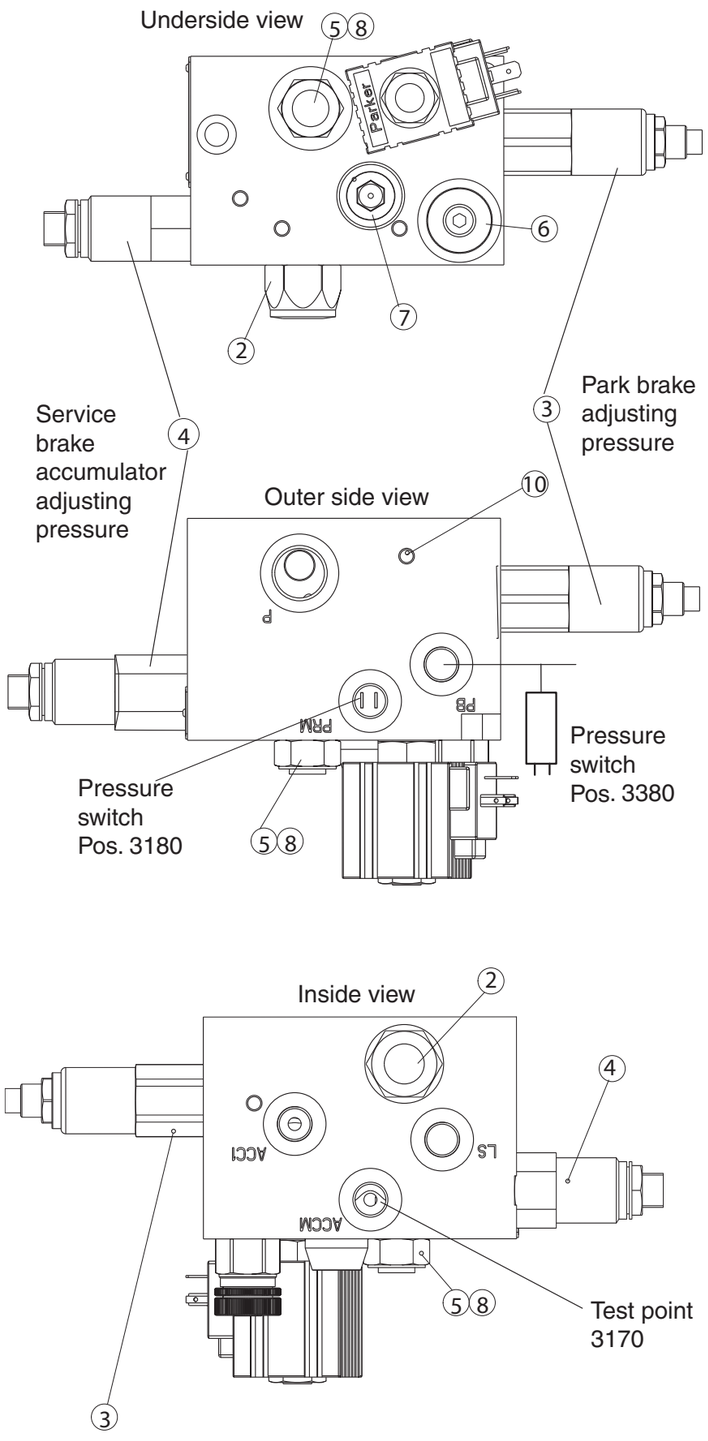
Adjusting

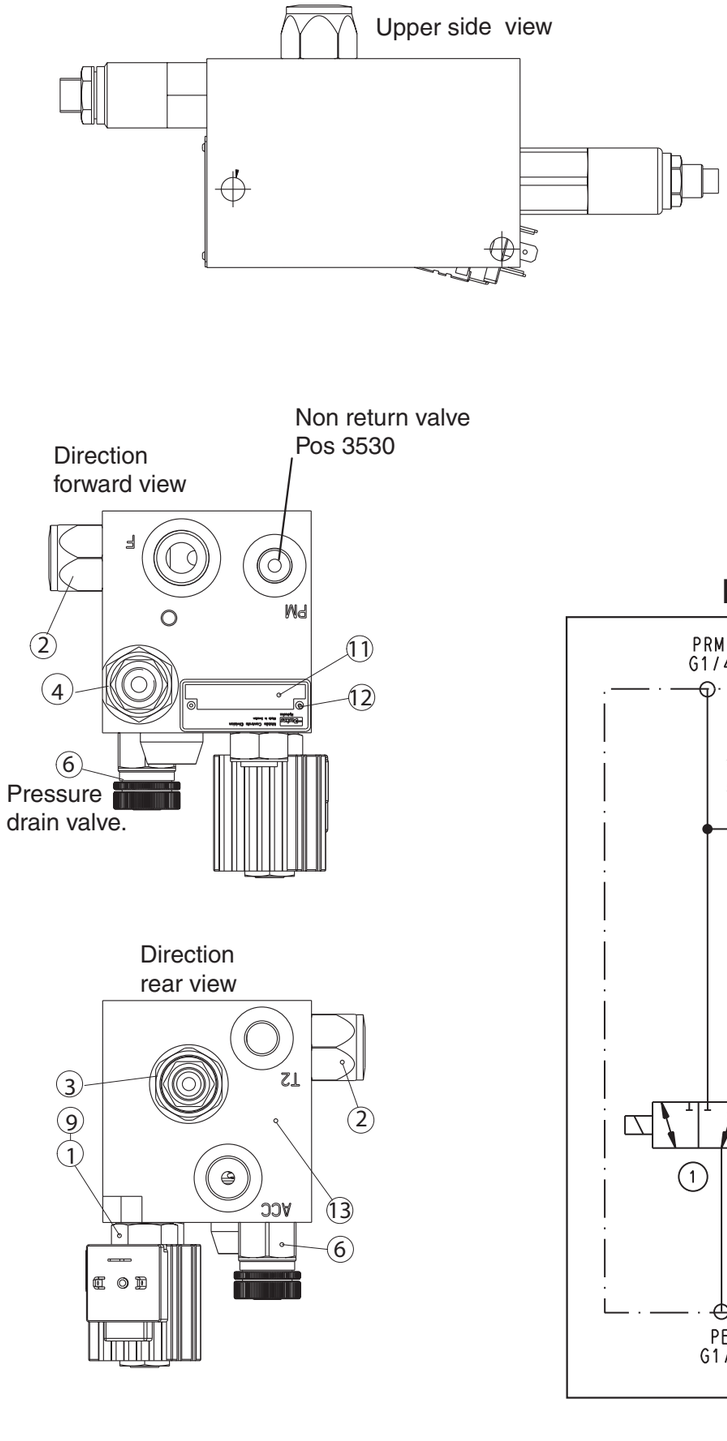






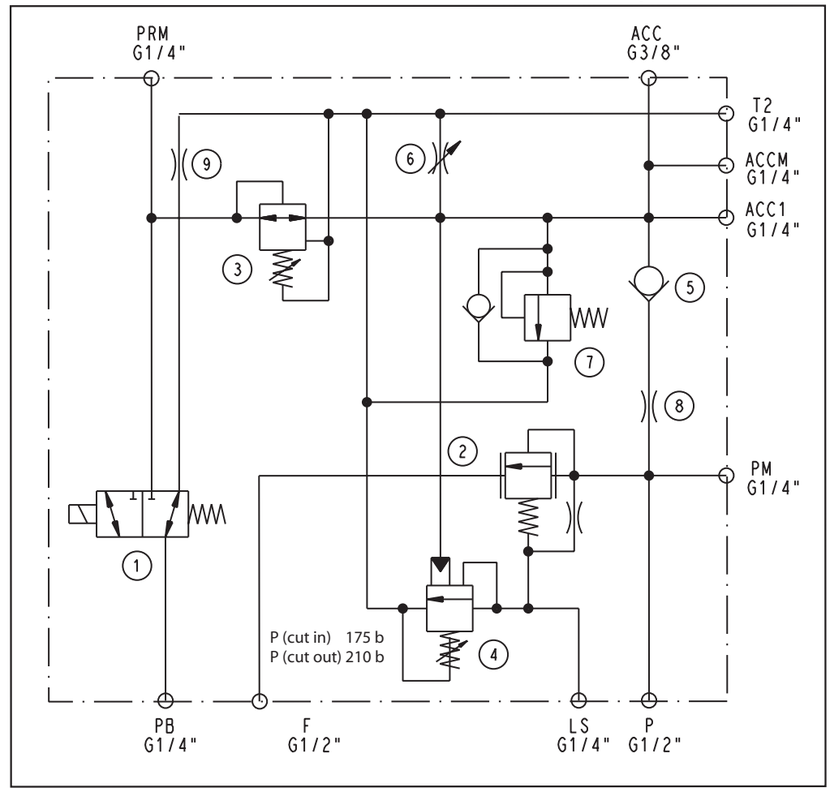
Accumulator valve





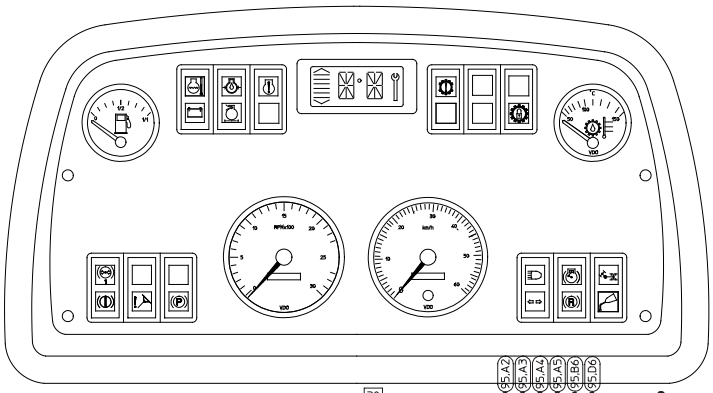
1	1	Park brake Control valve
2	1	Spool valve
3	1	Park brake reducing valve
4	1	Pressure Relief valve
5	1	Check valve
6	1	Pressure drain valve
7	1	Pressure relief valve
8	1	Orifice screw
9	1	Orifice screw
10	6	Ball
11	1	Plate
12	2	Screw
13	1	Manifold housing

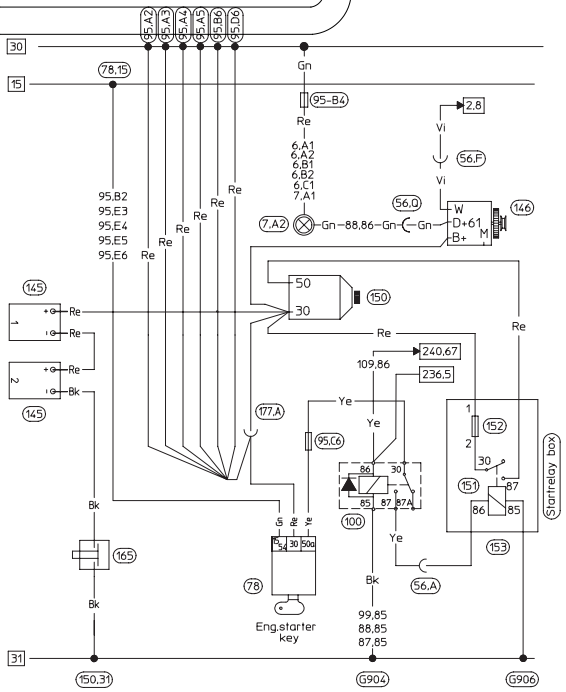
Pos 2460 accumulator valve cirquit

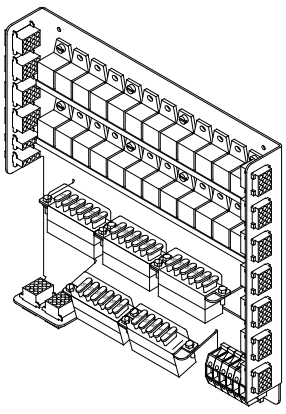


Chapter 6

Electrical system







El.system

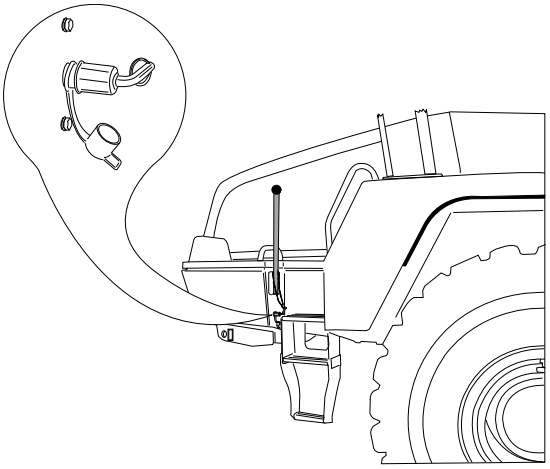
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Description of el. system

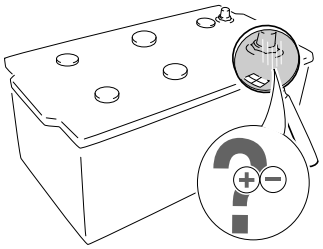
General description



Voltage
The truck has a 24V system.
The batteri ÷ is used as ground connection.

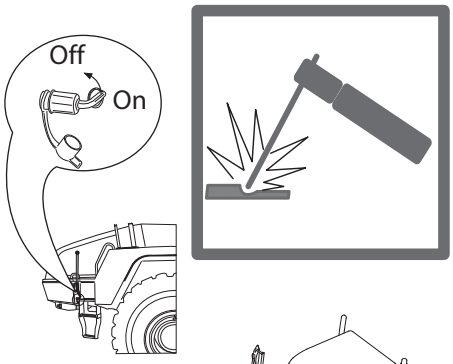
Supply
Two batteries, each 12V/230Ah, are connected together in serial connection to provide the system with 24V. The batteries are located in the right hand side fender.
A 28V/65A alternator is used to charge the batteries. The alternator is located on the front of the engine.

Battery main switch
A main switch is connected on the batteri ÷ supply cabel.
The batteri main switch is located in the left hand side fender.



Relays and fuses
The relays and fuses are located on the electrical central inside the cab, behind the cover on the back wall**.**
A specification of the relays and fuses are fitted on the inside of the cab wall above the electrical central.

Welding on the dump truck



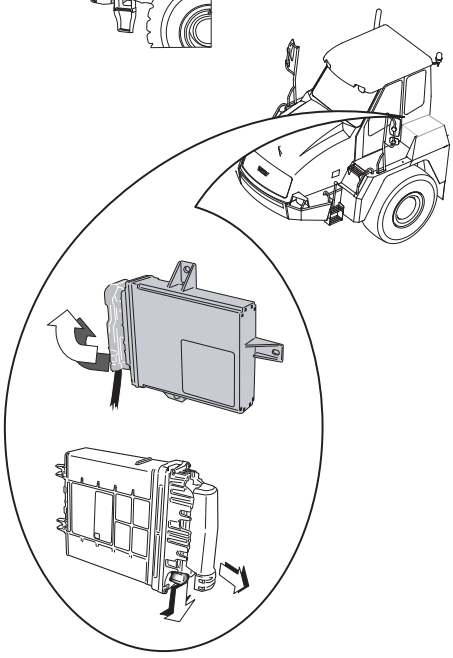
The transmission and the engine are equipped with electronic control units. Before welding on the dump truck:

1. Disconnect batteries.

2. Unplug the connector on the electronic control units for the engine and the transmission.
   The control units are located in the wall behind the seat.

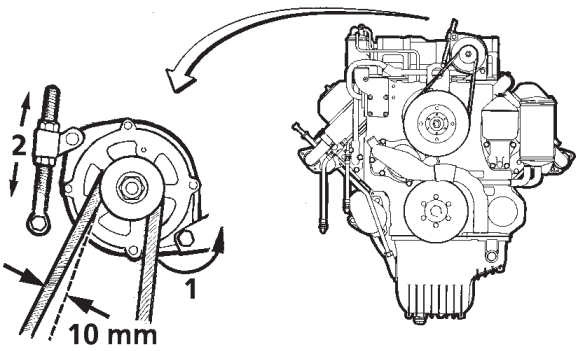
3. Earth point should be less than 1 m from welding point.

4. There should not be sealings, bearings or wiring harness between the welding point and the earth point.



Note!

- Keep the batteries in good condition.
- Batteri power assistance: see Operating and Maintenance manual
- When exchanging electrical components: allways turn off the battery main switch.
- Remember that a open circuit symptom in a warning light circuit might be a broken bulb.



Battery hazard prevention

Battery electrolyte contains sulphuric acid and can quickly burn the skin and eat holes in clothing. If you spill acid on yourself, immediately flush the area with water.



Battery acid could cause blindness if splashed into the eyes. If acid gets into the eyes, flush them immediately with largequantities of water and see a doctor at once.

If you accidentally drink acid, drink a large quantity of water or milk, beaten egg or vegetable oil. Call a doctor or hospital immediately!

When working with batteries ALWAYS wear safety glasses Batteries generate hydrogen gas. Hydrogen gas is very EXPLOSIVE, and is easily ignited with a small spark or flame.

Before working with batteries, turn the starter switch to the OFF- position, and the battery main switch must be turned OFF.

Avoid short-circuiting the battery terminals through accidental contact with metallic objects, such as tools, across the terminals.
When removing or installing, check which is the positive (+) and negative (-) terminal.

Removing the batteries:
1. Disconnect ÷ terminal connected to the earth point.
2. Disconnect the battery cable between the batteries.
3. Disconnect + terminal connected to the starter.

When installing the batteries, carry out the procedure in the opposite order, 3 - 2 - 1.
Tighten the battery caps securely.

When removing any battery cap, wear rubber gloves to prevent electrolyte contact with the skin.

Tighten the battery terminals securely, check that the terminals are not loose by trying to move the battery cables by hand.
Loosened terminals can generate sparks and lead to an explosion.

How to use the electrical documentation

The electrical documentation consists of three different types of documents:
map drawings, circuit drawings and a cross reference list.
Each document includes a different quantity of **component numbers.**

Map drawing (abbreviation: M..)
A map drawing shows the physical location of a component and its component number.

Component numbers (abbreviation: Comp.no.)
Each electrical component got its own private component number.
The component number is the same for the Shop Manual as for the Parts Catalogue.

Circuit drawings (abbreviation: C..)
A circuit drawing shows the current flow from the power supply through the different electrical components and further on to the ground connection point.

Cross reference list (abbreviation: x-list)
A list of component numbers sorted in an ascending order showing the connection between the Component numbers, Map drawings and the Circuit drawings.

Faultfinding, what to do

1 See index on page 1 to find the correct map description and page number.
2. Use the **maps** and find the **component number** of the component which is not working properly.
3. Open the **cross reference list** (x-list) and on the left hand side coloumn: find the line containing the **component number.**
   On the same line: see the right hand side coloumns.
   One coloumn shows the name (**M..**) of the map drawing you located the component on.
   The other coloumn shows the name(s) (**C..**) of the circuit drawing(s) containing this component number.
4. Find the correct **circuit drawing** by using the **index page.**
5. At the **circuit drawing:** see how the current flows from the power supply through the other different components or connection points until you find a component or connection point which can cause the malfunction.

   To find the location of the other component or connection point, use the cross reference list again and find the line containing the component or connection point number on the left hand side coloumn.
   On the same line: see the right hand side coloumns.
   On the right hand side coloumn you can find the name (**M..**) of the map containing the components.
   Find the component physical location on the truck and start the fault finding procedure.

Note!

Allways check out the fuse first.
Do remember that a components ground connection must be of the same quality as the components power supply!
See if the connection of the electrical cables are according to the circuit drawing.
See if the component is working according to its specifications.

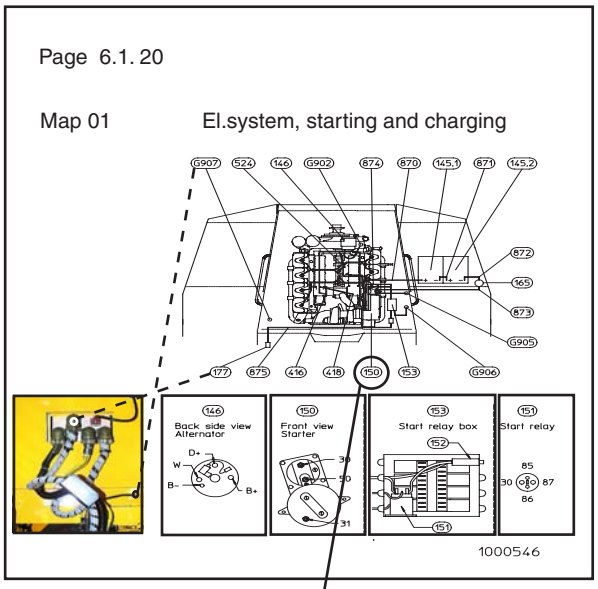
Practical example

1 Start with the index on page 1 to find the correct map description.

Page 1
Index



The correct map description leads to the page number, for instance page 20



2 Find the correct comp. no. that is to be utilized, for instance: 150.

3 Go to the cross reference list

Cross reference list



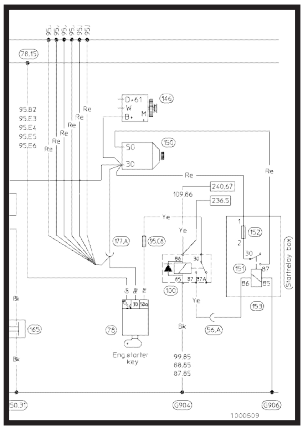
4 The comp. no. (150) in the cross reference list helps you to find the correct circuit drawing, for instance C 03.
Go to the index page to find the corresponding page number.

Page 1
Index

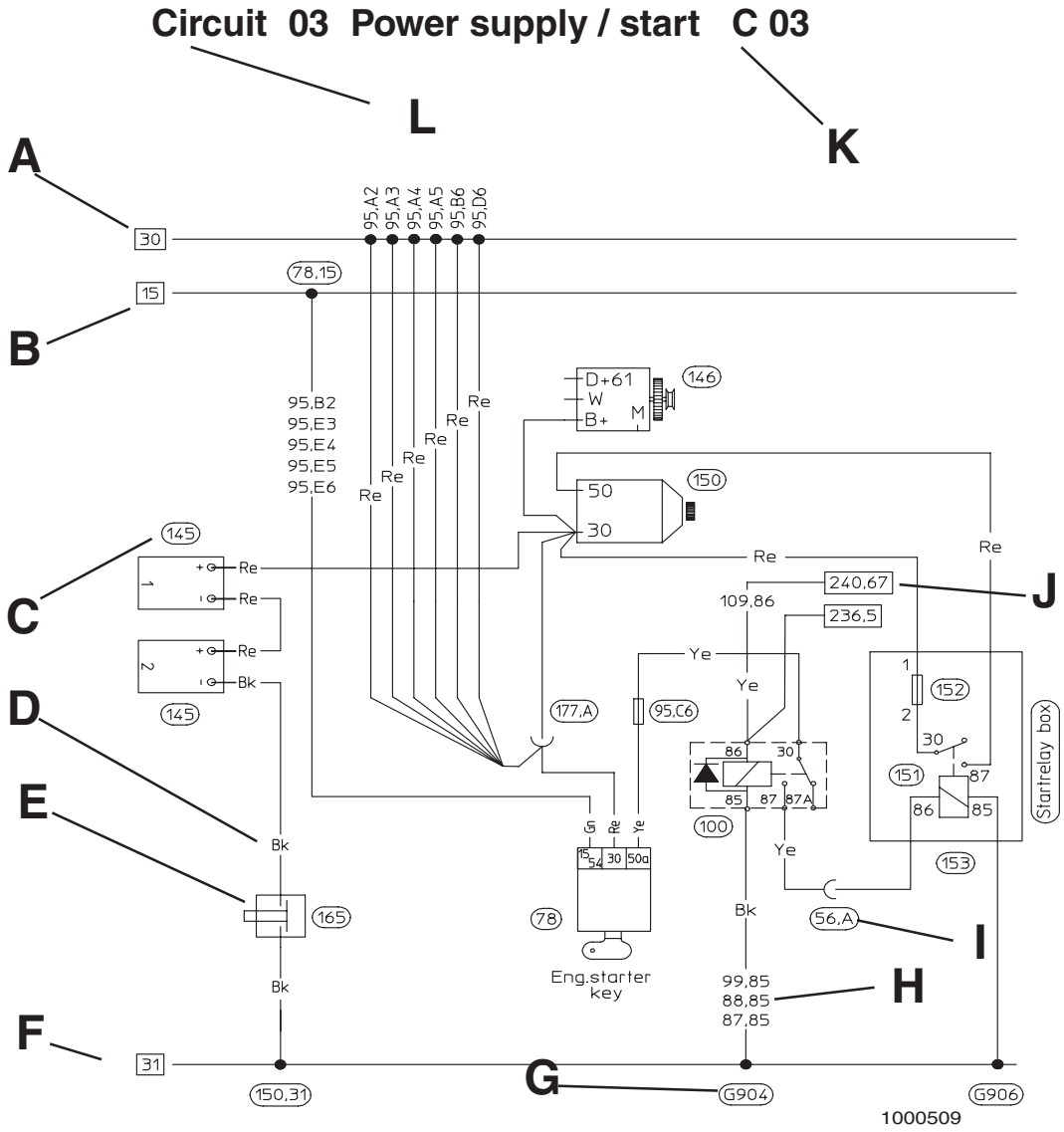


5 Find comp (150) on the circuit drawing (C 03)
at page 36

Page 6.1.36
Circuit 03



Description of circuit symbols



Component numbers in **baloon frames** and component numbers in **square frames** will both be found in Cross reference list.

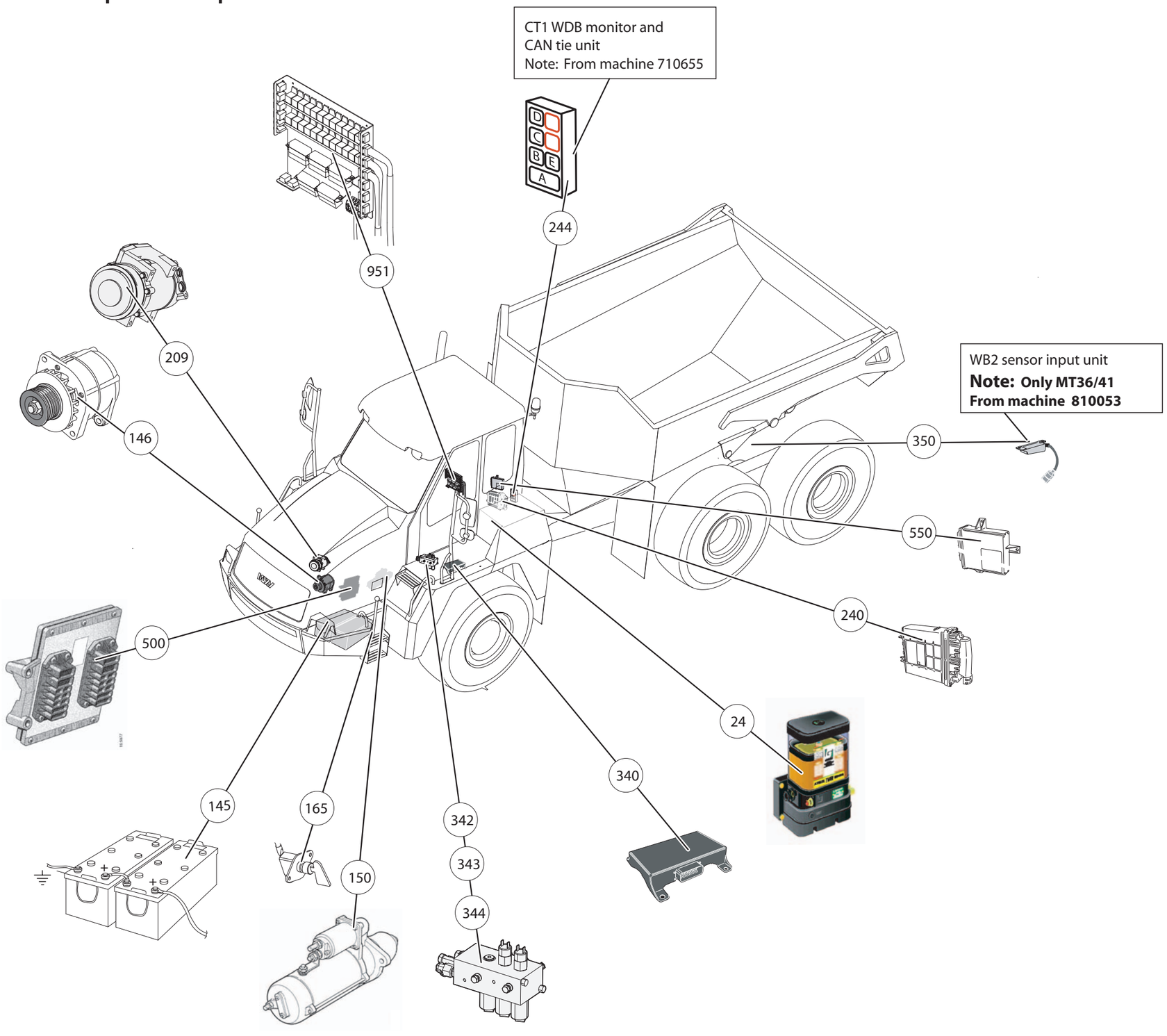
Pos A: Direct batteri +
Pos B: Switched batteri + (Ignition switch)
Pos C: Component number
Pos D: Cable colour
Pos E: Symbol
Pos F: Batteri ÷
Pos G: Ground connection point
Pos H: Connection points
Pos I: Connection point
Pos J: Reference to a component number in another circuit drawing.
Pos K: Circuit number abbrevation
Pos L: Circuit number and description

Wiring colour

Bk	Black
Re	Red
Gn	Green
Bl	Blue
Ye	Yellow
Wh	White
Br	Brown
Gr	Grey
Pi	Pink
Vi	Violet
Or	Orange

Electrical parts view

Principal components



24 Central lubrication main unit
145 Battery
146 Alternator
150 Starter
165 Main switch
209 Compressor, A/C
240 EST37 Transmission controll unit TCU
244 CT1 WDB monitor and CAN tie unit
340 IVC4B Valve adjuster box
342 Solenoid valve brake activation
343 Solenoid engine brake activation
344 Solenoid emergency retarder brake activation
350 WB2 Sensor input WDB unit
500 Engine Control Unit ECU
550 EMS Coordinator
951 El.central

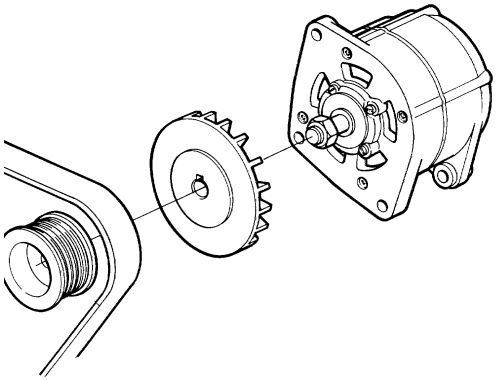
Spesification of electrical components.

Engine:

146 Alternator 80A, 1 pole.

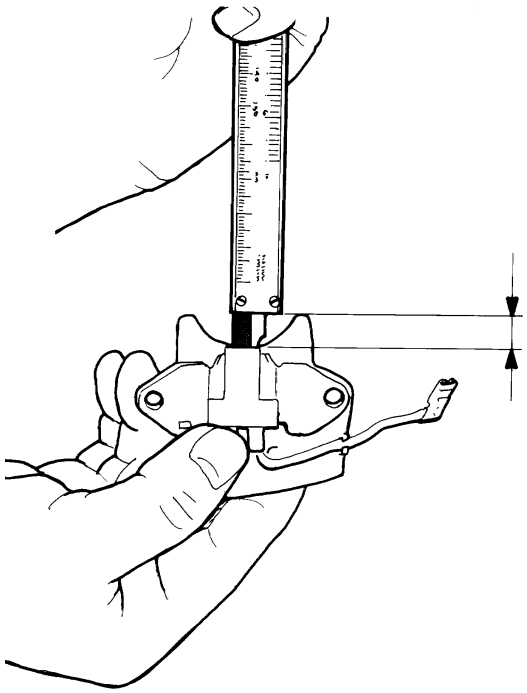
Specifications

Alternator	28V 35 - 80A
Output at 6000 rpm.	2500 W
Gear ratio	3,5:1
Number of poles	8
Resistance in rotor approx.	11.2 ohm +/- 5%
Resistance in stator, Phase-Phase	0.085 ohms +/- 0.001
Brushes, min, length	>2.5 mm
Slip rings, min. diameter	>13.8 +/- 1 mm
Tightening torque, belt pulley	65 Nm
Batteries	Qty 2x12V, series connected
Ground connection	Negative
System voltage	24V



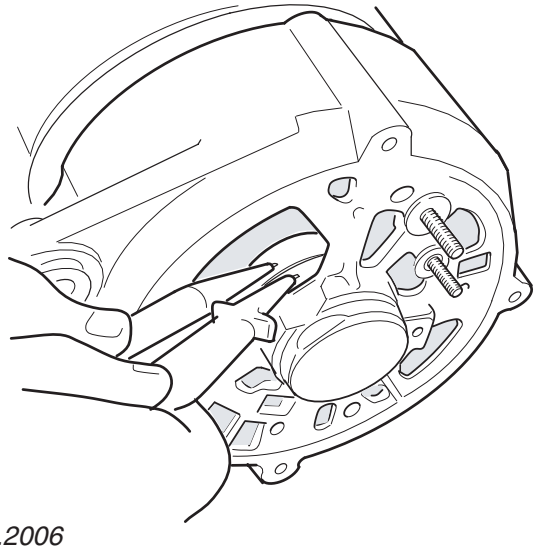
Brush length

The brush holder is fixed on the charge regulator. The brushes must be checked for damage and length. The ends must be bright and rounded off so they fit against the slip rings.
Brush length is measured between the end of the brush and the brush holder.
The correct length is >2.5 mm for 90A.



Rotor Slip rings

The slip rings must be bright metal across their whole surface. Dull slip rings indicate bad contact with the brushes. The slip rings can be accessed after removing the charge regulator.
Resistance
Measure the rotor resistance using an ohmmeter between the slip rings.
Correct resistance is 11.2 Ω for 90 A.
Correct resistance is 8.4 + 0.4 Ω for 65 A.
When measuring the strap between the slip rings and the core, the ohmmeter must show infinite resistance, at least 10 MΩ.



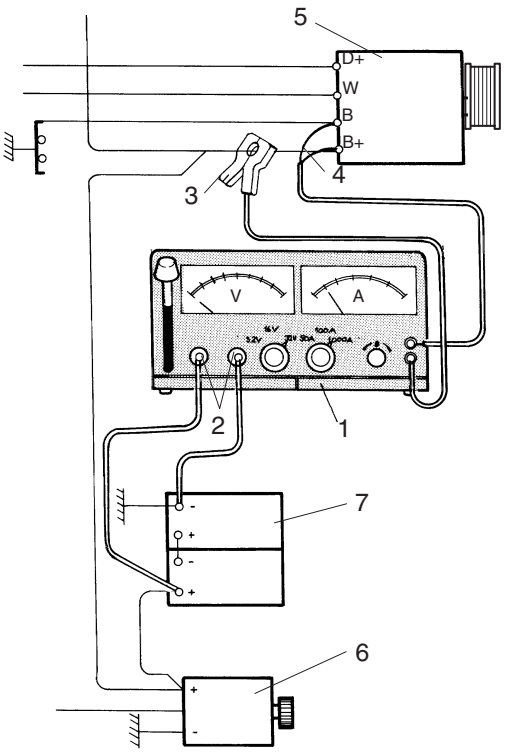
Charge testing

The alternator must not be run without the battery connected.
The rectifiers can otherwise overload and be damaged.

Output test

1 Connect a calibrated test instrument with load resistor as illustrated.
2 Start the engine and let it run for a few minutes before carrying out the test.
3 Rev up the engine to 1715 rpm, 6000 rpm for the alternator.
Apply current to the load resistor.
The voltmeter should read 28 V.
The alternator must supply at least 88 A for the 90 A alternator.

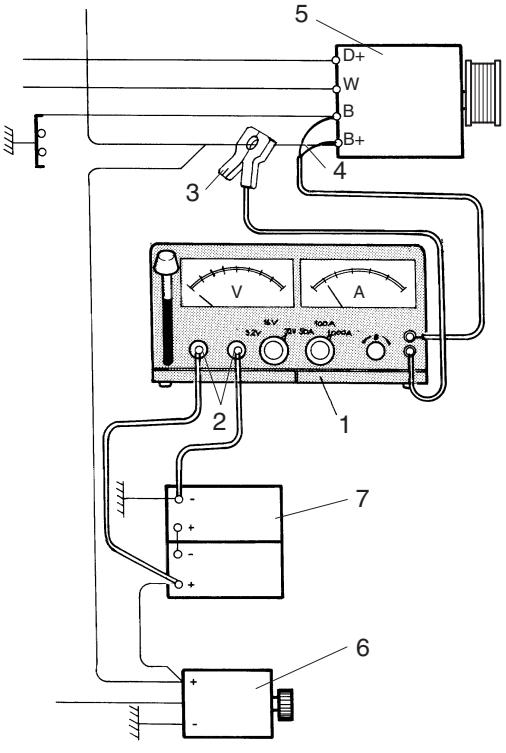
A digital clip-on ammeter can be connected to B+ on the alternator for a more precise reading.



1 Test instrument for alternator. Equipped with voltmeter and ammeter plus load resistor.
2 Connection to load resistor
3 Clip for current reading
4 Connection to voltmeter
5 Alternator
6 Starter motor
7 Battery

Control voltage test

This test requires fully charged batteries in order to obtain correct readings.
1 Connect the voltmeter and ammeter as illustrated.
2 Start the engine and allow it to run until the alternator delivers 5 A at B+.
3 Rev up the engine to 1715 rpm, 6000 rpm for the alternator.
Voltage at 20°C must be 28.0 V +0.5 V.



1 Test instrument for alternator
Equipped with voltmeter and ammeter plus load resistor.
2 Connection to load resistor
3 Clip for current reading
4 Connection to voltmeter
5 Alternator
6 Starter motor
7 Battery

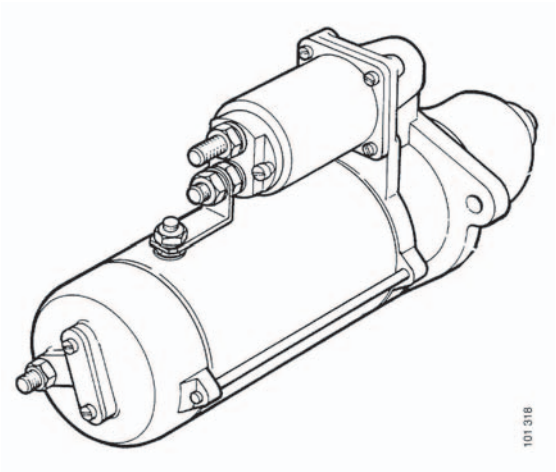
150 Starter 512510

Voltage: 24 V
Max power consumption: 6,7 kW (9,1 hp)

Bosch JE:

Assembly Specifications

Power	6.7 kW
Direction of rotation (viewed towards flywheel housing)	Anti-clockwise
Min. diameter of commutator	42.5 mm
Min. length of carbon brushes	17.5 mm
Spring pressure of carbon brushes	47-53 N
Resistance in drawing winding	0.5 ohms
Resistance in holding winding	2.5 ohms
Max. radial run-out in rotor	0.10 mm
Max. radial run-out in commutator	0.03 mm



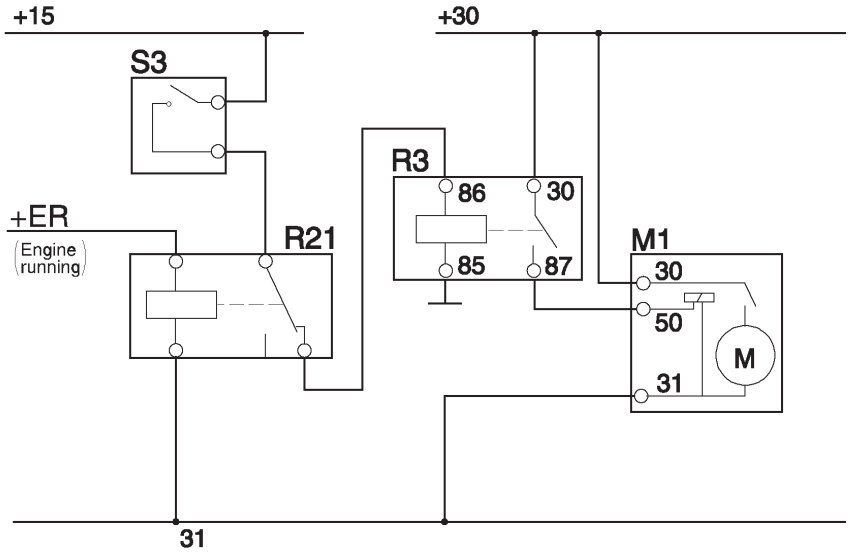
Skeleton diagram for connection

S3. Starter lock

R3. Starter relay

R21 Immobiliser relay

M1 Starter motor



Activation

The starter motor is activated via control voltage 50 and via battery supply 30.

The 50 supply is activated via a relay.
The precise way in which the relay is activated varies between the different motors and units.

When the 50 supply is activated, the solenoid switch and solenoid in the starter motor are powered up. When the 50 supply is interrupted, the solenoid switch is no longer powered.

The 30 supply is supplied directly from the battery and alternator.

Integral parts

1 Solenoid switch

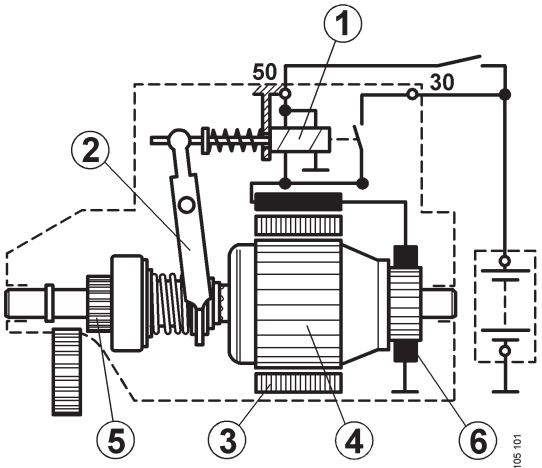
2 Coupling lever

3 Field windings with pole shoes

4 Rotor with commutator

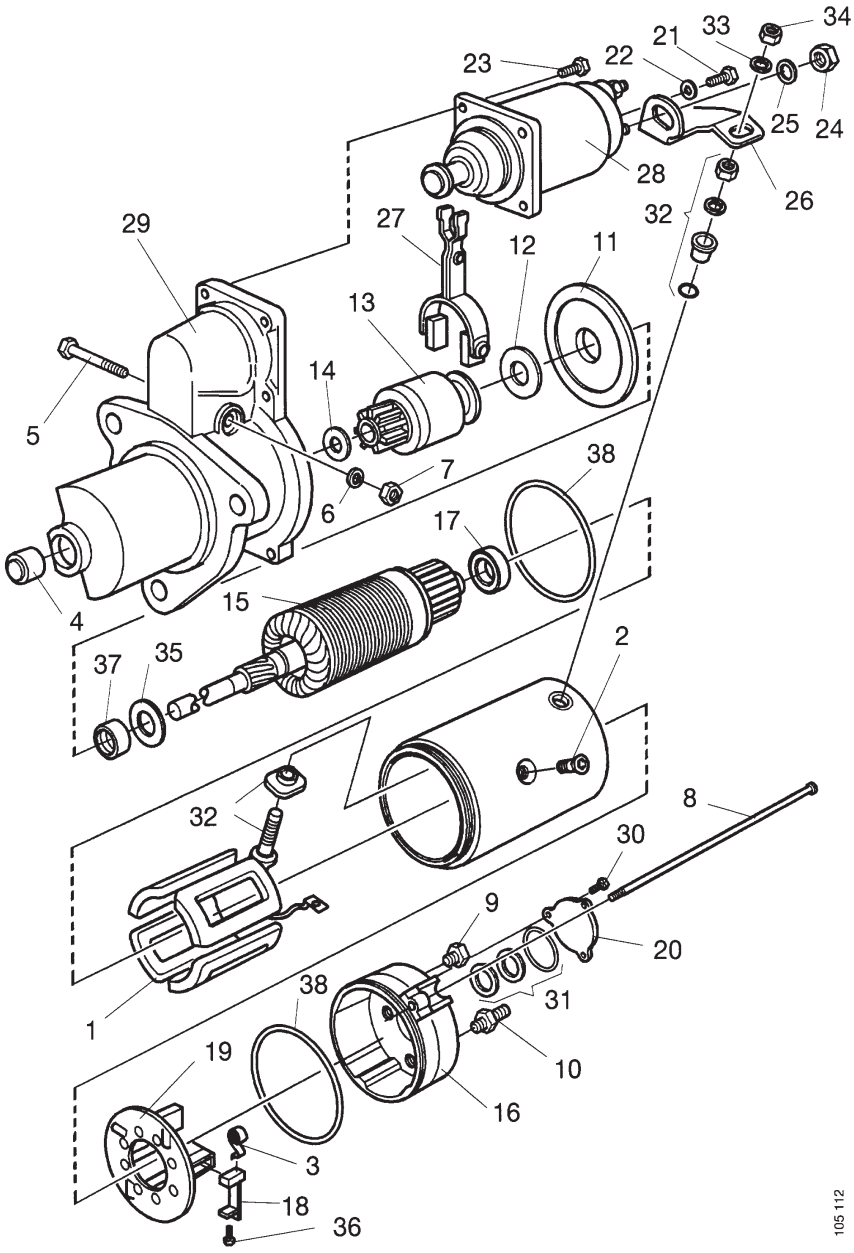
5 Starter pinion

6 Brush holder with four carbon brushes



Exploded view drawing

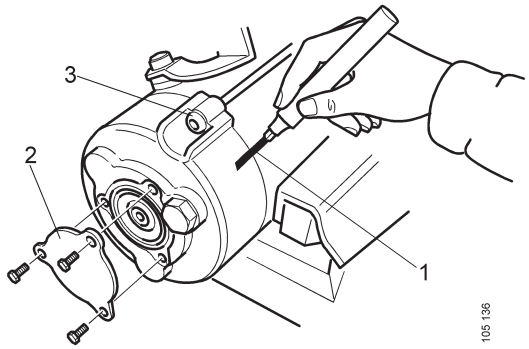
1 Excitation winding
2 Bolt
3 Compression spring
4 Bearing
5 Bolt
6 Gasket ring
7 Nut
8 Stud
9 Bolt
10 Bolt
11 Intermediate bearing
12 Spacer washer
13 Freewheeling gear
14 Washer
15 Rotor
16 Rear bearing shield
17 Bearing
18 Carbon brush kit
19 Carbon brush holder
20 Cover
21 Bolt
22 Bolt
23 Washer
24 Nut
25 Washer
26 Conducting bar
27 Coupling lever
28 Solenoid switch, solenoid
29 Front bearing shield
30 Bolt
31 Spacing washers and gasket
32 Assembly parts for conducting bar
33 Washer
34 Nut
35 Washer
36 Bolt
37 Bearing
38 O-ring



Renewal Carbon brushes

Equipment required

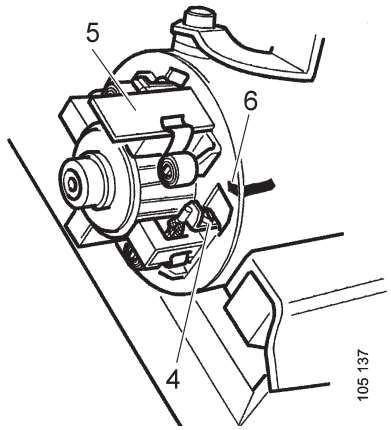
Four spring locks are required to renew the carbon brushes and springs simply and safely.
These can be easily made from thin sheet steel which is cut into four pieces approximately 20 x 40 mm.



Work description

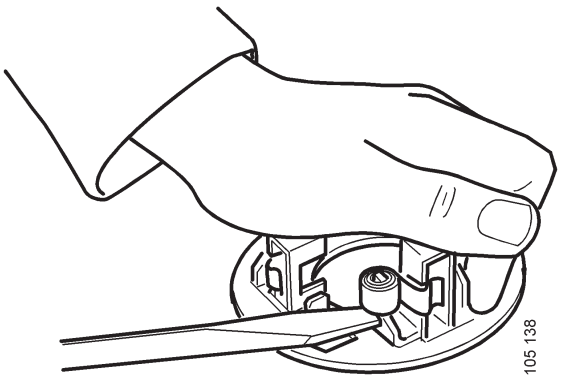
Before renewal, the starter motor should be removed.

1 Mark the position of the rear bearing shield with a marker.
2 Remove the rear protection cover.
3 Undo the through bolts and remove the rear bearing shield.



4 Undo the bolts to the carbon brush connections.
5 Fit the spring locks to relieve the spring pressure on the carbon brushes.
6 Remove the carbon brush retaining plate after marking its position against the pin housing.
7 Check that the commutator is not damaged. Wipe it over and clean the commutator segments if necessary.

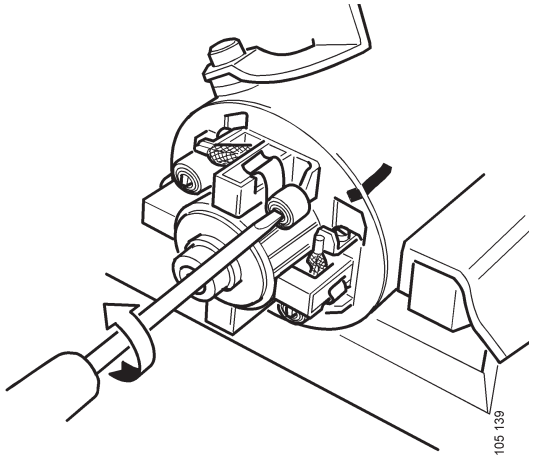
8 Remove the carbon brushes and the old springs with a screwdriver.
9 Place new carbon brushes in the brush holder. Do not fit the springs yet.
10 Refit the carbon brush retaining plate according to the mark with the new carbon brushes and connect the cables to the carbon brushes.



11 Fit the new springs to the carbon brushes. Use a small screwdriver in the centre of the springs and clamp them with it.

WARNING !

Wear protective goggles! The brush holder springs have a very high spring force.

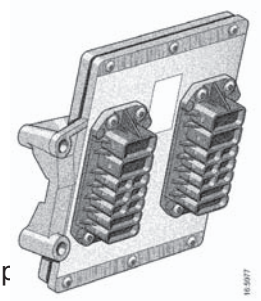


- Fit the comb which presses the carbon brush in position.
- Tension the spring one half turn.
- Press in the centre of the spring on the attachment plate

12 Refit the bearing shield as indicated by the marks.
13 Fit the protection cover.
14 Refit the starter motor.

500 Control unit S6

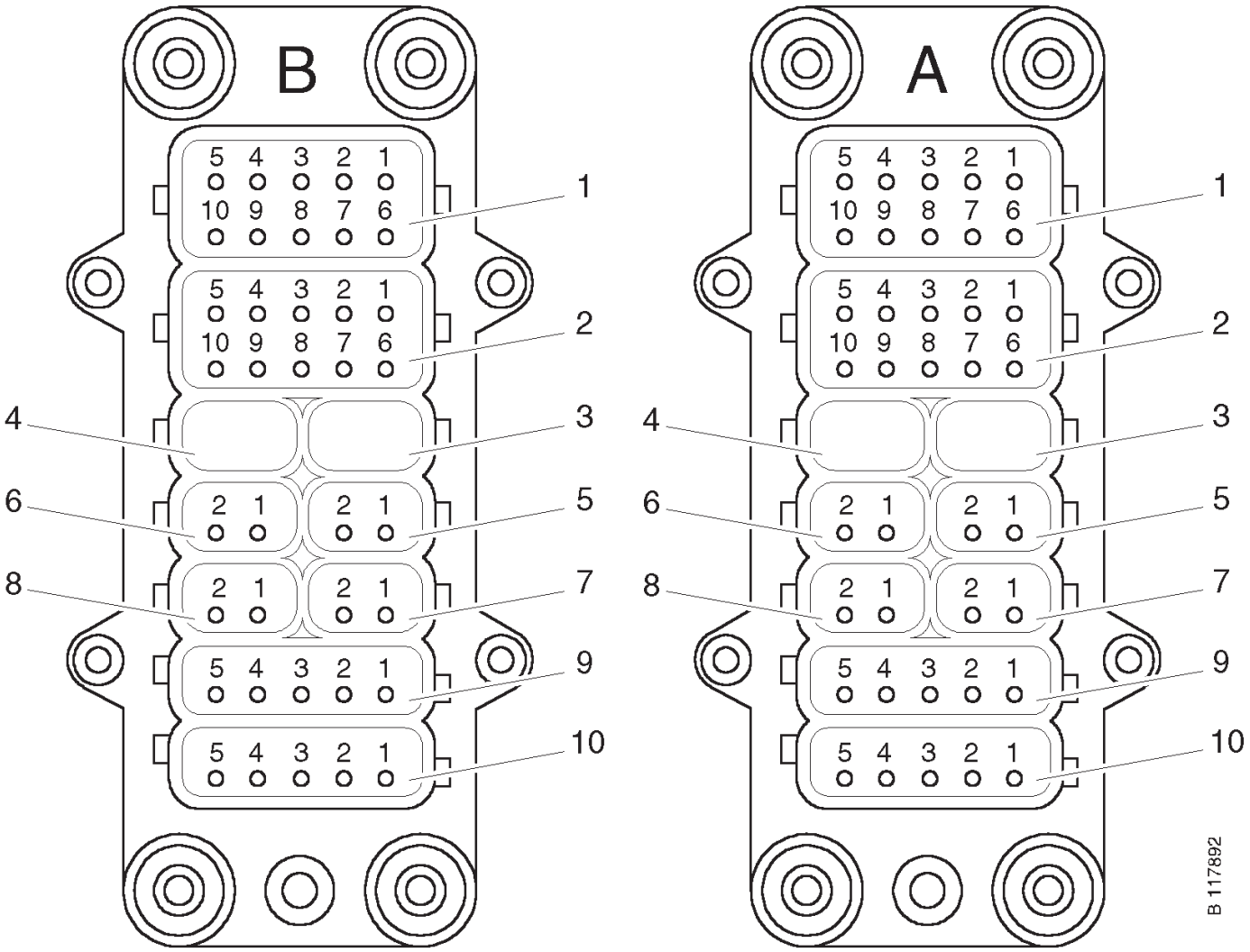
Power supply: Nominal 24 V DC .
The Control unit is transient and reverse voltage protected by a series diode.



See also description in chapter 1, Section: Engine Managment System

Function of EMS control unit:

The control unit collects information which it processes into signals that control the fuel volume and injection timing.
The control unit converts the system voltage to a voltage of approximately 5 V, which it sup sensors, etc. These sensors are always earthed through the control unit.
The control unit can be configured using ECOM.
The engine idling speed can be set, for example.
Every time the control unit is configured, the date and VCI identification number are stored in the memory of the control unit. This is the equivalent of security sealing.



How the pins are connected is shown below:

Connector	Pin	
A1	1	Voltage supply, +24 V to unit injectors. cyl 4
A1	2	Voltage supply, +24 V to unit injectors. cyl 5
A1	3	Not used.
A1	4	Voltage supply, +24 V to unit injectors. cyl 6
A1	5	Not used.
A1	6	Earth for unit injectors. cyl 4
A1	7	Earth for unit injectors. cyl 5
A1	8	Not used.
A1	9	Earth for unit injectors. cyl 6
A1	10	Not used.
A2	1	Not used.
A2	2	Not used.
A2	3	Not used.
A2	4	Not used.
A2	5	AUX_AN_0, Extra analogue input (Earth).
A2	6	Not used.
A2	7	AUX_AN_1, Extra analogue input (+ 5V).
A2	8	AUX_AN, Extra analogue input (Signal).
A2	9	Not used.
A2	10	Not used.
A3	1-2	Not used.
A4	1-2	Not used.
A5	1	Input signal from engine speed sensor 1.
A5	2	Earth for engine speed sensor 1.
A6	1	Input signal from engine speed sensor 2.
A6	2	Earth for engine speed sensor 2.
A7	1	Input signal from the coolant temperature sensor.
A7	2	Earth for coolant temperature sensor.
A8	1-2	Not used.
A9	1	Input signal from the oil temperature sensor.
A9	2	Voltage supply, + 5V to the oil pressure sensor.
A9	3	Input signal from the oil pressure sensor. The control unit detects the voltage level between pins 3 and 4.
A9	4	Earth for oil pressure sensor.
A9	5	Not used.
A10	1	Voltage supply, + 5V to the charge air pressure sensor.
A10	2	Input signal from the charge air pressure sensor. The control unit detects the voltage level between pins 2 and 3.
A10	3	Earth for charge air pressure sensor.
A10	4	Input signal from the charge air temperature sensor. The control unit detects the voltage level between pins 3 and 4.
A10	5	Not used.

How the pins are connected is shown below:

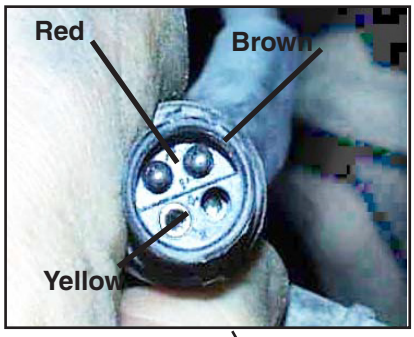
Connector	Pin	
B1	1	Voltage supply, + 24V to the control unit.
B1	2	Earth connection for the control unit to chassis.
B1	3	Input signal + 24V, from the ignition lock (when the key is in the drive position).
B1	4	Not used.
B1	5	Not used.
B1	6	Voltage supply, + 24V to the control unit.
B1	7	Earth connection for the control unit to chassis.
B1	8	Not used.
B1	9	CAN communication, H lead
B1	10	CAN communication, L lead
B2	1	Voltage supply, + 24V to unit injectors. cyl 1
B2	2	Voltage supply, + 24V to unit injectors. cyl 2.
B2	3	Not used.
B2	4	Voltage supply, + 24V to unit injectors. cyl 3.
B2	5	Voltage supply, + 24V to unit injectors. cyl 4.
B2	6	Earth for unit injector cyl 1
B2	7	Earth for unit injector cyl 2
B2	8	Not used.
B2	9	Earth for unit injector cyl 3
B2	10	Earth for unit injector cyl 4
B3	1-2	Not used.
B4	1-2	Not used.
B5	1-2	Not used.
B6	1-2	Not used.
B7	1	Voltage supply, + 24 V to the fan.
B7	2	Earth for fan.
B8	1-2	Not used.
B9	1-5	Not used.
B10	1-5	Not used.

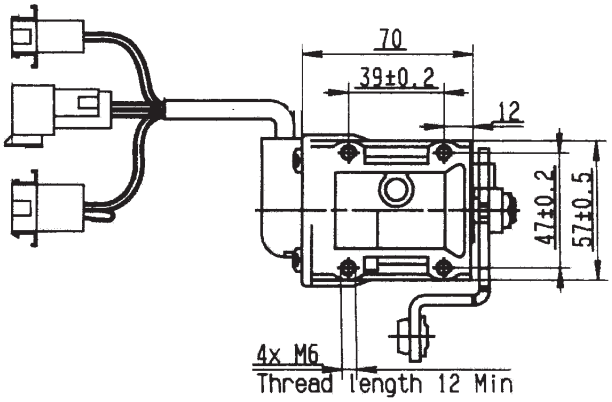
Spesification of electrical components

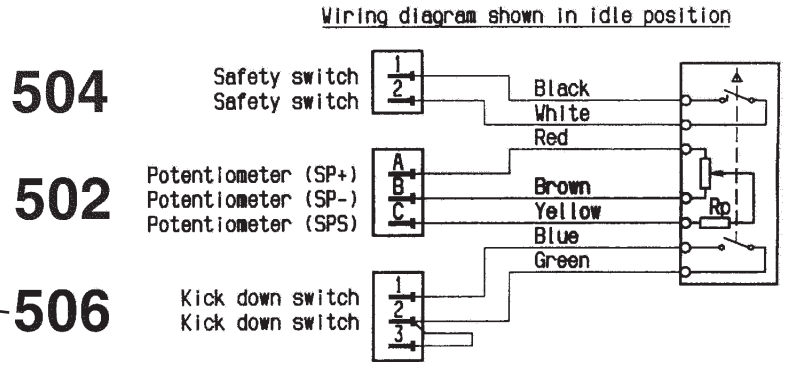
502 Sensor accelerator pedal potentiometer

	Acc. Pedal position	
	Min.	Max
Measure between A and C:	1,7 kΩ	2,6 kΩ
Measure between B and C:	2,9 kΩ	2,0 kΩ
Measure between A and B:	1,5 kΩ	1,5 kΩ

Tolerance ±25 %







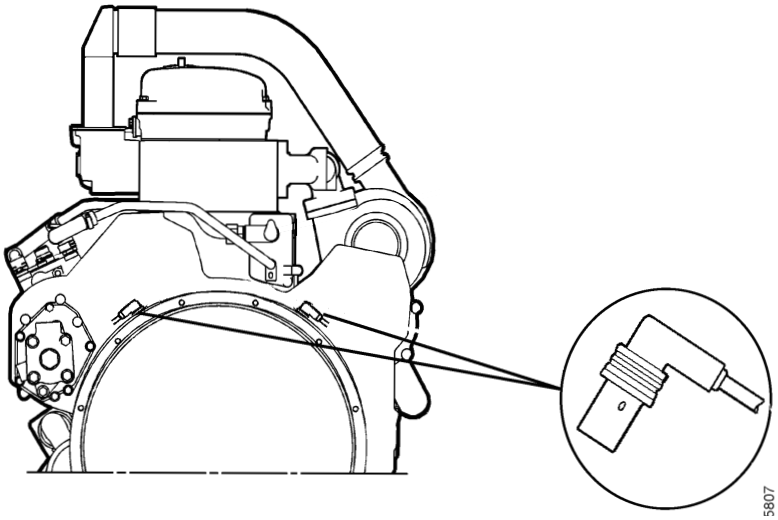
NOTE !
Pos 506:
Not used on MT41

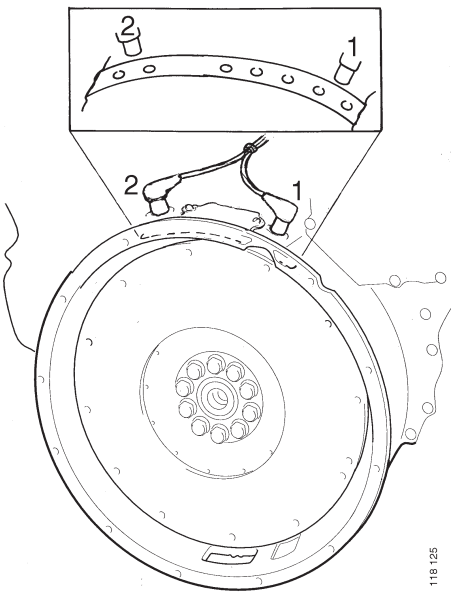
Spesification of electrical components

541 Engine speed sensor

Resistance:	486-594 W
Inductance:	187-253 mH
Measure between:	541- 1 and 2
Distance between sensor and flywheel/gear ring:	0,5- 1,5mm

Location of engine speed sensors on the engine.





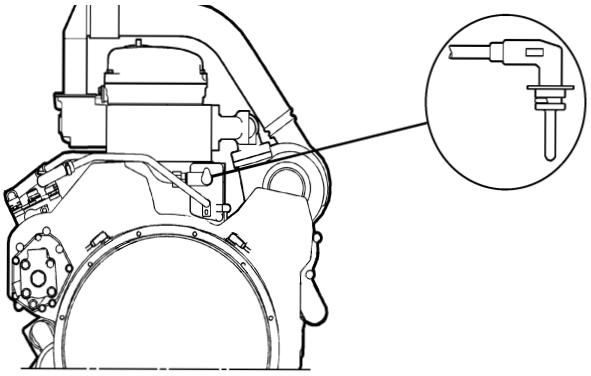
Engine speed sensors
1 Engine speed sensor 1, T28
2 Engine speed sensor 2, T29

The detail shows some of the holes in the flywheel that are detected by the engine speed sensors.

There are two engine speed sensors in the EMS system, engine speed sensor 1 and engine speed sensor 2.
The sensors are inductive. This means that they only produce signals when the engine is running.
The signal strength varies significantly, depending on the air gap between the sensors and the flywheel as well as on the engine speed.
The EMS system performs an assessment of the signal strength at different engine speeds.
If the signal strength becomes too low, a fault code is generated.
Both engine speed sensor 1 and engine speed sensor 2 read the position of the flywheel.
This means that the system cannot determine which of two possible revolutions the engine is at, i.e. whether, for example, cylinder 1 or cylinder 6 is at the ignition position.
Every time the engine is stopped and the voltage cut off, the engine position is stored.
Next time the voltage is switched on, the stored position of the engine is used to determine which revolution the engine is at.
When the engine has started, a system check is performed to verify that the stored position is correct.

542 Sensor engine coolant temperature

From machine 81001 - 810001 the temperature sensor Pos 542 is placed as shown



	37334 5041 Ω	-40 C
Resistance vs temperature	13329 1491 Ω	-20 C
	5382 355 Ω	0 C
	2410 195 Ω	20 C
	621 58 Ω	60 C
	207 23 Ω	100 C
	129 16 Ω	120 C

544 Switch engine oil pressure

The switch closing at oil pressure:	< 0,7 bar		11 Ω
The switch open at oil pressure:	1,1 bar	± 0,15 bar	111 Ω

Measure between : 542 - 1 and 2
543 - 1 and 2

543 Sensor engine boost temperature

The charge air temperature sensor detects the temperature in the intake manifold. The control unit uses the signal from the sensor to finely adjust the fuel quantity so that black smoke is not produced.
The warmer the charge air, the less fuel the control unit allows to go out to the unit injectors.
The sensor is of the NTC type, which means that its resistance is temperature dependent. If the temperature increases, the resistance in the sensor drops.
If the voltage is outside a certain range, the control unit will operate according to a preset temperature value.
The engine will then react more slowly than normal when actuating the throttle in cold weather, as the control unit thinks that the air is warmer than it really is.

	37334 5041 Ω	-40 C
Resistance vs temperature	13329 1491 Ω	-20 C
	5382 355 Ω	0 C
	2410 195 Ω	20 C
	621 58 Ω	60 C
	207 23 Ω	100 C
	129 16 Ω	120 C

550 Coordinator

Installation position of the Coordinator.

The following factors can cause electronic component malfunctions:

• EMI (Electromagnetic interference) • Extreme heat and cold
• High voltage • Vibrations • Water and moisture.

NOTE:

Measures must be taken so that the coordinator is not exposed to the environmental factors described above.

The coordinator should be positioned so that the wiring leaves the coordinator downwards, to minimize the risk of moisture and water coming from the cable into the coordinator.

Tolerance levels for EMS and Coordinator

Operating voltage for EMS and Coordinator
If the EMS and Coordinator are to work according to the specification, the supply voltage must be between the operating levels for the EMS and Coordinator.
The operating levels for EMS and Coordinator are 22 - 30 V (typical voltage 28 V).
Degree of protection for EMS and Coordinator
The coordinator has IP-class: 5K4
The EMS has IP-class: 6K9K, when all connectors are connected to the EMS.
The EMS has IP-class: 40, with the connectors not connected to the EMS.

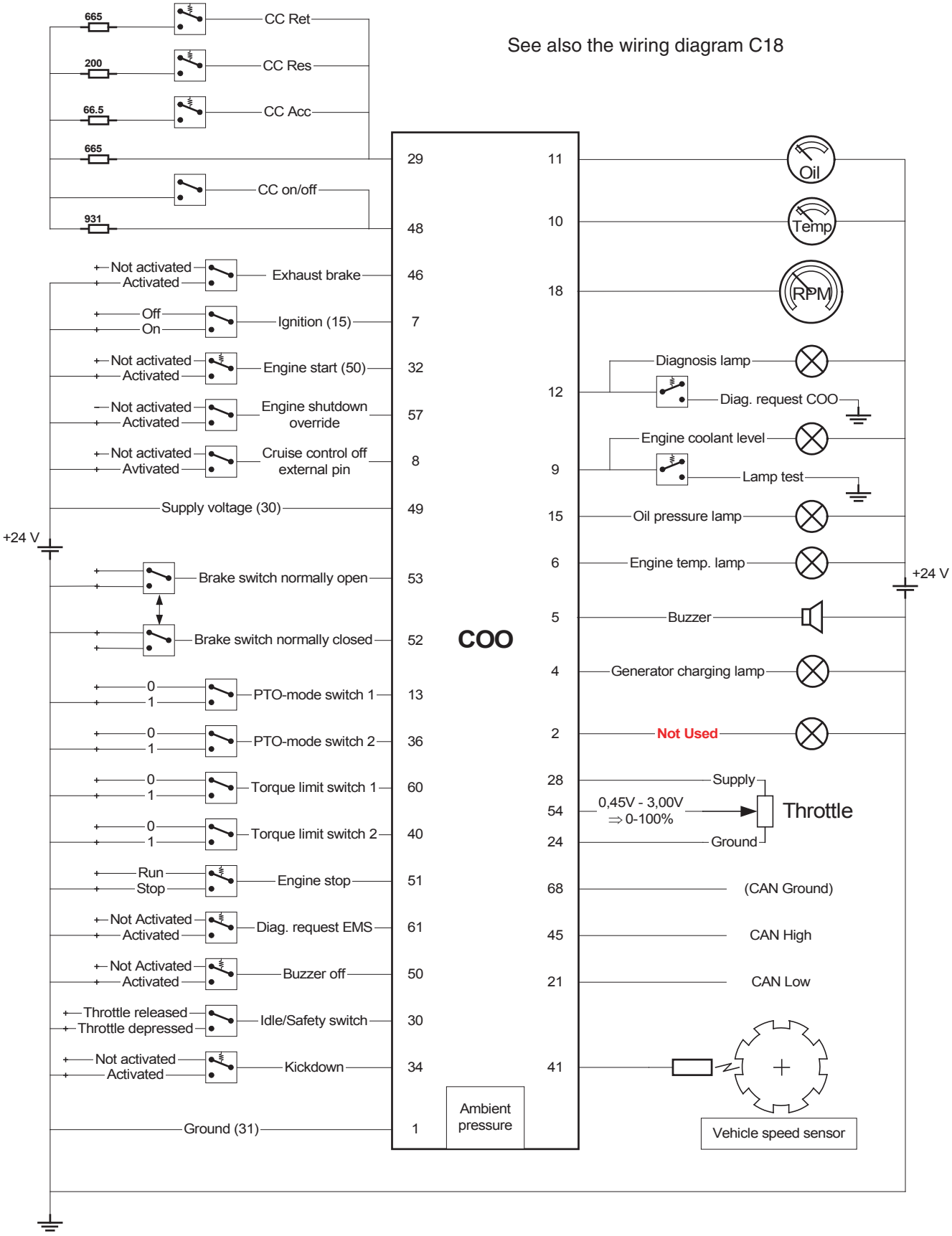
Vibration levels for the Coordinator
The coordinator has the following vibration levels:

ASD level	Frequency range	RMS level
$0.05g^2/Hz$	10Hz - 50Hz	Total 3.2g
$0.015g^2/Hz$	100Hz - 500Hz	

Flashing code list for the EMS control unit.

See in Chapter 1

General coordinator connection diagram 710655 -



See next page, Coordinator description

Coordinator description (Scania) page 1. 710655 -

Pin	I/O	Name	Description	Comment
1	-	*GND* (earth) (*U31*)	*GND* for the Coordinator	
4	O	Charge warning lamp for alternator 1 and/or alternator 2.	The alternator (-s) is connected directly to the *S6*.	A CAN message is sent to the *COO*. The charge lamp indicates if an alternator is not charging correctly. **Note:** The lamp must be a glow lamp.
5	O	Buzzer	Supplies a +24 V signal when the engine has an alarm.	
6	O	Warning lamp -engine coolant temperature	*GND* signal supplied when the engine temperature is too high.	**Note:** The lamp must be a glow lamp.
7	I	Ignition (*U15*)	Ignition key, which gives (*U 15*) - supply	Should be connected to *U15* (+24 V), when it is active.
9	O/I	Warning lamp for coolant level / Lamp test	*CAN* message to the *COO* when the coolant level is too low / Lamp test	The level monitor is connected to the *S6*. At low coolant level the *COO* supplies *GND* (*U31*) on this pin. If the pin is connected to *GND*, lamp test is done on pins 4, 5, 6, 15, 9 and 12. Lamp test is active as long as pin 9 is connected to *GND*. **Note:** The lamp must be a glow lamp.
10	O	Engine temperature gauge	Gauge indicator which shows engine coolant temperature.	If the instrument is not supplied by Scania, it should be an instrument that can be configured against a *PWM* signal. See page 14.
11	O	Oil pressure gauge	Gauge indicator which shows the engine oil pressure.	If the instrument is not supplied by Scania, it should be an instrument that can be configured against a *PWM* signal. See page 15.
12	O/I	Diagnostic lamp for *EMS* and *COO* / Diagnosis request for *COO*	This pin has double functions: Signal which shows if there is a fault code for *COO* or *S6*. / Diagnostic request and read off of flashing codes for *COO*.	For read out flashing codes, this pin should be connected to *GND* for 1 S. The *COO* then sends out pulsed *GND* signals for *COO*. **Note:** The lamp must be a glow lamp.
13	I	Nominal speed switch 1	A switch to shift the pre-set value for engine speed.	By connecting pins 13 and 36 to GND in different combinations, the nominal speed can be changed. See page 11.
15	O	Warning lamp for low oil pressure	Signal (*GND*) which is activated when the oil pressure is too low	This pin supplies a GND signal when the oil pressure is too low. **Note:** The lamp must be a glow lamp.
18	O	Tachometer	Connection of Scania instrument for engine speed.	If pin 46 is activated, *droop adjustable enable*, the droop value is shown on the instrument instead. See table on page 12.
21	-	CAN low		
24	-	Fine tune of nominal speed	Zero-potential from *COO* for the signal for *fine tune of nominal speed signal*	This pin is the zero-potential (0 V) for the potentiometer for fine adjustment of the speed around the pre-programmed speed value. More information on page 13.
28	-	Fine tune of nominal speed	Supply potential from *COO* for the signal for *fine tune of nominal speed signal*.	This pin is the supply potential (5 V) for the potentiometer for fine adjustment of the speed around the pre-programmed speed value. More information on page 13.
29	-	Governor function	Connection of resistors acc. to fig. gives *stiff* or *soft* governor function. In combination with pin 48.	If no resistor network has been connected, the default governor function (EEPROM parameter) will be used.
30	I	Droop / Isochronous	Switching between droop and isochronous (0% droop) speed	If the pin is left unconnected, the engine can be run with droop. See pin 46 for droop adjustment. If the pin is connected to *GND* (*U31*) the engine can be run isochronous.
32	I	Engine start	Engine start via CAN.	To activate the pin it should be connected to +24 V.
34	I	Speed control / torque control	For regulation of engine speed or engine torque..	This function enables regulation of engine torque instead of engine speed. The engine is pre-set (default) for regulation of of speed. For regulation of torque the pin should be connected to *GND* (*U31*).
36	I	Nominal speed switch 2	Switch for changing the fixed speed programmed for the engine	By connecting pins 13 and 36 to *GND* in different combinations the nominal speed can be changed. See page11.
40	I	Torque limit switch 2	A *switch* which together with Torque limit switch 1can be used for selecting a pre-set torque curve.	It is also possible to program two output curves via the diagnostic tool *ECOM*. See table below how pins 40 and 60 are earthed to program two curves with the diagnostic tool. See also page 14.

Pin 40	Pin 60	Curve
Not connected	Not connected	Max. torque curve
Not connected	U31	Other requested lower torque curve
U31	Not connected	ECOM set curve
U31	U31	ECOM set curve

Coordinator description (Scania) page 2. 710655 -

Pin	I/O	Name	Description	Comment
45	-	CAN high		
46	I	Droop adjust enable	Adjustment of the droop value.	When this pin is connected to +24 V, it is possible adjust the droop value via pin 52 and 53 on *COO*. The actual droop value is then shown on the tachometer. See pin 18 and page 12.
48	-	*GND* for governor function	See pin 29.	
49	-	Supply voltage (*U30*)	Supply voltage to the coordinator	The pin should be connected to *U30* (+24 V)
50	I	Buzzer OFF	Disconnection of buzzer signal.	If this pin is connected to *GND*, the connected buzzer signal is off. *COO* is not sending out any signal on pin 5.
51	I	Stop	Stop of the engine.	In order for the engine to stop, the pin should be connected *GND* (*U31*). (Alternative stop function is switch off of *U15* for *EMS S6*).
52	I	Droop decrease	Decrease of the droop value.	See page11.
53	I	Droop increase	Increase of the droop value.	See page11.
54	I	Fine tune nominal speed (output 5 V)	Fine tuning of the engine speed around the chosen nominal speed.	0,45 V - 3,0 V correspond to 0-100 %. 0% corresponds to -120 rpm, 100% corresponds to +120 rpm and it is linear inbetween. See page 13. Out of range-limits are 0-0,25 V and 4,0-5,0 V. If there is a value in these areas, a fault code is generated. ***See Note A*** and page 13.
57	I	Engine shutdown override	When activated the engine will continue running contrary to the fault code which stipulates that the engine should shut down for safety reasons.	For activating the function the pin should be connected to *U15* (+24 V). The S6 must be programmed for the function. When this pin is activated, the engine will continue running in spite of the alarm. An information code is generated to show that the function has been used.
60	I	Torque limit switch 1	A *switch* which together with Torque limit switch 2 can select a pre-set torque curve.	It is also possible to program two output curves via the diagnostic tool *ECOM*. See table below how pins 40 and 60 are earthed to program two curves with the diagnostic tool. See also page 14.
61	I	Diagnostic request for the *S6*.	This pin has the function diagnostic request for the *S6*.	In order to read out fault codes for the *S6*, this pin should be connected to *GND* for 1 S. The *COO* then sends out pulsed signals on pin 12.

Pin 40	Pin 60	Curve
Not connected	Not connected	Max. torque curve
Not connected	U31	Other requested lower torque curve
U31	Not connected	ECOM set curve
U31	U31	ECOM set curve

Note A

Nominal speed at full load: 1500 rpm.
Min offset: -120 rpm (0%)
Max offset: +120 rpm (100%)
***Fine tune nominal speed* (with potentiometer) = e.g. 54% = (3,0 – 0,45) x 0,54 + 0,45 = 1,827 V => speed offset = +10 r/min**
Without droop (= isochronous) = 1500 + 10 = 1510 r/min
With droop 4% = 1500 + (0,04 x 1500) + 10 = 1570 r/min

Transmission:

156 Main connector for transmission.

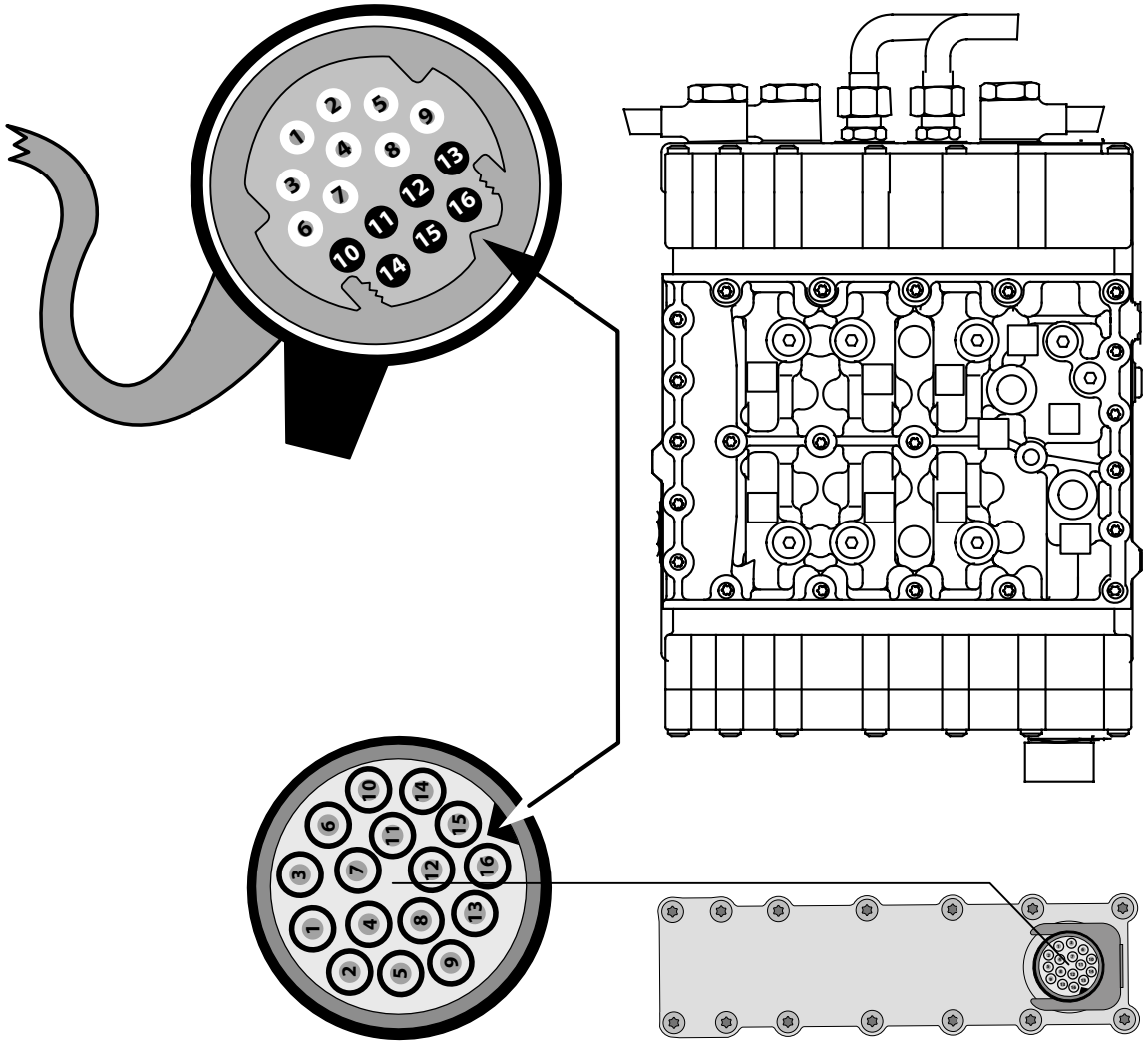
Data for the Proportional valves in the shift control unit:
Measure point: Connector pos 156

Resistance:	19Ω 10 % at 20 °C
Current:	100 to 500 mA
Pressure range:	0,8 bar to 8,3 bar

Operating unit	Connect with	Wiring to
Valve Y1	Pos 7 and 1	240 No. 10
Valve Y2	Pos 7 and 2	240 No. 56
Valve Y3	Pos 7 and 3	240 No. 32
Valve Y4	Pos 7 and 4	240 No. 55
Valve Y5	Pos 7 and 5	240 No. 09
Valve Y6	Pos 7 and 6	240 No. 51
Supply peripherals switchable 1	Pos 1 - 7	618 No. 01
Input resistance/temperature sensor 1	Pos 8	240 No. 39
Input resistance/temperature sensor 2	Pos 9	1017 No. 05

Sensor, sump temperature

Restance: 1 kΩ to 1,5 kΩ
Measure point: Connector pos 156 between 8 and 9



Spesification of electrical components

616 Sensor, retarder temperature TCU

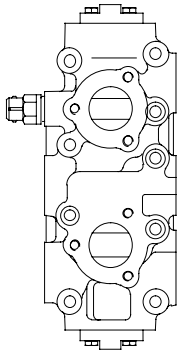
Resistance: 800 Ω to 1500 Ω

614 Solenoid valve lock-up clutch

Voltage: 24 V
Resistance: 60 Ω to 80 Ω
Current: 0,25 A to 0,35 A

200 Sensor retarder oil temperature

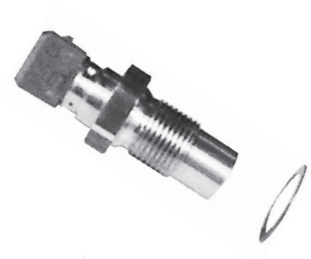
Operating temperature: –30 °C - +150 °C



Resistance at:

60 °C	216 Ω	30 Ω
90 °C	81,2 Ω	10 Ω
100 °C	62,2 Ω	6,0 Ω
120 °C	36,5 Ω	3,5 Ω
150 °C	18,7 Ω	2,1 Ω

Transmission sensors for speed pick-up.



606 Transmission input shaft and

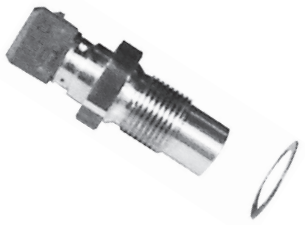
608 Transmission turbine

Resistance:	1050 Ω ± 10% at 20 °C
Torque limit:	30 Nm
Distance between sensor and gear ring:	0,5 mm + 0,3 mm



610 Hall-Sensor of the Output

Working range:	2 Hz to 5 Khz
Supply voltage:	24 V
Distance between sensor and gear ring:	1,0 mm + 0,5 mm



612 Internal gearchain

Resistance:	1050 Ω ± 10% at 20 °C
Torque limit:	30 Nm
Distance between sensor and gear ring:	0,3 mm ± 0,1mm

Sensor, sump temperature

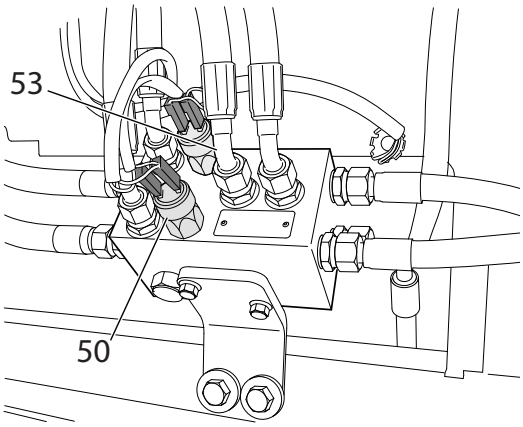
Restance:	1 kΩ to 1,5 kΩ
Measure point:	Connector pos 156 between 8 and 9

50 Low pressure switch, warning accumulator cirquit 1

Note:
Machine 810001 - 810052 N/C- 145,0 bar
Machine 810053 - N/C- 110,0 bar

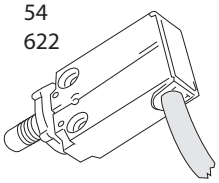
53 Low pressure switch, warning accumulator cirquit 2
Machine 810001 - 810052 N/C- 145,0 bar
Machine 810053 - N/C- 110,0 bar

Accumulator connector block



54 Pressure switch, brake lights

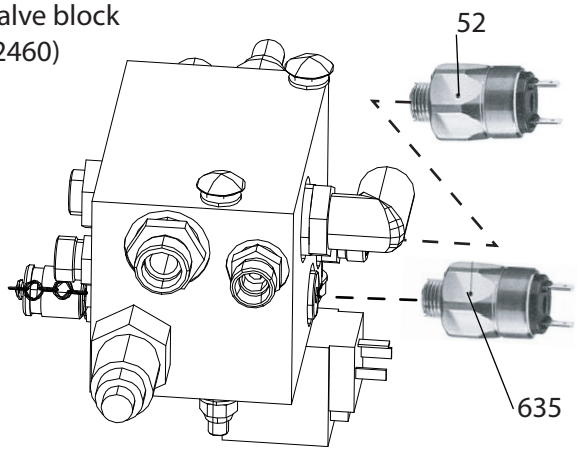
622 Switch, retarder request at brake pedal



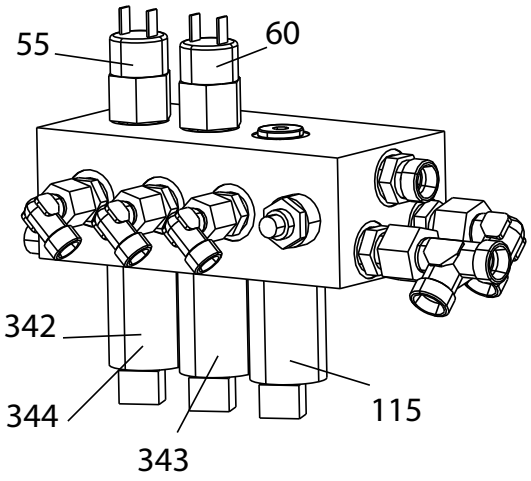
52 Pressure switch, parking brake activated
N/C - 5,0 bar Park brake on

635 Pressure switch, N/C -110 bar
park brake system

Accumulator valve block (2460)



Spesification of electrical components

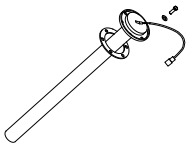


55 Pressure switch, retarder activated

60 Pressure switch, engine brake activated

75 Sensor fuel gauge

Voltage:	24V	
Resistance at high position:		0,7 Ω
Resistance at low position:		78,0 Ω

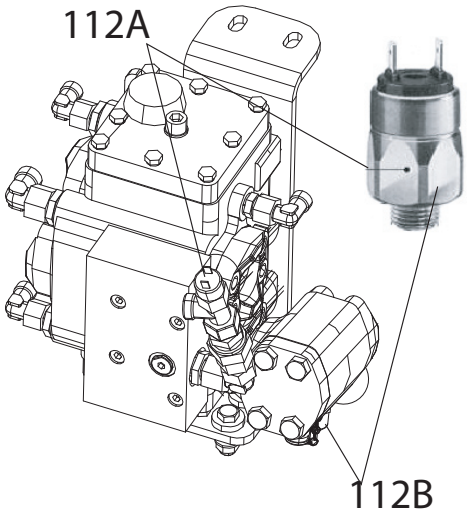


112A Flow sensor emergency steering circuit

Switches, pressure drop: < 3,2 bar

112B Flow sensor emergency steering circuit

Switches, pressure drop: < 5 bar

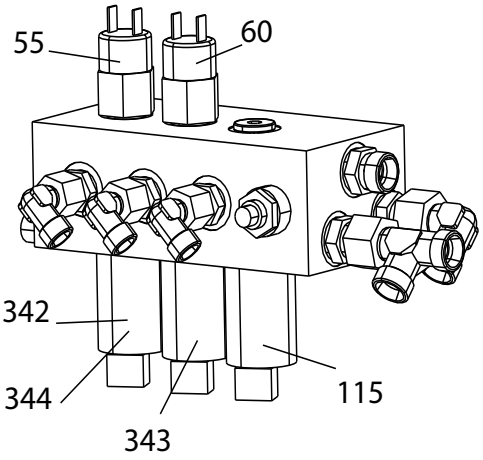


The electrical switch closes when the differential pressure between input and output gate is less than 3 bar

342 Solenoid valve retarder brake activation

343 Solenoid valve engine brake activation

344 Solenoid valve emergency retarder brake:



Solenoid N C	
Operating voltage:	22 V to 29 V
Coil resistance:	40 Ω ± 2 Ω at +23 °C ± 5 °C
Operating voltage at 4,5 bar:	19 V at + 23 C ± 5 °C

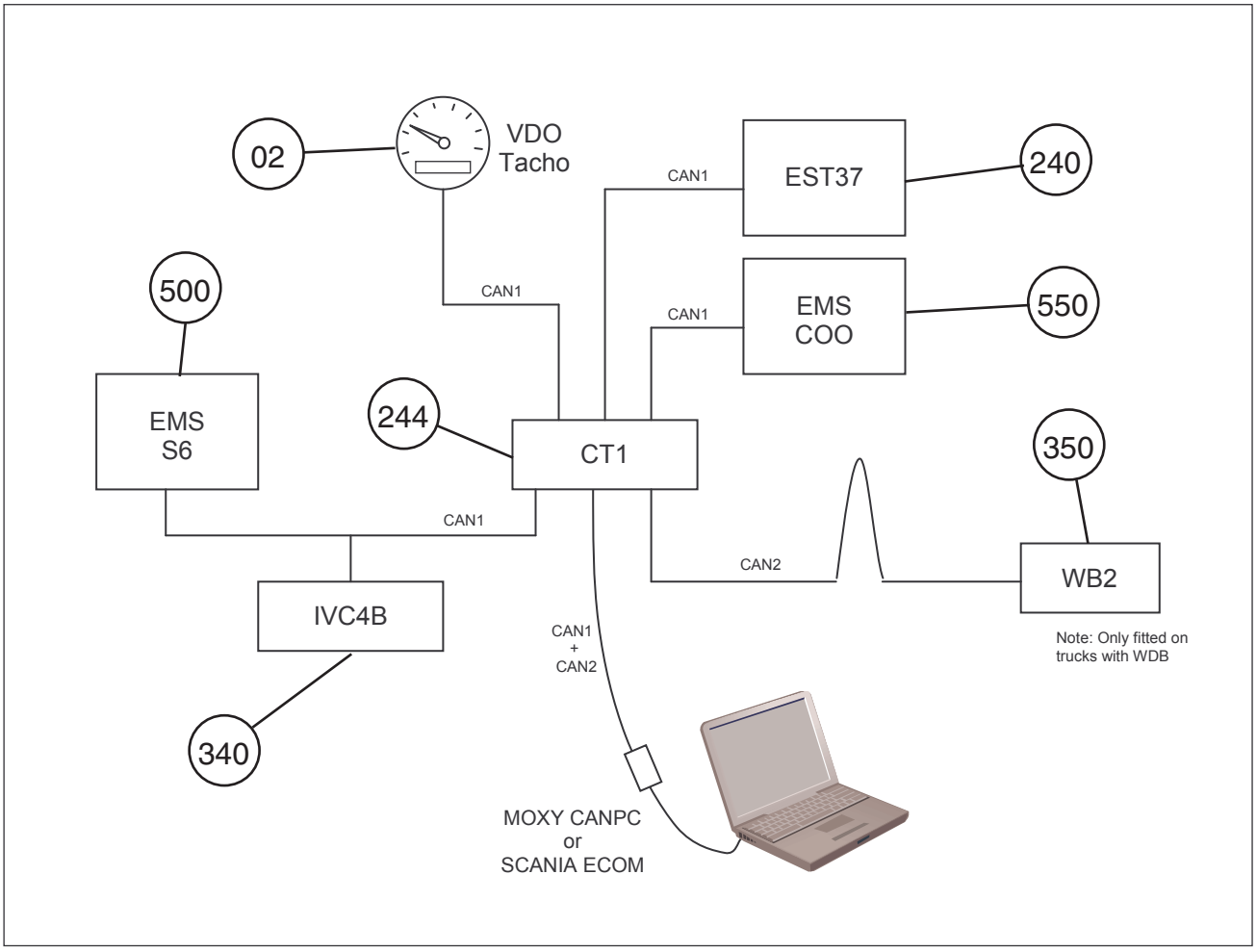
CT1 introduction

MT26/31 from machine 710655 -
MT36/41 from machine 810053

The CT1 has the following functions:

- Connection point for all CANbus devices on the truck
- Contains two independent CANbus interfaces and handles data transfers between these buses
- Connection point for engine diagnosis
- Handle WDB monitoring and alarm
- Handle histogram logging

2.1 CANbus device connection overview



CT1 Tecnical data

3.1 Features

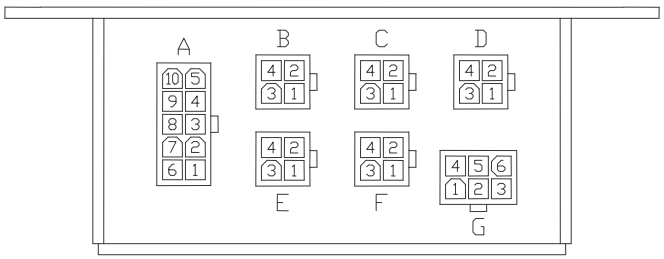
- PIC18F458 microcontroller running at 32MHz
- Two independent CANbus interfaces
- Ignition controlled power supply to perform data storage after power off
- Built in 32kbyte EEProm memory
- 3 voltage inputs
- 2 outputs (sinking to GND)

3.2 Electrical characteristics

Vs = 28V unless othervise noted

Paramter	*Min*	*Typ*	*Max*	*Unit*	*Note*
Supply voltage (Vs)	17	28	36	VDC	
Supply current running (Is1)		25		mA	Vs=28VDC and no load at outputs
Supply current off (Is2)		80		µA	Vs=28VDC, Ignition input=0V
CAN1 Termination		---			No termination
CAN2 Termination		120		Ω	
Ignition input on state voltage	17	28	36	VDC	
Ignition Input resistance		50		kΩ	Resistance to GND
Input 1-3 voltage range	0		36	VDC	
Input 1-3 resistance		78		kΩ	Resistance to GND
Output 1-2 open voltage			36	VDC	
Output 1-2 ON current		1.0		A	Internal short circuit and temperature protected
Output 1-2 ON resistance		130	250	mΩ	
Output 1-2 OFF leakage current		0.1	50	µA	
Operating temperature range	-40		+85	°C	

3.3 Connector pinouts



Connector **A** pinout	
Pin	*Description*
1	24V supply from battery (U30)
2	Ignition signal (U15)
3	GND (U31)
4	CAN1 High
5	CAN1 Low
6	Input 1
7	Input 2
8	Input 3
9	Output 1 (sink to GND)
10	Output 2 (sink to GND)

Connectors **B..F** pinout	
Pin	*Description*
1	CAN1 High
2	CAN2 High
3	CAN1 Low
4	CAN2 Low

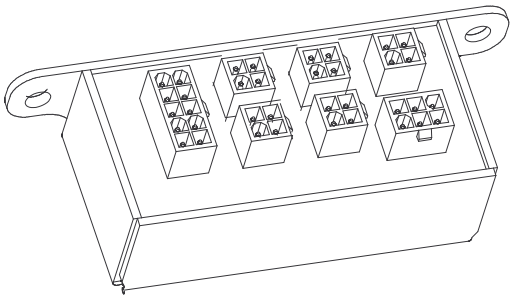
Connector **G** pinout	
Pin	*Description*
1	CAN1 High
2	CAN2 High
3	24V supply output (U31)
4	CAN1 Low
5	CAN2 Low
6	GND (U30)

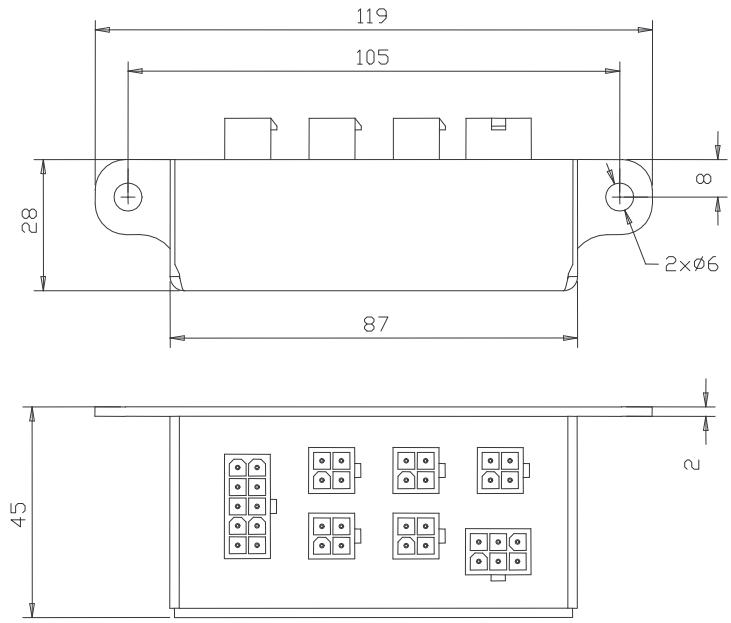
3.4 Connector types

The following connectors are used on the harness side to connect to the CT1.

Connector A:	10pin AMP Mini UMNL	AMP partno = 770580-1
Connector B-F:	4pin AMP Mini UMNL	AMP partno = 172167-1
Connector G:	6pin AMP Mini UMNL	AMP partno = 172168-1
	Crimp socket 0.3..0.9mm^2 wire	AMP partno = 770988-1

3.5 Mechanical data





Housing material: Painted steel

PCB and electronics are moulded into the housing using a PUR compound.

Total weight: approx. 290g

4 WDB monitoring and alarm

The CT1 are continuously reading data from the CANbus. The following readings from the CANbus are used for performing the WDB monitoring and alarm function:

- Temperatures from the front hubs (received from IVC4B at CAN1)
- Temperatures from the tandem housings (received from WB2 at CAN2)
- Reservoir tank level for the front cooling circuit (received from IVC4B at CAN1)

These parameters are checked against various alarm levels. The CT1 is then generating an error code that is transmitted on CAN1. This message is received by the VDO Tachometer instrument to show error codes in the intrument LCD display. The VDO instrument is also controlling an error lamp and a buzzer to alert the driver.

4.1 WDB error codes

Below is an explanation of the WDB error codes.

Note: If two or more error conditions are occuring simultaneously, only the *highest number* error code will be reported.

Error Code	*Description*	*Conditions*
0	**OK (No error)**	
1	**Temperature warning**	Activated: If front hub temperature >100°C *or* tandem temperature >80°C. Deactivated: If front hub temperature <93°C *and* tandem temperature <76°C.
2	**Temperature alarm**	Activated: If front hub temperature >120°C *or* tandem temperature >90°C. Deactivated: If front hub temperature <113°C *and* tandem temperature <86°C.
3	**Temperature sensor fault**	Activated if one or more of the temperature sensors are faulty. This can also indicate a cable breakage, bad connection or a short circuit condition. If the sensor resistance measured is <580ohm or >3330ohm this error will be activated.
4	**Reservoir tank level low**	Activated if the float switch in the reservoir tank detects low level. Switch is closed for normal level and open for low level. Will also be activated if cable is not connected.
5	**CANbus fault**	Activated if the CT1 can't read data from either IVC4B *or* WB2. This can be caused by cable breakage (loss of power or CANbus connection) or device malfunction.

Position list.

List

Comp. no.		Description	Opt-ion	Map no:	Circuit no.:
2		Engine revolution counter and hour meter		M11	C10
5		Switch, test warning light brake fluid		M12	C20
6	A2	Warning light, brake fluid		M11	C20
6	B2	Warning light, emergency steering		M11	C26
6	C1	Warning WDB error (from 810053)		M11	
6	C2	Warning light, parking brake		M11	C20
7	A1	Warning light, engine coolant temperature		M11	C18
7	A2	Warning light, battery charge		M11	C03-C18
7	B1	Warning light, engine oil pressure		M11	C18
7	B2	Warning light, air filter		M11	C18
7	C1	Warning light, engine error.		M11	C18
7	C2	Indicator light, Coordinator - 810035	*	M11	C24
8	A1	Warning light, transmission main alarm		M11	C19
8	B1	Low coolant level		M11	C18
8	B2	Seat belt warning lamp		M11	C15
8	C2	Indicator light, Lock-up engaged		M11	C19
9	A1	Indicator light, High beam activated		M11	C21-C24
9	A2	Indicator light, direction signal		M11	C24
9	B1	Indicator light, engine brake activated		M11	C19
9	B2	Indicator light, retarder brake activated		M11	C19
9	C1	Indicator light, inter-axle differential lock engaged		M11	C19
9	C2	Indicator light, Central lubrication system	*	M11	C28-C29
10		Speedometer		M11	C10-C19
17		Pressure switch, air filter		M02	C18
18		Switch, engine fault code and lamp test		M12	C18
20		Switch, extra reverse/ backward working lights fenders	*	M12	C09
23		Audible alarm central lubrication		M08	C28-C29
24		Central lubrication pump unit	*	M01	C28- C29-C30
25		Pressure switch, central lubrication	*	M03	C28
28		Gauge transmission oil temperature		M11	C10-C19
30		Gauge fuel level		M11	C10
36		Operating panel, fan and air condition		M08-M10-M12	C06
37		Switch, ventilation fan		M12	C06
38		Switch, extra high beam/ worklight roof		M12	C04
40		Switch, steering column		M11	C14-C21-C24

Comp. no.		Description	Opt-ion	Map no:	Circuit no.:
43		Motor, windscreen wiper		M07	C14
47		Switch, engine brake and retarder brake request		M12	C19
48		Switch for parking brake on/off		M12	C20
50		Low pressure switch brake circuit 1		M07	C20
52		Pressure switch, parking brake activated		M02	C20
53		Low pressure switch brake circuit 2		M07	C20
54		Pressure switch, brake lights		M08	C02
55		Pressure switch, retarder activated		M02	C19
58		Rotating beacon		M01-M07	C12
59		Horn		M01-M02	C14
60		Pressure switch, engine brake activated		M02	C19- C25
61	I	Connector, cab roof cable set		M07-M08	C04
61	II	Connector, cab roof cable set for radio		M07-M08	C12-C13
61	III	Connector, cab roof cable set for radio		M07-M08	C13-
64		Mirror, heated, right hand side	*	M01	C05-
65		Mirror, heated, left hand side	*	M01	C05-
67		Interior light		M07	C01
68		Switch for interior light, located in door		M07	C01
69		Connector, cab front wall		M07-M08	C14-C20
70		Connector mirrorarm right hand side		M01-M02	C05-C09
71		Connector mirrorarm left hand side		M01-M02	C05-C09
75		Sensor fuel gauge		M01-M02	C10-
76		Window washer tank with pump		M07	C14-
77		Switch, inter-axle differential lock		M08-M12	C19-
78		Switch, ignition and starter		M08-M12	C03-C05-C06-C09-C10-C12-C13-C15-C15-C16-C19-C20-C21-C22-C24-C25-C26-C27-C30
79		Cigarette lighter		M08-M12	C11
84		Buzzer, parking brake		M08	C20
85		Relay, wiper/ washer		M09	C14
86		Buzzer, low air pressure		M08	C20
87		Relay, engine control unit DEC2		M09	C18
89		Switch, hazard light		M12	C24
90		Switch, main light		M12	C09- C21
92		Switch, rotating beacon		M12	C12
93		Switch, cab interior light		M12	C01
94		Switch, heated mirrors		M12	C05

Comp. no.		Description	Opt-ion	Map no:	Circuit no.:
95	AA	Fusebox, supply connection		M09	C03
95	A1	Fuse, ignition		M09	C03
95	A2	Fuse, low beam		M09	C21
95	A3	Fuse, high beam		M09	C21
95	A4	Fuse, wiper supply		M09	C14-C20
95	A5	Fuse, SPARE	*	M09	C06
95	A6	Fuse, heater and A/C		M09	C06
95	AF	Fusebox, supply connection		M09	C03
95	B1	Fuse, engine controller		M09	C03-C18
95	B2	Fuse, transmission controller		M09	C19
95	B3	Fuse, reverse light and alarm		M09	C09
95	B4	Fuse, heated seat and heated mirror	*	M09	C05-C16
95	B5	Fuse, parking light		M09	C12-C21
95	B6	Fuse, hazard light		M09	C24
95	BA	Fusebox, supply connection		M09	C03
95	C1	Fuse, radio memory		M09	C13
95	C2	Fuse, air dryer		M09	C05-C16-C19-C20-C29
95	C3	Fuse, brake light and cab light		M09	C02
95	C4	Fuse, lighter		M09	C11
95	C5	Fuse, extra high beam/ worklight roof	*	M09	C04
95	C6	Fuse, work light rear	*	M09	C09
95	CA	Fusebox, supply connection		M09	C03
95	D1	Fuse, direction light, gauge supply and light		M09	C06-C10-C19-C21
95	D2	Fuse, radio, lights in switches and control lights		M09	C04-C05-C09-C12-C13-C16
95	D3	Fuse, extra high beam/ worklight roof	*	M09	C27
95	D3			M09	C15-C18-C19-C20-C26-
95	D4	Fuse, engine cooler		M09	C03-C14-C18-C19-C20-C25
95	D5	Fuse, transmission, park brake alarm		M09	C19-C20
95	D6	Fuse, park brake alarm, retarder, engine brake		M09	C19-C20- C22
95	DA	Fusebox, supply connection		M09	C03
95	DF	Fusebox, supply connection		M09	C03
95	E1	Fuse, central lubrication system	*	M09	C28- C29- C30

Comp. no.		Description	Opt-ion	Map no:	Circuit no.:
95	E2	Fuse, headlights		M09	C21
95	E3	Fuse, starter		M09	C03-C18
95	E4	Fuse, Parking light right hand side		M09	C21
95	E5	Fuse, Parking light left hand side		M09	C21
95	E6	Fuse, spare space		M09	C24
95	EA	Fusebox, supply connection		M09	C03
95	G1	Fuse, radio supply unit	*	M09	C13
98		Flasher relay, direction light and hazard light		M09	C24
98	B	Flasher relay, direction light and hazard light, USA		M09	C24
99		Relay, chargeing activated		M09	C05-C16-C29
100		Relay, start lock		M09	C03-C18-C19
102		Relay, extra high beam/ worklight roof	*	M09	C04
104		Relay, low beam		M09	C21
105		Relay, high beam		M09	C04-C21
106		Relay, reverse light		M09	C09-C19
107		Relay, heated seat	*	M09	C16
108		Relay, heater unit		M09	C06
109		Relay, parking brake alarm		M09	C06-C20
112	A	Flow sensor, emergency steering circuit		M02	C26
112	B	Flow sensor, emergency steering circuit		M02	C26
114		Connection point, main supply electrical central		M09	C02-C03-C04-C05-C09-C11-C12-C13-C14-C16-C19-C20-C21
115		Solenoid, inter axle diff.lock		M2	C19
118		Relay, heated mirrors	*	M09	C05-C06
119		Relay, engine cooler		M09	C19-C25
120		Relay, control retarder		M09	C19
121		Relay, park brake alarm		M09	C06-C20
122		Direction light, front, right hand side		M01	C24
123		Direction light, front, left hand side		M01	C24
126		Main light, front right hand side		M01-M02	C21- C24
127		Main light, front left hand side		M01-M02	C21-C24
129		Relay, brake light		M09	C02-C06
130		Relay engine running		M09	C18
133		Back up light, optional	*	M03	C09
134		Back up light, prepared for Back up alarm		M01	C09

Comp. no.		Description	Opt-ion	Map no:	Circuit no.:
135		Back up alarm		M03	C09
138		Rear light left hand side		M01-M03	C02- C21- C24
139		Rear light right hand side		M01-M03	C02- C21- C24
140		Connection point, gear restriction		M09	C19- C28- C29- C30
145		Battery		M01-M02	C03
146		Alternator		M02-M04	C03- C16- C18
150		Starter		M02-M04	C03- C18
151		Start relay		M04	C03- C18
156		Connector, electro-hydraulic control unit, TCU		M06	C19
160		Pressure switch, inter axle diff.lock activated		M06	C19
165		Main switch, battery connection		M02	C03
190		Converter for radio, DC24V-> DC12V		M07	C13
191		Radio	*	M07	C13
192		Loudspeaker right hand side	*	M07	C13
193		Loudspeaker left hand side	*	M07	C13
200		Sensor, retarder oil temperature MT		M06	C10-C19
203		Heating element, drivers seat	*	M08	C16
204		Air compessor, chair		M8	C16
205		Switch, heating element in drivers seat		M12	C16
206		Switch, seatbelt lock		M8	C15
209		Compressor, A/C		M02-M04	C06
210		Pressure switch, A/C		M02	C06
228		Flasher relay, alarm for parking brake		M09	C20
236		Gear selector		M08-M12	C03-C19-C20
240		Transmission control unit (TCU)		M7-M08	C10-C19- C30
241		Connector, CAN-bus connection ECU/TCU		M08	C19
242		Connection point CAN in front frame cable		M04	C18-C19
243		Can-bus connection for valve adjuster box		M04	C18-C19
244		CAN-bus test connection		M08	C18-C19
245		Light, extra high beam/ worklight roof	*	M01-M04	C04
246		Working light, backwards on mirror arms, right hand side.	*	M01	C09
247		Working light, backwards on mirror arms, left hand side.	*	M01	C09
248		Connector, 3 pos for TCU Display		M08	C19
249		Connector, 4 pos for TCU Display		M08	C10-C19
250		Display, Transmission control unit		M11	C19
252		Relay, Transmission control		M09	C09-C19

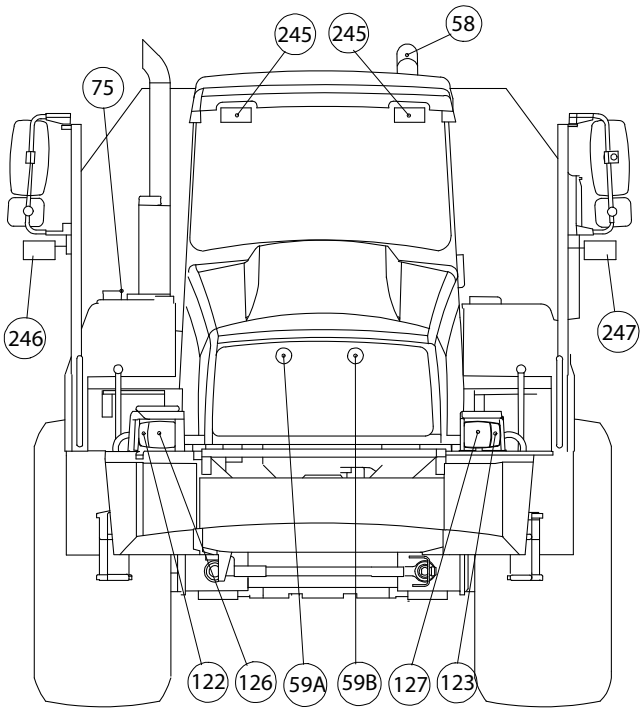
Comp. no.		Description	Opt-ion	Map no:	Circuit no.:
253		Relay, wiper/ washer and horn		M09	C14-C20
254		Relay, extra reverse/ backward working lights on mirror arms	*	M09	C09
265		Heater unit		M10	C06
265	A	Fan heater unit		M10	C06
265	B	Fan heater unit		M10	C06
266		Switch, A/C thermostat in heater unit		M10	C06
268		Resistance in heater unit		M10	C06
269		Motor for air intake selection heater unit		M10	C06
270		Switch for air intake selection heater unit		M12	C06
340		Valve adjuster box		M02	C19
342		Solenoid, retarder brake activation		M2	C19
343		Solenoid, engine brake activation		M2	C19
344		Solenoid, emergency retarder brake activation		M2	(See pos 342)
500		Engine control unit (ECU)		M04	C03-C18-C19
501		Accelerator pedal unit		M08	C18
502		Sensor, accelerator pedal potentiometer		M08	C18
504		Switch, low idle positon accelerator pedal		M08	C18
530		Switch, low coolant level		M04	C18
541		Sensor, engine speed, ECU		M04	C18
542		Sensor, engine coolant temperature, ECU		M05	C18
543		Sensor, engine boost temperature, ECU		M04	C18
544		Sensor, engine oil pressure, ECU		M05	C18
550		Coordinator		M7- M08	C03-C10-C18-C19
606		Sensor, transmission input shaft RPM, TCU		M06	C19
607		Connector, TCU diagnosis port		M08	C19
608		Sensor, transmission internal gear chain RPM, TCU		M06	C19
610		Sensor, transmission output shaft RPM, TCU		M06	C19
612		Sensor, transmission turbine RPM, TCU		M06	C19
614		Solenoid, transmission Lock Up clutch		M06	C19
616		Sensor, retarder oil temperature, TCU		M06	C19
617		Connection point, transmission net		M06	C19
618		Connection point, transmission net		M06	C19
620		Pressure switch, transmission oil filter		M02	C19
622		Switch, retarder request at brake pedal		M08	C19
630		Solenoid, engine fan control		M02	C25-

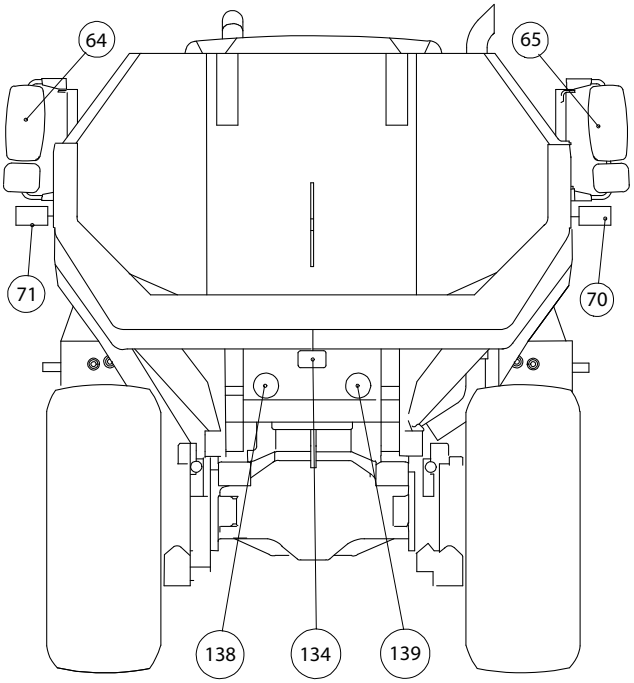
Comp. no.		Description	Opt-ion	Map no:	Circuit no.:
635		Pressure switch, park brake system		M02- M07	C20-
640		Solenoid, parking brake		M02	C20-
708		Detent magnet, tip control lever		M08	C22-
718		Pressure switch for detent magnet control, tip system		M02	C22-
850		Cable set, front frame		M02	View at the map
851		Cable set, cab roof		M07	View at the map
852		Cable set, engine		M04	View at the map
855		Cable set, rear frame		M03 ??	View at the map
865		Cable set, transmission		M06	View at the map
870		Battery cable, red , batt.+ to starter +		M02-M04	View at the map
871		Battery cable, red , batt.- to batt. +		M02	View at the map
872		Battery cable, black, batt.- to main switch		M02	View at the map
873		Battery cable, black, main switch to starter -		M02-M04	View at the map
875		Cable set, starting and charging		M02	View at the map
876		Cable set, cab front wall		M07	View at the map
880		Cable set, cab main net, el. central to switches		M08	View at the map
881		Cable set, cab main net, el. central to gauges		M08	View at the map
G902		Ground connection point, on engine for alternator		M04	View at the map
G904		Ground connection point, cab back wall below el. central		M02-M07-M08	C02-C03-C04-C05-C09-C10-CC16-C19-C20- C21- C22- C24-C25- C27- C28- C29
G909		Ground connection point, inside cab for cab roof cable set, in front of radio.		M07	C04-C12-C13
G910		Ground connection point, on transmission		M06	C19
G913		Ground connection point, cab right hand side, below ash-tray		M08	C04-C05-C09-C11-C12-C13-C15-C16-C20- C21- C24
G914		Ground connection point, behind middle instrument panel		M08	C10- C21- C28- C29
G915		Ground connection point, cab outside front wall		M07	C14-C20
951		El.sentral		M02-M09	View at the map
G999		Ground connection due to assembly		Chassis ground	C10

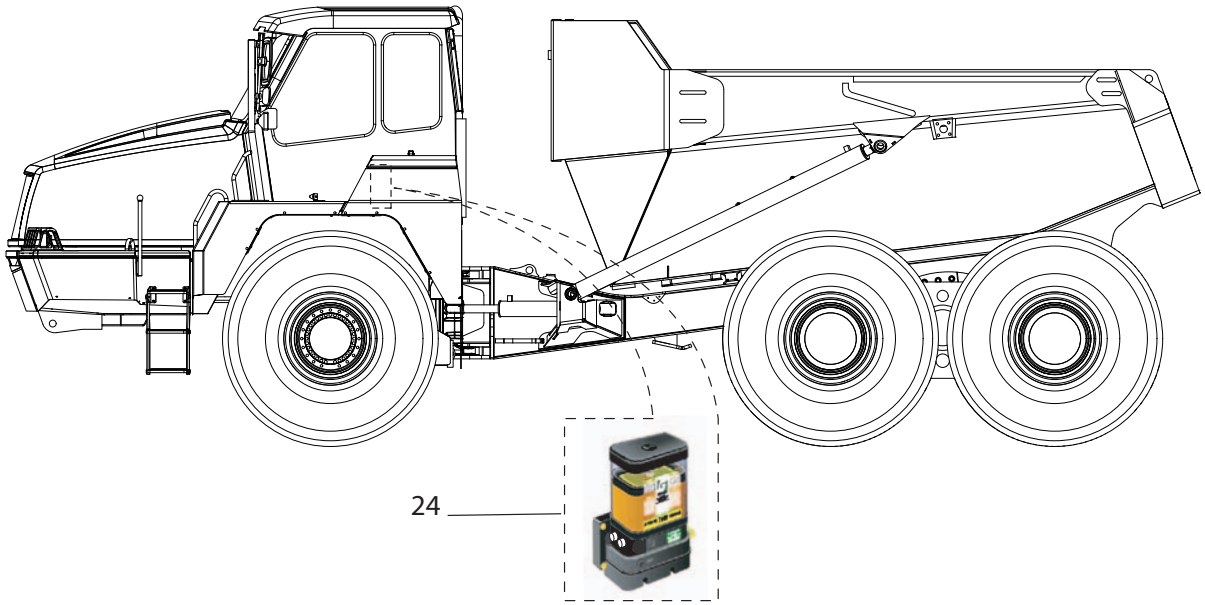
Comp. no.		Description	Opt-ion	Map no:	Circuit no.:
1001		Connector, main net right hand side, el. Central to switches		M09	View at the map
1002		Connector, main net right hand side, el. Central to switches		M09	View at the map
1003		Connector, main net right hand side, el. Central to switches		M09	View at the map
1004		Connector, main net right hand side, el. Central to gauges and lamps		M09	View at the map
1005		Connector, main net right hand side, el. Central to gauges and lamps		M09	View at the map
1006		Connector, main net right hand side, el. Central to gauges and lamps		M09	View at the map
1007		Connector, main net right hand side, el. Central to switches		M09	View at the map
1008		Connector, main net right hand side, el. Central to gauges and lamps		M09	View at the map
1011		Connector, engine cable set		M09	View at the map
1012		Connector, front frame cable set, lightning part		M02-M09	View at the map
1013		Connector, front frame cable set		M02-M09	View at the map
1014		Connector, front frame cable set		M02-M09	View at the map
1015		Connector, rear frame cable set		M03-M09	View at the map
1016		Connector, transmission cable set		M09	View at the map
1017		Connector, transmission cable set		M09	View at the map

Map

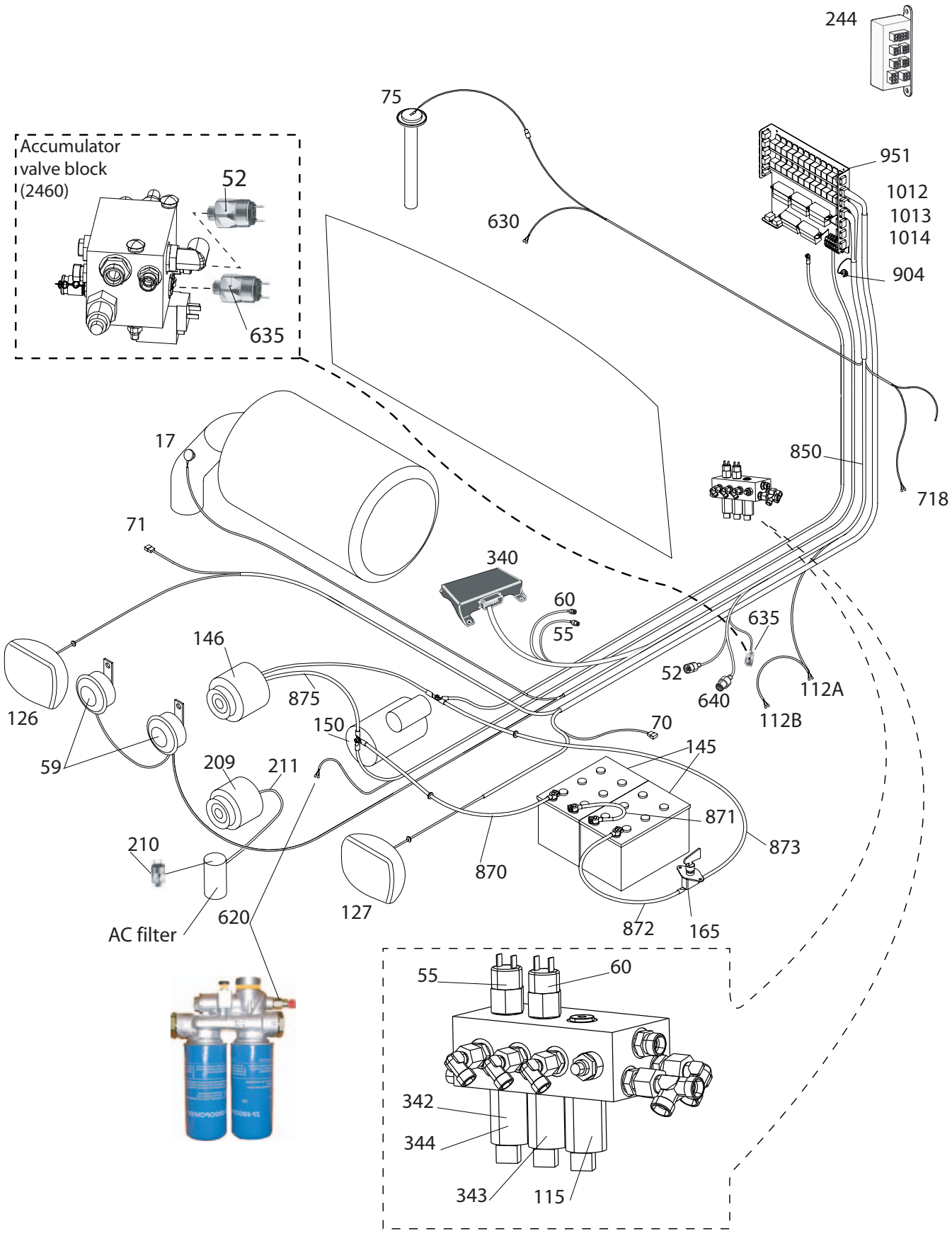
Map 01 El.system, outside front and rear



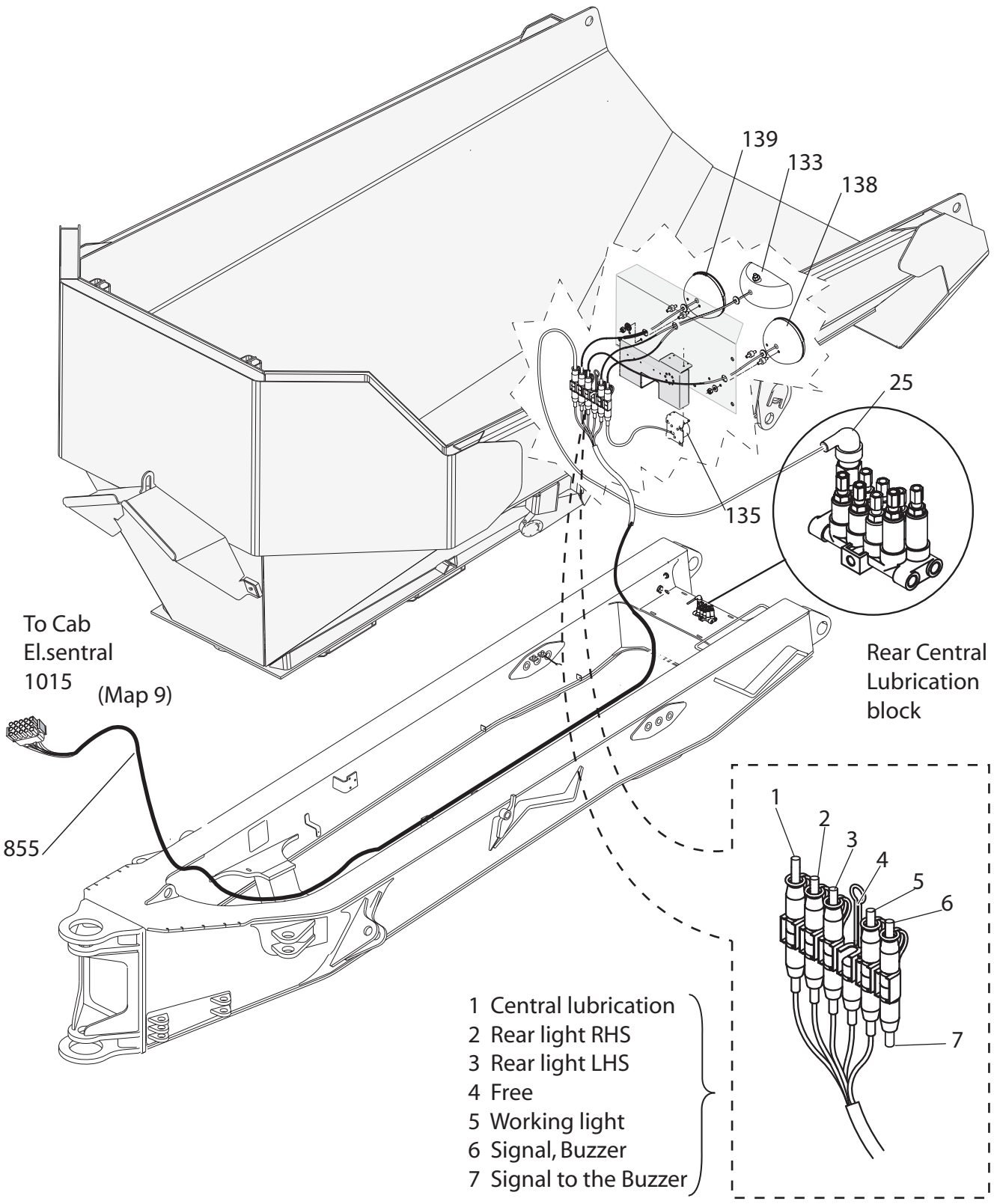




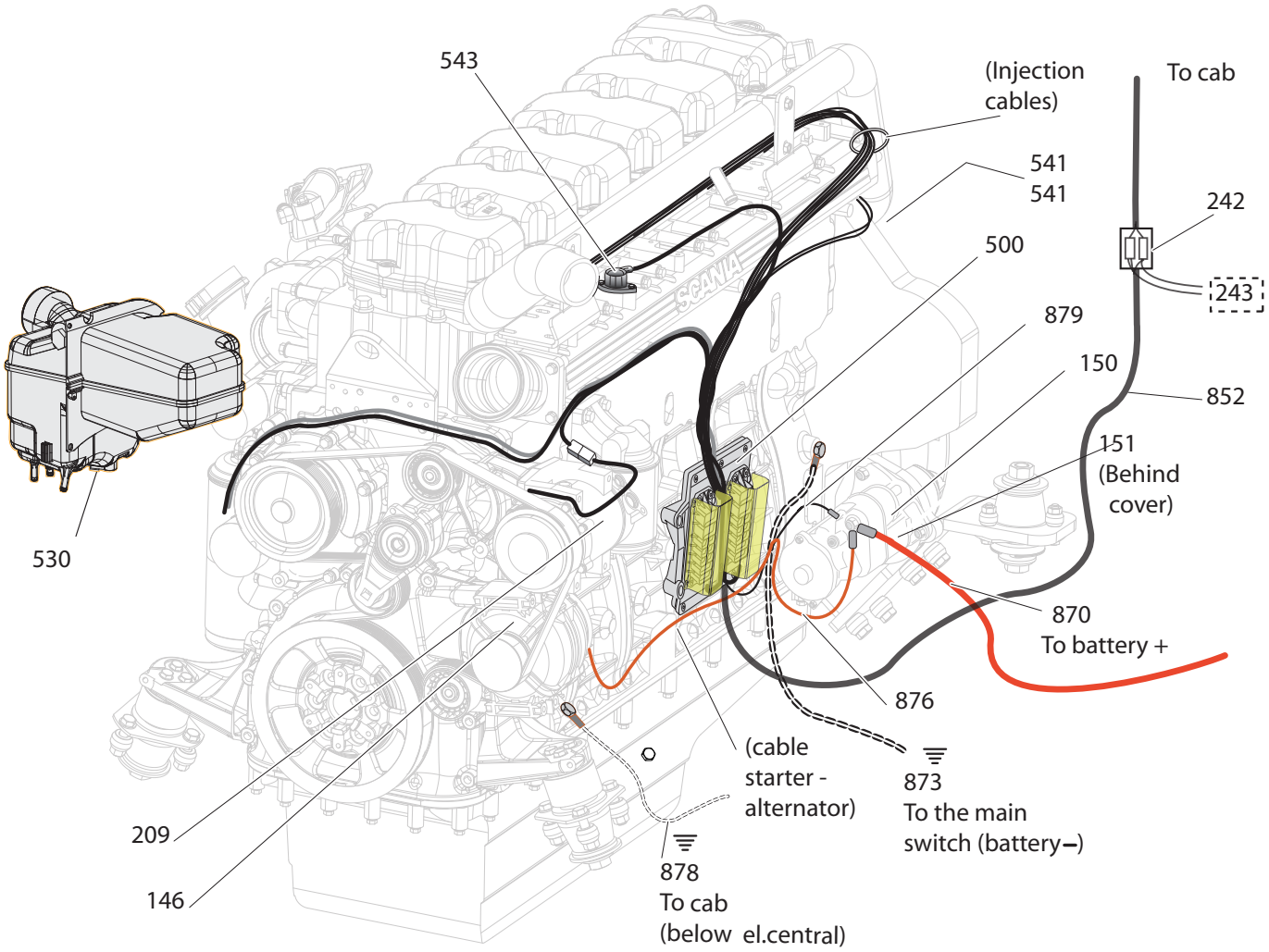
Map 02 El.system, Front frame



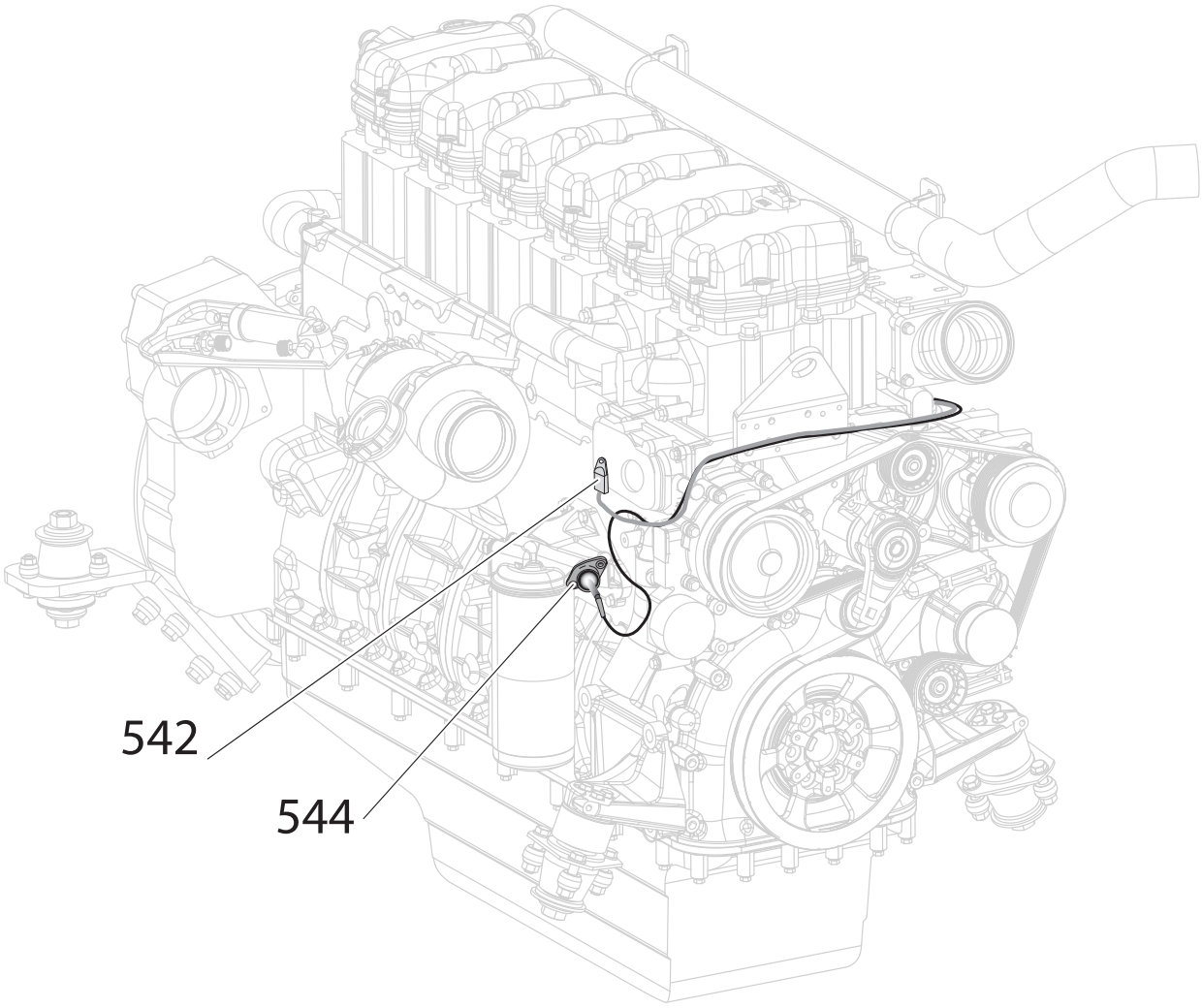
Map 03 El.system, Rear frame



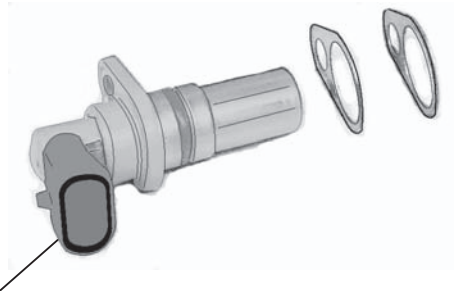
Map 04 El.system, Sensors on Engine

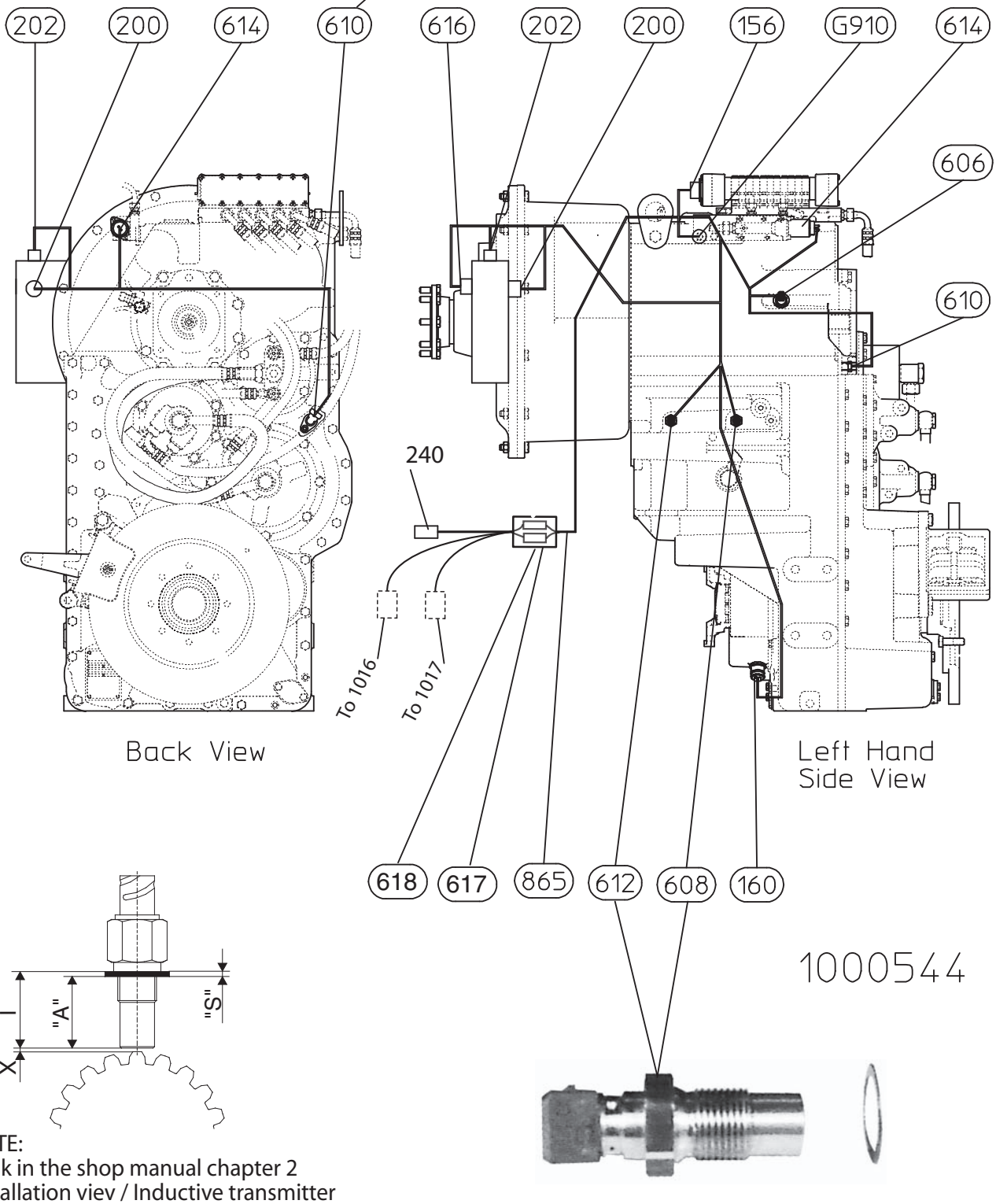


Map 05 El.system, Sensors on Engine



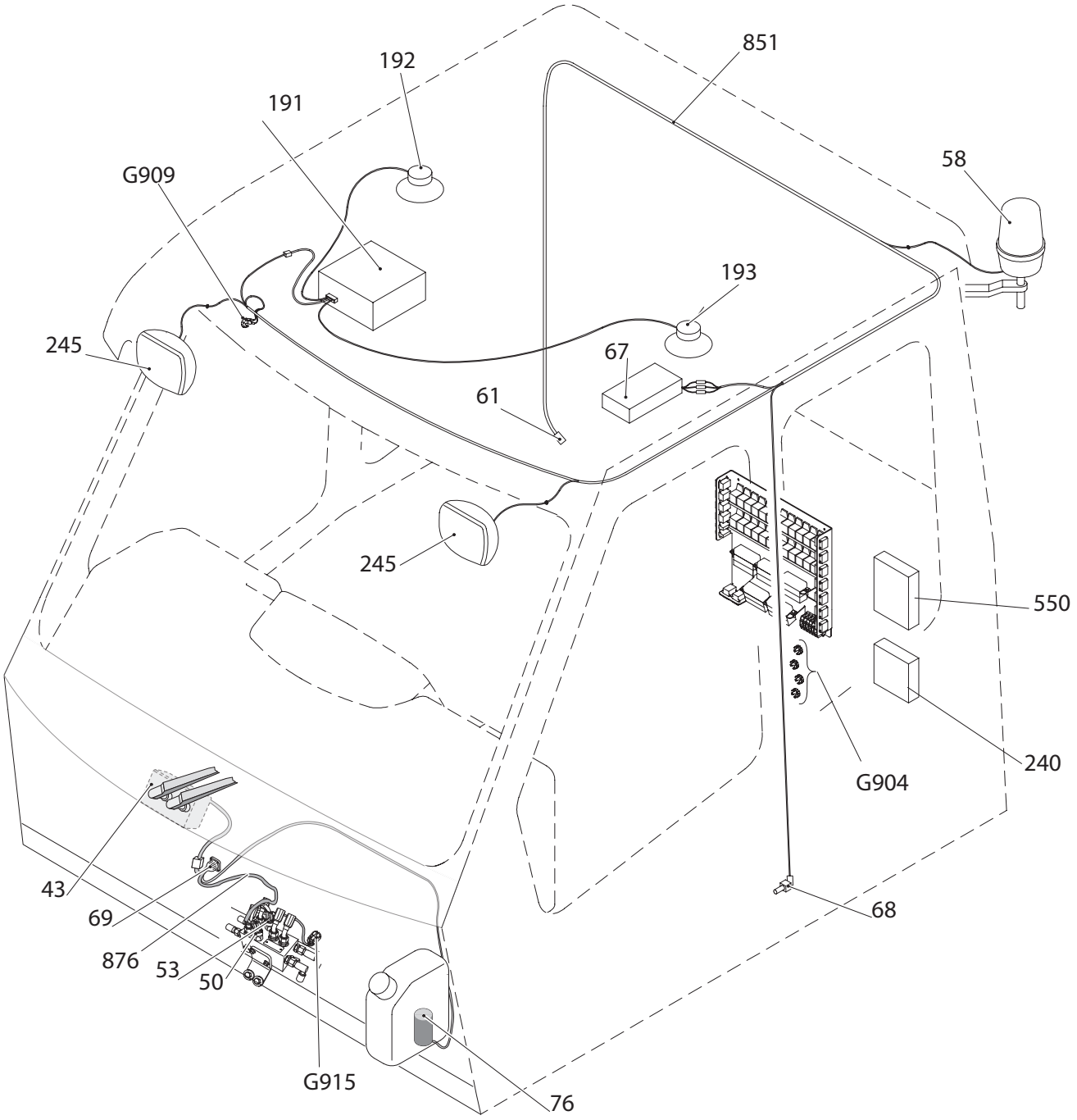
Map 06 El.system, Sensors on Transmission



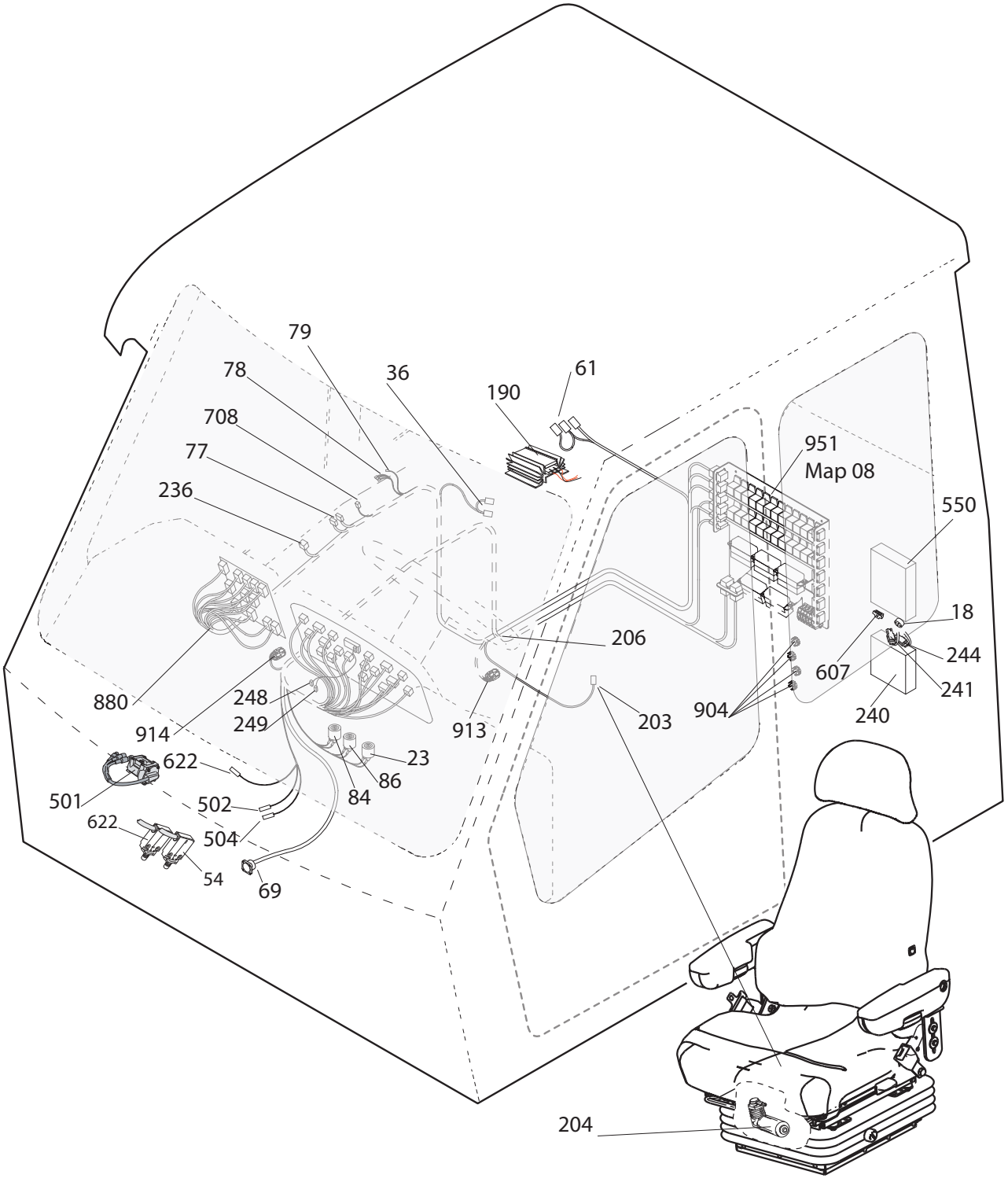


NOTE:
Look in the shop manual chapter 2
Installation viev / Inductive transmitter
when assembly the induct. transmitter.

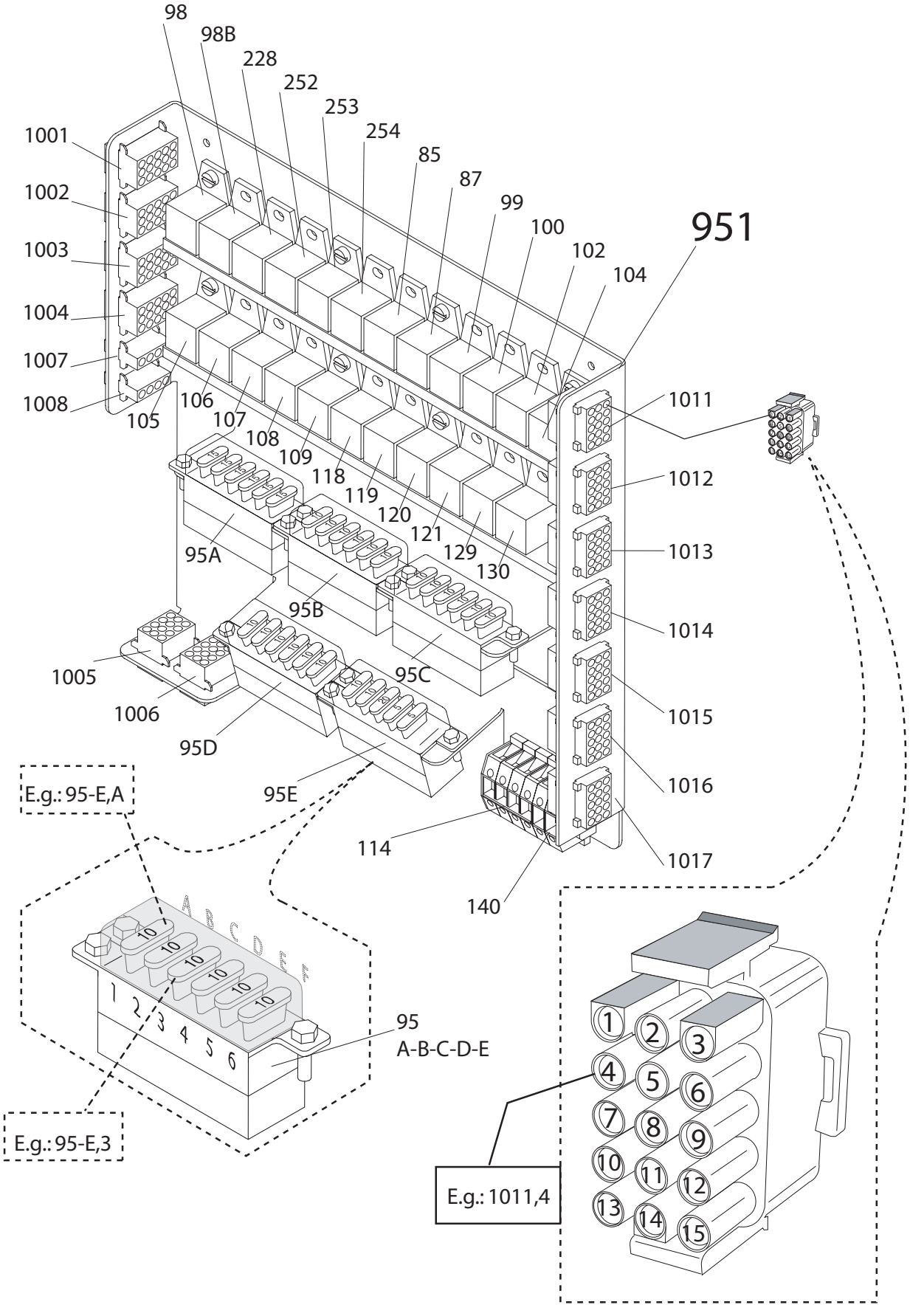
Map 07 El.system, Cab outside and ceiling



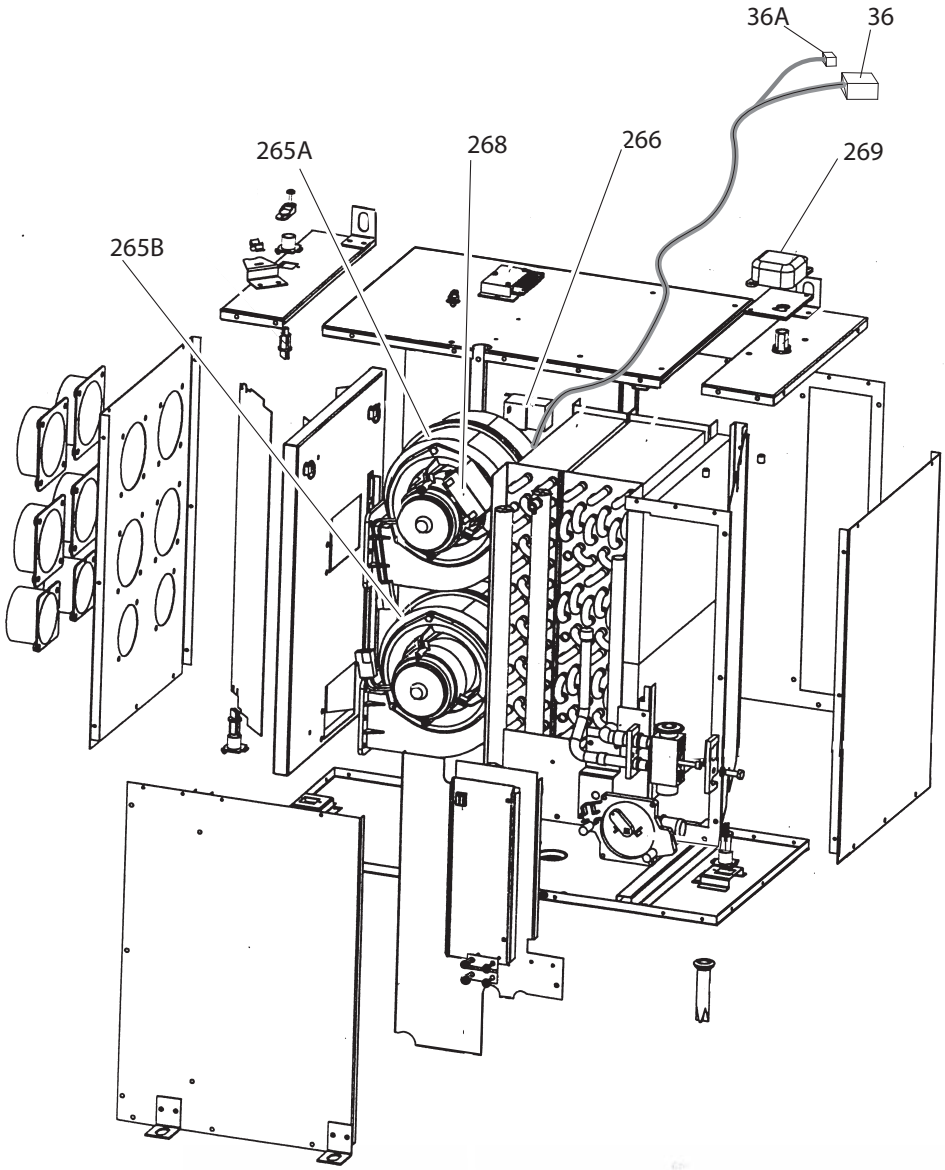
Map 08 Cab lower

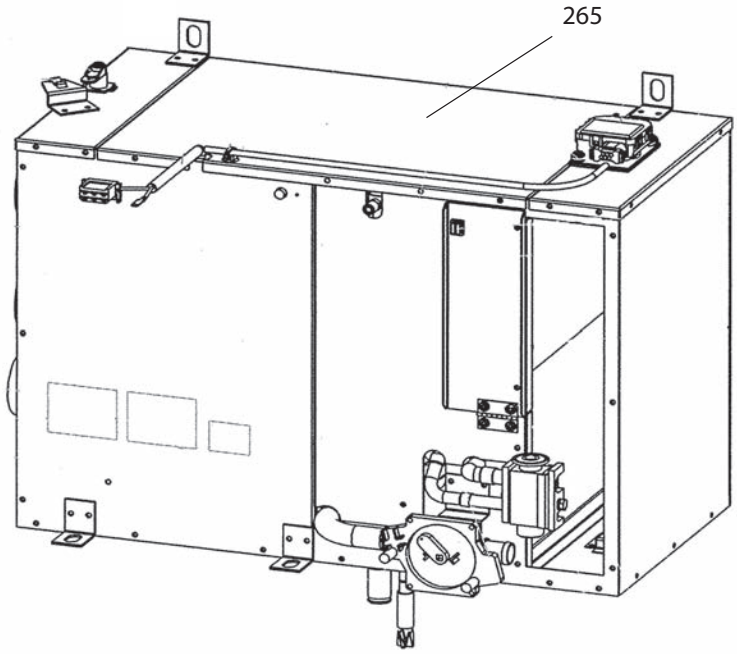


Map 09 Fuse box and relays

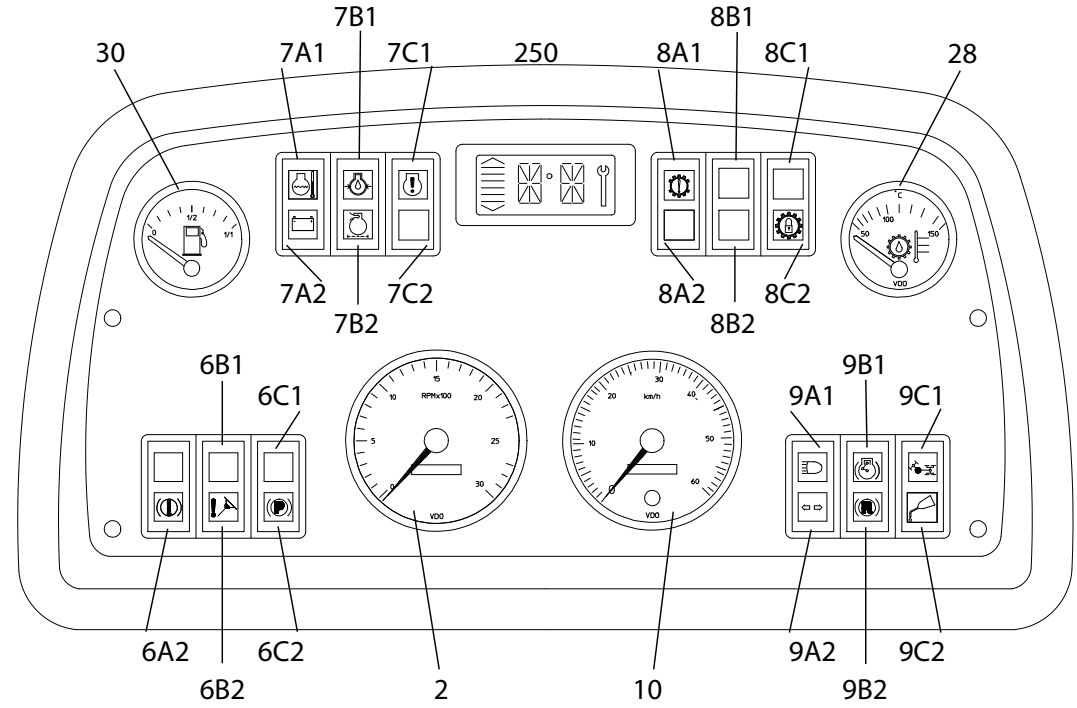


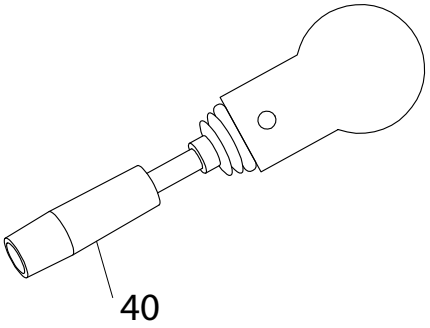
Map 10 Heater unit



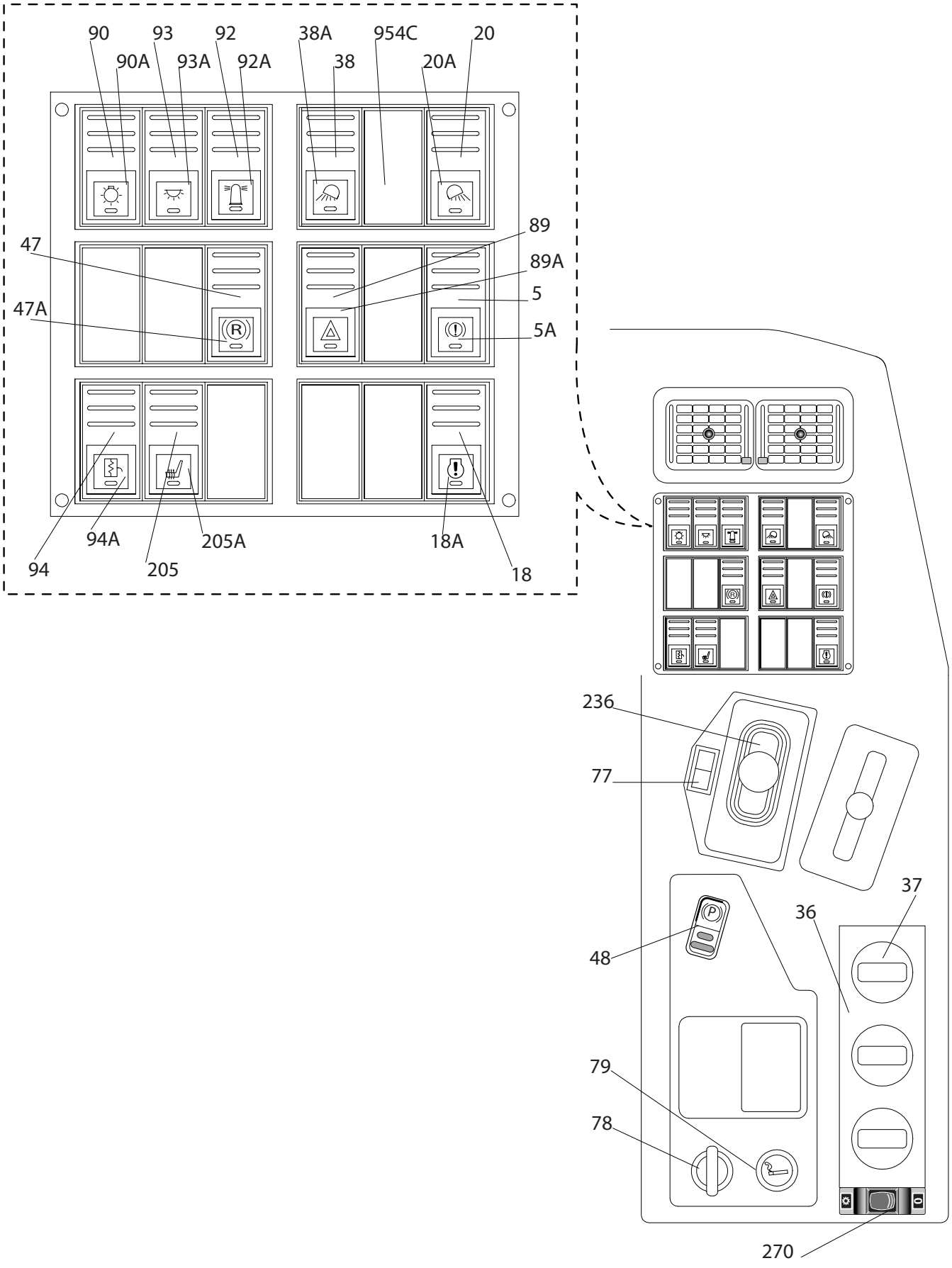


Map 11 El.system, Instrument panel



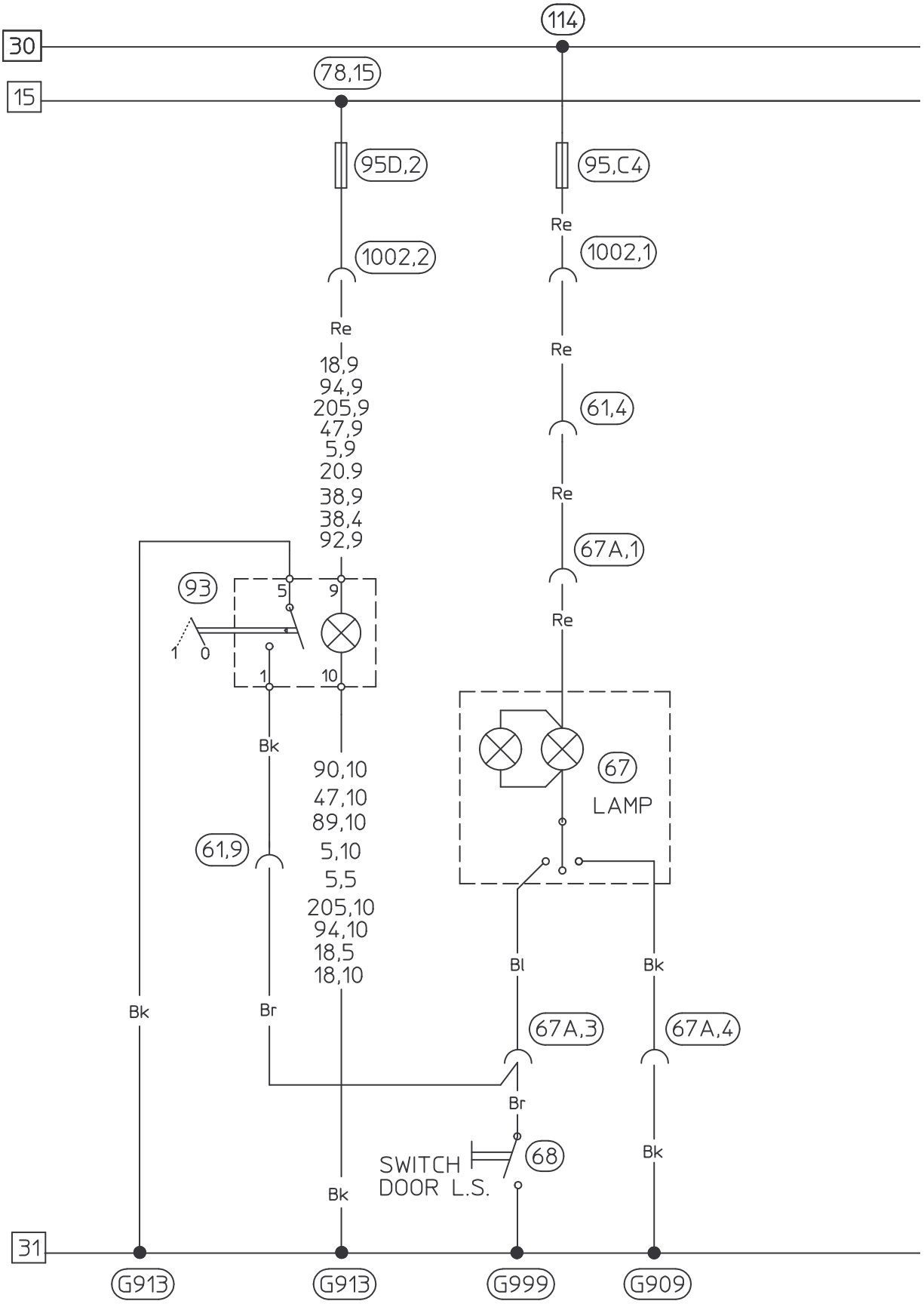


Map 12 Cab innside, lower panel

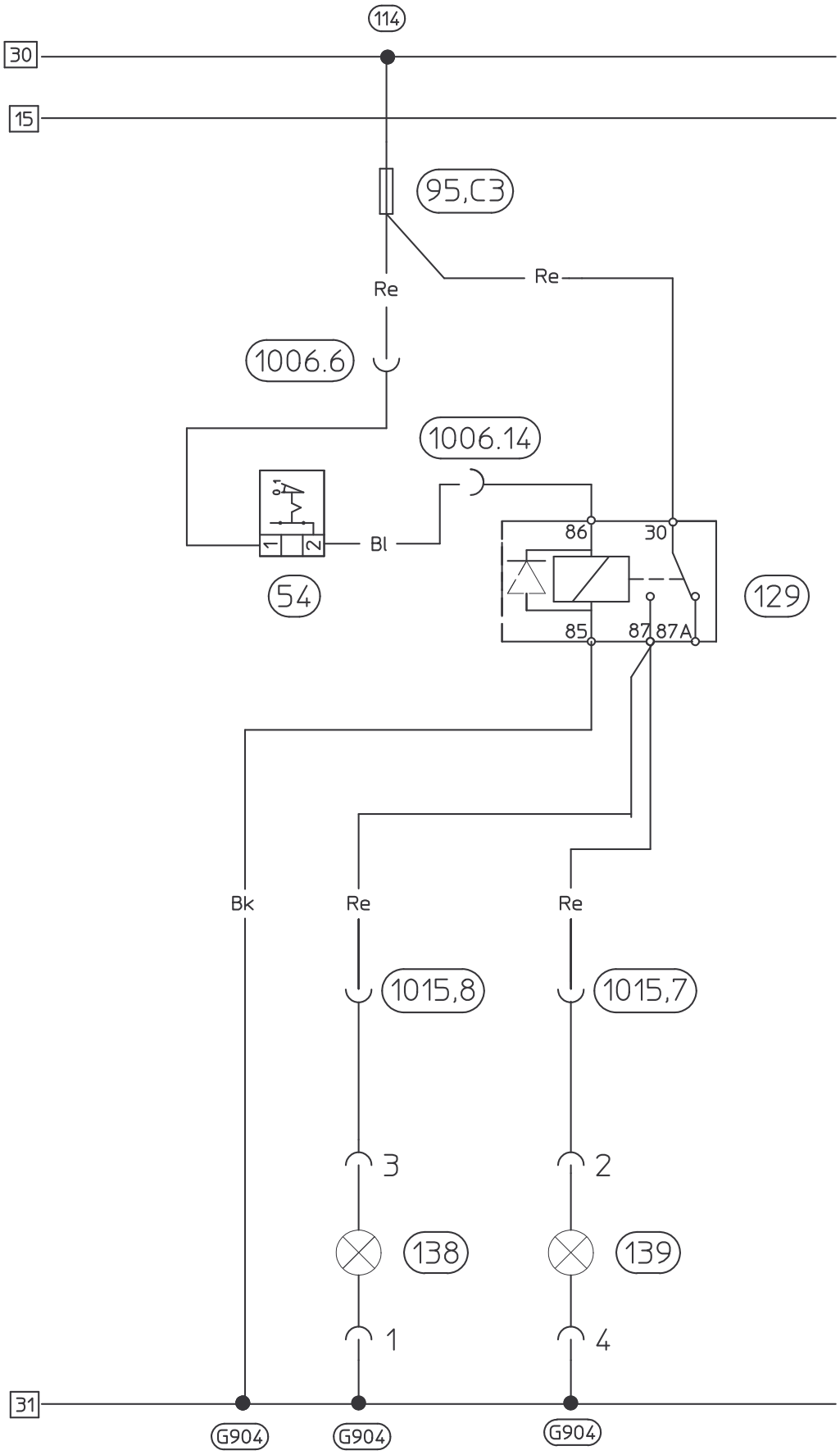


Circuits

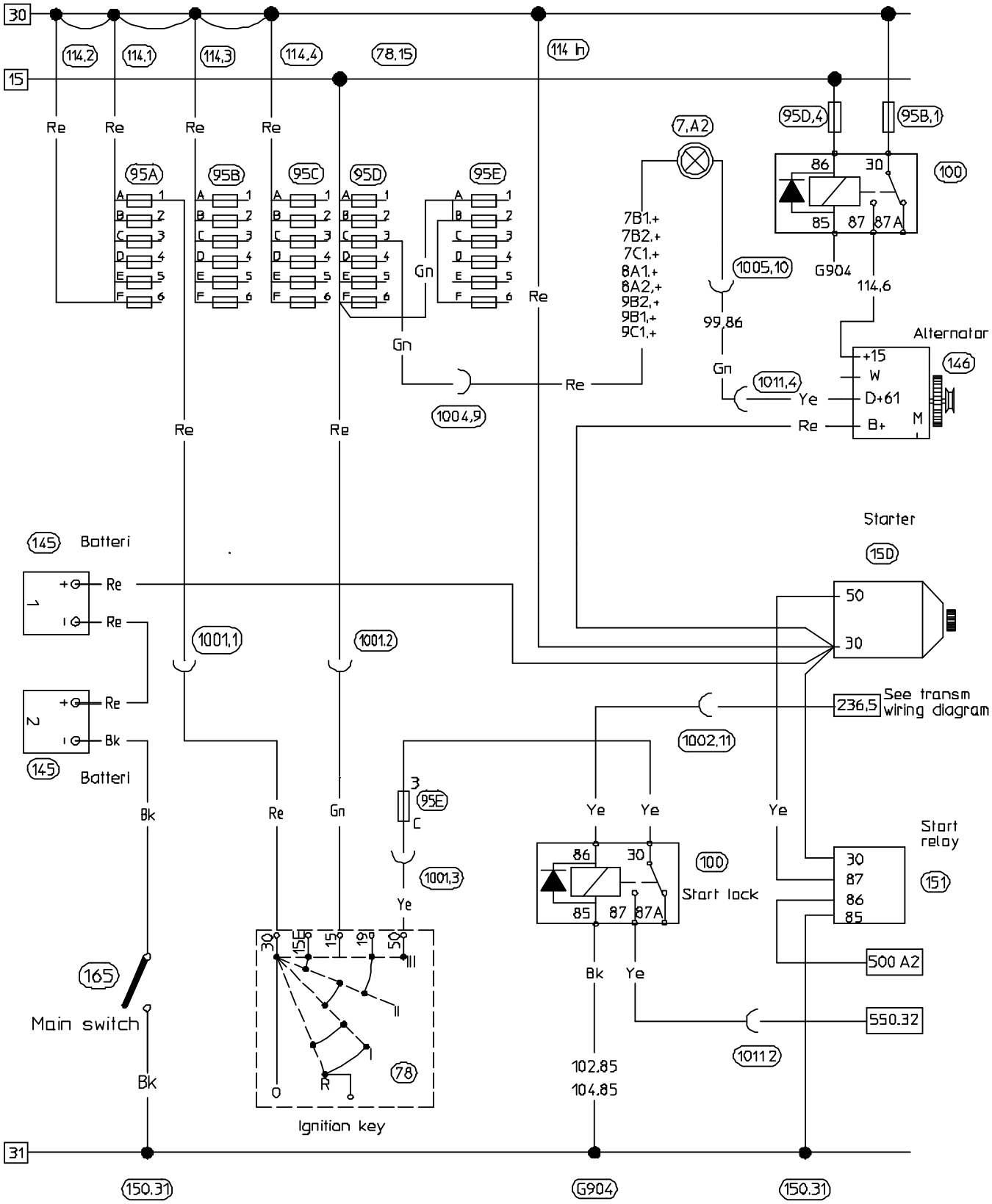
Circuit 01 Compartment and cab light



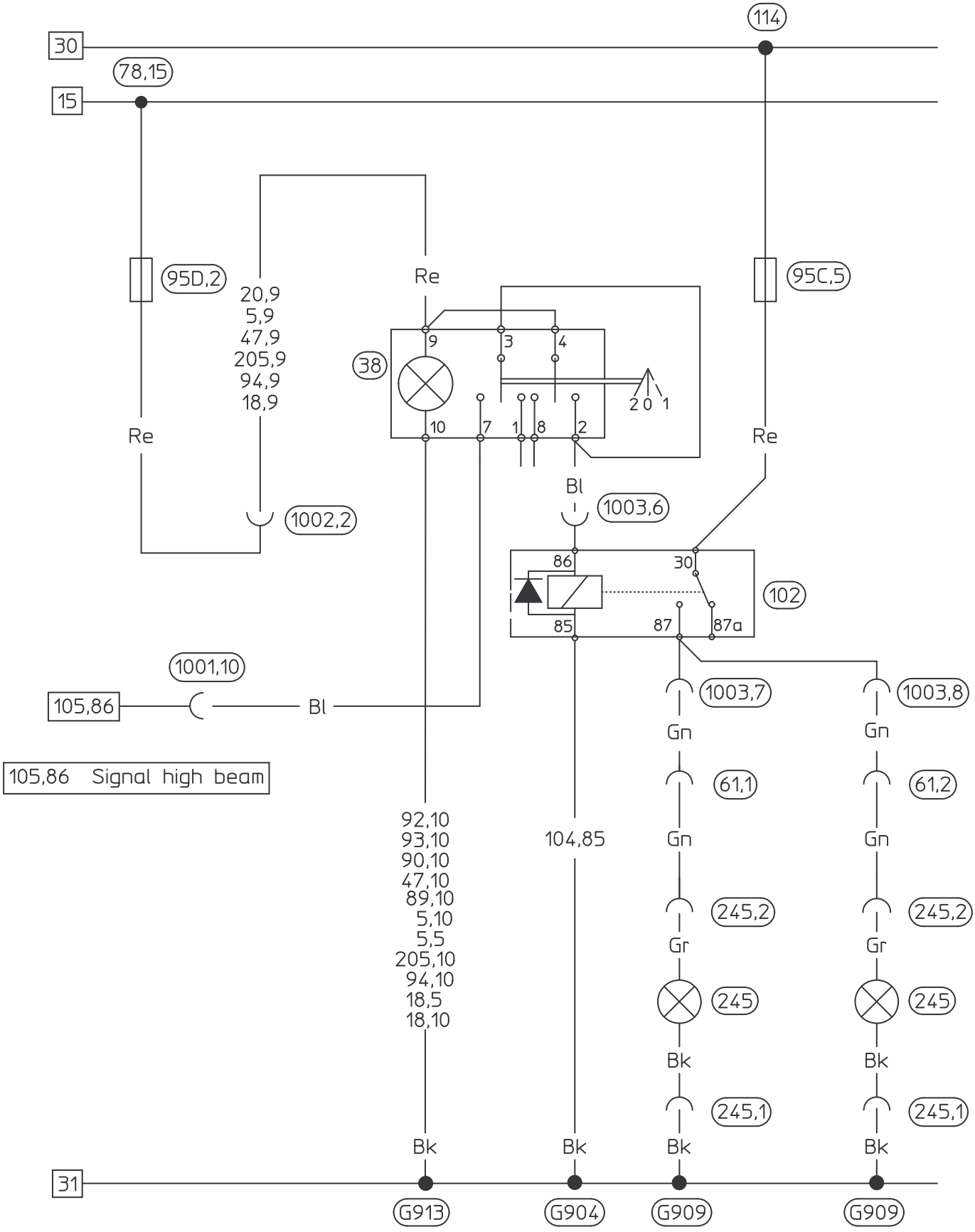
Circuit 02 Brake light



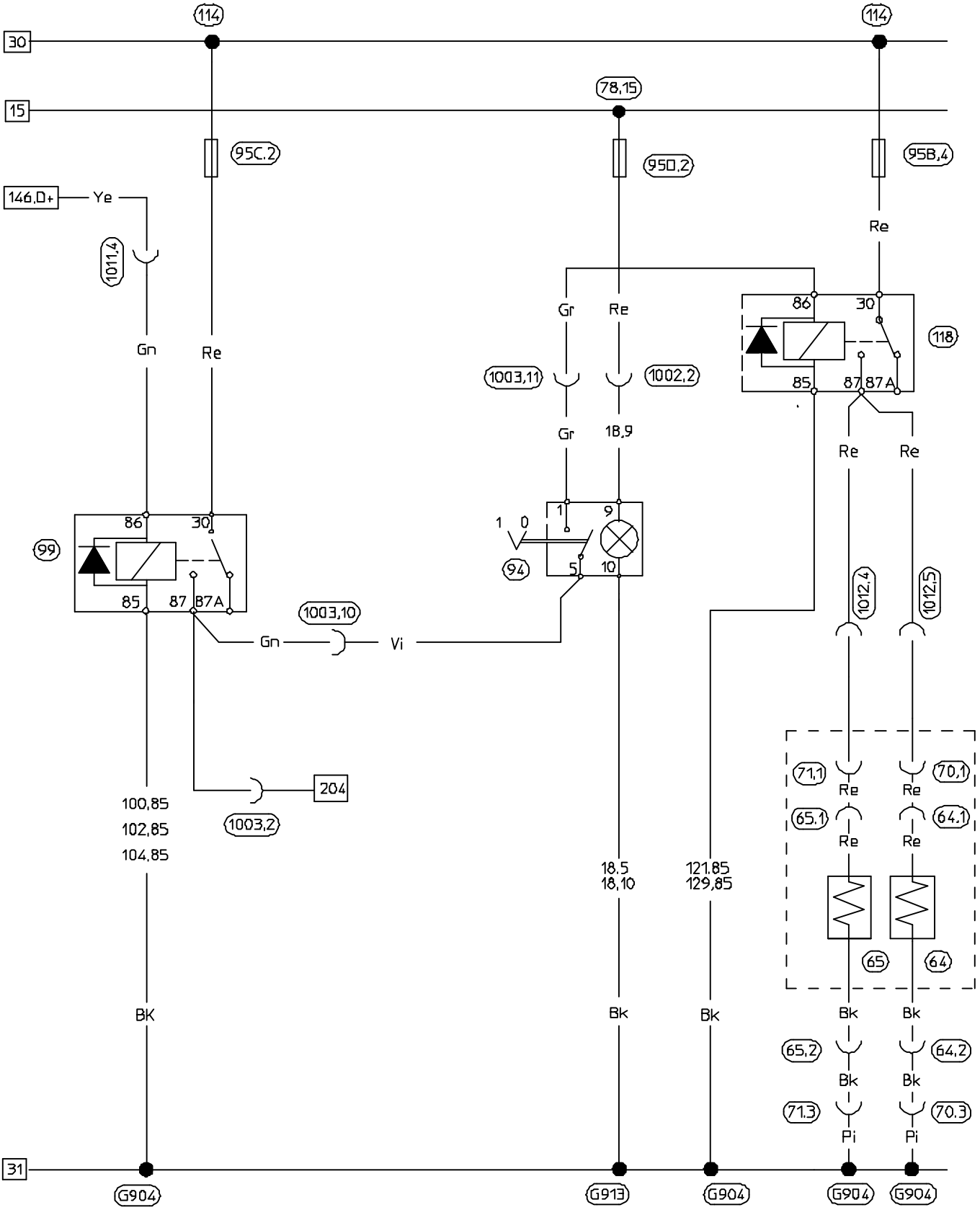
Circuit 03 Power supply / start



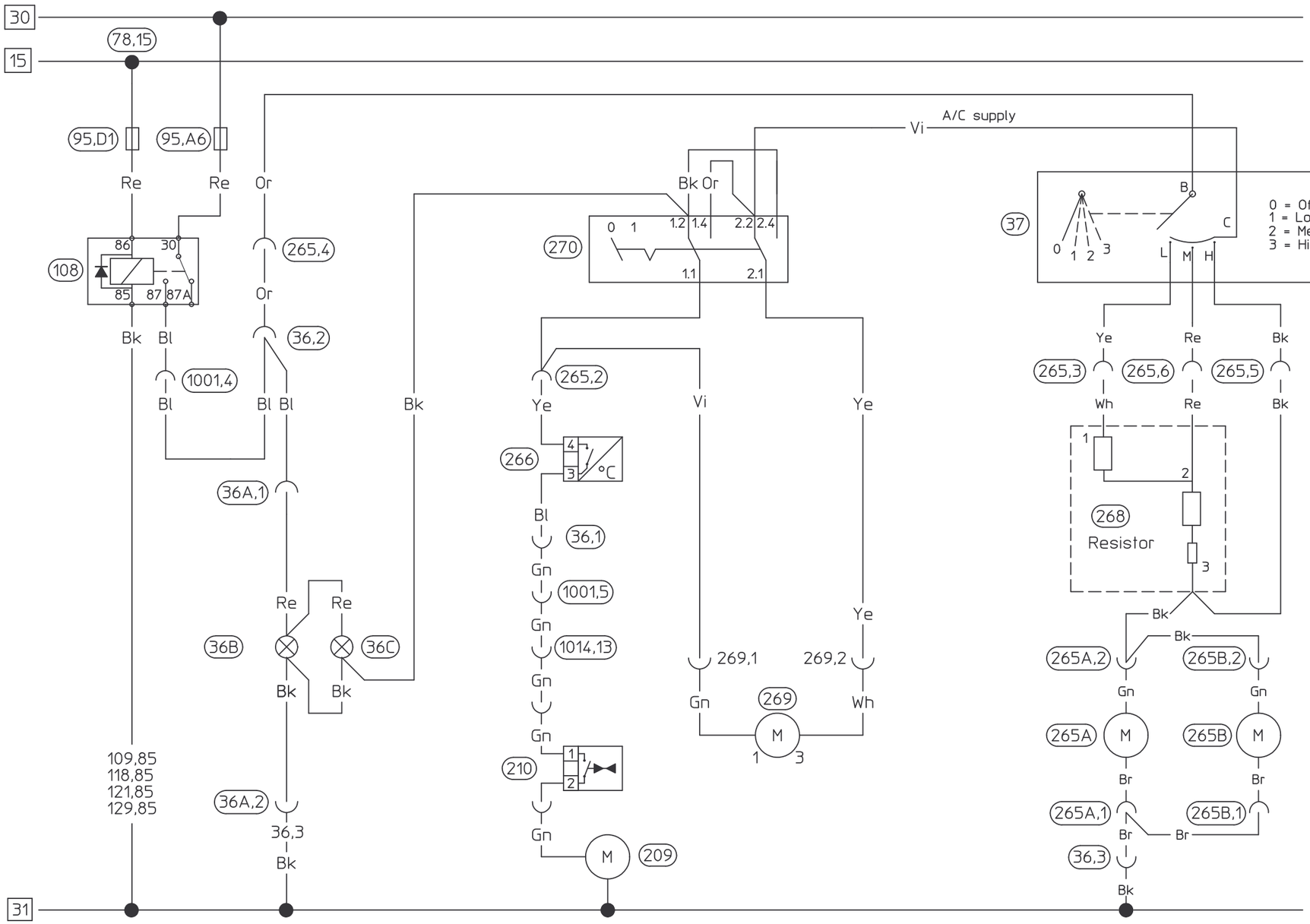
Circuit 04 Work light / Extra high beam



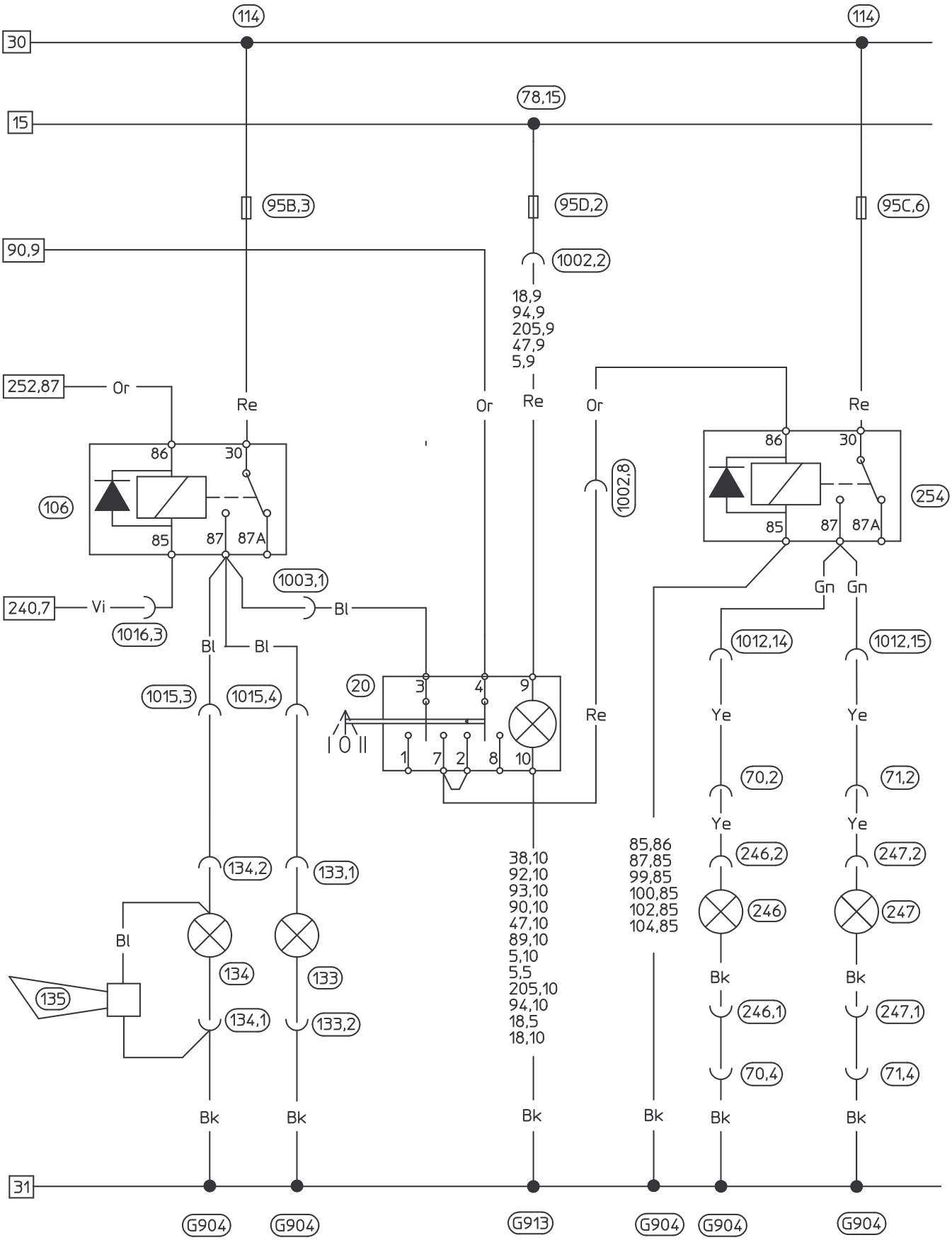
Circuit 05 Heated mirrors



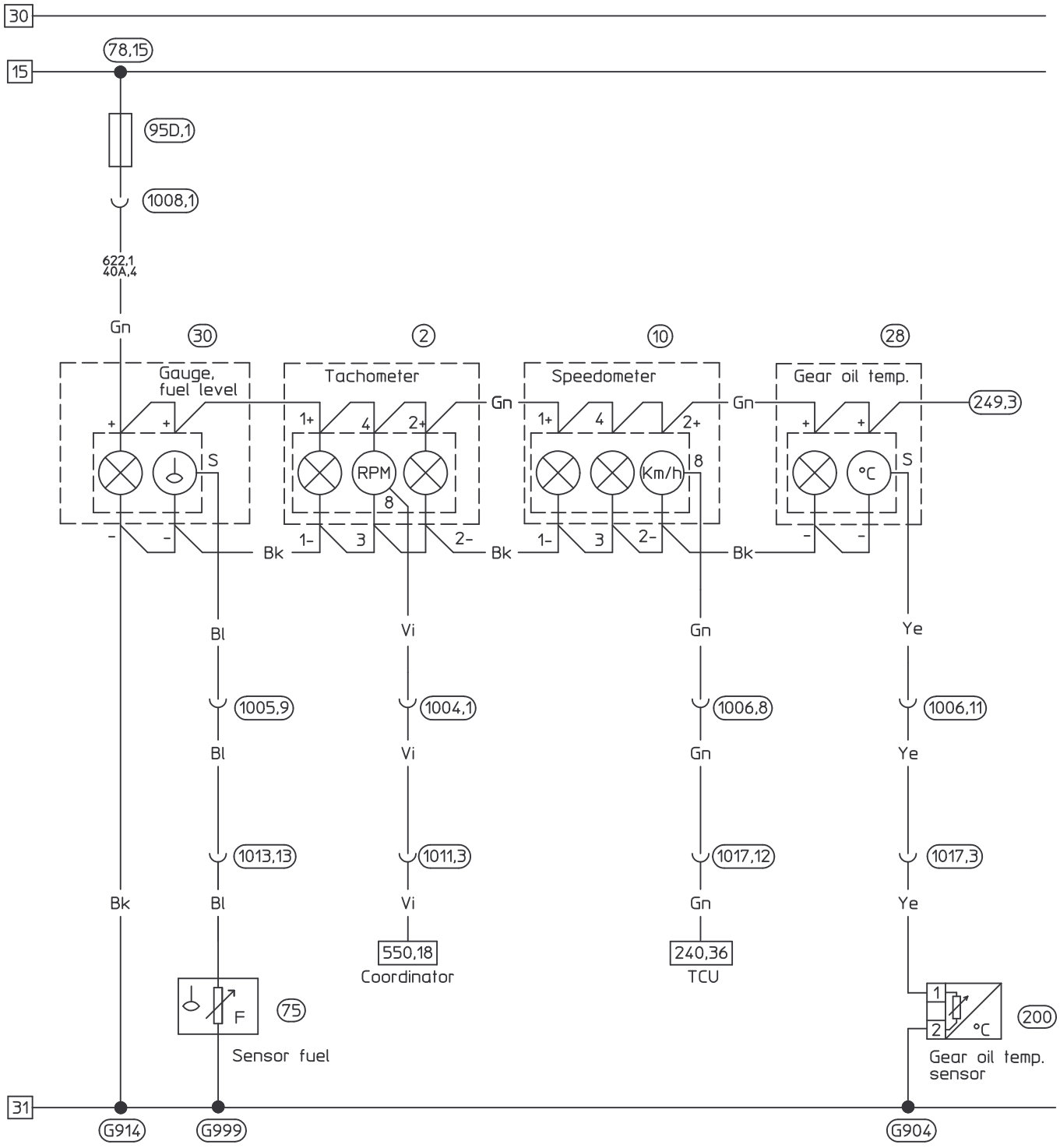
Circuit 06 Fan and A/C



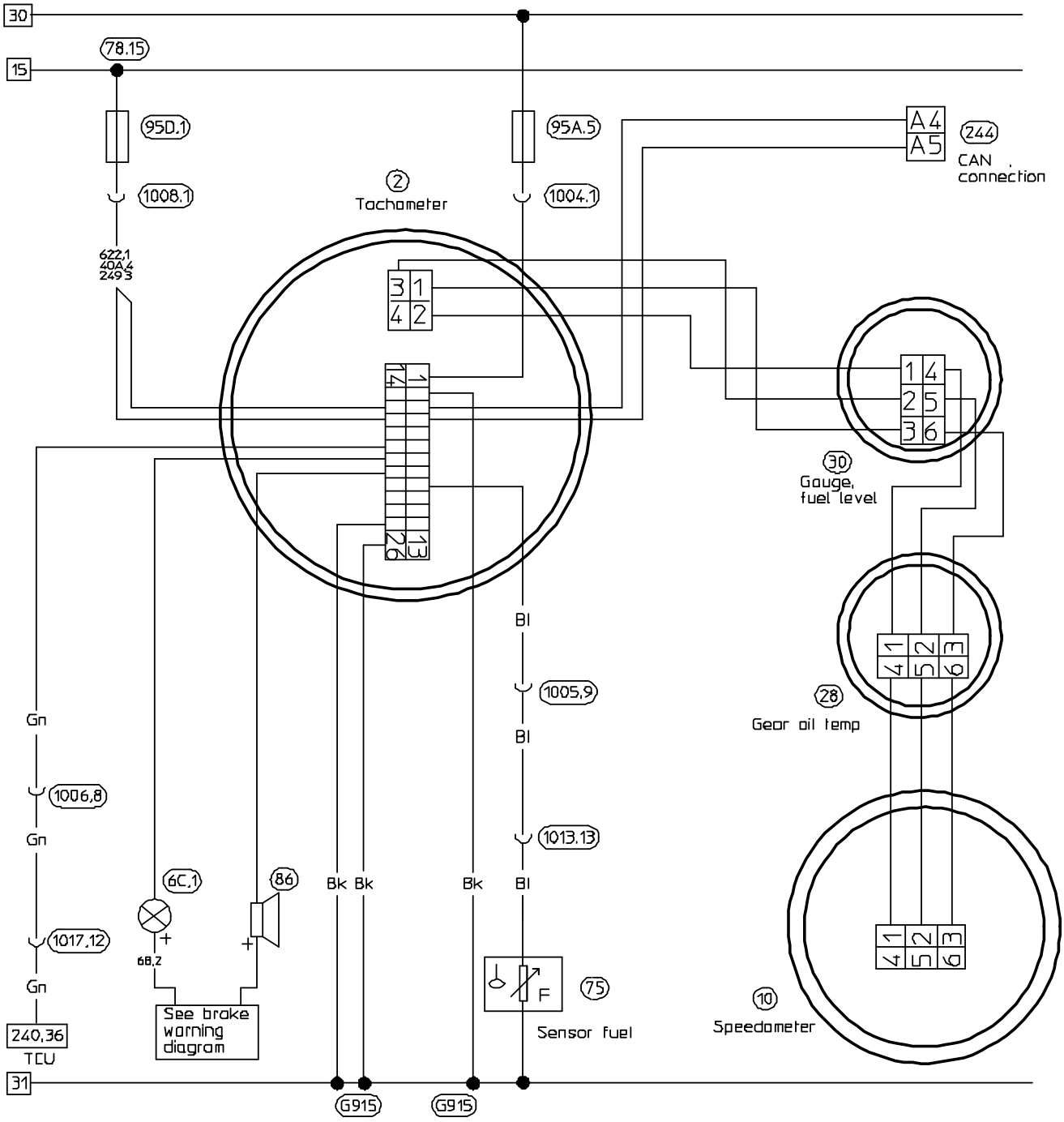
Circuit 09 Rewerse and work light rear



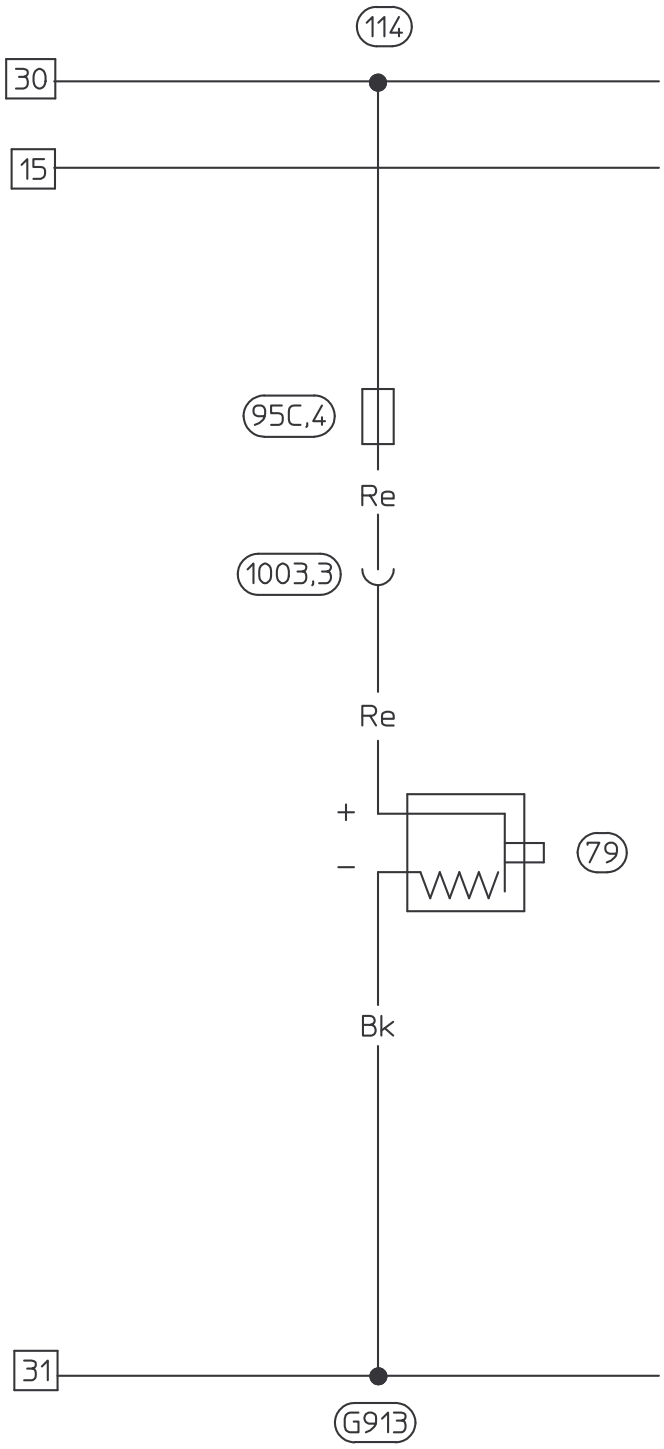
Circuit 10 Gauge and Instrument light



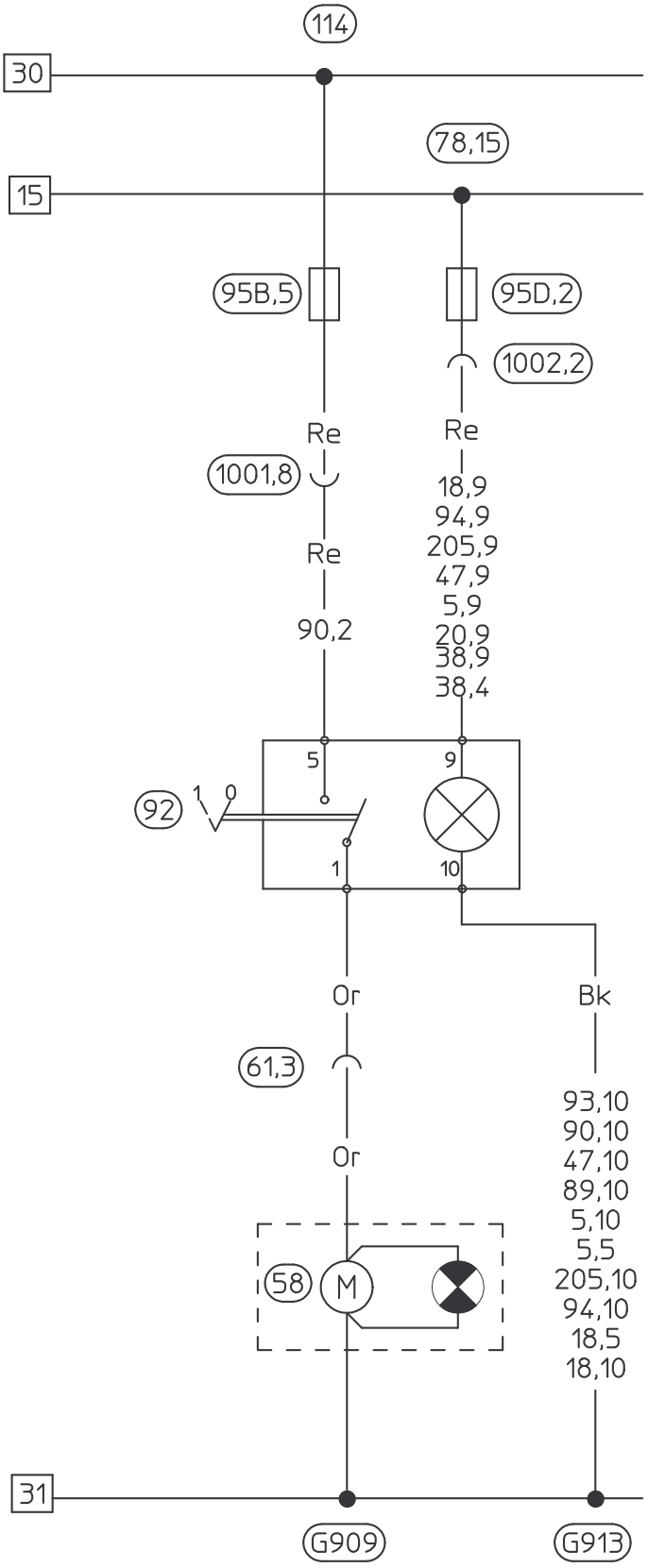
Circuit 10 Gauge and Instrument light. 810053-



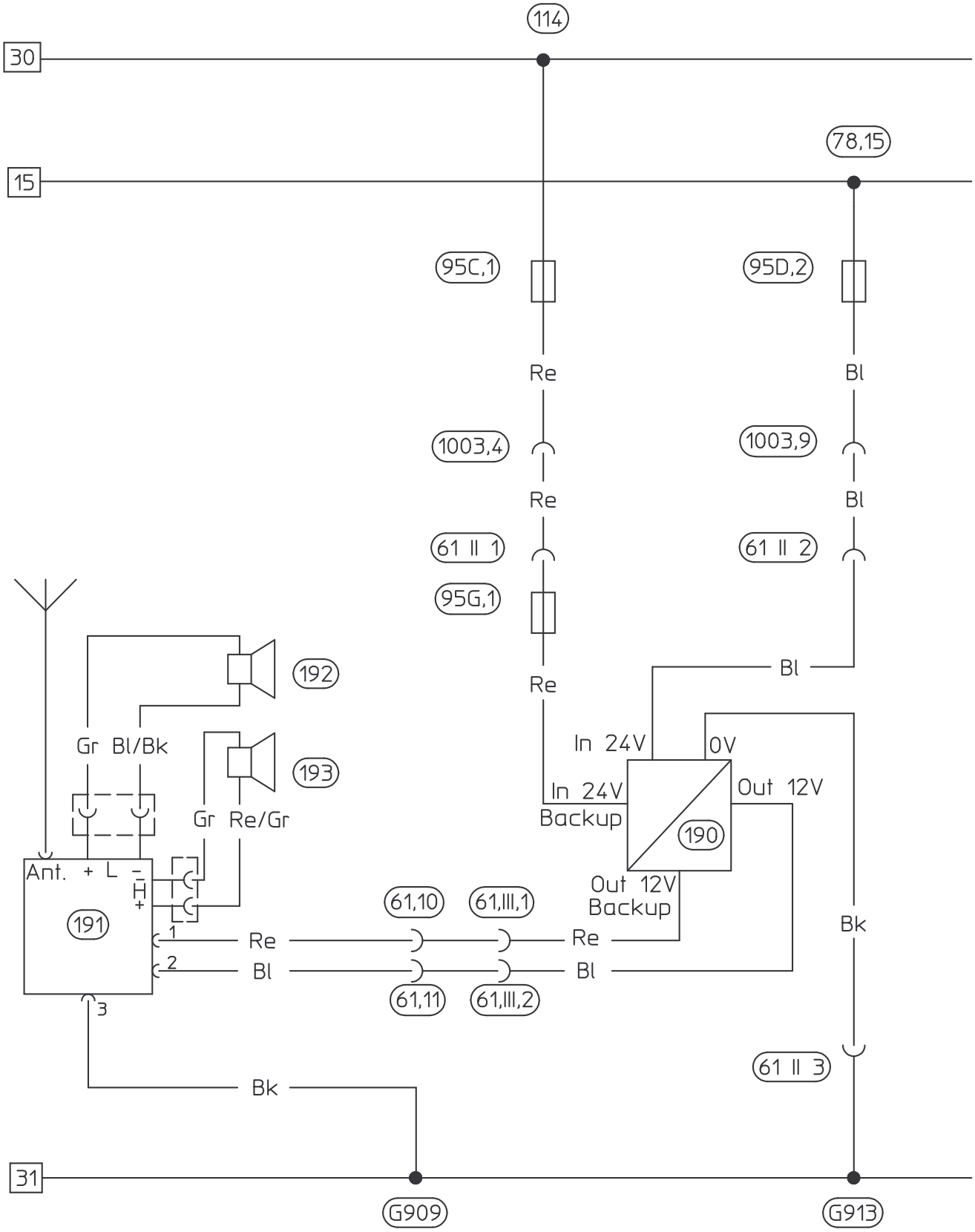
Circuit 11 Lighter



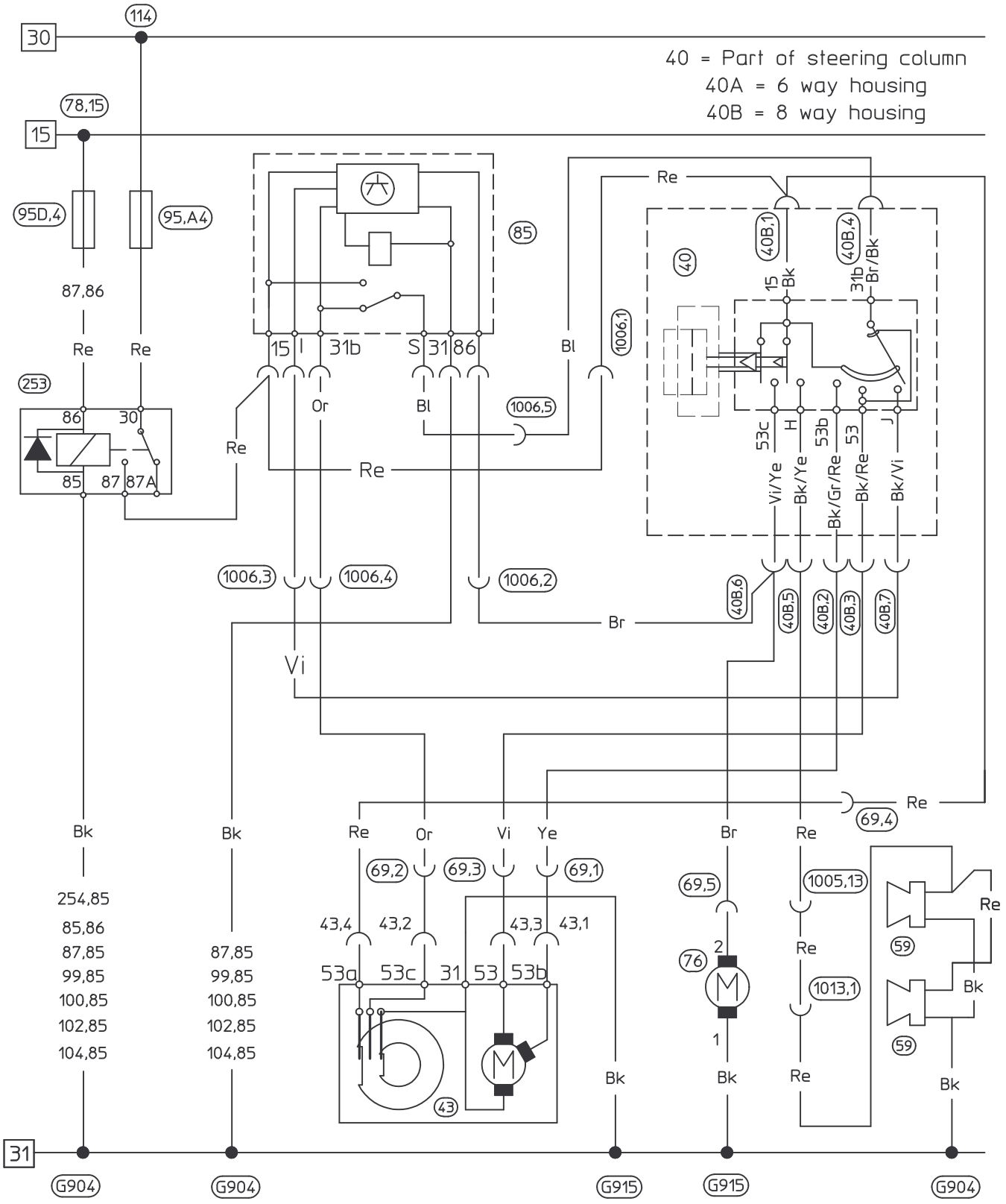
Circuit 12 Rotating beacon



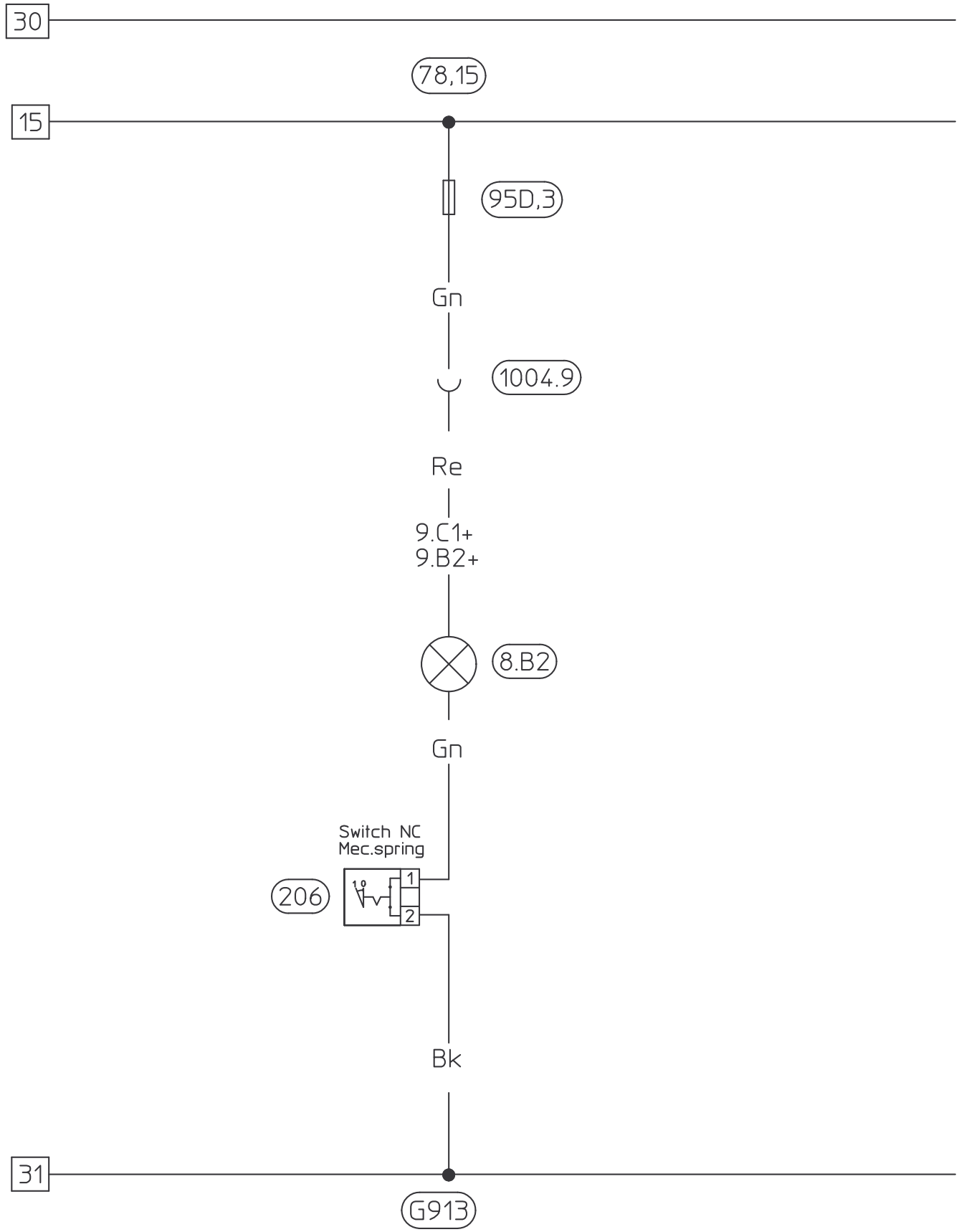
Circuit 13 Radio



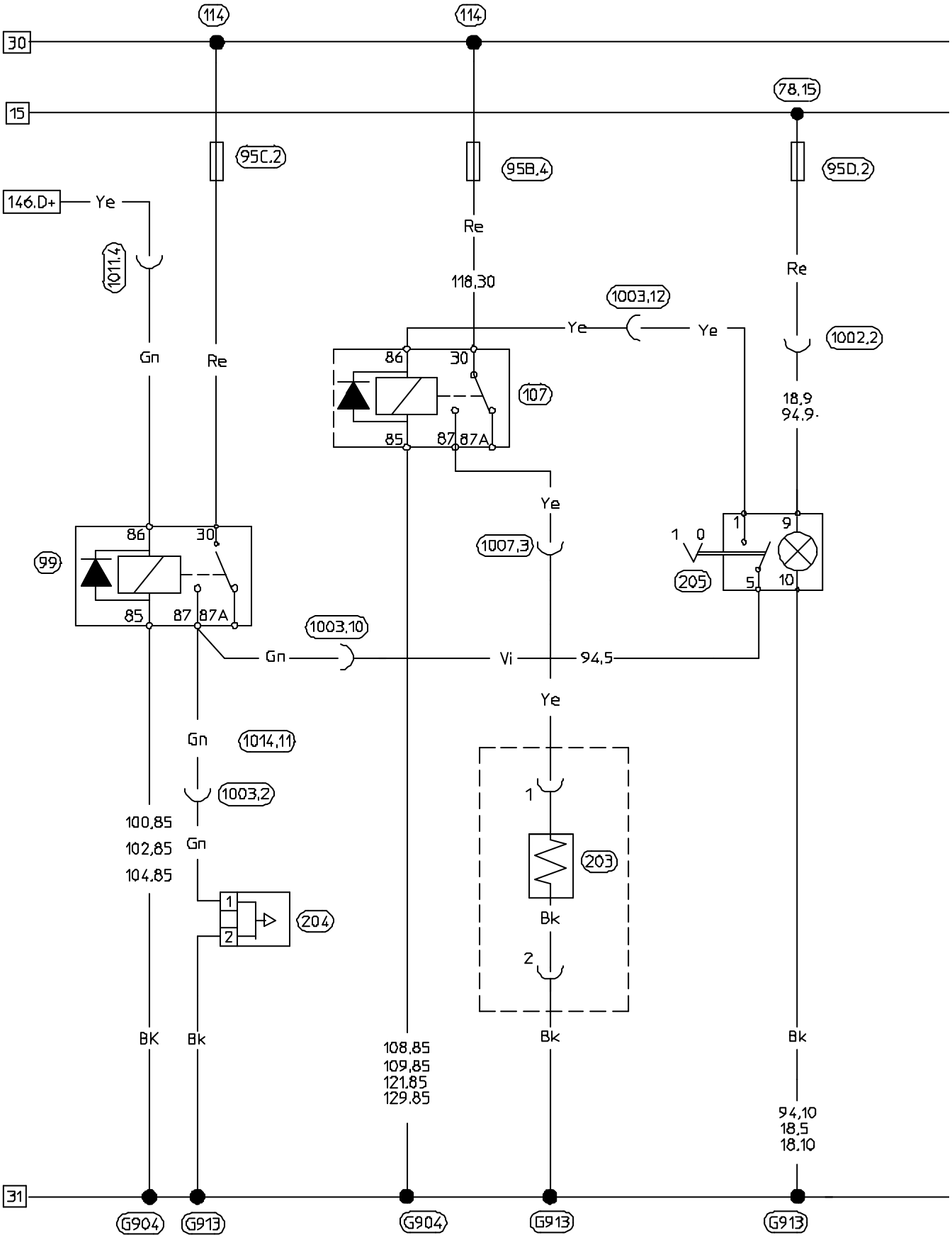
Circuit 14 Wiper, washer and horn



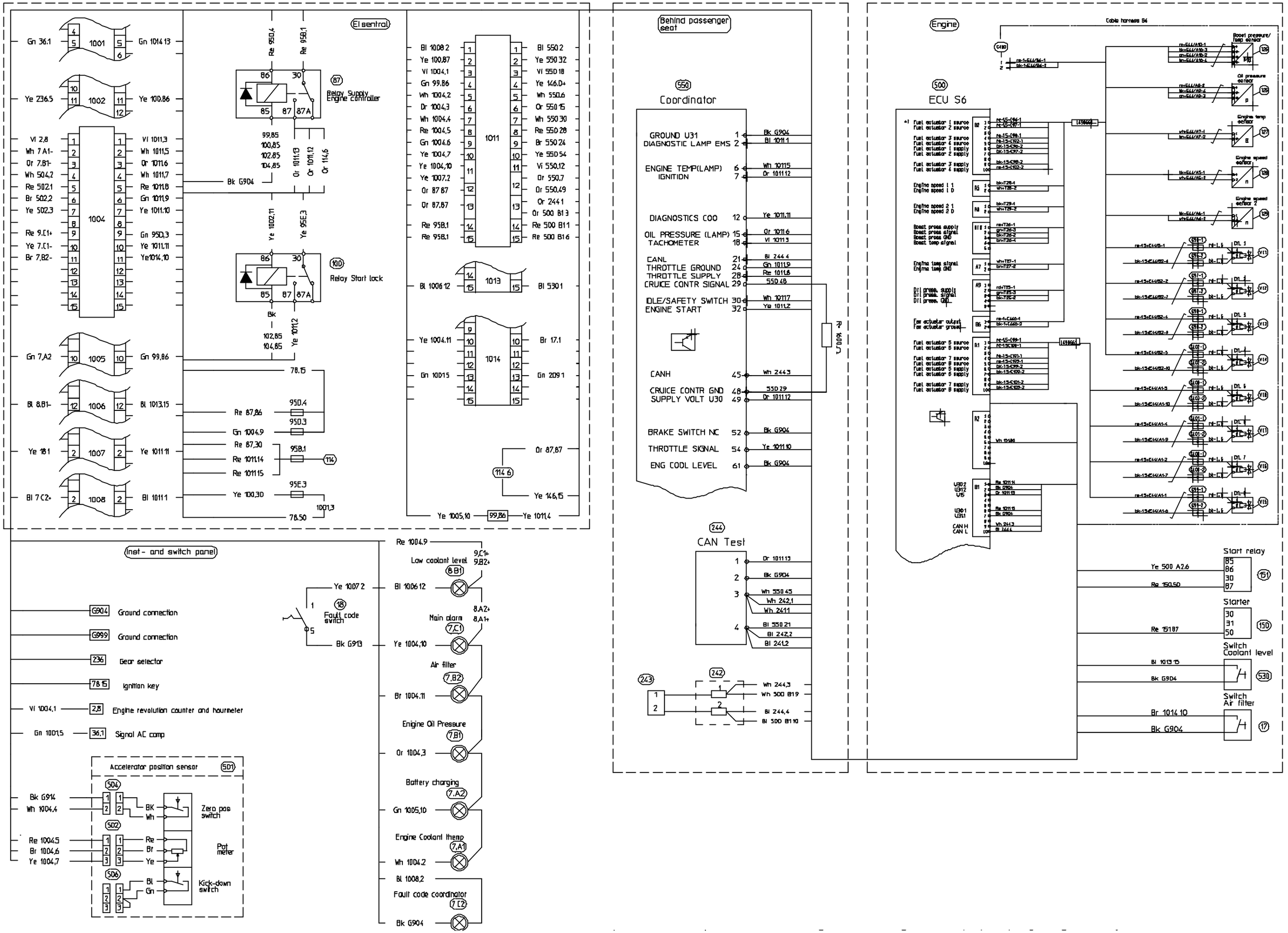
Cirquit 15 Seat belt warning



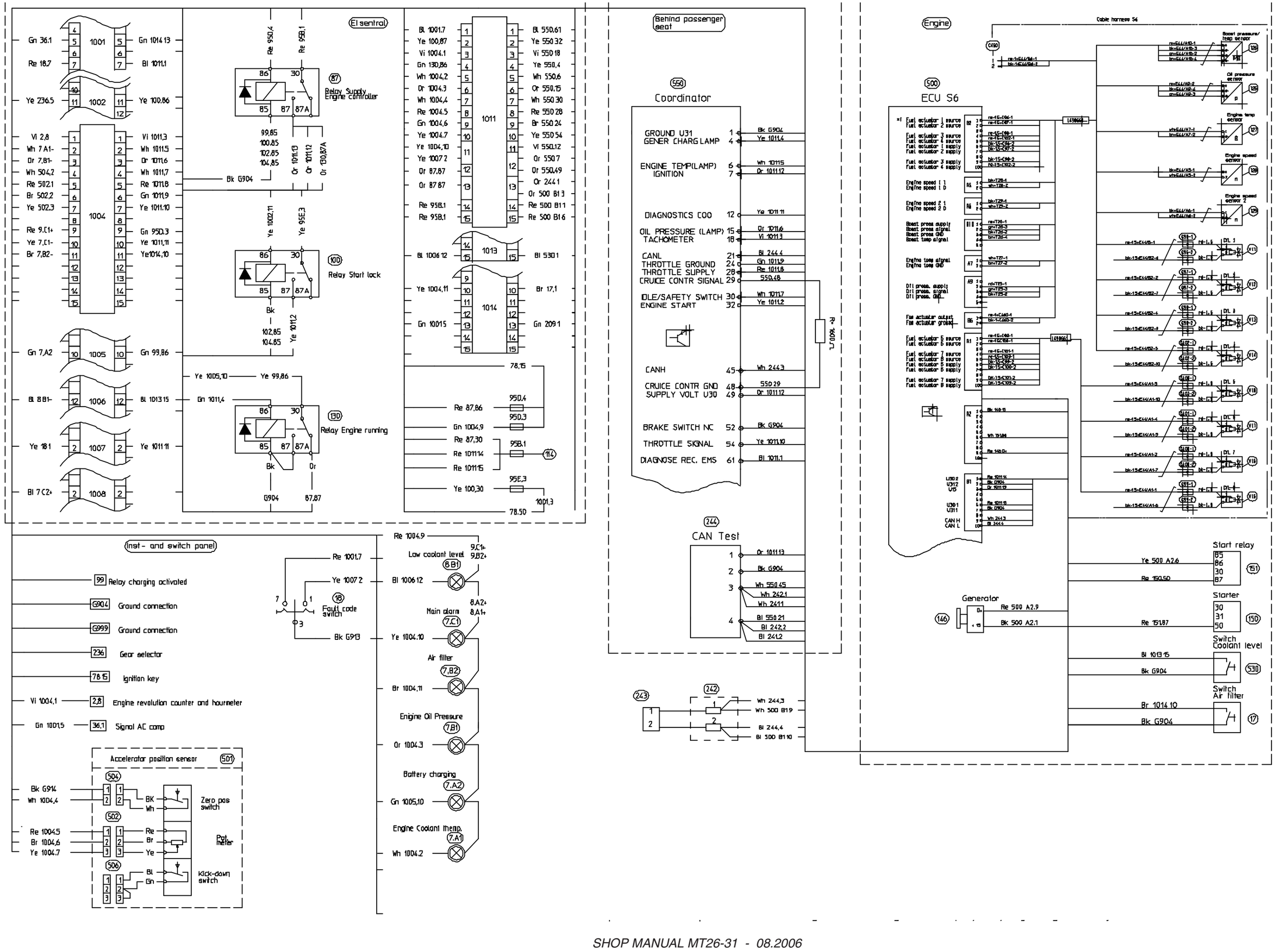
Cirquit 16 Heated chair and chair compressor



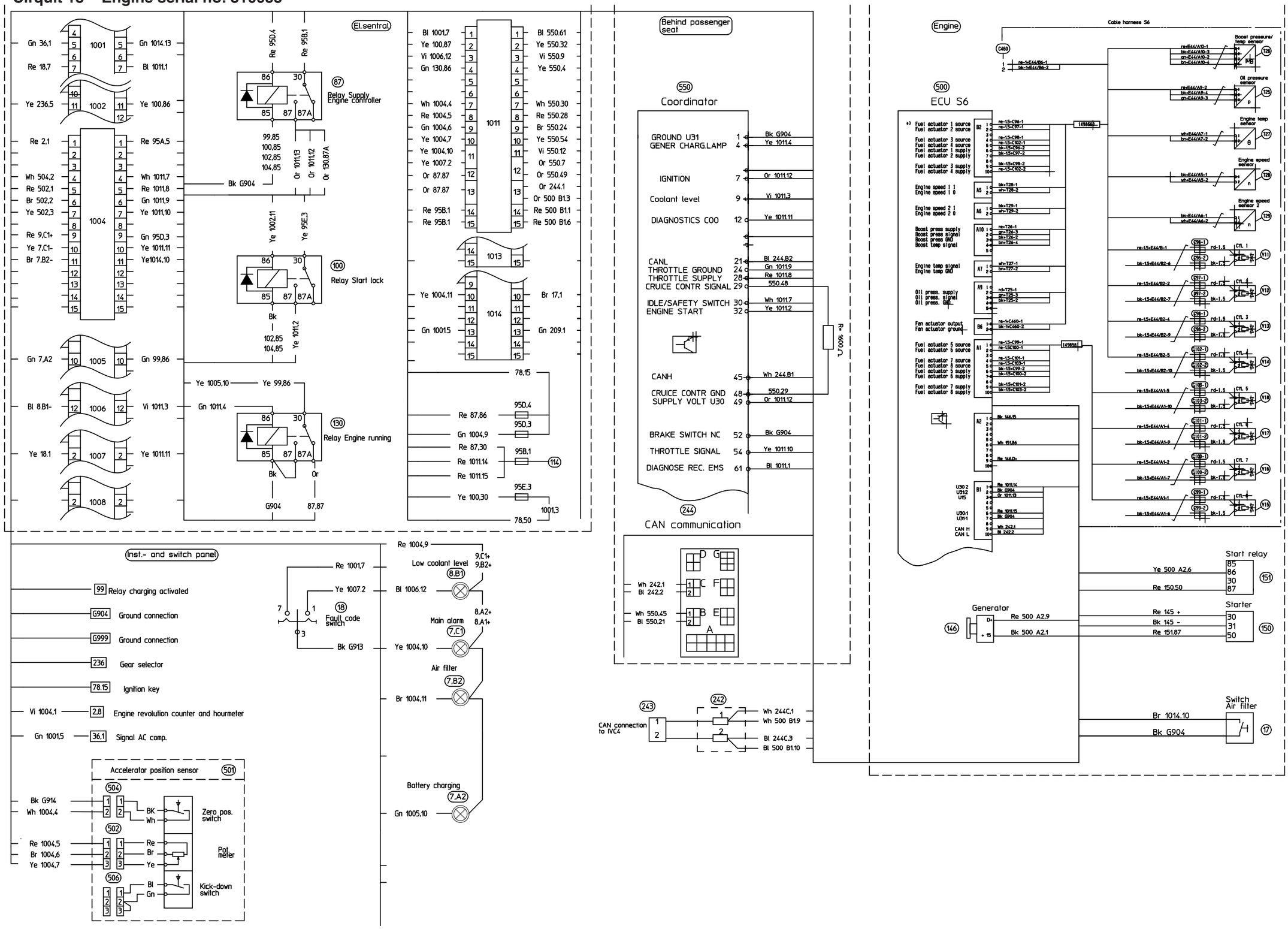
Cirquit 18 Engine serial no: 810001 - 810035



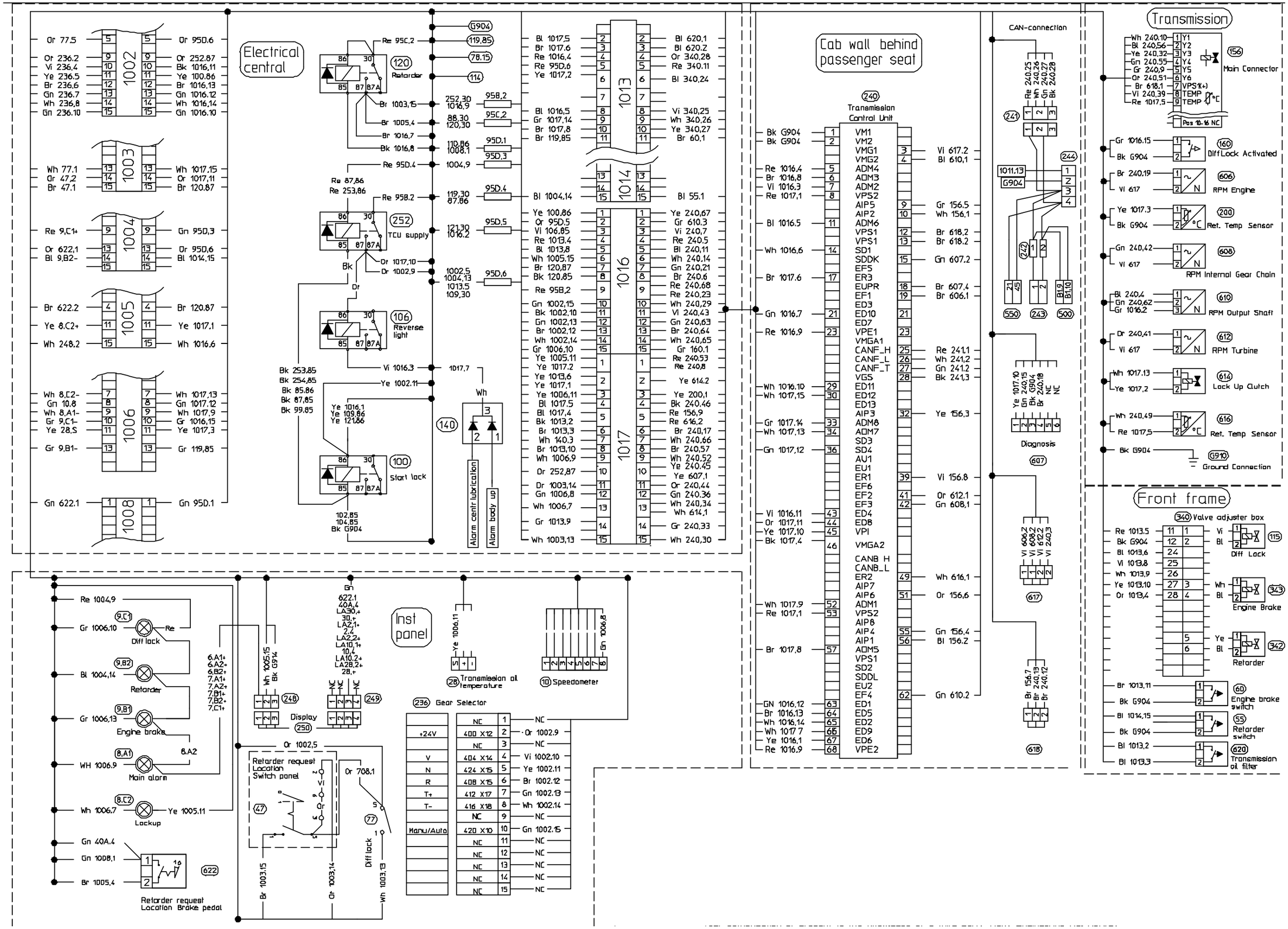
Cirquit 18 Engine serial no: 810036-810052



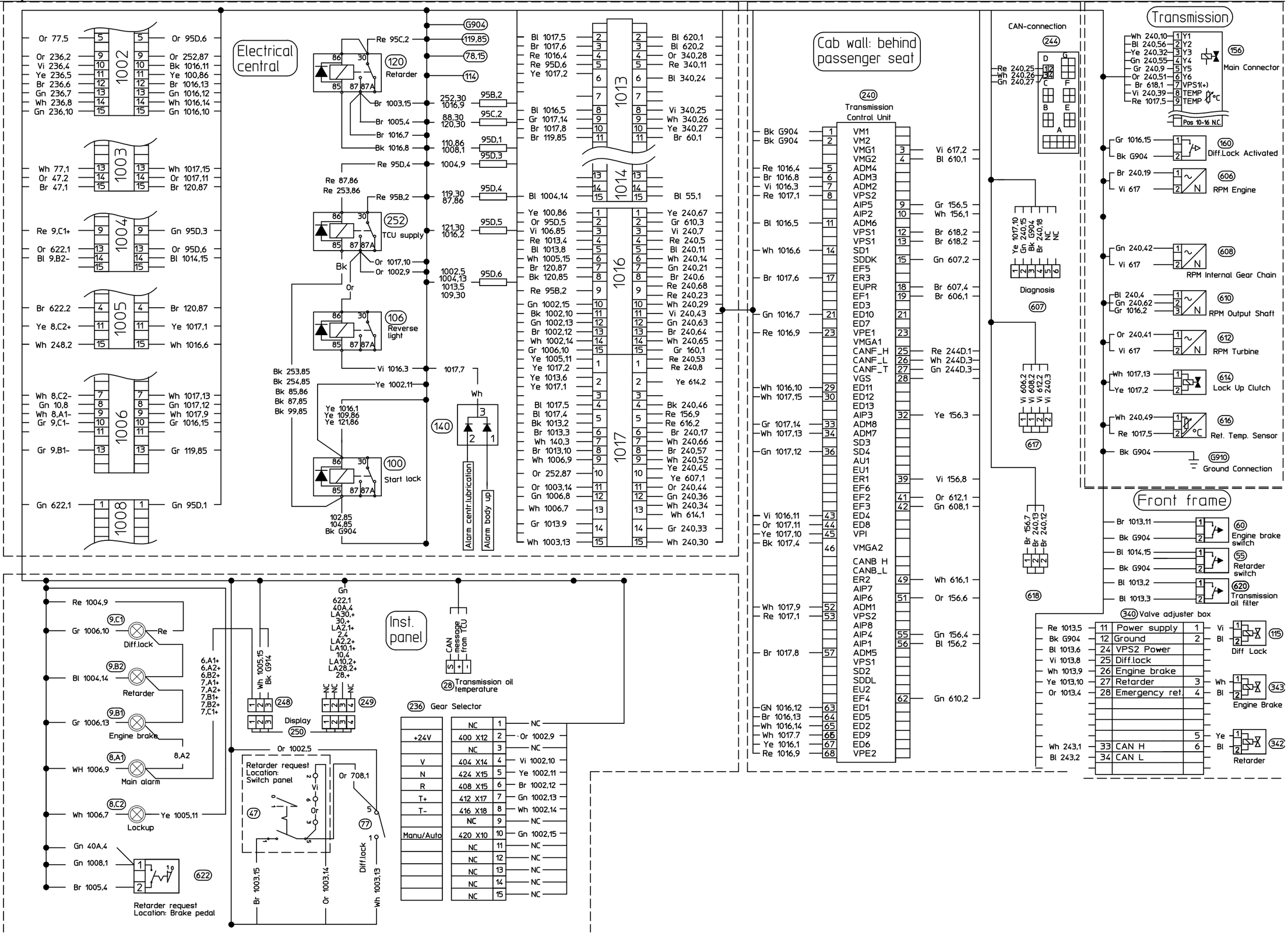
Cirquit 18 Engine serial no: 810053-



Cirquit 19 Transmission serial no. 810001-810052



Cirquit 19 Transmission serial no. 810053-



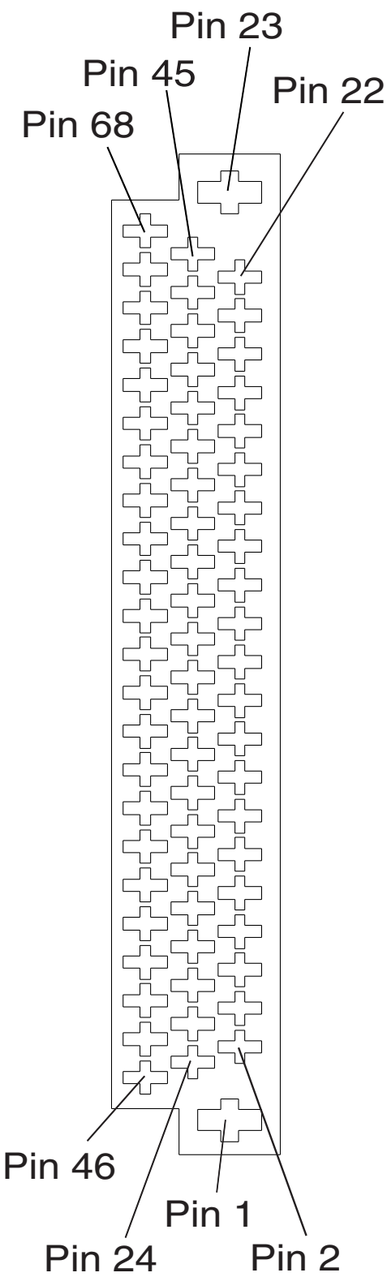
IVC4B Connector pinout

1	+VO1	Differential blocking valve output +
2	-VO1	Differential blocking valve output –
3	+VO2	Engine exhaust blocking valve output +
4	-VO2	Engine exhaust blocking valve output –
5	+VO3	Transmission retarder valve output +
6	-VO3	Transmission retarder valve output -
7	+VO4	Cooling fan control valve output +
8	-VO4	Cooling fan control valve output -
9	PTIN1-	PT1000 sensor input 1 – (left hub)
10	PTIN2-	PT1000 sensor input 2 – (right hub)
11	+VIN	24V supply
12	GND	Ground
13	+AIN1	Body tip pressure sensor input + (4-20mA signal)
14	-AIN1	Body tip pressure sensor input - (4-20mA signal)
15	-	*Reserved*
16	-	*Reserved*
17	WLIN+	WDB cooling circuit oil level switch +
18	WLIN-	WDB cooling circuit oil level switch -
19	-	*Reserved*
20	PTIN1+	PT1000 sensor input 1 + (left hub)
21	PTIN2+	PT1000 sensor input 2 + (right hub)
22	+AIN2	Extra function pressure sensor input + (4-20mA signal)
23	-AIN2	Extra function pressure sensor input - (4-20mA signal)
24	+IN	Common + signal for all 4 inputs
25	-IN1	Differential blocking signal input
26	-IN2	Engine exhaust blocking signal input
27	-IN3	Transmission retarder signal input
28	-IN4	Transmission emergency retarder signal input (referenced to +VIN supply)
29	-	*Reserved*
30	-	*Reserved*
31	-	*Reserved*
32	-	*Reserved*
33	CANH	CANbus H signal
34	CANL	CANbus L signal
35	CAN_SHLD	CANbus Shield (optional)

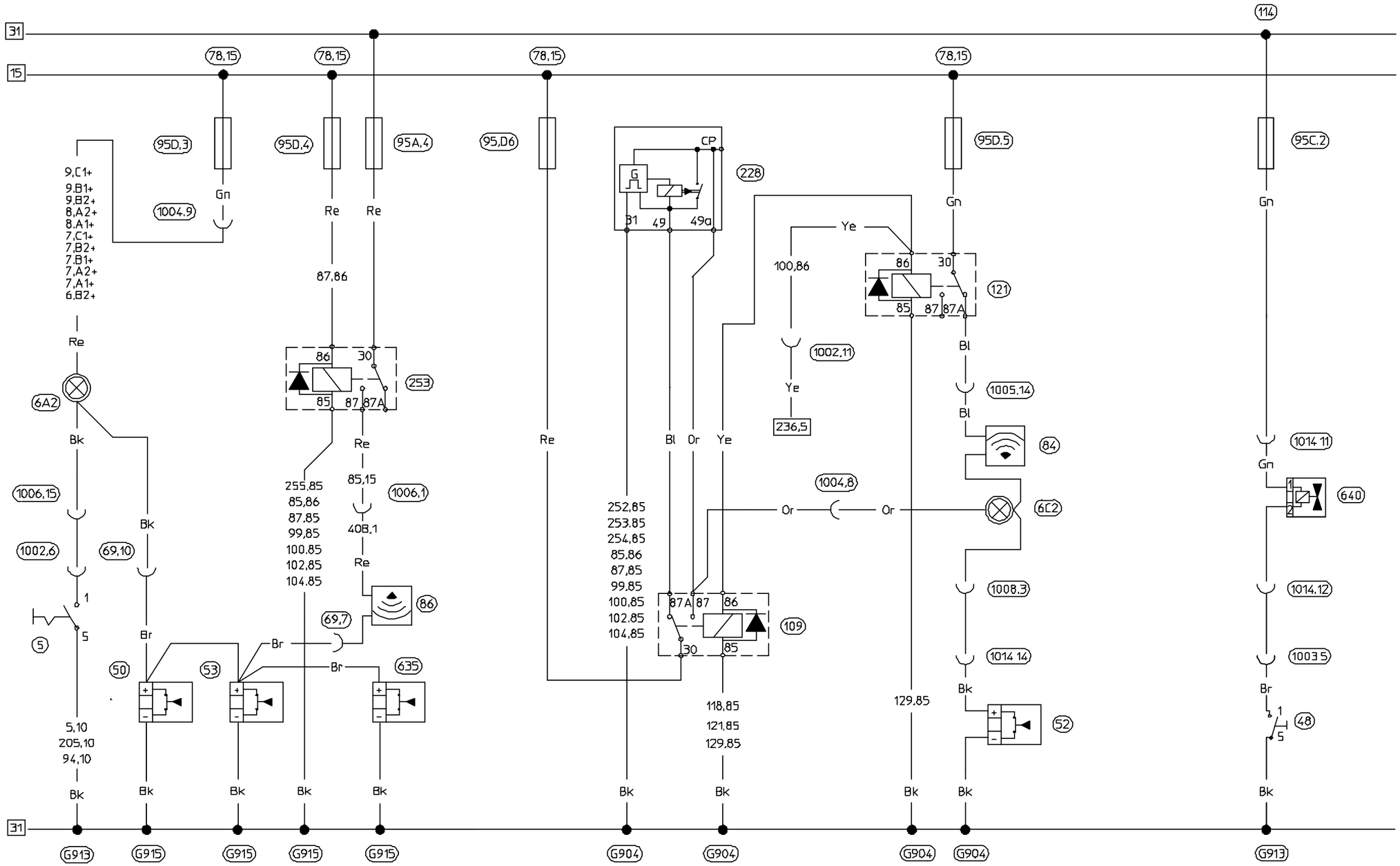
EST 37 pinout

Pos Description

1 Ground
2 Ground
3 Speed sensor ground supply (turbine, engine, int. gear chain)
4 Speed sensor ground supply, ground speed
5 Retarder emergency solenoid ground
6 Automatic retarder control output, ground
7 Reverse light output, ground
8 Power supply 24 Volt (lock up, Retarder, Differential and exhaust brake)
9 Solenoid M5 output (0,1 too 0,5 Amps)
10 Solenoid M1 output (0,1 too 0,5 Amps)
11 Diff. Lock solenoid output (active low)
12 T/M control valve output, 24 Volt
13 T/M control valve output, 24 Volt
14 LED display output
15 Programming pin for SDDK
16 EF5 (not used)
17 Pressure switch t/m oil filter output (clean:3 too 9,6 V clogged: above)
18 Programming pin for EDP 1
19 Speed sensor input, engine
20 ED3 (not used)
21 Switch power input, retarder request
22 Switch power input, kick-down request (opt)
23 Constant power input, 24 Volt
24 VMGA 1 (not used, minus for load sensor)
25 CanBus, engine communication
26 CanBus, engine communication
27 CanBus, engine communication
28 CanBus, engine communication
29 Auto / man. Shifting switch input
30 Switch power input, differential request
31 ED13 (not used)
32 Solenoid M3 output (0,1 too 0,5 Amps)
33 Eng. Brake output (active low)
34 Lock-up solenoid output (active low)
35 SD3 (not used)
36 Speedometer output
37 AU1 (not used)
38 EU1 (not used)
39 Temp. sensor t/m, return
40 EF6 (not used)
41 Speed sensor input, turbine
42 Speed sensor input, int gear chain
43 Gear selector input, V (forward)
44 Switch power input, exhaust brake switch request
45 Switch power input, 24 Volt relay(#252) supplied
46 Temp. sensor, ground
47 Not used
48 Not used
49 Temp. sensor retarder, return
50 AIP7 (not used)
51 Solenoid M6 output (0,1 too 0,5 Amps)
52 Main warning light output, ground
53 Power supply, 24 Volt (lock up, Retarder, Differential and exhaust brake)
54 AIP8 (not used)
55 Solenoid M4 output (0,1 too 0,5 Amps)
56 Solenoid M2 output (0,1 too 0,5 Amps)
57 Retarder solenoid output, active low
58 VPS1 (not used)
59 SD2 (not used)
60 SDDL (not used)
61 EU2 (not used)
62 Speed sensor signal, ground speed+D28
63 Gear selector input, T+ (upshifting)
64 Gear selector input, R (reverse)
65 Gear selector input, T- (downshifting)
66 ED9 Gear restriction
67 Gear selector input, N (neutral)
68 Constant power input, 24 Volt

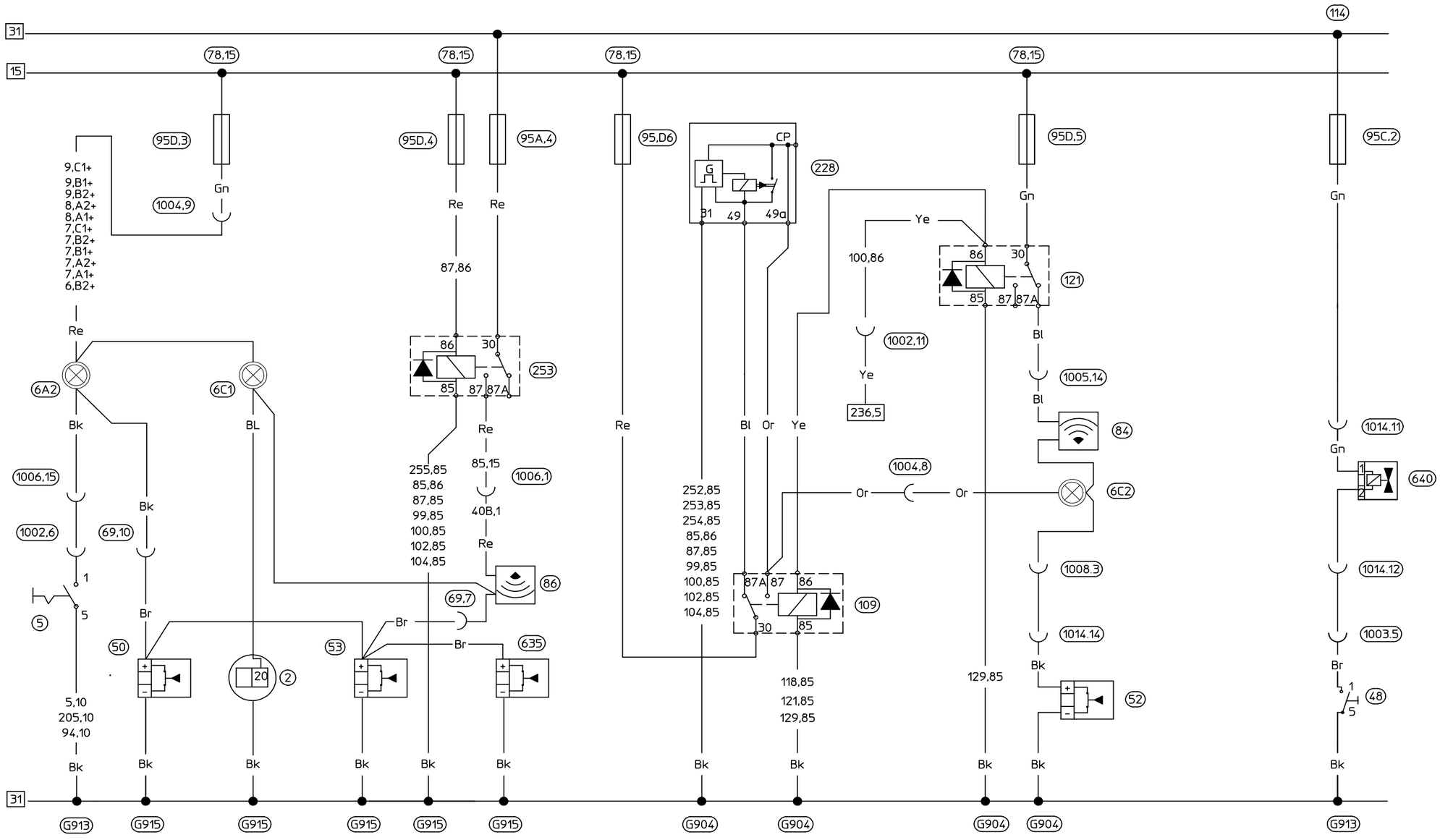


Cirquit 20 Brake warning light 810001 - 810052



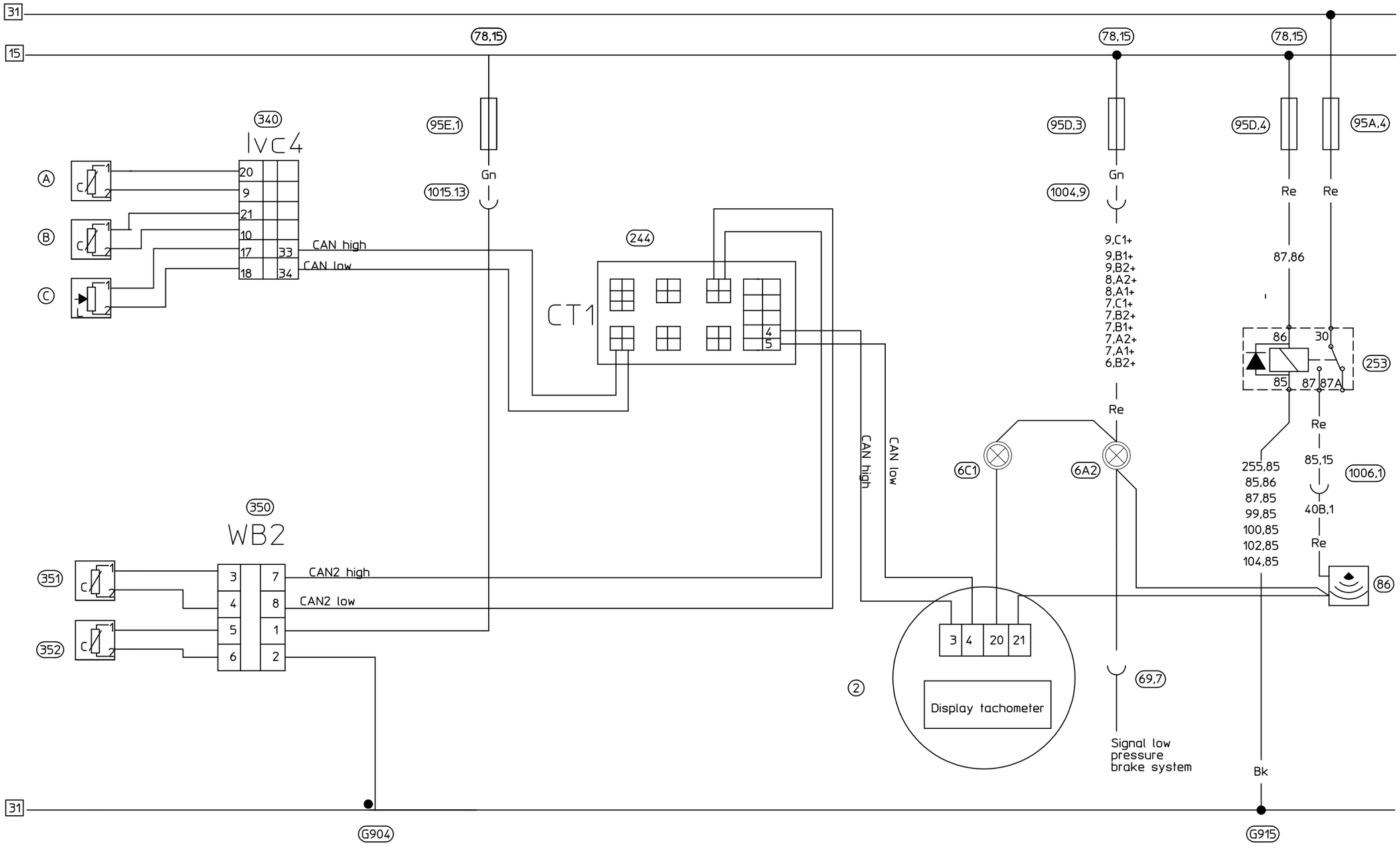
236,5 - See transmission diagram

Cirquit 20-1 Brake warning light - WDB 810053-

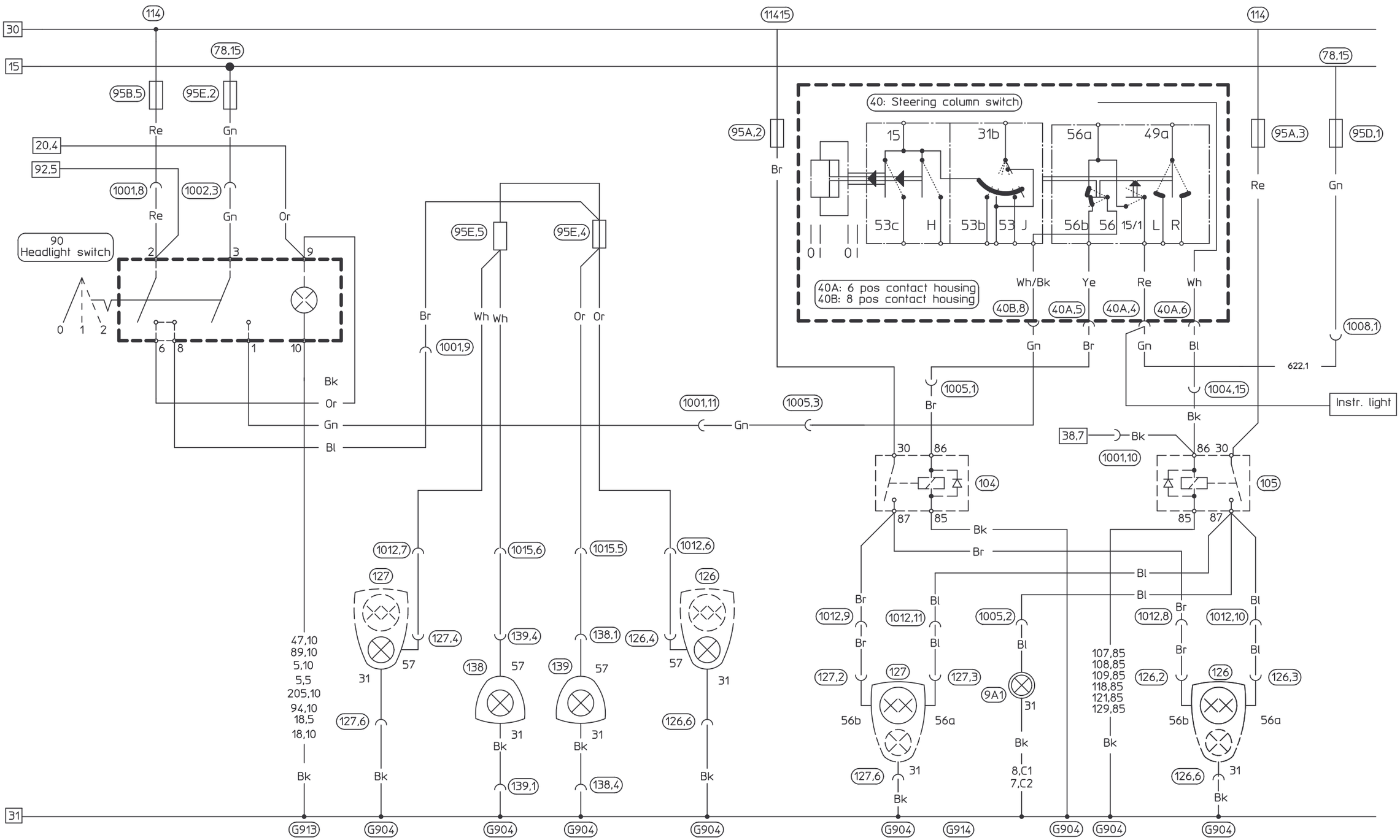


236,5 - See transmission diagram

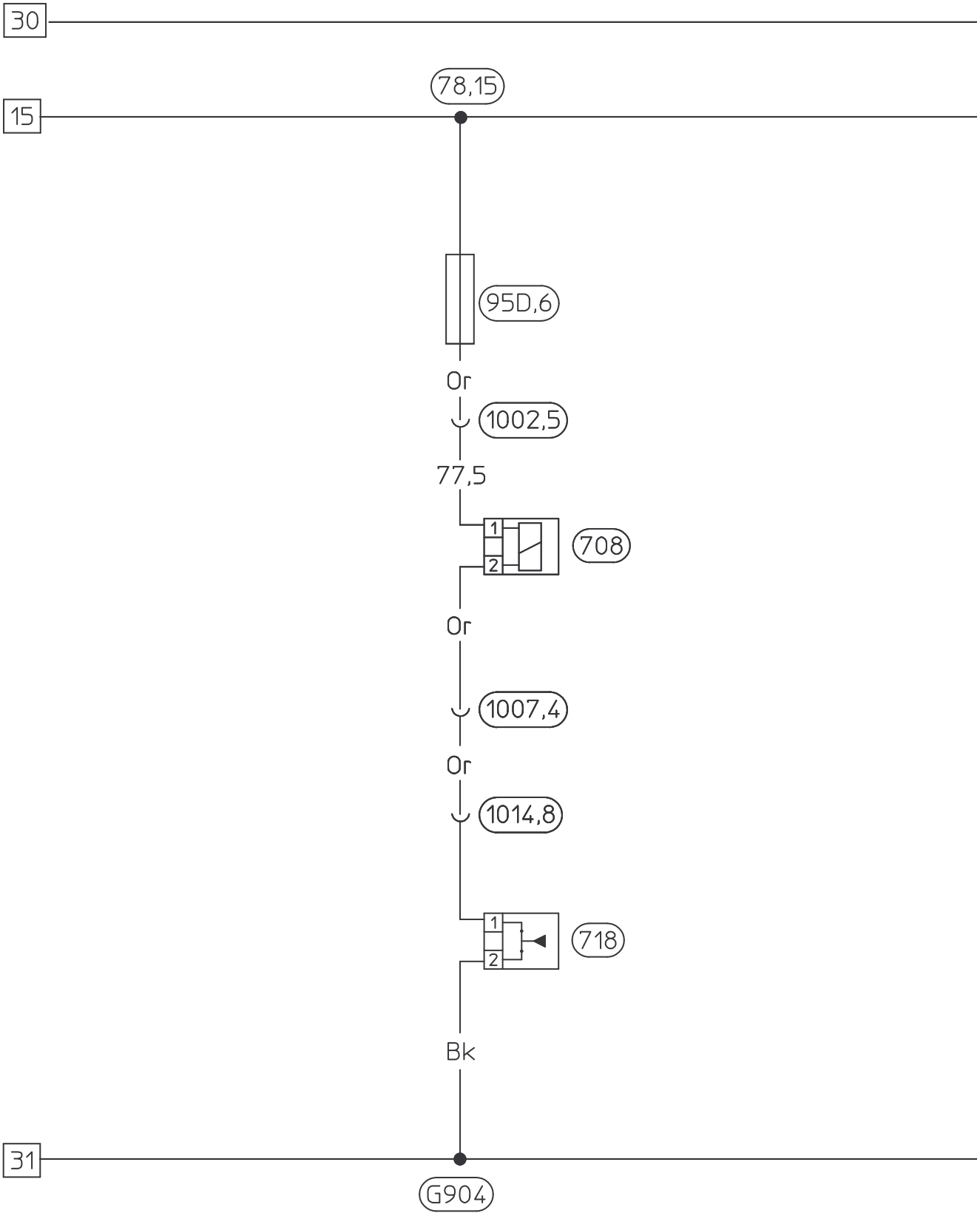
Cirquit 20-2 WDB Brake monitoring 810053-



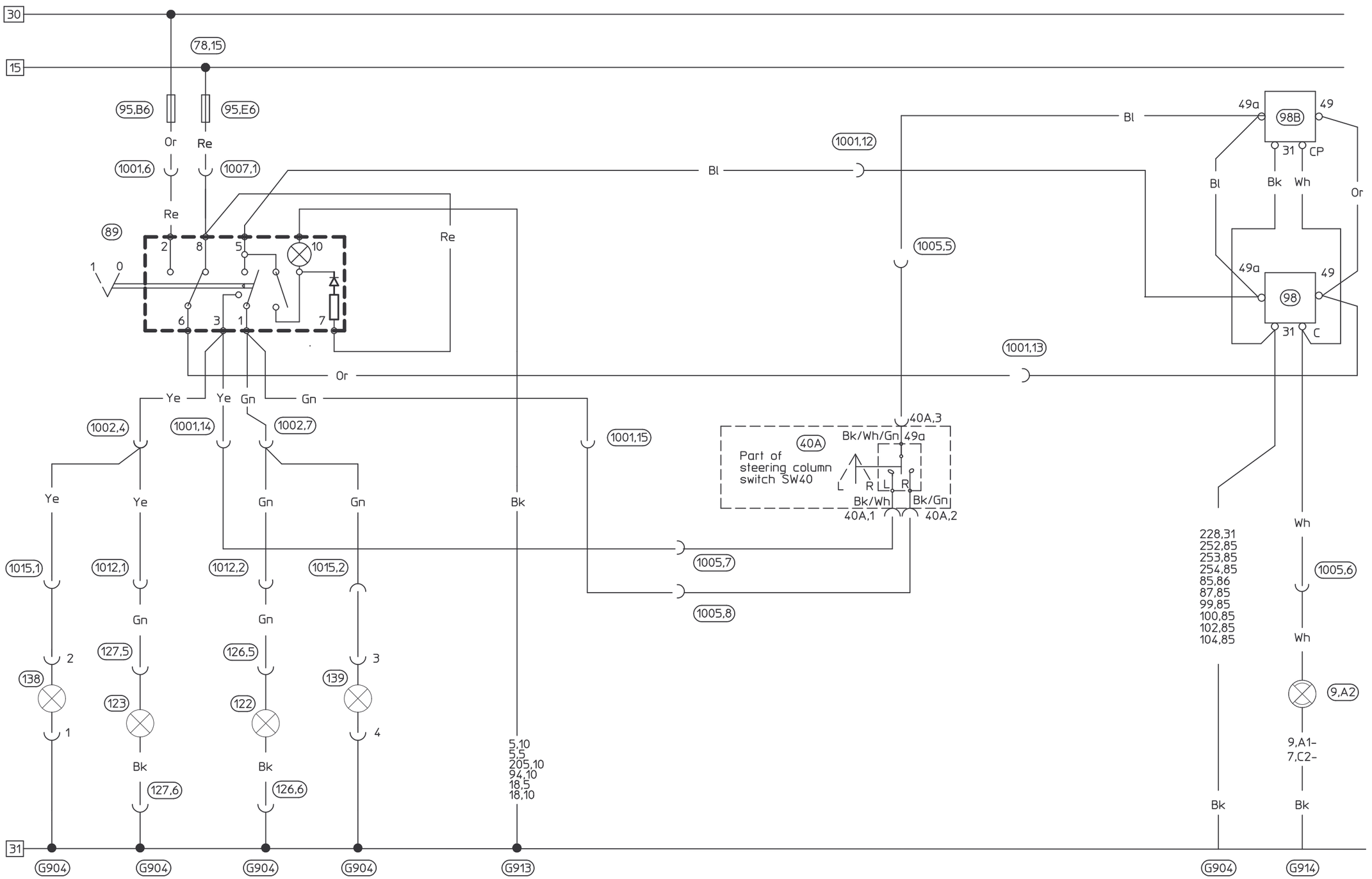
Cirquit 21 Head light



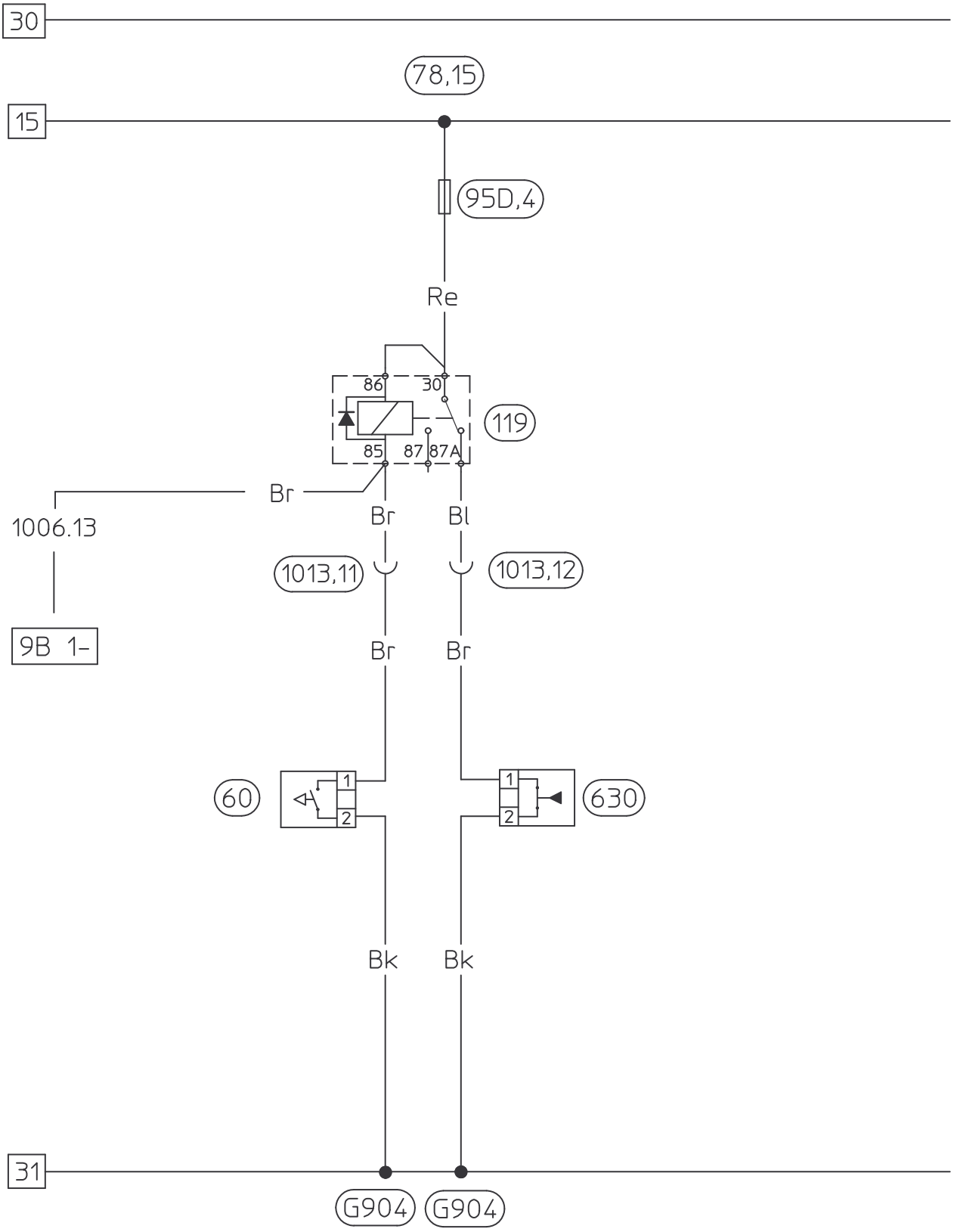
Cirquit 22 Tilt magnet (servo valve)



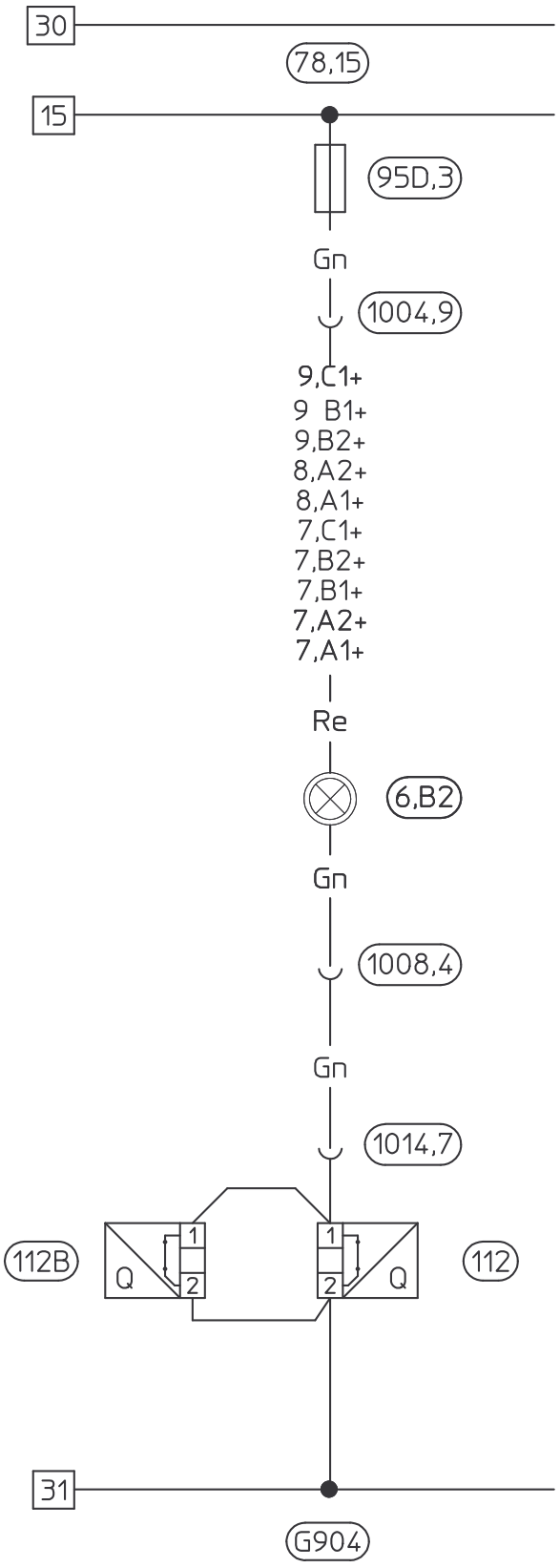
Cirquit 24 Direction and hazard light



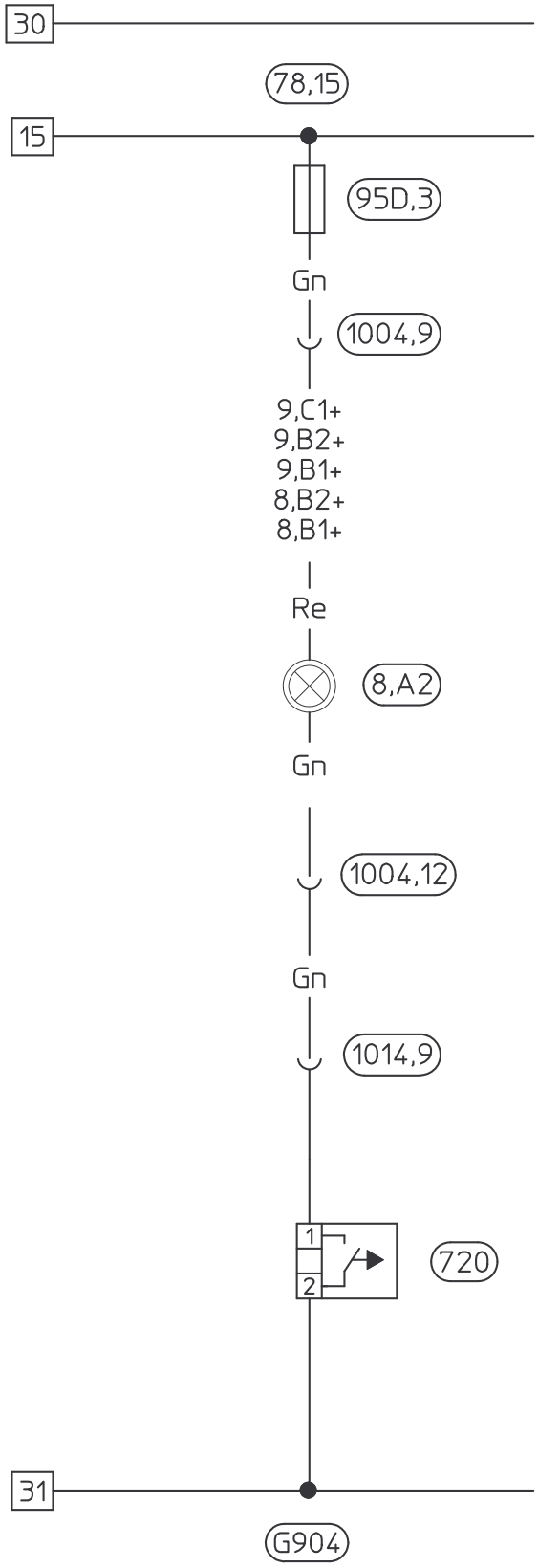
Cirquit 25 Cooling fan



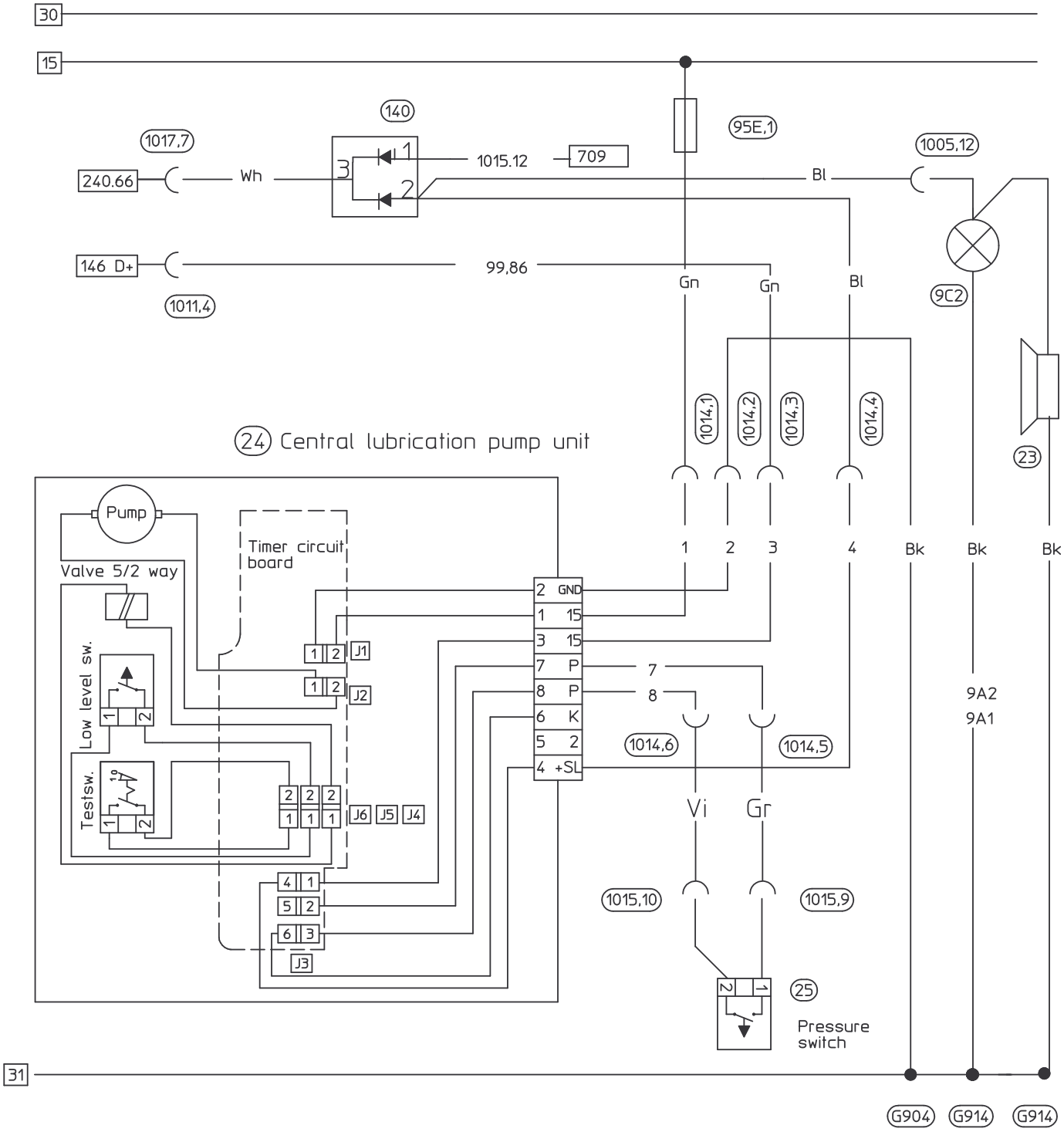
Cirquit 26 Emergency steering



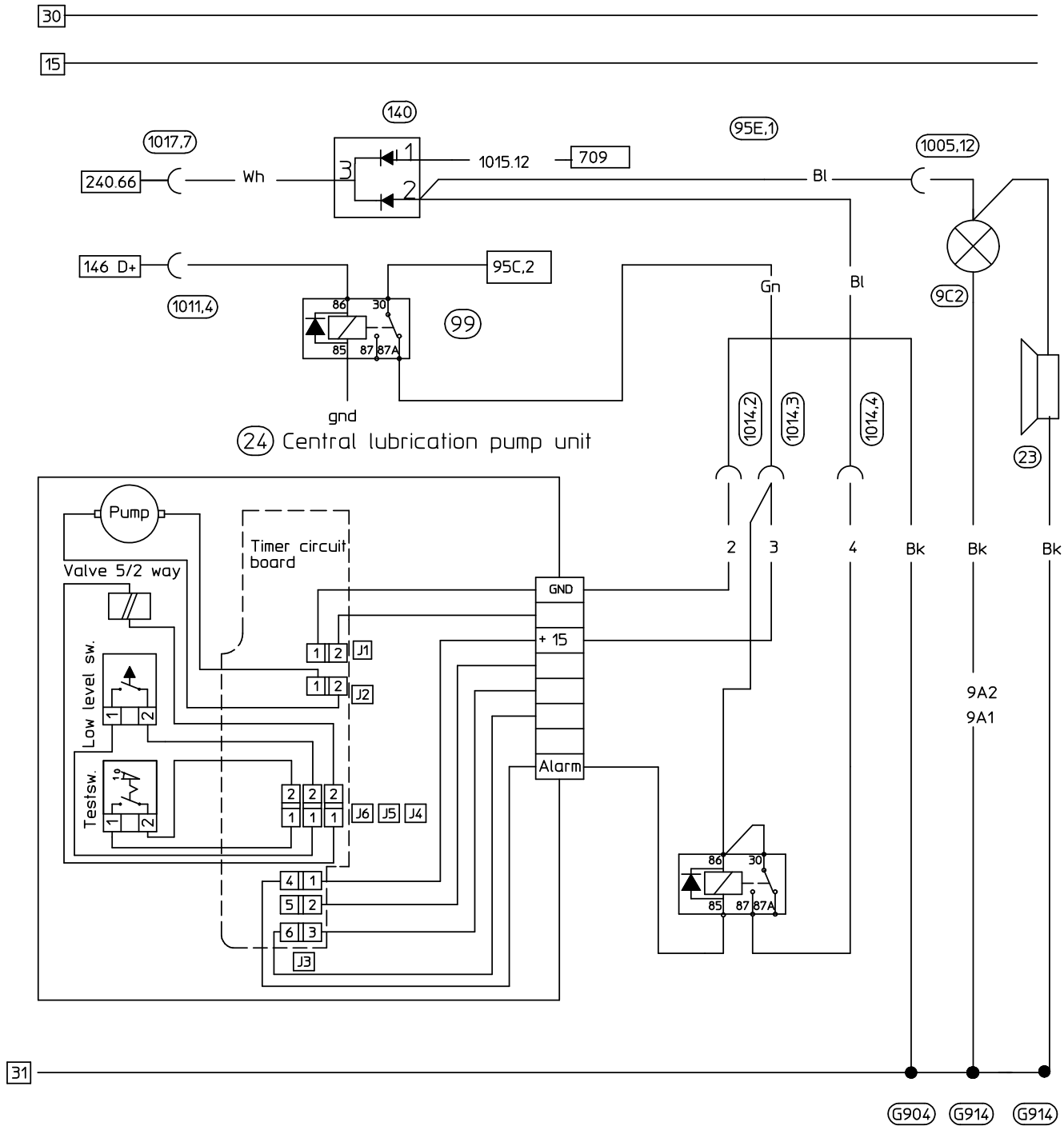
Cirquit 27 Hydraulic oil filter



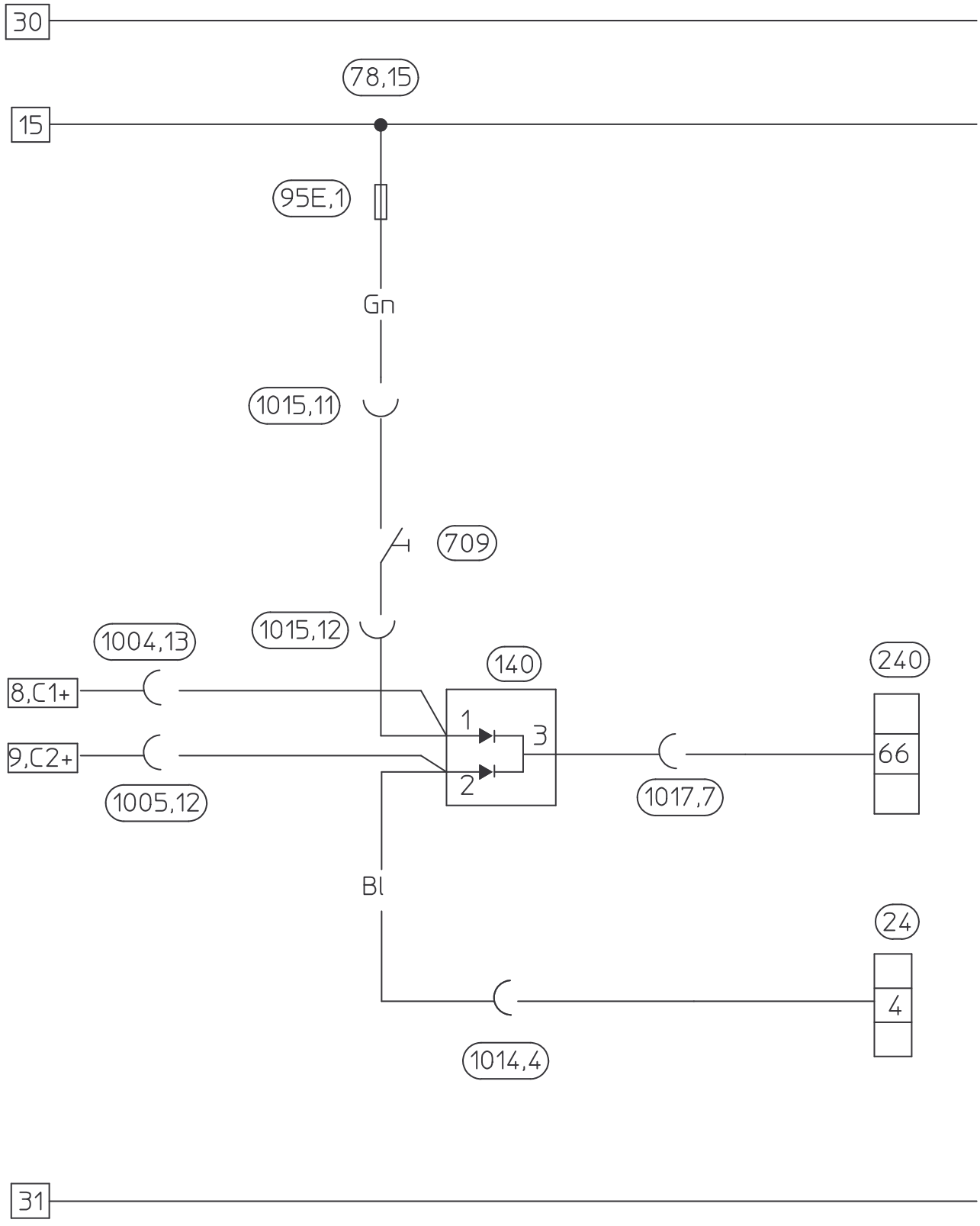
Cirquit 28 Central lubrication, Groeneveld



Cirquit 29 Central lubrication, Lincoln



Cirquit 30 Gear restriction



Chapter 7 Front Wagon

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7.1 Introduction

The Front Wagon is built up around the front frame, which is the base for the engine and the transmission. The frame is resting on the front suspension, and connected to the rear wagon in the articulation bearing.
The fenders and mudguards are attached to the frame as well as the cab and the bonnet.
Both the cab and the bonnet are hinged for easy access to engine and transmission for inspection and maintenance.

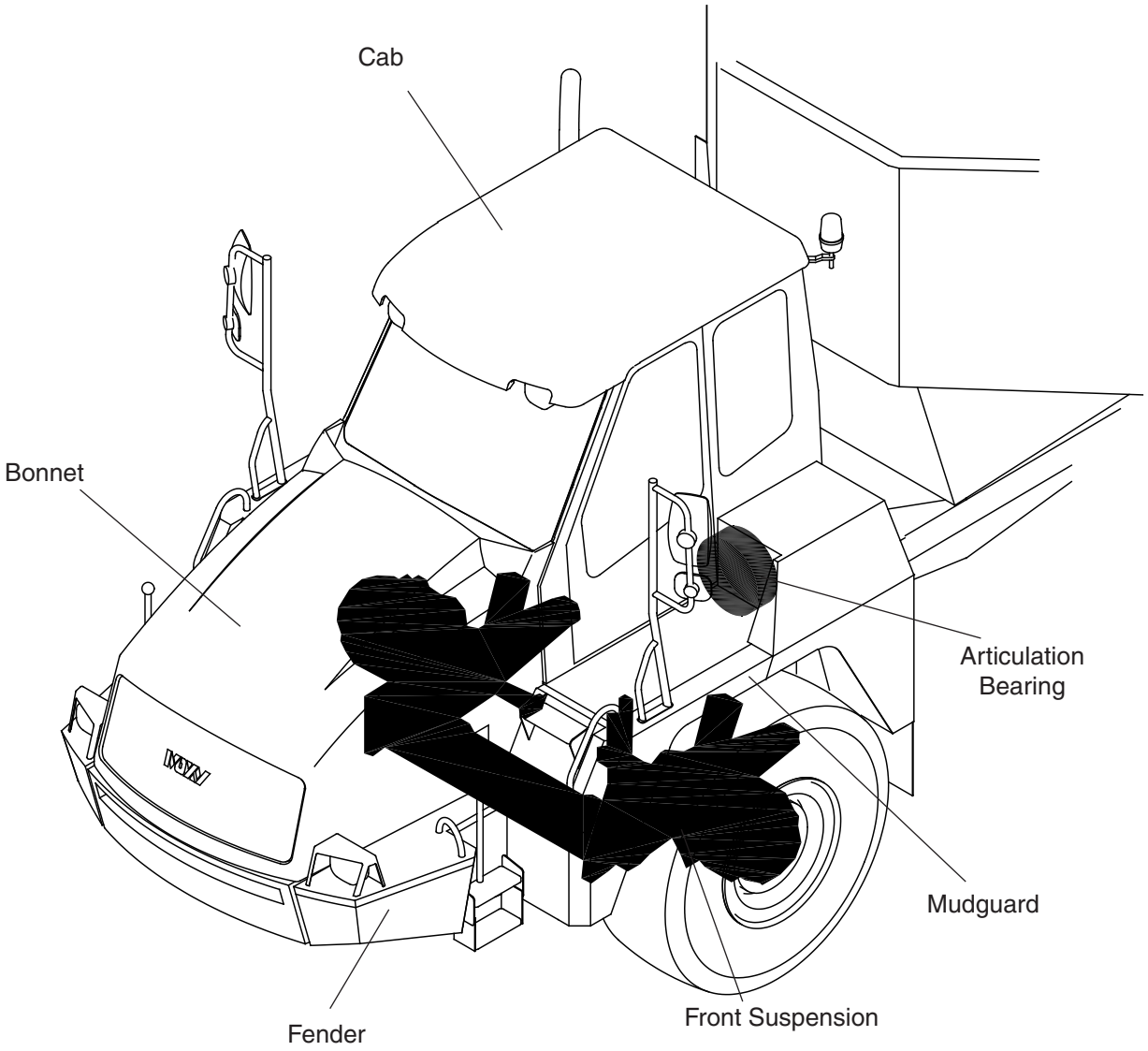


Fig 7.1 Front Wagon Overview

7.2 Front Axle Suspension

The Front Axle Suspension consists of two independent suspension arms connected to each other via the cross tube. Rubber cushions are acting as springs, and take the weight resting on the suspension which also are equipped with dual sets of shock absorbers.
In addition the suspension is stabilized by the panhard bar connected to the front wagon frame.

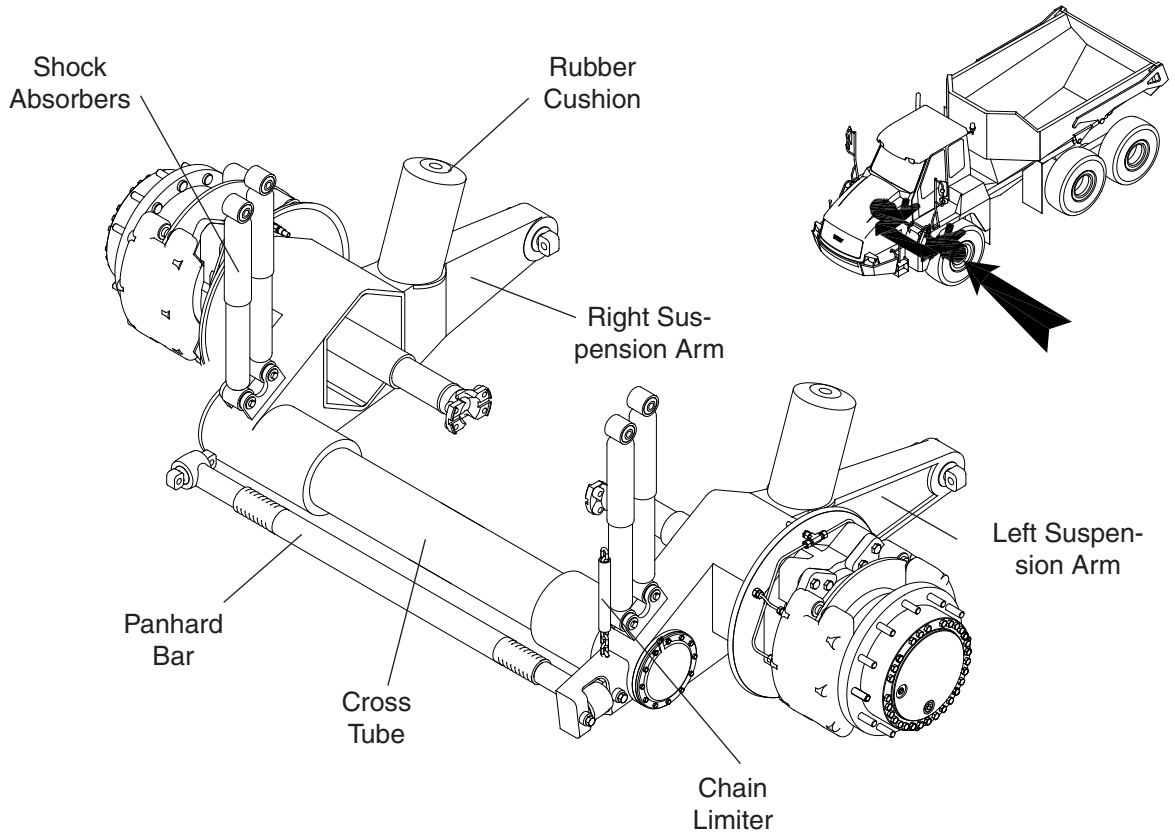


Fig 7.2 Front Axle Suspension

7.2.1 Shock Absorber

The Shock Absorbers reduce the motion in the wheel suspension when driving on rough road condition.

Removal
Thoroughly clean the front suspension.
Remove actual wheel (Ref. 3.4.1) Front frame must be supported on safety stands, not the suspension.
Use a floor jack under the cross tube to release the weight on the chain limiter, and compress the absorbers slightly.
Remove shock absorber lower fastening bolt by removing the cotter pin and washer, and tap the bolt out.
Remove upper bolt, and withdraw shock absorber for exchange. Always remove the rear absorbers first.

Installation
Position the front shock absorber in the upper bracket, and replace the bolt. Adjust the length of the damper, or use the floor jack to line up the holes for the lower fastening bolt.
Replace lower bolt and washer and secure with cotter pin.
Tighten the upper bolt.
Replace rear absorber as described for the front absorber.

Control
Before replacing the wheel, check that all components are located as when removed.
Replace wheel. (Ref.3.4.1)
Perform a test drive to see that the front suspension is functioning properly.

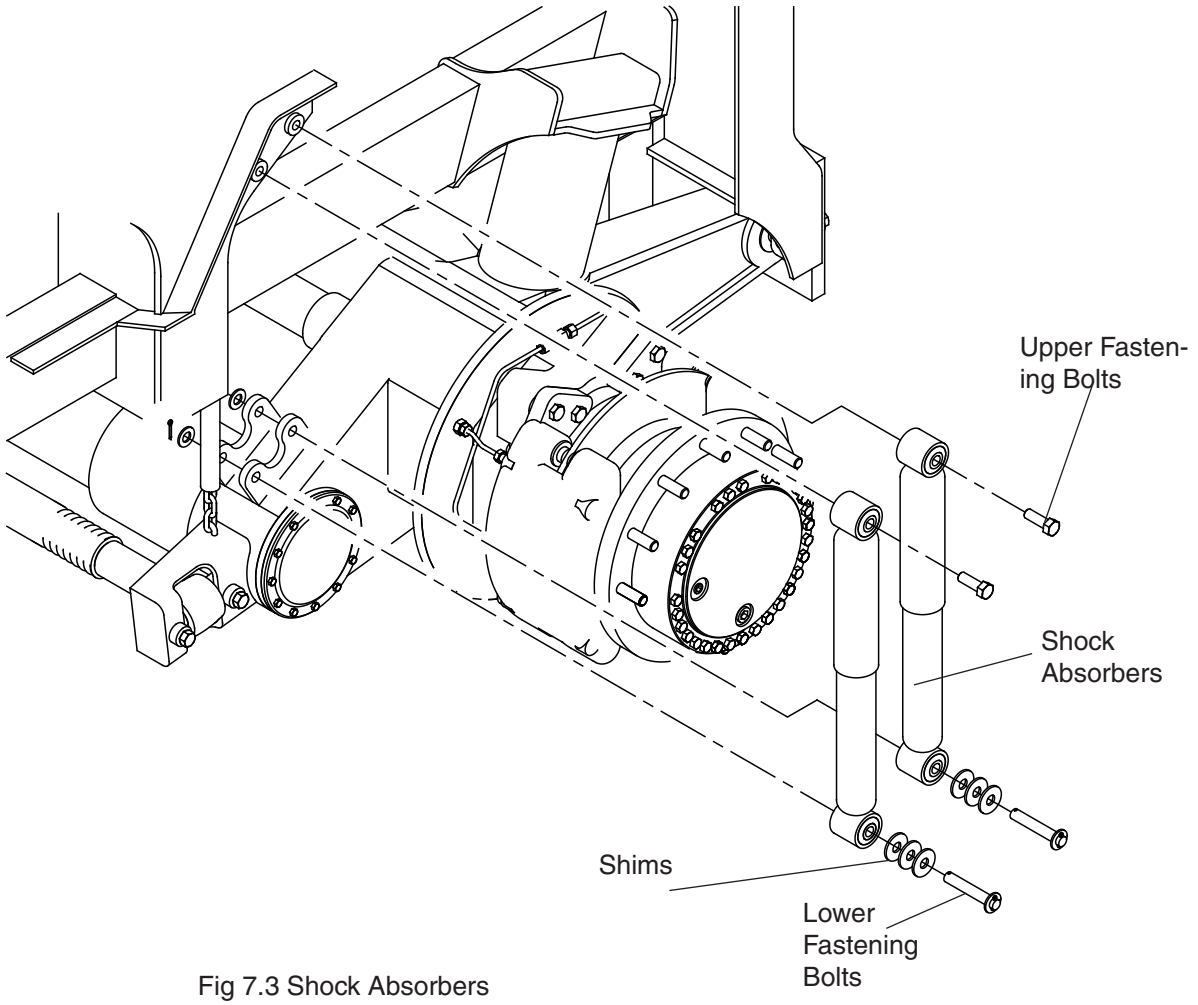


Fig 7.3 Shock Absorbers

7.2.2 Chain Limiter

The Chain Limiters stop the suspension arms from swinging to far when dumper is rised by crane or by jack, and also limits the suspension motion under extreme driving conditions.
The limiter have an important function in the suspension, and the dumper should not be used without.

Removal
Thoroughly clean the front suspension.
Remove actual wheel (Ref. 3.4.1) Front frame must be supported on safety stands, not the suspension.
Use a floor jack under the cross tube to release the weight on the chain limiter.
Unscrew the two nuts securing the chain to the suspension arm.
Unscrew the two nut securing the chain to the buffer cover, and retrieve the chain and hose.
Remove buffer and buffer cover.

Installation
Position chain limiter in the upper bracket with buffer and buffer cover, and tighten the two nuts.
Position the limiter in the mounting holes on top of the suspension arm, and tighten the two nuts.

Control
Before replacing the wheel, check that all components are located as when removed.
Replace wheel. (Ref.3.4.1)
Perform a test drive to see that the front suspension is functioning properly.

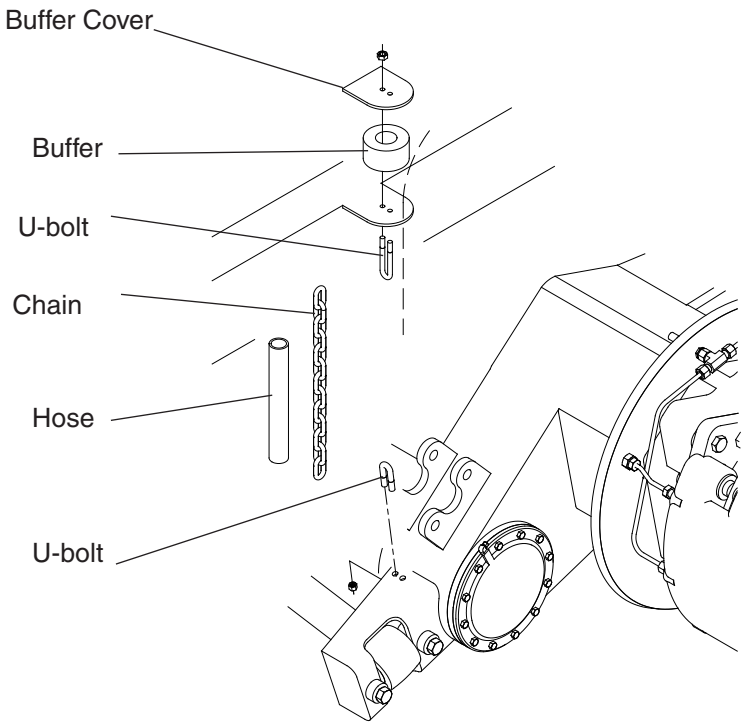


Fig 7.4 Chain Limiter

7.2.3 Rubber Cushion

The Rubber Cushions are acting as springs in the front wheel suspension.
Cushions should be replaced in pairs.

Removal
Thoroughly clean the front suspension.
Cushions are accessed by removing the actual wheel (Ref. 3.4.1) Front frame must be supported on safety stands, not the suspension.
Remove shock absorber lower fastening bolts. (Ref. 7.2.1)
Release chain limiter lower connection. (Ref. 7.2.2)
Lower the suspension arm until rubber cushion is free, and remove from dumper.
The shims under the rubber cushion should be saved for reuse.
Shims are used to level the dumper, and are made in three different sizes.

Installation
Place the rubber cushion and shims in position, and rise the suspension arm to engage the mounting studs in the cushion holes.
Replace chain limiter lower connection. (Ref. 7.2.2)
Replace the shock absorber lower bolts. (Ref.7.2.1)

Control
Before replacing the wheel, check that all components are located as when removed.
Replace wheel. (Ref.3.4.1)
Check that dumper is riding level, and adjust by repeating the procedure, and changing shims if necessary.
Perform a test drive to see that the front suspension is functioning properly.

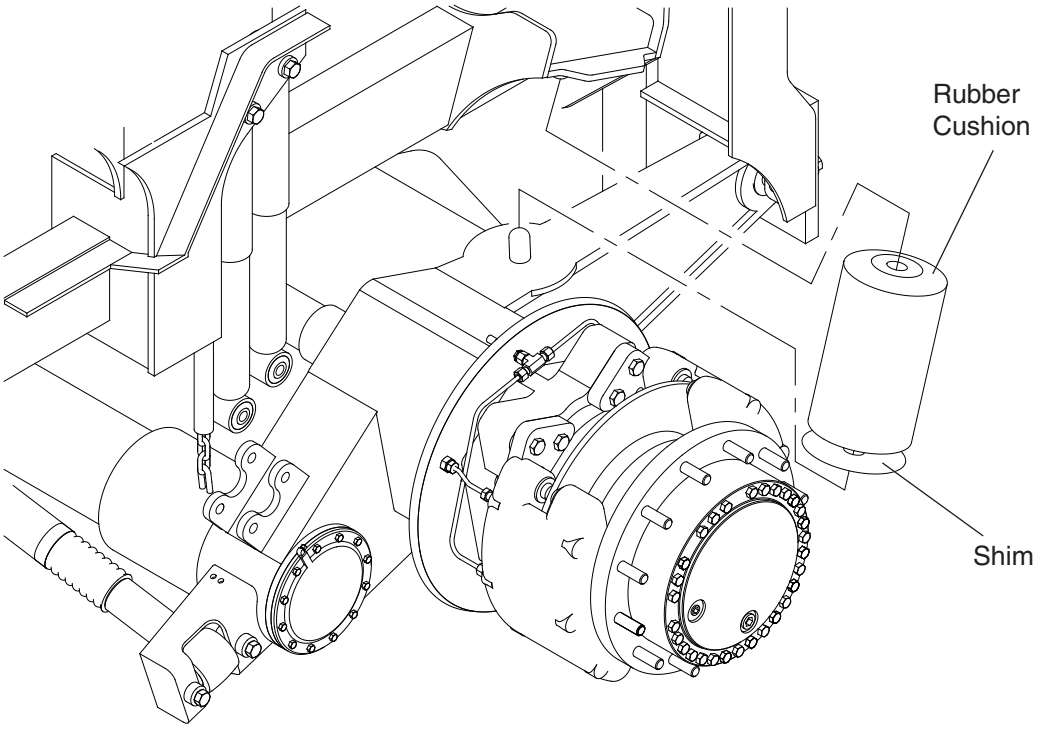


Fig 7.5 Rubber Cushion

7.2.4 Panhard Bar

The Panhard Bar restrict the sideways motion and stabilises in the front suspension.

Removal
Thoroughly clean the front suspension.
Remove the two bolts securing the bar to the front frame.
Save the shims.
Remove the two bolts securing the panhard bar to the left suspension arm.

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

Installation
Position the panhard bar in the left suspension arm bracket. Thighten the two bolts.
Position the bar in the right side front frame bracket.
Replace the shims, and tighten the two bolts.

Control
Check that all components are located as when removed.
Perform a test drive to see that the front suspension is functioning properly.

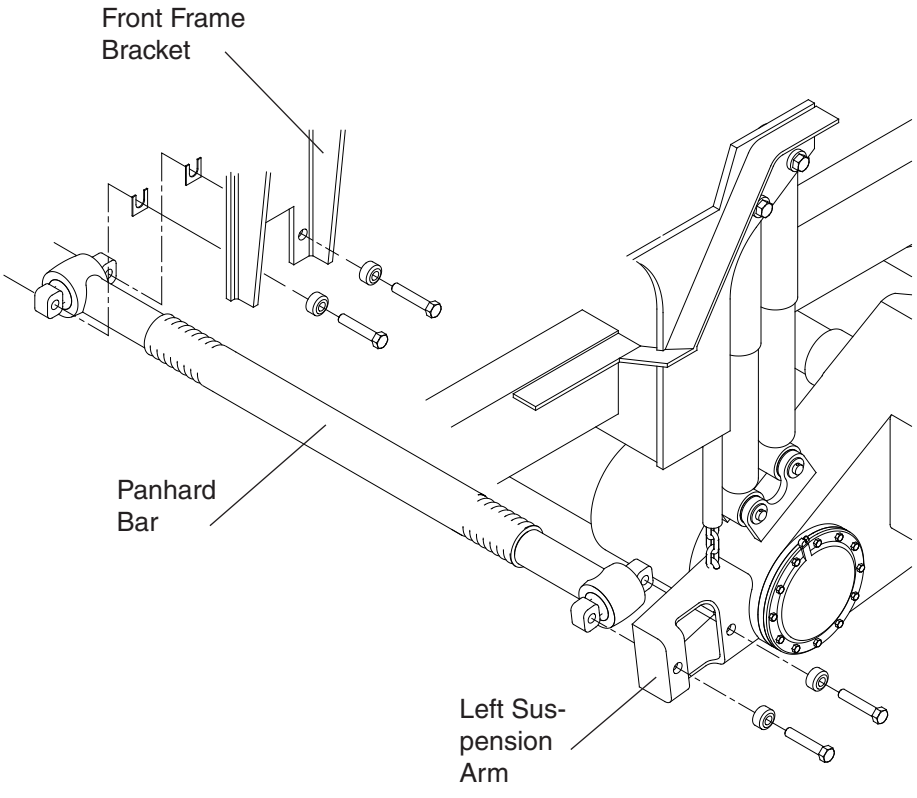


Fig 7.6 Panhard Bar

7.2.5 Suspension Bearing

The Suspension Bearings are the pivot points for the front wheel suspension arms.

Removal
Thoroughly clean the front suspension.
Remove actual wheel (Ref. 3.4.1) Front frame must be supported on safety stands, not the suspension.
Remove shock absorber lower fastening bolts. (Ref. 7.2.1)
Remove rubber cushion. (Ref. 7.2.3)
Remove panhard bar. (Ref. 7.2.4)
Attach a chain hoist between the suspension arm and an eye bolt inserted in the upper rear attachment hole for the wheel well side cover. (Ref. illustration 7.7)
Lift suspension arm to take up the weight on the suspension bearing. Remove any jack positioned under suspension.
Remove the two bolts securing the suspension bearing to the front frame. Save the shims.
Attach another chain hoist between the cross tube and the attachment point in front of the dumper. (Ref. ill 7.7)
Pull suspension arm slowly forward to expose the suspension arm bearing. Take care not to damage brake lines and lubrication lines.

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

Unscrew the eight bolts securing the bearing cover to the suspension arm, and remove cover.
The cover compresses the rubber bearing, and by removing cover the bearing can be withdrawn from suspension arm.

Installation
Insert suspension bearing in suspension arm, and replace the bearing cover. Orient the mounting holes to align to the front frame bracket. Tighten the cover bolts until cover is snug against suspension arm to expand the bearing.
Slowly release the chain hoist pulling from front to get suspension arm back in position, - adjust with the other hoist, and position fastening bolts and shims to secure suspension arm against front frame bracket.
Thighten bolts.
Replace panhard bar. (Ref. 7.2.4)
Replace rubber cushion. (Ref. 7.2.3)
Replace chain limiter lower connection. (Ref. 7.2.2)
Replace the shock absorber lower bolts. (Ref.7.2.1)

Control
Before replacing the wheel, check that all components are located as when removed.
Replace wheel. (Ref.3.4.1)
Perform a test drive to check that the front suspension is functioning properly.

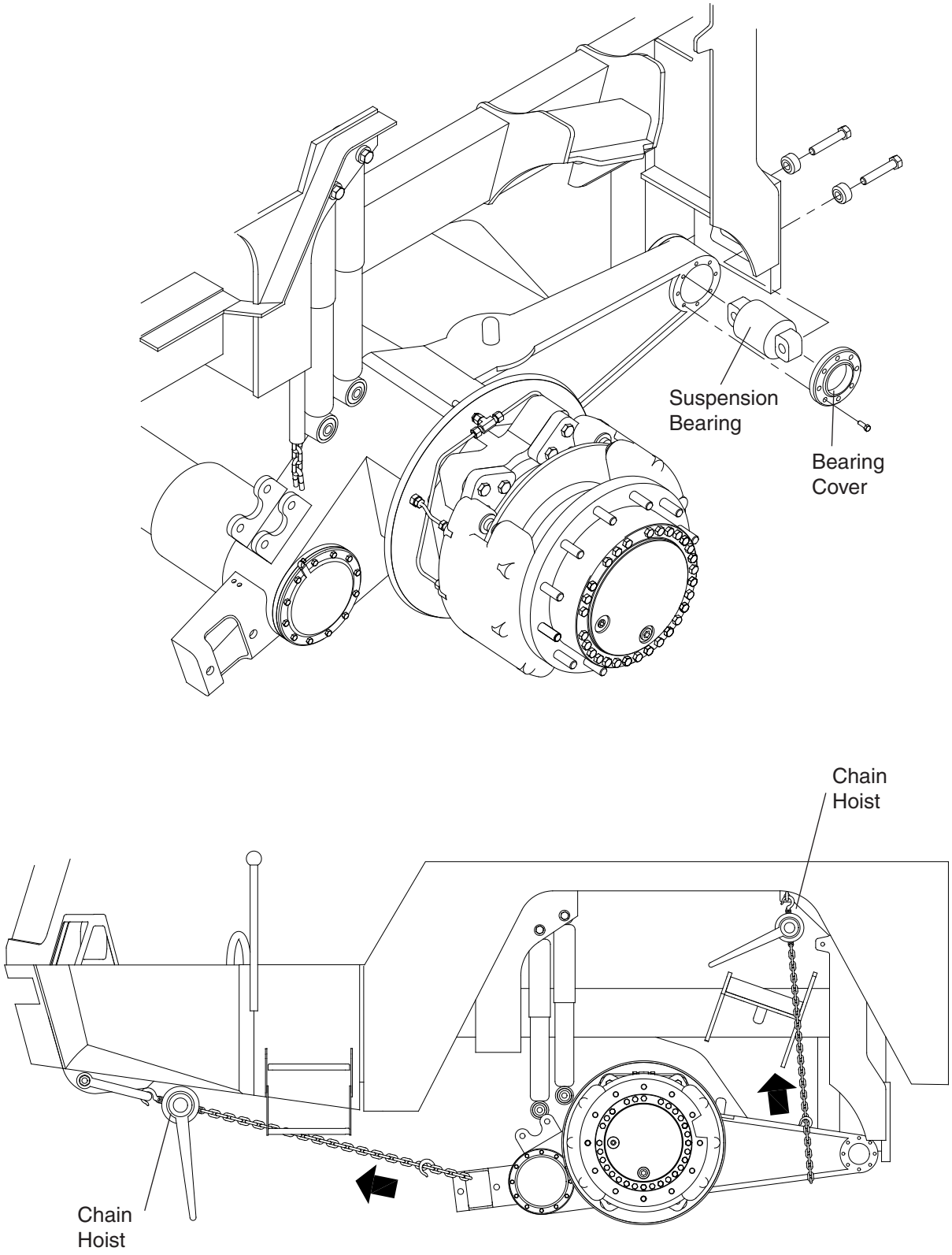


Fig 7.7 Suspension Bearing

7.2.6 Cross Tube Bushings

The Cross Tube connects the left and right front suspension arms.
The suspension arms rotate relative to the cross tube on the cross tube bushings.

Removal
Thoroughly clean the front suspension.
Remove front wheels (Ref. 3.4.1) Front frame must be supported on safety stands, not the suspension.
Remove right shock absorber lower fastening bolts. (Ref. 7.2.1)
Remove right rubber cushion. (Ref. 7.2.3)
Disconnect right front axle drive shaft (Ref. 3.2.2)
Disconnect right front wheel brake lines. (Ref.3.6.1.3)
Disconnect lubrication line to the right suspension arm .
Remove right suspension bearing (ref. 7.2.5)
Support right suspension arm on a pallet.
Support cross tube on a safety stand.
Remove cross tube cover by unscrewing twelve bolts, and disconnect lubrication line.
Retrieve the thrust ring behind cover.
Remove cross tube right thrust plate by unscrewing twelve bolts.
Pull suspension arm to the right, away from cross tube by means of a pallet jack.

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

Right suspension arm is now free for removal of the cross tube bushings and seal ring.
To expose left cross tube bushings, disconnect lubrication line, and remove cross tube left cover by unscrewing twelve bolts. Retrieve the thrust ring behind cover.
Remove cross tube left thrust plate by unscrewing twelve bolts.
Place cross tube on pallets, and by means of a pallet jack pull cross tube out of left suspension arm.
Left suspension arm is now free for removal of the cross tube bushings and seal ring.
Tap bushings and seal ring out of suspension arm by means of a soft dowel.

Installation
Thoroughly clean the bushing mating surfaces, and tap the new bushings in place. Cover the bushings with chassis grease. Install the seal ring.
Assemble the cross tube in opposite order as described for removal.

Control
Before replacing the wheels, check that all components are located as when removed.
Replace wheels. (Ref.3.4.1)
Perform a test drive to check that the front suspension is functioning properly.

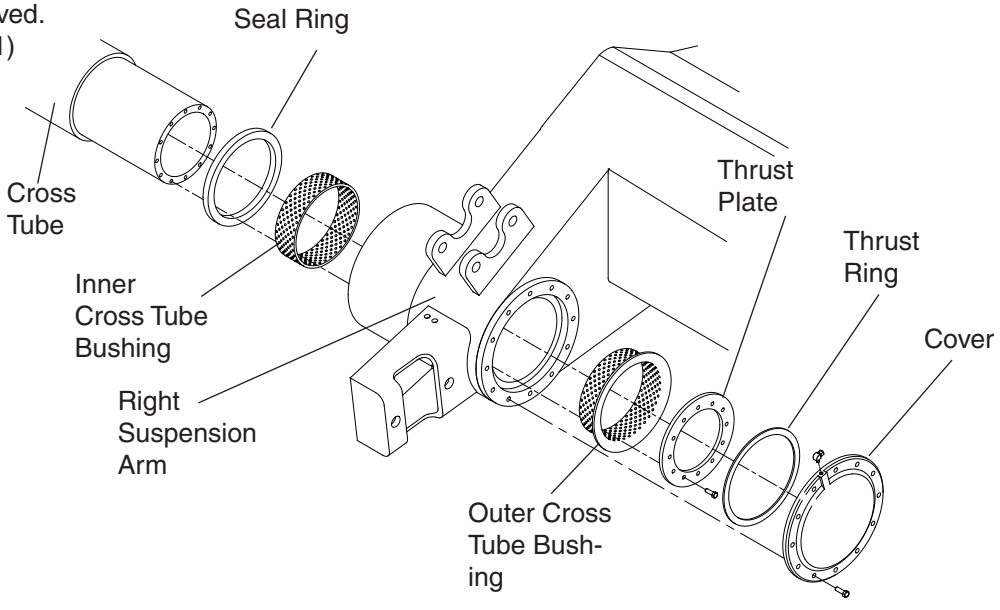


Fig 7.8 Cross Tube Bushing

7.3 Articulation Hinge System

The Articulation Hinge System consists of the Articulation Hinge, and the Articulation Bearing.
The articulation hinge is the turning point of the steering motion, and the articulation bearing permits the front wagon and the rear wagon to roll relative to each other during driving.

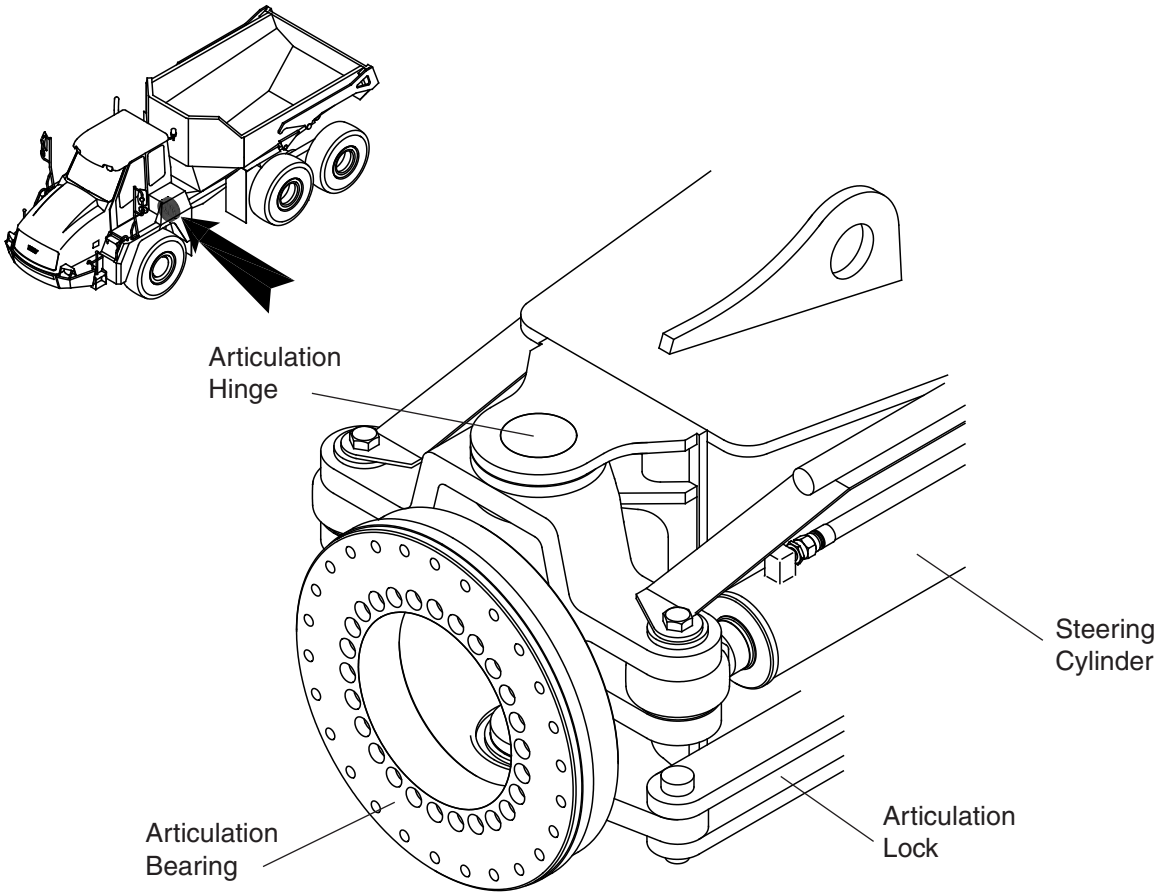


Fig 7.9 Articulation Hinge System

7.3.1 Articulation Bearing

To measure the wear on the articulation bearing, place the truck on level ground, with front and rear frame in line. For axial measurement place a dial indicator on the articulation bearing as shown in figure 7.10.
Open the bonnet and the lift the front wagon in the lifting points with 800 kp. Read the dial indicator.
Acceptable value max. 1.0 mm.

For radial measurement, place the dial indicator as shown in figure 7.11.
Using a floor jack, lift the rear wagon in the articulation hinge with approx. 2000 kp. Read the dial indicator. Acceptable value max. 1.0 mm.

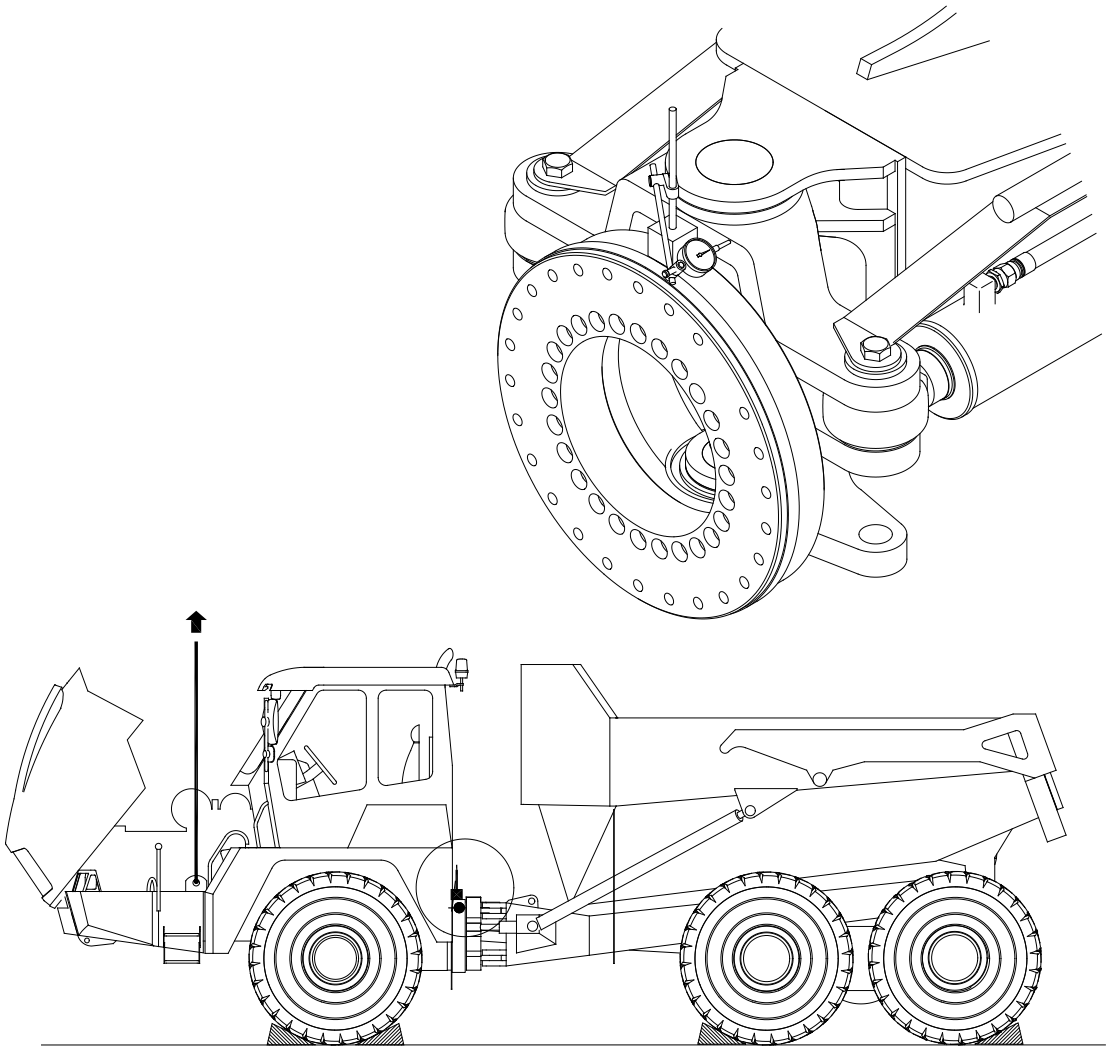


Fig 7.10 Articulation Hinges System Vertical Check

Removal
Thoroughly clean the articulation bearing and the area around for accumulated dirt.
Disconnect the intermediate drive shaft in the articulation hinge. (Ref. 3.5.3) Support the drive shaft, as it rotates when rear wagon is moved.
Release the hose support to gain more movement on hoses and cables.
Support the front wagon on safety stands, and block the wheels.
Support the rear wagon front end to release the pressure on the articulation bearing on a rollable stand, and block the rear wheels.
Manually release the emergency brake
(Ref. Operation & Maintenance Manual 5.13)
Disconnect the lubrication line to the
articulation bearing if fitted.
Unscrew the 26 bolts securing the
bearing to the front wagon frame.
Move the blocks behind the rear wheels, and carefully move the rear wagon away from the front wagon to access the bolts fastening the bearing to the articulation hinge.

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

Place pallets and a pallet jack under the bearing.
Unscrew the 26 bolts securing the articulation bearing to the hinge and remove bearing.

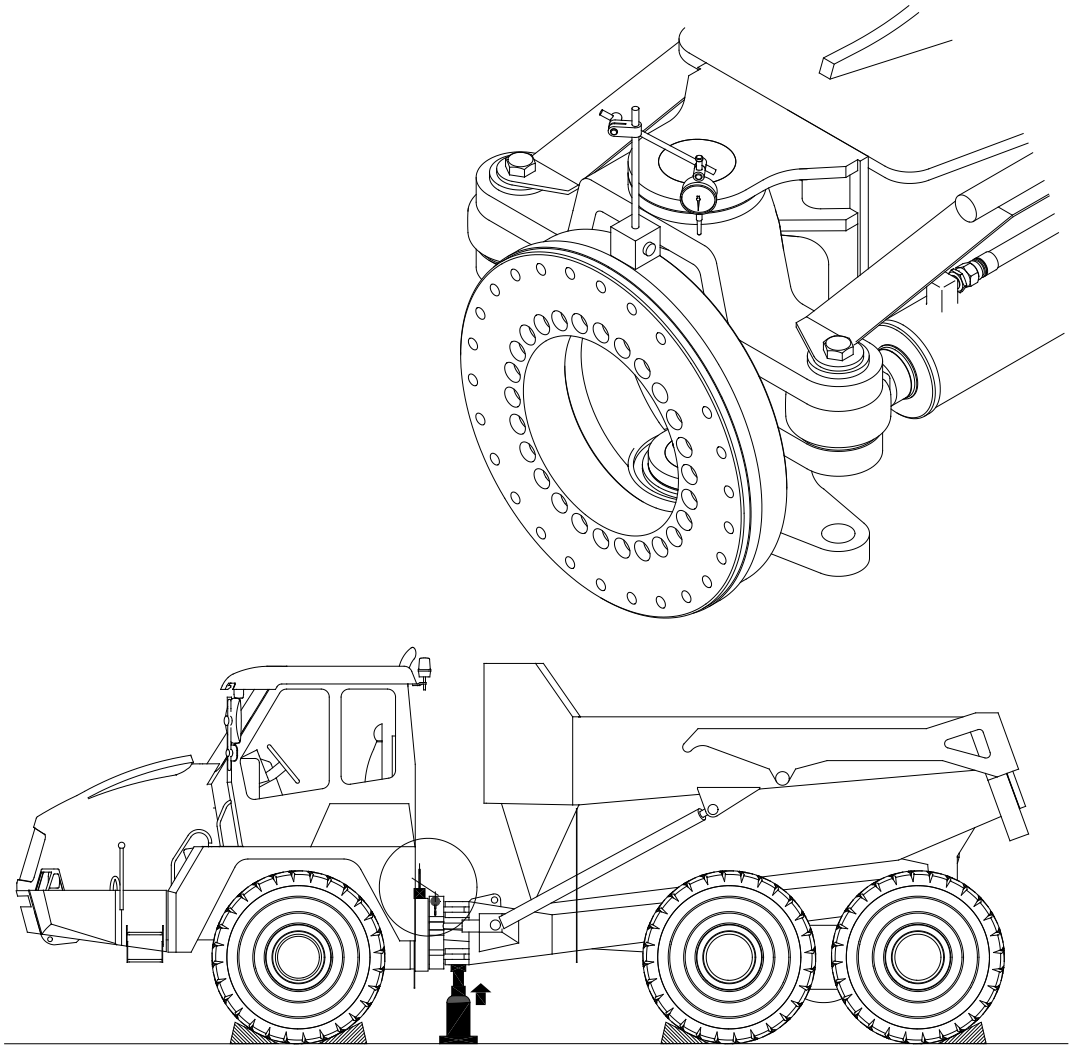
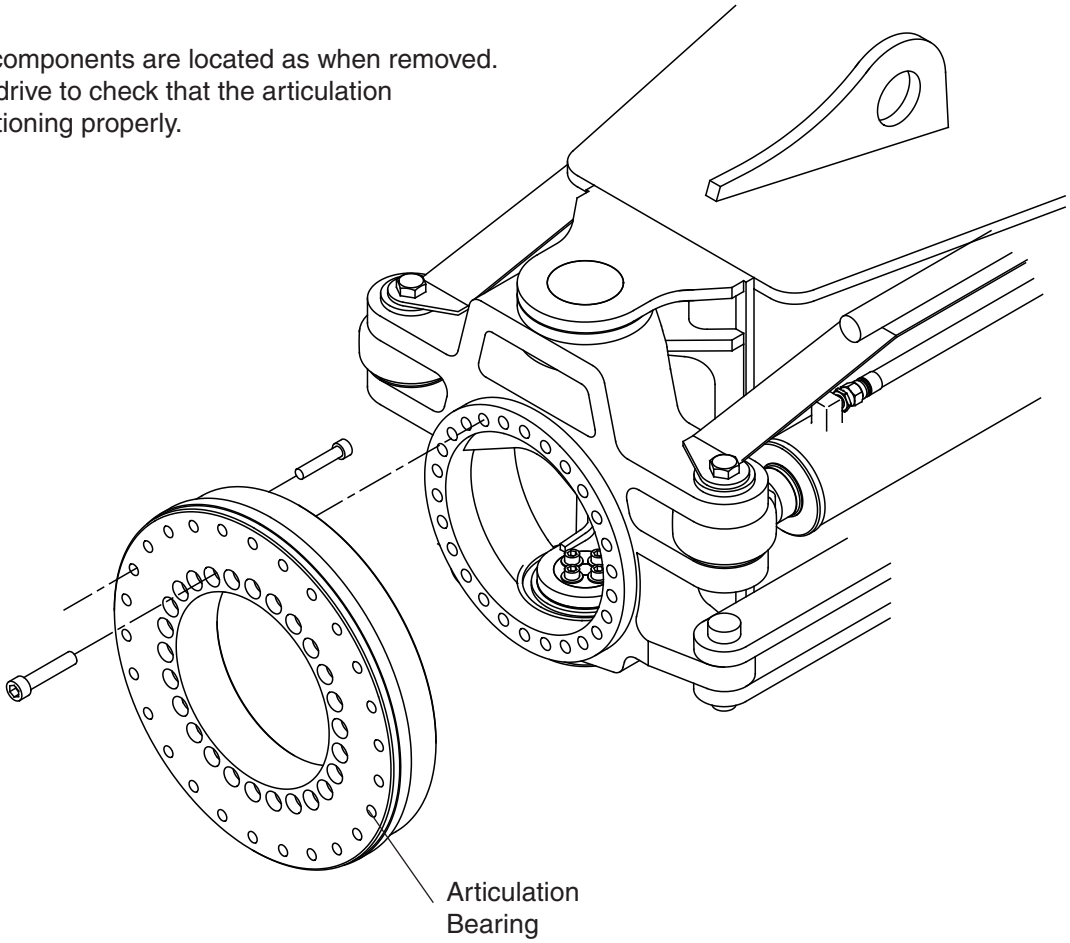


Fig 7.11 Articulation Hinges System Horizontal Check

Installation
Position articulation bearing on articulation hinge flange
Tighten the 26 bolts.
Move the rear wagon into position to enter the bolts fastening the bearing to the front frame.
Tighten the 26 bolts.
Connect the lubrication line.
Manually engage the parking brake. (Ref. Operation & Maintenance Manual 5.13)
Install hoses and cables in the hose support.
Connect the intermediate drive shaft. (Ref. 3.5.3)
Remove safety stands.
Operate the central lubrication system to ensure proper lubrication of bearing.

Control
Check that all components are located as when removed.
Perform a test drive to check that the articulation bearing is functioning properly.



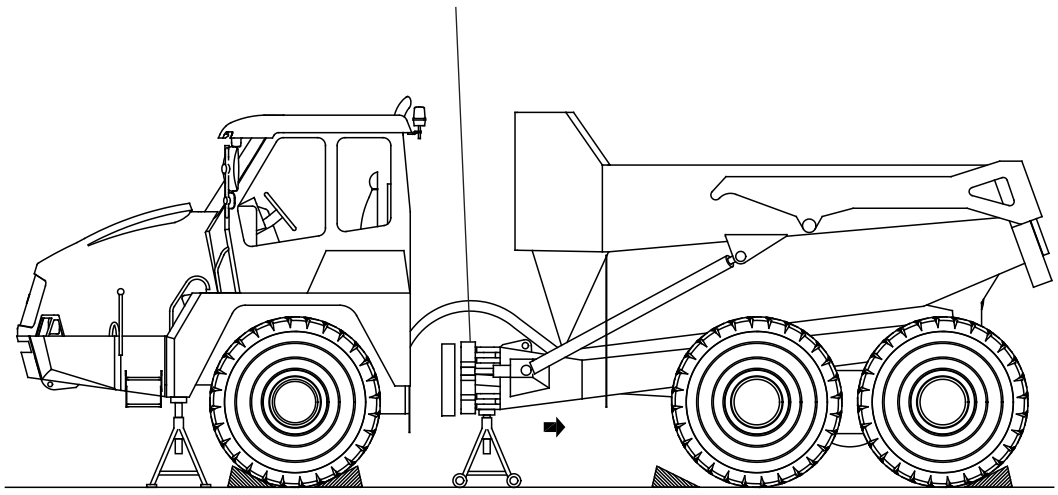


Fig 7.12 Articulation Bearing

7.3.2 Articulation Hinge

To measure the wear on the articulation hinge, place the truck on level ground, with front and rear frame in line.
Place a hydraulic jack under center of lower articulation hinge bolt according to Fig 7.10
Lift with a force of 1800 kp, and read the dial indicator.
Acceptable value max. 0.0XXmm

Removal
Separate the front wagon and the rear wagon. (Ref. 7.3.1)
Disconnect the steering cylinders from the articulation hinge, by removing the front pivot bolts (Ref. 5.3.9)
Release articulation lock (Ref. Operation & Maintenance Manual 2.24)
Place pallets and a pallet jack under the articulation bearing and hinge.
Disconnect hinge bolts lubrication lines.
Unscrew the four bolts securing each hinge bolt, save the shims for re-use.
Tap the bolts out using a soft mallet.
Free the hinge by pulling forwards, and out from the rear wagon.

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

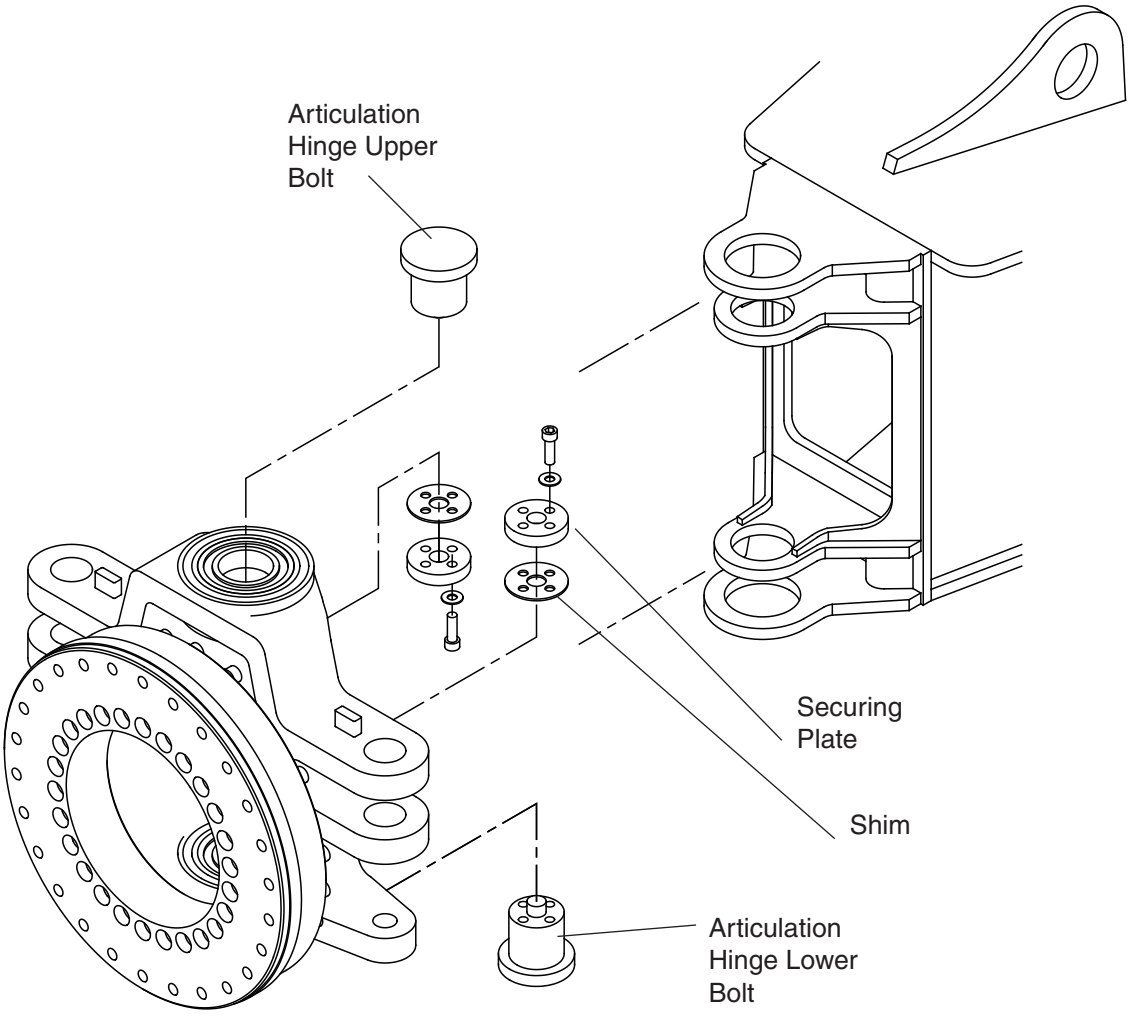


Fig 7.13 Articulation Hinge Bolts

Remove the four bearings and the two distance rings from the hinge.
Check the condition of the seal rings for possible
re-use.

Installation
Install new seal rings if necessary.
Install the four bearings and the two distance rings in the hinge.
Position the articulation hinge on rear frame, and install the hinge bolts.
Secure the bolts by installing shims and retainers.
Tighten the four bolts on each hinge bolts.
Replace lubrication lines.
Engage articulation lock.
Connect the steering cylinders by installing the front pivot bolts. (Ref. 5.3.9)
Join the front wagon and the rear wagon. (Ref. 7.3.1)
Control
Check that all parts are located as before removal.
Perform a test drive to check that the articulation bearing is functioning properly.

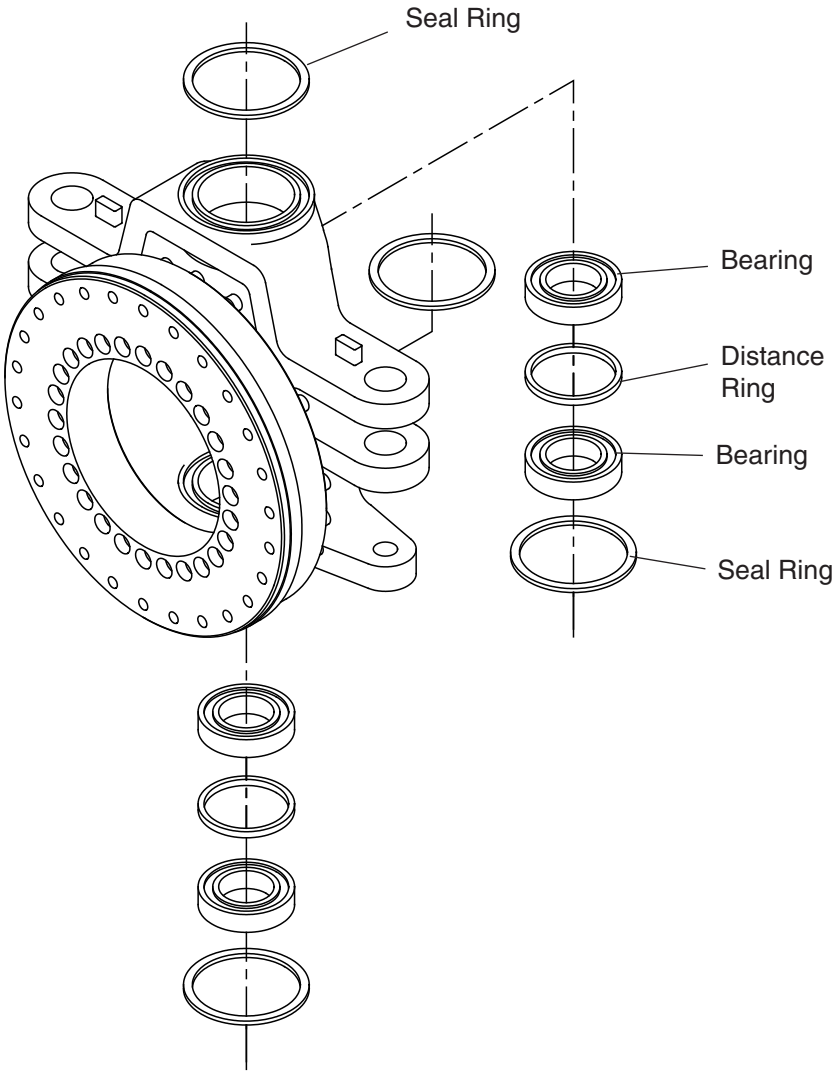


Fig 7.14 Articulation Hinge Bearings

7.4 Fenders, Mudguards and Bonnet

Fenders, Mudguards and Bonnet are together with the hydraulic tank, diesel fuel tank and cab, the bodywork of the dumper.
Fenders and mudguards are exposed parts which are likely to be beaten up under heavy use, and should be replaced if damaged, as misalignment will reduce the protection for the internal parts, and reduce service life. Damages also reduce the general appearance of the dumper.

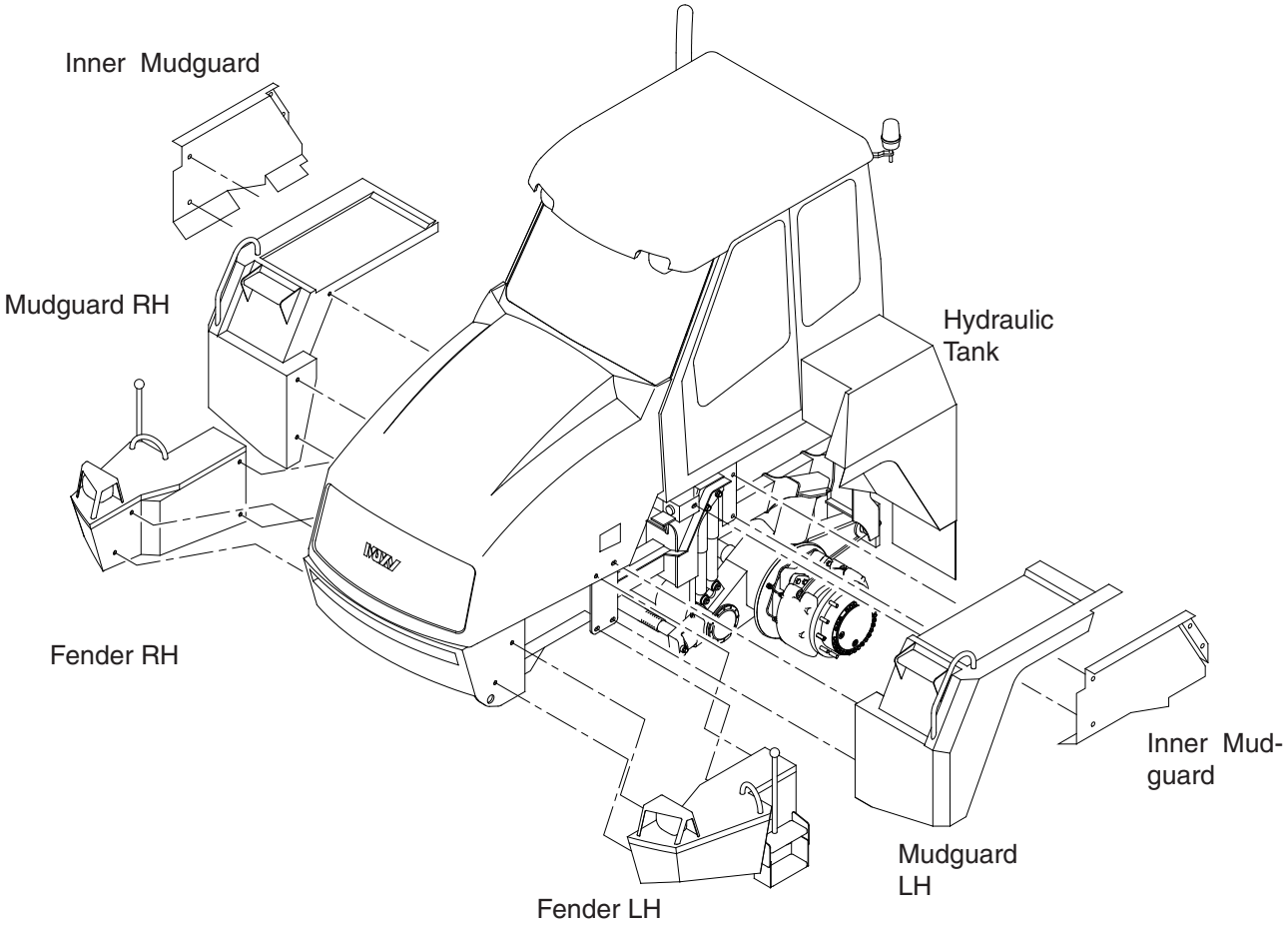


Fig 7.15 Fenders and Mudguards

7.4.1 Fender RH

The right hand Fender contains an air supply tank, and the safety support for the cab, accessed by a hatch. The hatch is also the base for the right hand head lamp, as well as serving as working platform for engine maintenance.

Removal
Thoroughly clean the fender and the area around for accumulated dirt.
Make sure the main battery switch is turned off. (Ref. Operation & Maintenance manual)
Open the bonnet.
Release the pressure in the air system. (Ref. Operation & Maintenance manual)
Open the fender hatch.
Lift out the cab safety support.
Remove the air tank, and pull back the hose. (Ref. 4.3.2)
Disconnect the electrical cable to the head lamp, remove the clamps, and pull the cable back from fender.
Remove the head lamp protection by removing four bolts and nuts, and remove the head lamp.
Remove external parts that will be re-used if fender is going to be replaced by a new.
Release the four bolts securing the fender to the front frame, and lower fender to ground.
Check attachment points, and repair any damages to ensure proper fit of the new fender.

Installation
Position the fender on the front frame, and secure by tightening the four fastening bolts.
Replace the external parts. New parts when necessary, or re-use from the old fender where possible.
Replace the head lamp and the cable using the same amount of straps and clamps as removed.
Replace the air tank and the hose. (Ref.4.3.2)
Put back the cab safety support.

Control
Check that all parts are located as before removal. Close hatch, and close the bonnet.
Turn the main battery switch on, and check the function of the lights.
Adjust head lamp if necessary.

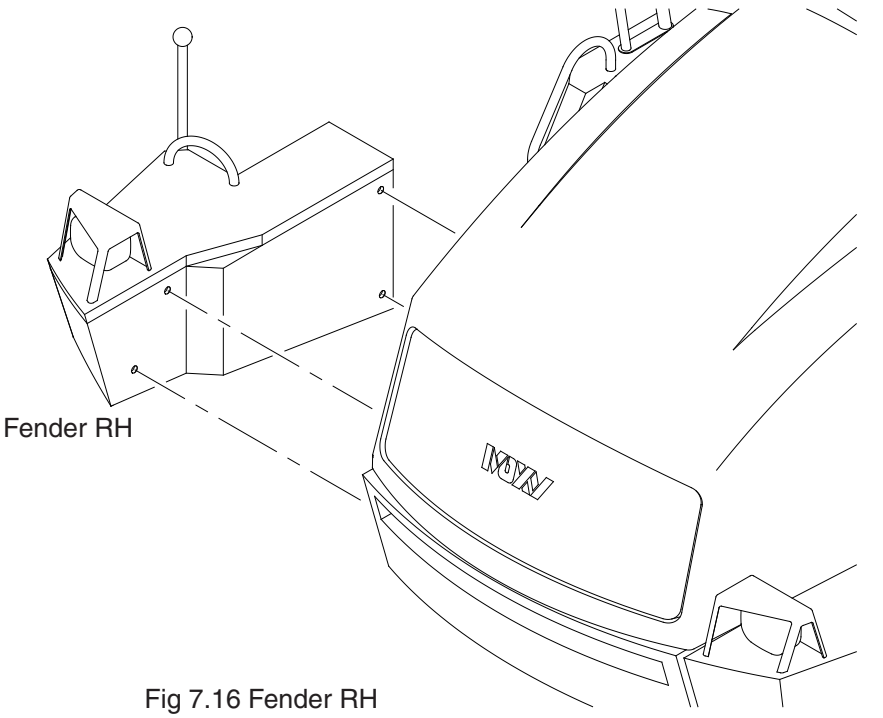


Fig 7.16 Fender RH

7.4.2 Fender LH

The left hand Fender contains an air supply tank, the air dryer unit, the battery main switch and the batteries, accessed by a hatch. The hatch is also the base for the left hand head lamp, as well as serving as working platform for engine maintenance.

Removal
Thoroughly clean the fender and the area around for accumulated dirt.
Make sure the main battery switch is turned off. (Ref. Operation & Maintenance manual)
Open the bonnet.
Release the pressure in the air system. (Ref. Operation & Maintenance manual)
Open the fender hatch.
Remove the air tank and the air dryer unit, and pull back the hoses. (Ref. 4.3)
Disconnect the electrical cable to the head lamp, remove the clamps, and pull the cable back from fender.
Remove batteries.
Remove main battery switch and battery cables.
(Ref.6.4)
Remove the head lamp protection by removing four bolts and nuts, and remove the head lamp.
Remove external parts that will be re-used if fender is going to be replaced by a new.
Release the four bolts securing the fender to the front frame, and lower fender to ground.
Check attachment points, and repair any damages to ensure proper fit of the new fender.

Installation
Position the fender on the front frame, and secure by tightening the four fastening bolts.
Replace the external parts. New parts when necessary, or re-use from the old fender where possible.
Replace the head lamp and the cable using the same amount of straps and clamps as removed.
Replace the battery cables and the battery main switch. (Ref.6.4 and 6.5)
Replace the batteries
Replace the air tank, air dryer and hoses. (Ref.4.3)

Control
Check that all parts are located as before removal. Close hatch, and close the bonnet.
Turn the main battery switch on, and check the function of the lights.
Adjust head lamp if necessary.

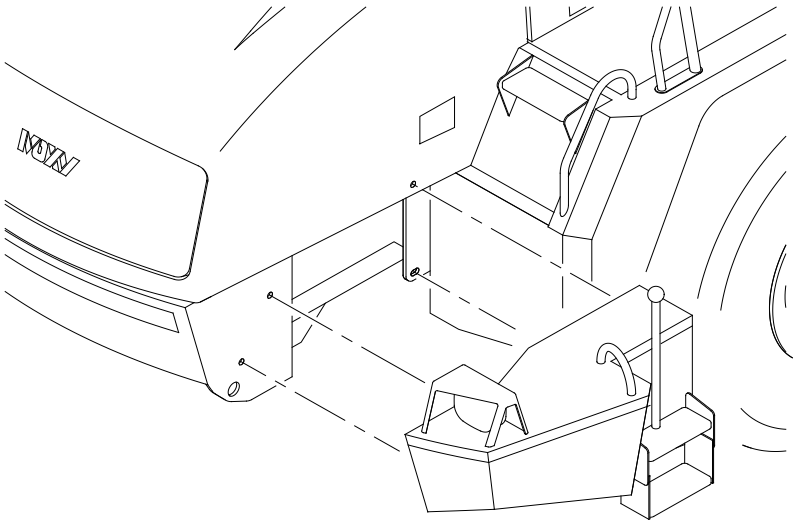


Fig 7.17 Fender LH

7.4.3 Mudguard

The Mudguards cover the front halves of the front wheels, and also act as a bridge from the fender working platform towards the diesel fuel tank on the right side, and to the cab door and hydraulic tank/central lubrication on the left side.

Removal
Thoroughly clean the mudguard and the area around for accumulated dirt.
Make sure the main battery switch is turned off.
Remove actual wheel. (Ref. 3.4.1)
Open the bonnet.
Remove any electrical connections to the mirror, remove clamps, and pull back the cable.
Remove the mirror bracket.
Remove external parts that will be re-used if mudguard is going to be replaced by a new.
Release the three bolts securing each mudguard to the front frame.
One is accessed from the wheel well, one is accessed from the engine compartment, and one is accessed from the underside of the front frame.
Lift mudguard off the dumper.
Check attachment points, and repair any damages to ensure proper fit of the new mudguard.

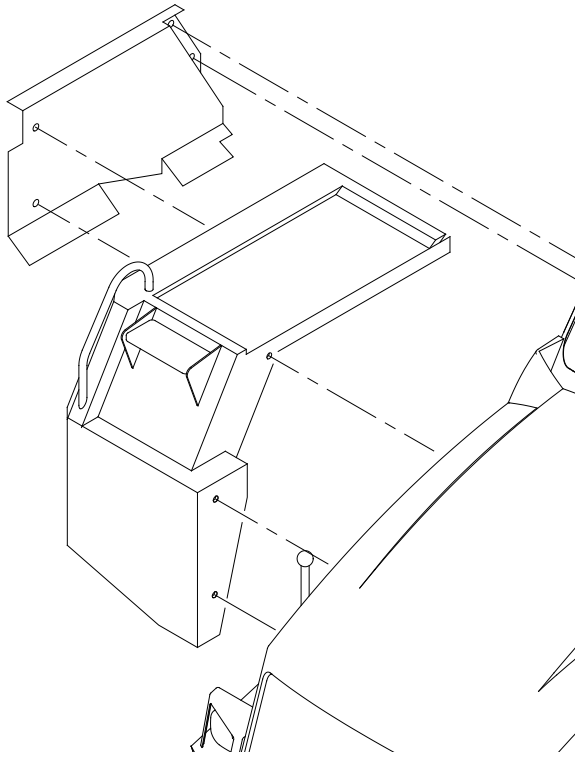


Fig 7.16 Mudguard RH

Installation
Position the mudguard on the front frame, and secure by tightening the three fastening bolts.
Replace the external parts. New parts when necessary, or re-use from the old mudguard where possible.
Replace the mirror bracket.
Replace any electrical cables and clamps removed, and connect.
Close the bonnet.
Replace the wheel. (Ref. 3.4.1)

Control
Check that all parts are located as before removal.
Turn the main battery switch on, and check the function of electrical components affected.

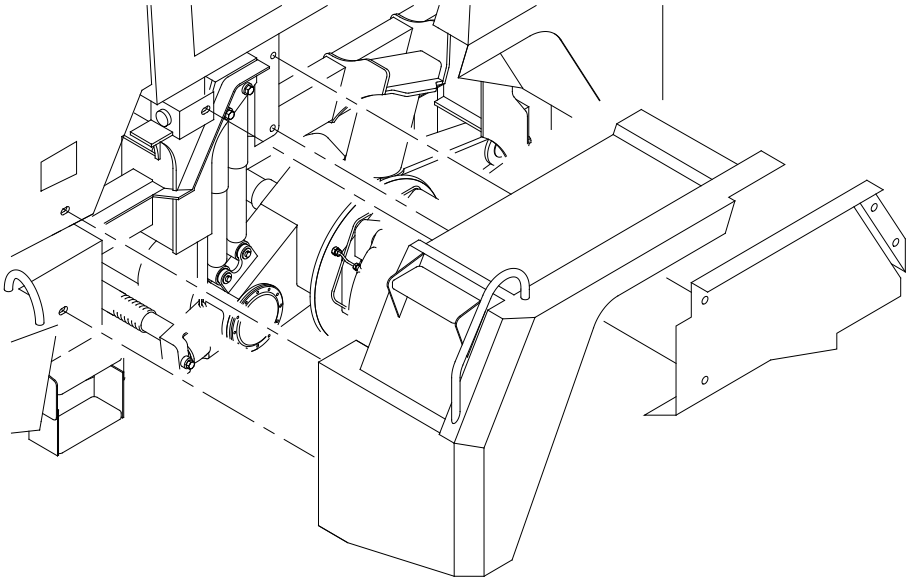


Fig 7.18 Mudguard LH

7.4.4 Bonnet Lock

The Bonnet Lock keeps the bonnet closed under all driving conditions, the bonnet is released with the handle on the left side. The bonnet can also be locked with the key to keep unauthorized personnel from opening.

For maintenance on the bonnet lock and release mechanism, the bonnet must be opened.
If the bonnet can not be opened do to a malfunction in the mechanism, contact Moxy for information on how to proceed.

Removal
Thoroughly clean the bonnet and the area around for accumulated dirt.
Open the bonnet, and secure with the catcher.
(Ref. Operation and Maintenance Manual 2.19)
To remove the wire, release lower wire end by unscrewing two nuts. One fastening the wire to the release arm, and one securing the wire sleeve to the bracket.
Remove the clamp supporting the wire to the bonnet shell.
Then unscrew the wire from the upper bracket by loosening the adjusting nut, and unhook the wire end from the bonnet lock.
To remove the handle and release mechanism, remove the wire lower end as described, and unscrew the two nuts securing the handle and the mechanism to the bonnet shell.
Separate and remove.
To remove the bonnet lock, unhook the upper wire connection as described.
Unscrew the two bolts securing the bonnet lock to bracket, and remove.

Installation
Place the bonnet lock in position, and replace the two bolts securing the lock to the bracket.
Place the release mechanism and handle in position, and tighten the two nut securing the two parts together on the bonnet shell.
Replace the wire as described for removal, and adjust the wire to engage and disengage the lock properly.

Control
Re-check that the lock can be disengaged by the handle, and close the bonnet.
Close bonnet.

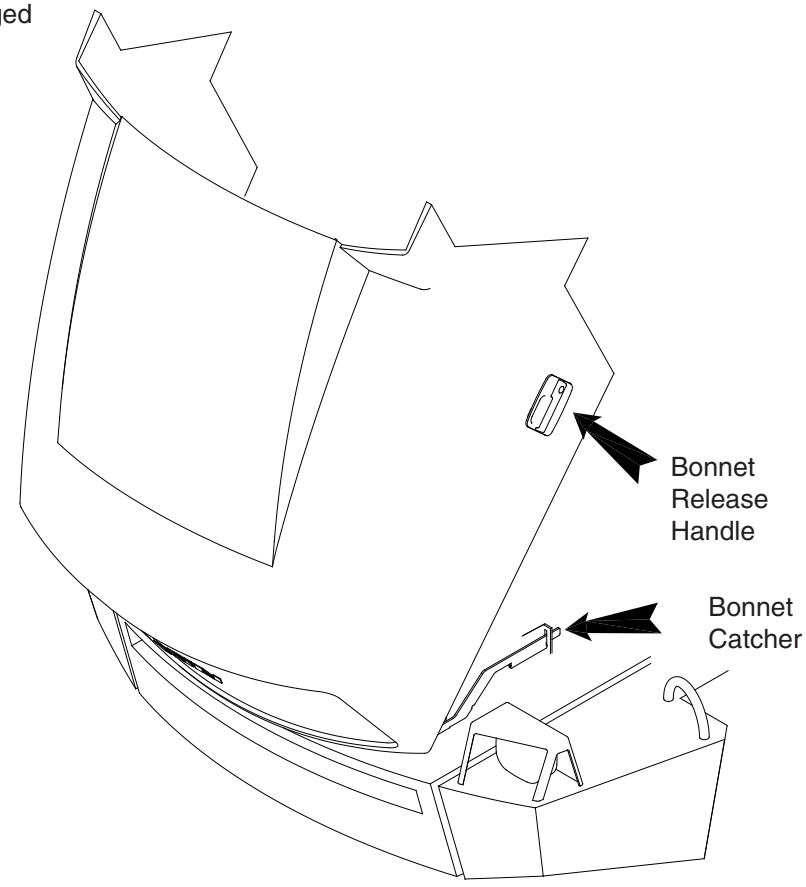


Fig 7.19 Bonnet

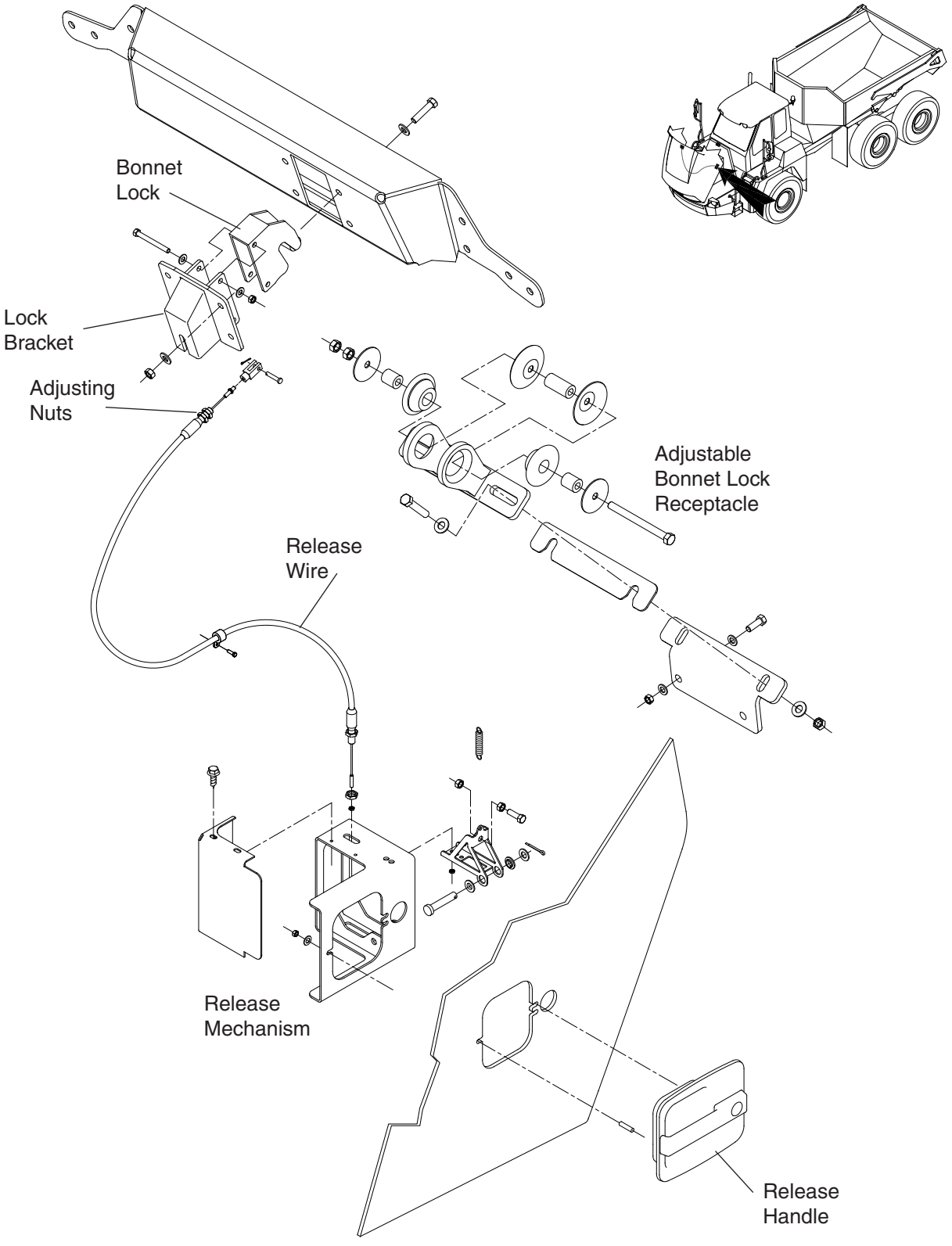


Fig 7.20 Bonnet Lock Assembly

7.4.5 Bonnet

Removal
Thoroughly clean the bonnet and the area around for accumulated dirt.
Open the bonnet, and secure with the catcher.
(Ref. Operation and Maintenance Manual 2.19)
Replace two nut with lifting eyes. (See Fig 7.21)
Attach lifting device in the two lifting eyes, and use a crane to lift to take up the weight of the bonnet.
Unhook the two springs.
Remove the grille by unscrewing the ten fastening screws.
Remove the four bolts securing the bonnet to the bonnet hinge.
Lift bonnet off the dumper and place on the ground in a safe place.

Replacement
Lift the bonnet and position on the bonnet hinge.
Replace the four bolts, and tighten.
Hook the two springs in position.
Remove the lifting device and the lifting eyes, and replace with nuts.

Control
Close the bonnet and check that the lock is functioning properly.
Adjust if necessary, by re-positioning/re-shimming the bonnet lock receptacle. (Ref. fig 7.19)

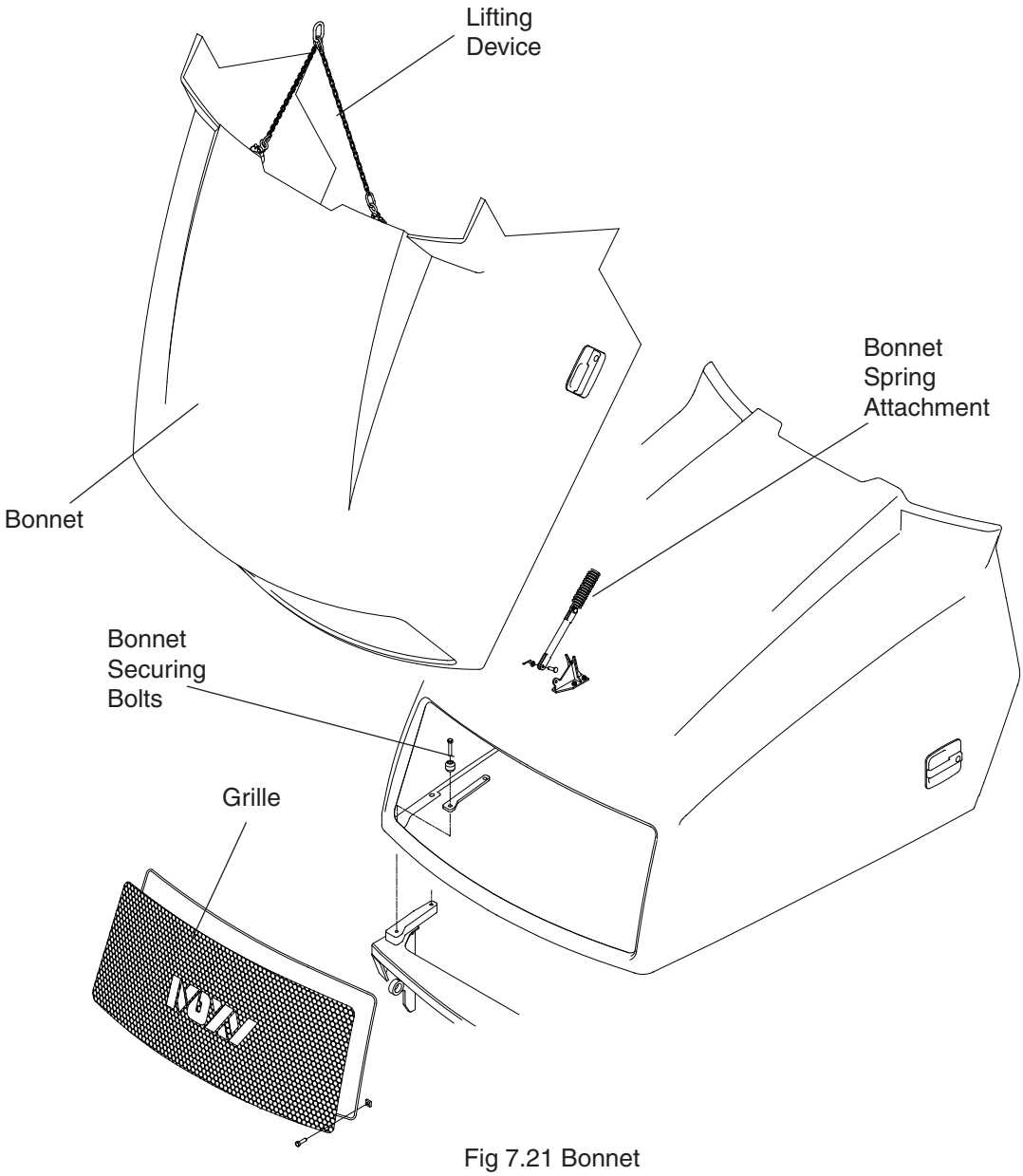


Fig 7.21 Bonnet

7.5 Cab

The cab is tilted to gain access for maintenance, but if the cab has to be removed from the dumper for some reason, proceed as follows.

7.5.1 Cab Removal

Thoroughly clean the cab and the area around for accumulated dirt.
Check that the battery main switch is turned off.
Disconnect all connections from the left hand side of the electrical central. Disconnect the ground connections to the cab and check that cables are free to be pulled out from cab.
Drain the engine coolant. (Ref. 1.3.2)
Tilt the cab fully. (Ref. Operation & Maintenance Manual 2.20)
Remove the cover plates under the cab for access to cables and hoses.
Mark each removed part for proper location.
Disconnect the electrical cables from the electrical central left hand side. (Ref.6.6)
Disconnect and remove the cables to the reduction valves, and to the pressure switches.
Disconnect the air supply line from the air supply valve.
Disconnect the air line to the hand brake unit at the rear end of the cab.
Disconnect and plug the two brake lines hoses at the rear of the cab.
Disconnect and plug the five hydraulical hoses at the steering servo valve, Orbitrol. (Ref.5.7)
Disconnect and plug the two lines marked SA and SB from the tilting servo valve at the steering valve. (Ref.5.8)
Disconnect and plug the two lines from the tilting servo valve at the pressure reduction valve. (Ref.5.13)
Disconnect and plug the hydraulic and coolant lines connected to the thermoswitch block under the cab.
Disconnect and plug the two Air Conditioning hoses, one at the AC compressor, and one at the AC filter located on the cooler package.

WARNING!
If AC system is leaking, or if any part of the Air Conditioning circuit has to be disconnected or replaced, contact authorized specialists.

Unhook the two springs holding the hose support over the articulation bearing.
Lower the cab slightly and place on safety stand.
(Ref. Operation & Maintenance Manual 2.20)
Disconnect cab hydraulic tilting cylinder, if fitted, by removing the bolt and nut.
Attach a crane to the lifting eyes on top of the cab.
Lift and remove the safety stand, then lower slowly to normal position.
Maintain enough lifting force to release the weight on the rear cab hinge bolts.

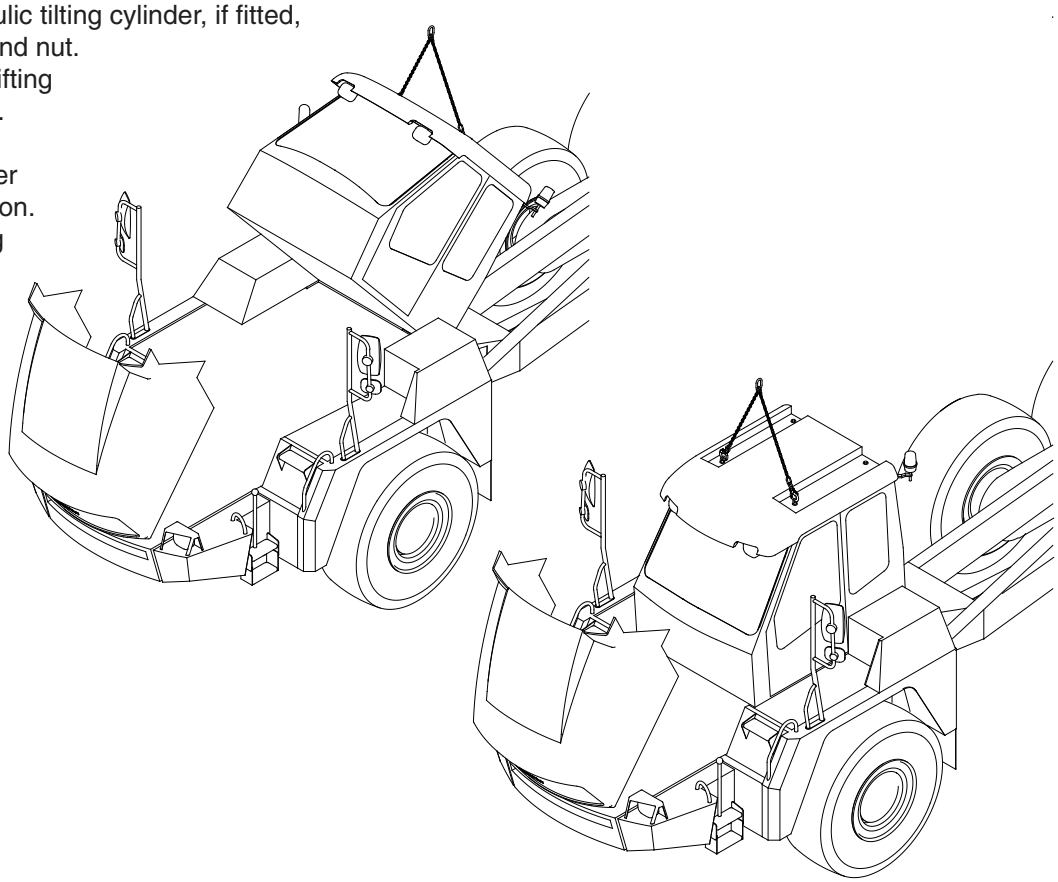


Fig 7.22 Cab

Remove the locking rings and drive the hinge bolts inwards to free the cab from the front frame. Retrieve the bolts.
Lift the cab off the dumper, and place on woodblocks, resting on the mounting brackets.

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

Check the cab bolt rubber bushings for wear, and replace if necessary.
If the cab is going to be replaced with another unit, parts have to be moved over until the new cab has the same configuration as the one removed.
The amount is determined by the configuration of the new cab supplied.

Installation
Lift the cab onto the dumper, using the crane, and position the cab to enter the two rear mounting/hinge bolts.
Drive the bolts in position from inside.
Replace the locking rings.
Tilt the cab, by means of the crane, high enough to place on safety stand.
Replace the hydraulic tilting cylinder in the cab bracket, if fitted, by installing the bolt and nut.
Tilt the cab fully.
Hook the two springs, holding the hose support, back into position.
Replace hoses and cables in opposite order of what described for removal.
Replace the cover plates under the cab.
Lower the cab to normal position, and install the front cab bolts.
Replace the electrical connections on the left hand side of the electrical central.
Replace ground connections.
Refill AC system.(Authorized personnel only)
Refill engine coolant. (Ref 1.3.2)

Control
Check that all parts are located as before removal.
Turn the main battery switch on, and check the function of electrical components affected.
Start the engine and check that the hydraulic system is functioning properly.
(Ref. 5.15)
Bleed the brake circuits.
(Ref.3.6.1.6)
Perform a test drive.

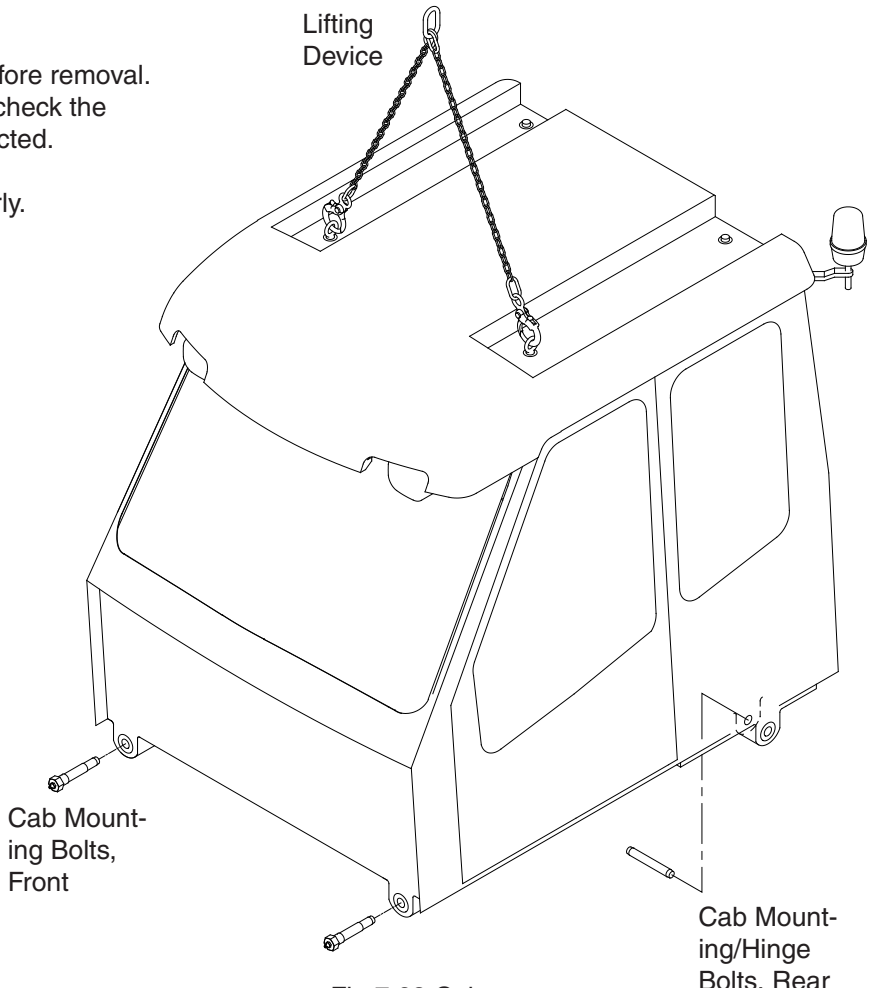


Fig 7.23 Cab

7.5.2 Cab Ventilation Control Panel

The Cab Ventilation Control Panel is located in the driver's side console, in a far right position.

Removal
Make sure the battery main switch is turned off.
The control panel is fastened in similar manner as a car radio, and can be removed inserting special tools to release the locks. Lift the panel from console to access the different connectors and control wires.
Mark each cable connection for correct location and disconnect.
Mark and disconnect the two control wires.

Installation
Connect the control wires, and adjust to obtain full travel of control arms according to marking on control handles.
Connect electrical cables as removed.
Position the control panel in the console and push down until the two tabs snaps into locked position.

Control
Check that all parts are located as before removal.
Start the engine and check that the ventilation system is functioning properly according to the Operation & Maintenance Manual.

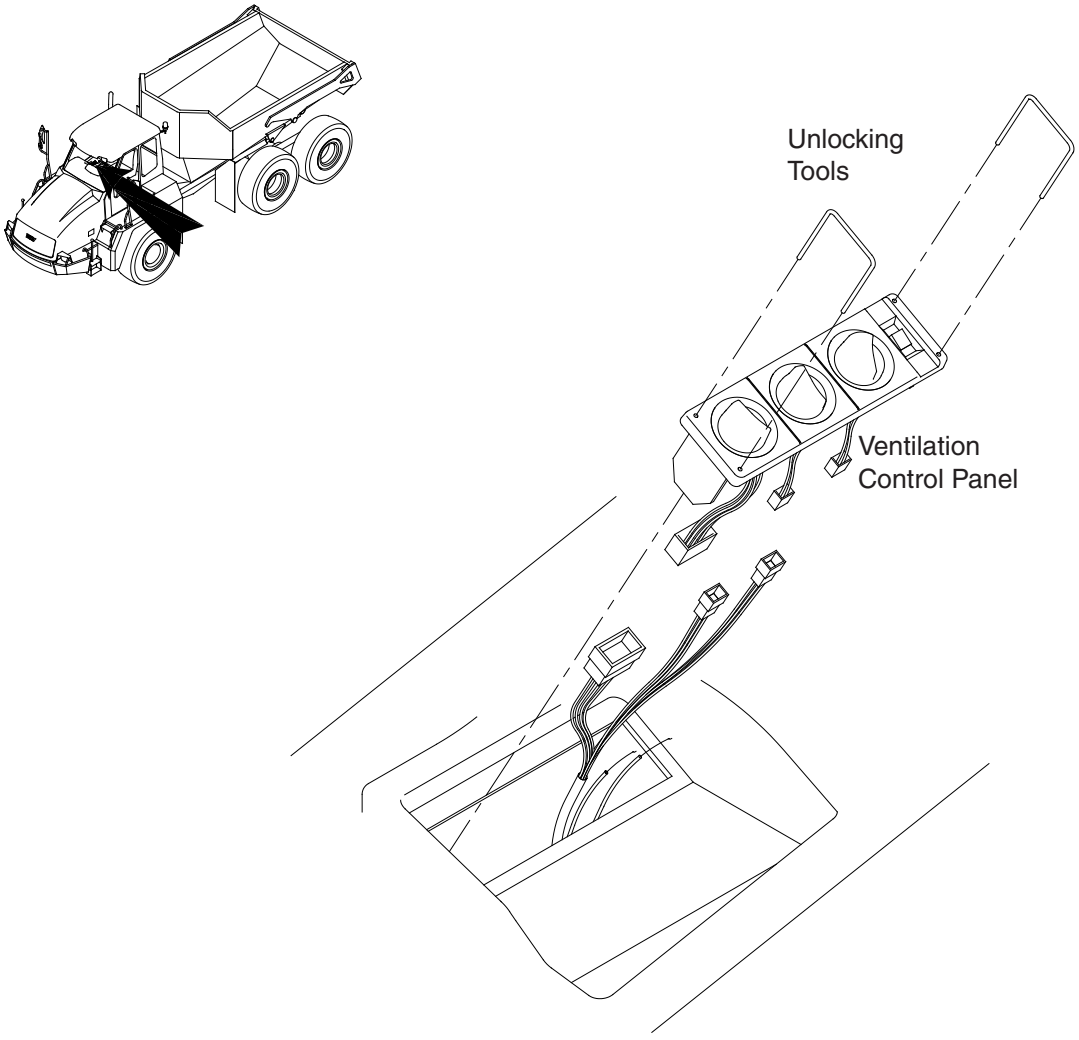


Fig 7.24 Ventilation Control Panel

7.5.3 Cab Ventilation Unit

The Ventilation Unit provides temperature regulated air to all outlets in the cab ventilation system.
Heat is provided from the engine cooling system, circulating through the heater unit, and cooling is provided from the air conditioning evaporizer.
The ventilation unit is located in the rear right corner of the cab, inside the drivers side console.

Removal
Make sure the battery main switch is turned off. Drain the engine cooling system (Ref. 1.3.2)
Run down and drain the AC-system.

WARNING!
If any part of the Air Conditioning circuit has to be disconnected, contact authorized specialists.

Disconnect the coolant hose connected directly to the ventilation unit from the underside of the cab. The hose can be identified by the wire protection.
Remove floor mat retaining strip just below the door opening, by unscrewing the four screws, and remove floor mat.
Remove the driver seat by removing the four bolts securing the seat to the seat console. Disconnect the electrical and air connections if equipped.
Remove seat console by unscrewing the side cover to access the four bolts securing the console to the cab floor.
Remove side panel cover by loosening the two fasteners.
Remove document holder by loosening the two screws.
Remove the rear wall kick panel, fastened by seven screws.
Remove the air nozzle from the right kick panel. Pull out the cover to access the four allen screws.
Remove right kick panel by unscrewing three screws.
Pull out the ventilation control panel, and disconnect the electrical cables. (Ref. 7.5.3)

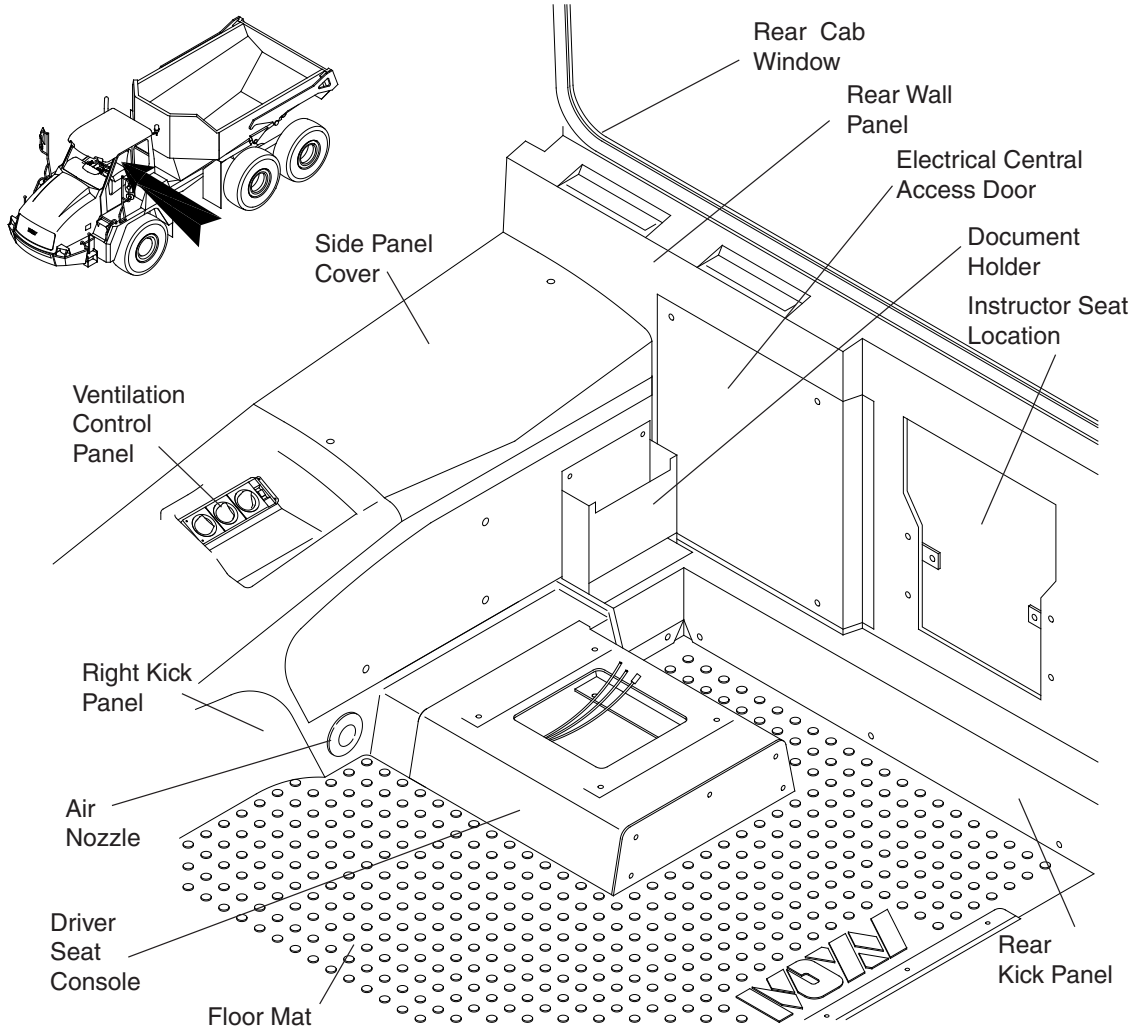


Fig 7.25 Cab Ventilation Unit Access

Remove the instructor back rest by unscrewing two bolts, and pushing approx. 5 cm down to free the attachment to the rear wall panel.
Remove instructor seat, by unscrewing four bolts.
Remove the access door for the electrical central by loosening the four fasteners.

Disconnect the cable to the warning light, and remove the clamps securing the cable to the rear window protection.
Unhook the springs supporting the rear wagon hose cluster and remove the rear window protection by unscrewing eight bolts.
From outside, pull out the expansion lining from the rear window channel, starting from the end at bottom center.
Remove rear window.
Remove rear wall panel by prying out to release the velcro fastening.
Remove the ventilation unit protection bar.
Disconnect and remove the radio/CD player converter by unscrewing the two screws.
Remove the control wires connected to the ventilation unit.
Remove the six air ducts connected to the ventilation unit. Mark to ensure correct future relocation.
Disconnect the coolant hose from the heater control valve.
Disconnect the AC hoses from the ventilation unit by removing retaining plate.
Loosen the clamps securing the cable bundle to the floor, and remove the four bolts securing the electric central to the rear wall, to shift the central to left to gain space for removal of ventilation unit.
Loosen the four screws securing the ventilation unit to the cab, and remove unit from cab.

Installation
Position the ventilation unit and tighten the four screws fastening the unit to the cab.
Replace the other parts in opposite order of described for removal.
Adjust control wires to obtain full travel of control arms according to marking on control handles.
Refill AC system.(Authorized personnel only)
Refill engine coolant. (Ref 1.3.2)

Control
Check that all parts are located as before removal.
Check that the ventilation system is functioning according to the Operation & Maintenance Manual.

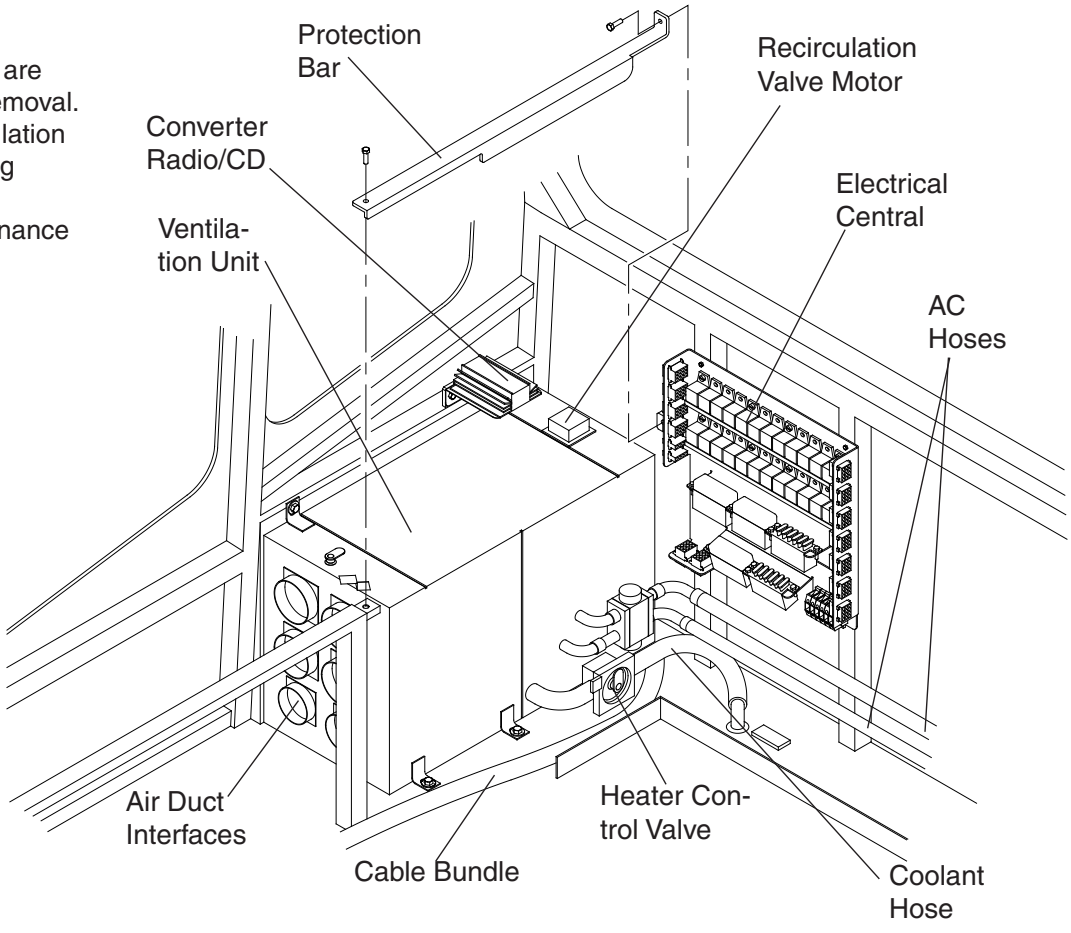


Fig 7.26 Cab Ventilation Unit Removal

7.5.4 Cab Door

The Cab Door is the only access to the cab, and should close properly to ensure driver safety and comfort.
If door for some reason has to be removed, proceed as follows.
Open door fully and pry rear bottom corner of door panel out to disengage some of the velcro securing panel, to get access to the four bolts fastening the door check arm to the door. Remove the four bolts.
Have someone to support the door, and remove the four bolts fastening the two hinges to the door.
Remove the door.
If the door is going to be replaced with a new unit, the configuration of the new unit will indicate which parts that should be moved over from the old door.

Installation
If the same door as removed are going to be refitted, the procedure will be the same as for removal, in opposite order.
If a new door is going to be fitted, only the rubber strip should be attached before door is replaced in cab.
Door replacement is easier if side panel, door glass, and door locking mechanism are replaced after the door is in place, and adjusted.
Lubricate and adjust locking mechanism for firm closing and easy opening. Lubricate the hinges.
Adjust the mudguard mounted door bumper if necessary.

Control
Check the fit of the door, for proper sealing, and for operation of the locking mechanism, opening, closing and locking.

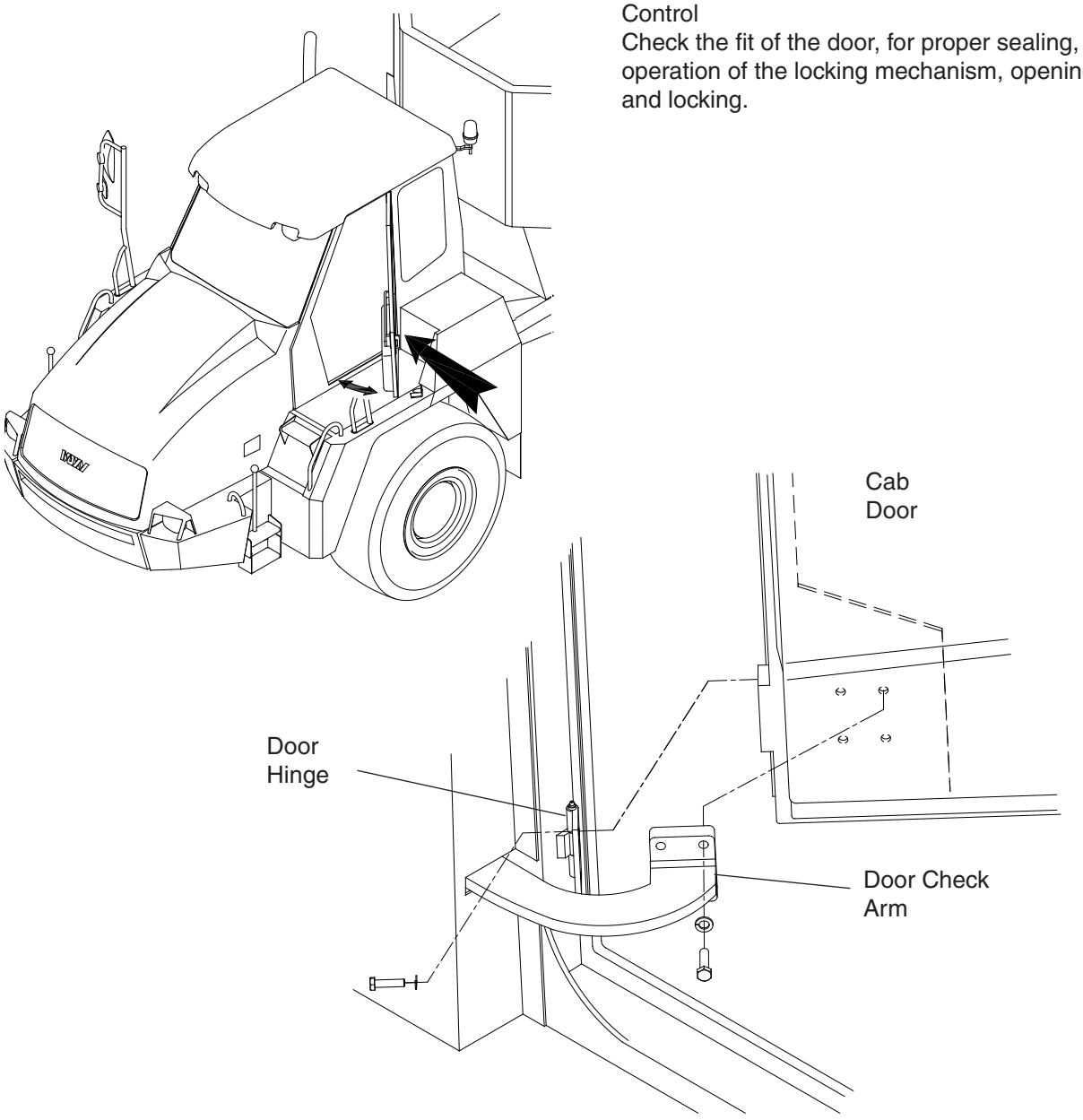


Fig 7.27 Cab Door
Detail seen from inside

7.5.5 Door Damper Cylinder

The Door Damper Cylinder keeps the door in open position when opened, and dampens the door movement.

Removal
Remove floor mat and rear kick panel. (Ref. 7.5.3)
From outside, pull out the expansion lining from the sliding window channel, starting from the end at bottom center.
Remove sliding window.
Pull out the left wall panel by prying loose the velcro fasteners.
Strap the door in open position.
Remove the door damper cylinder, by loosening the two nuts.
Installation
Adjust the length of the damper cylinder by pushing it together, and position in the mounting holes.
Tighten the two nuts.
Push the wall panel back in position to engage the velcro locks.
Replace sliding window.
Put back rear kick panel and floor mat. (Ref. 7.5.3)

Control
Check the operation of the door, and that no parts are binding.

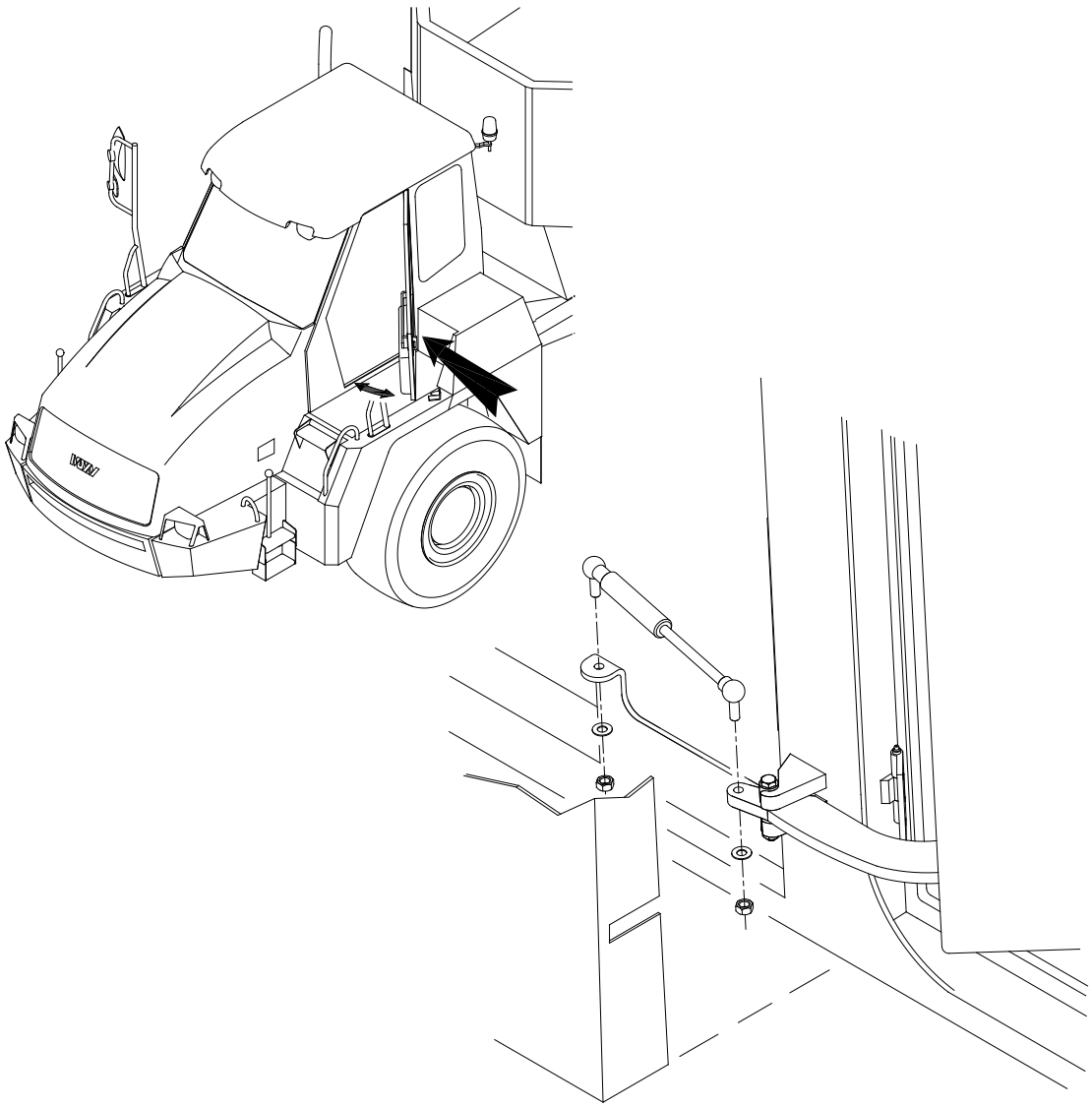


Fig 7.28 Door Damper Cylinder
Detail seen from inside

7.5.6 Steering Column

The adjustable steering column comprises the steering wheel and the control handle for lights, turn signals, horn and windscreen wiper/washer.

Removal
Check that the steering is in neutral position, and ensure that the articulation lock is engaged.
Make sure the battery main switch is turned off.
Disconnect the electrical connection for the steering column behind the instrument panel.
Remove the four bolts securing the steering column to the cab floor.
Remove the clamp securing the steering column to the instrument panel, and lift out of cab.
Installation
Position the steering column in the floor bracket engaging the splines into the orbitrol steering servo valve and enter the mounting bolts.
Make sure the steering wheel has the orientation wanted for neutral position.
Replace the clamp securing the column to the instrument panel, and tighten the nuts loosely.
Tighten the four bolt in the floor bracket.
Tighten the two nuts on the clamp.
Replace the electrical connections.

Control
Check that all parts are located as before removal, and that all functions controlled by steering column controls are functioning according to the Operation & Maintenance Manual.

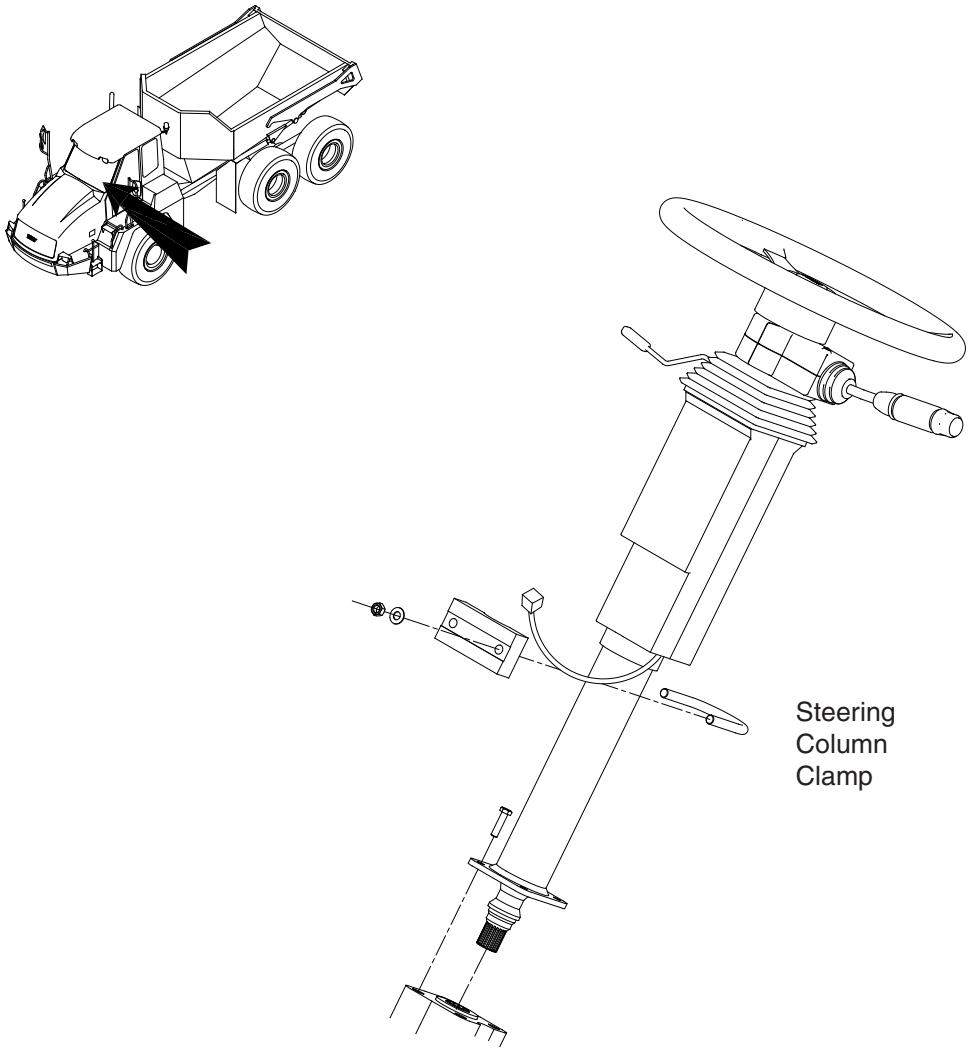


Fig 7.29 Steering Column

Chapter 8 Rear Wagon

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8.1 Introduction

The Rear Wagon main part is the rear frame which is the base for the dumper body, and the support for the rear axles.
The rear wagon is connected to the front wagon in the articulation bearing.
The tiltable dumper body is attached to the rear frame in the tilt bearing.
For work on the rear wagon drive line,
ref. chapter 3

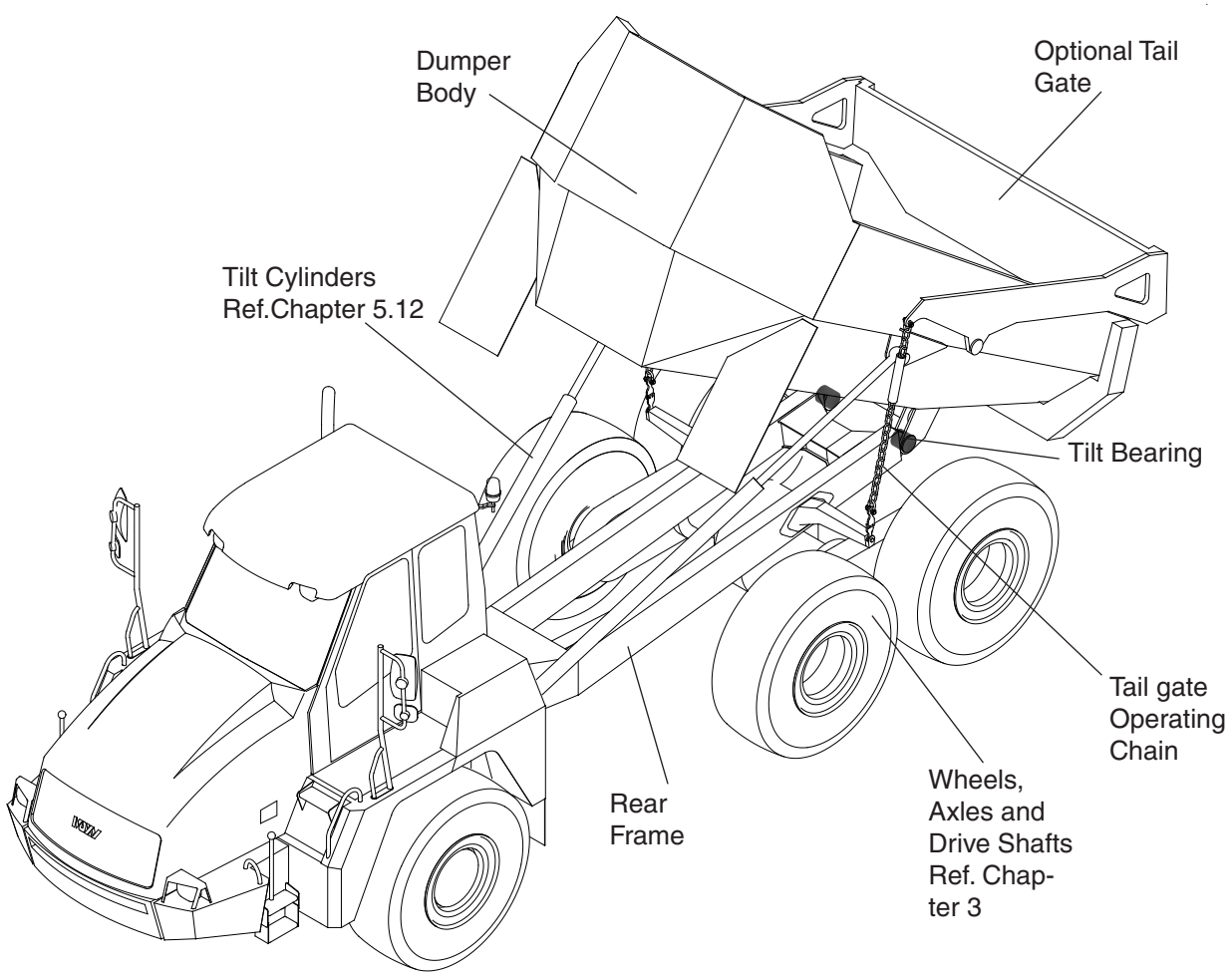


Fig 8.1 Rear Wagon Overview

8.2 Dumper Body

8.2.1 Dumper Body

Thoroughly clean the dumper body and tilt bearings for accumulated dirt.
To remove Dumber Body, remove the hydraulic tilt cylinders (Ref.5.12)
Hook the crane to the dumper body front lifting point, and lift the body to release the safety stand, and lower the body until resting on the rear frame.
Disconnect the tail gate operating chains, if equipped, by opening one shackle on each side.
Remove tilt bearing lubrication line if fitted.
Attach the lifting device in all three dumper body lifting points, and lift to release the weight on the tilt bearings.
Remove tilt bearing bolts. (Ref. 8.2.2)
Lift body aside and place on level ground, resting on wooden blocks, tilt bearing ears shall not touch the ground.

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

Installation
Lift body over the rear frame, and position to align tilt bearings.
Attach tilt bearings. (Ref 8.2.2)
Connect tail gate operating chains, if equipped.
Hook the crane to the dumper body front lifting point, and lift the body to engage the safety stand.
Attach the hydraulic tilting cylinders. (Ref.5.12)

Control
Check that all parts are located as before removal, and that all hoses are correctly routed.
Check hydraulic functions. (Ref.5.12)
Check the tilt bearings (Ref 8.2.2)

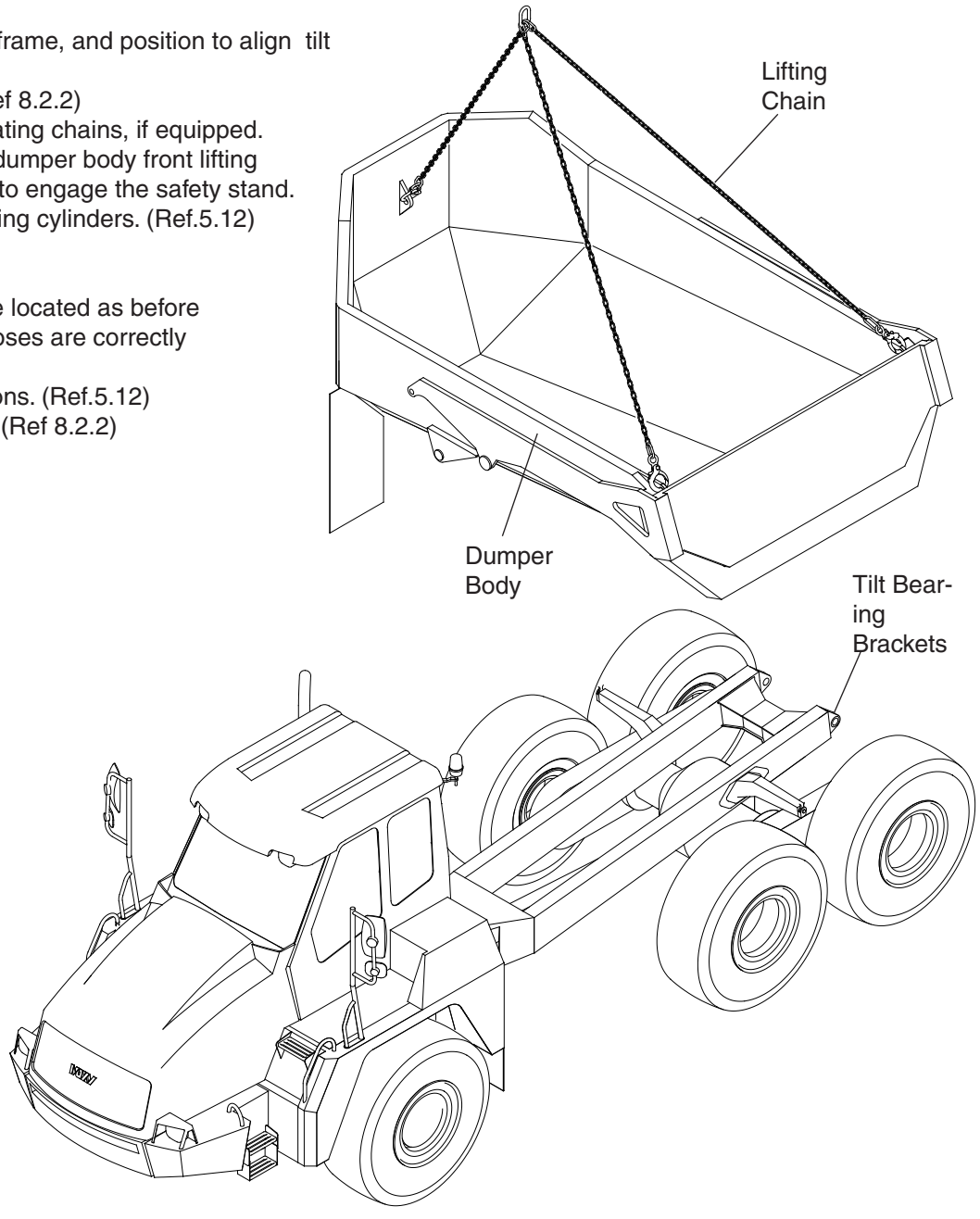


Fig 8.2 Dumper Body Removal

8.2.2 Tilt Bearing

If tilt bearings only are going to be replaced it is not necessary to disconnect the tilt cylinders, tail gate operating chains, and remove the body.
Remove the six bolts securing each tilt bearing bolt to the dumper body..
Disconnect lubrication lines if equipped.
Lift by the two rear lifting points to release the weight of the dumper body, and drive the bolts out, using a soft dowel. Retrieve the thrust washers.
Lift clear, and place wooden blocks between body and rear frame.

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

Installation
Check the condition of bolts, bushings, thrust washers and seals, renew if necessary.
Place, seal ring and thrust washer on bearing bolts, and position dust seals in rear frame.
Position dumper body to align the tilt bearings, and drive the bolts in, taking care to line up the holes for the securing screws.
Tighten securing screws and replace lubrication lines if equipped.
Lubricate the bearings by grease gun or lubrication system.

Control
Check that all parts are located as before removal, and that hoses are correctly routed.
Tilt dumper body, and check the operation of the tilt bearings.

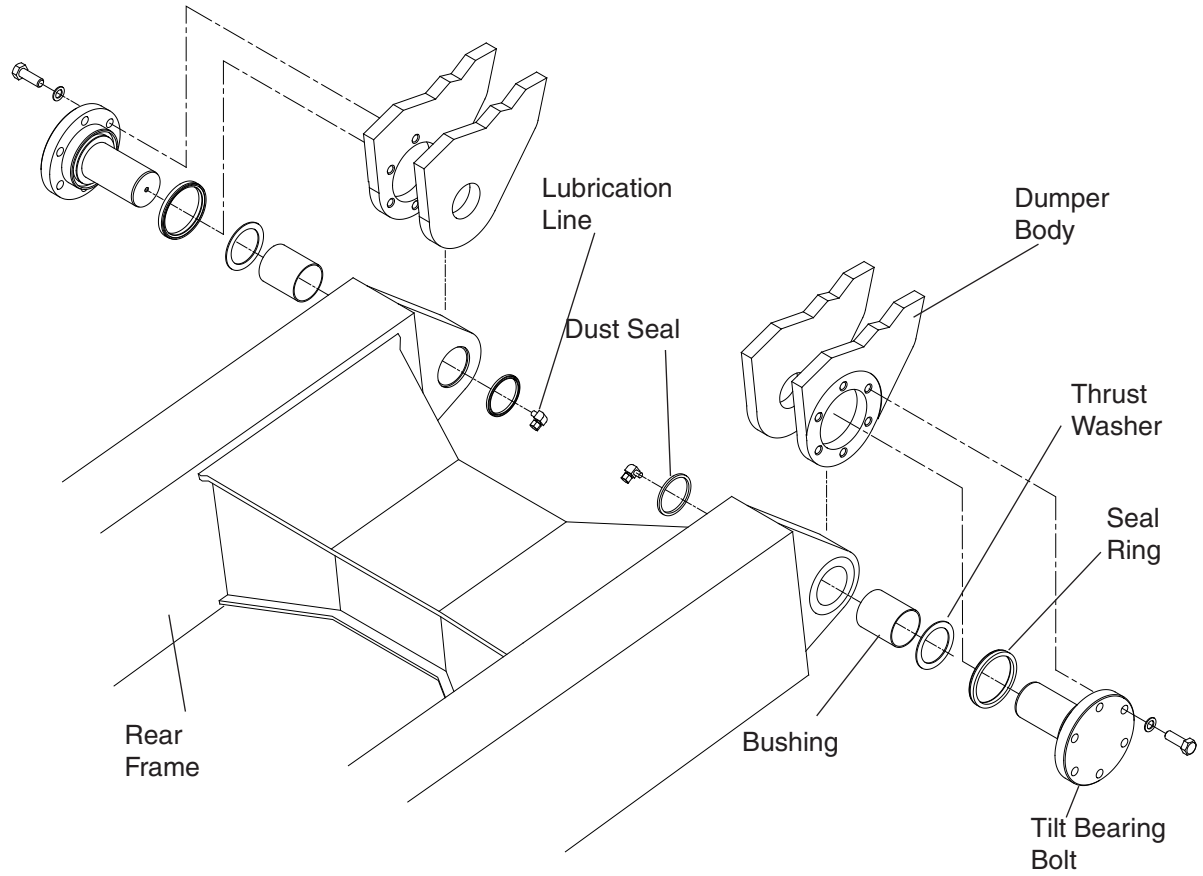


Fig 8.3 Tilt Bearing

Chapter 9 Optional Equipment

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9 Optional Equipment

The MOXY trucks are usually equipped with a number of options.
For maintenance purposes the more complex of these options will be described in this chapter.

9.1 Automatic Tail Gate

The optional automatic tail gate is closed when dumper body is down in transport position, and opens as the body is tilted.
The tail gate consists of the gate itself, and two arms pivoting in the tail gate bearings.

Removal
Thoroughly clean the tail gate and area around for any accumulated dirt
Dumper body must be in the down position for removal of the tail gate.
Secure the tail gate to the dumper body by using heavy clamps.

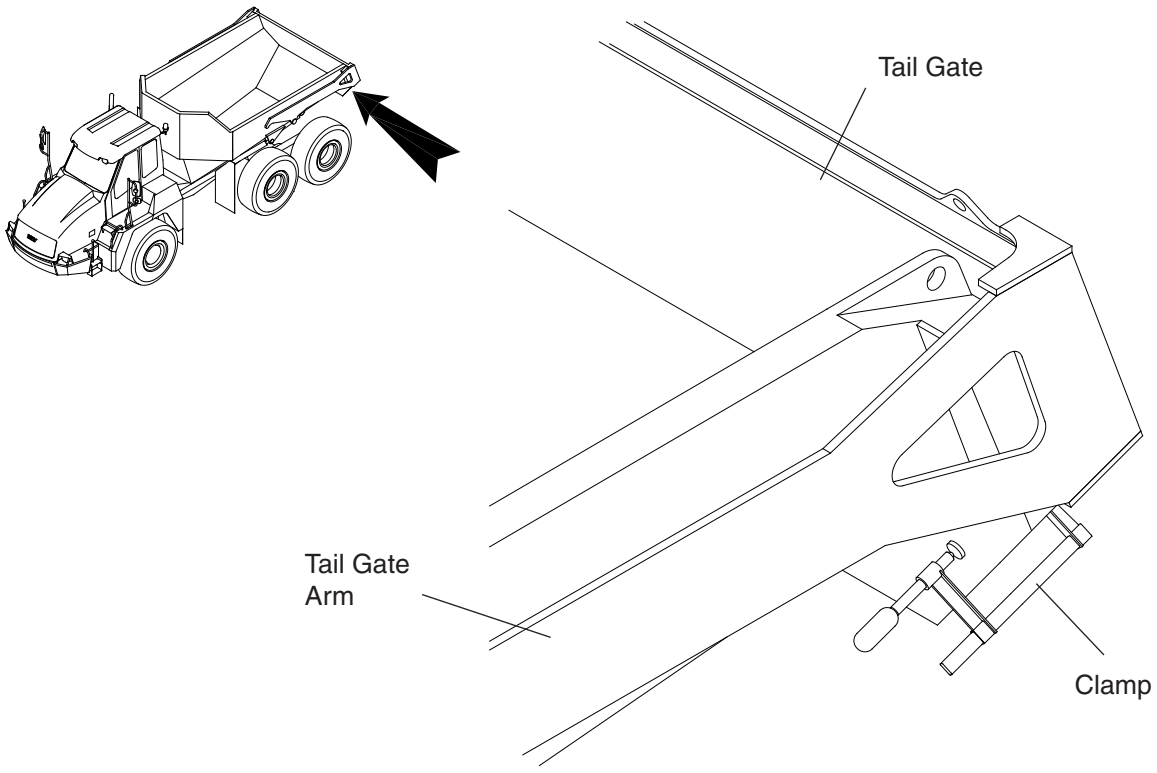


Fig 9.1 Securing Tail Gate

Unhook the chain links in front of each arm by opening the top shackle.
To remove tailgate, both arms have to be removed first.
Attach a crane to the actual arm, and loosen the six bolts attaching the arm to the tail gate.

Remove the lubrication line if equipped.
Remove the four bolts securing the arm bearing to the bracket on the dumper body, and lower arm to the ground. Place arm on wood blocks.

WARNING!
Be aware of the risk of injury to people and equipment when handling heavy objects!

When both arms are removed, attach the crane to the tail gate lifting eyes, loosen clamps, and lift off the tail gate.
To take apart the tail gate bearings, remove the six screws securing the cover. Remove the four screws securing the bearing retainer plate, and tap out the hinge pivot.
Remove the circlip and tap out the bearing.
Thoroughly clean the internal parts.

Assembly
Check the condition of each arm bearing housing and bearing. Lubricate and insert the bearing. Secure with circlip.
Insert the hinge pivot and secure with the bearing retainer plate by tightening the four screws.
Pack bearing housing with grease, and close with the bearing cover, secured by six screws.

Check the condition of the tail gate rubber cushions, replace if worn.

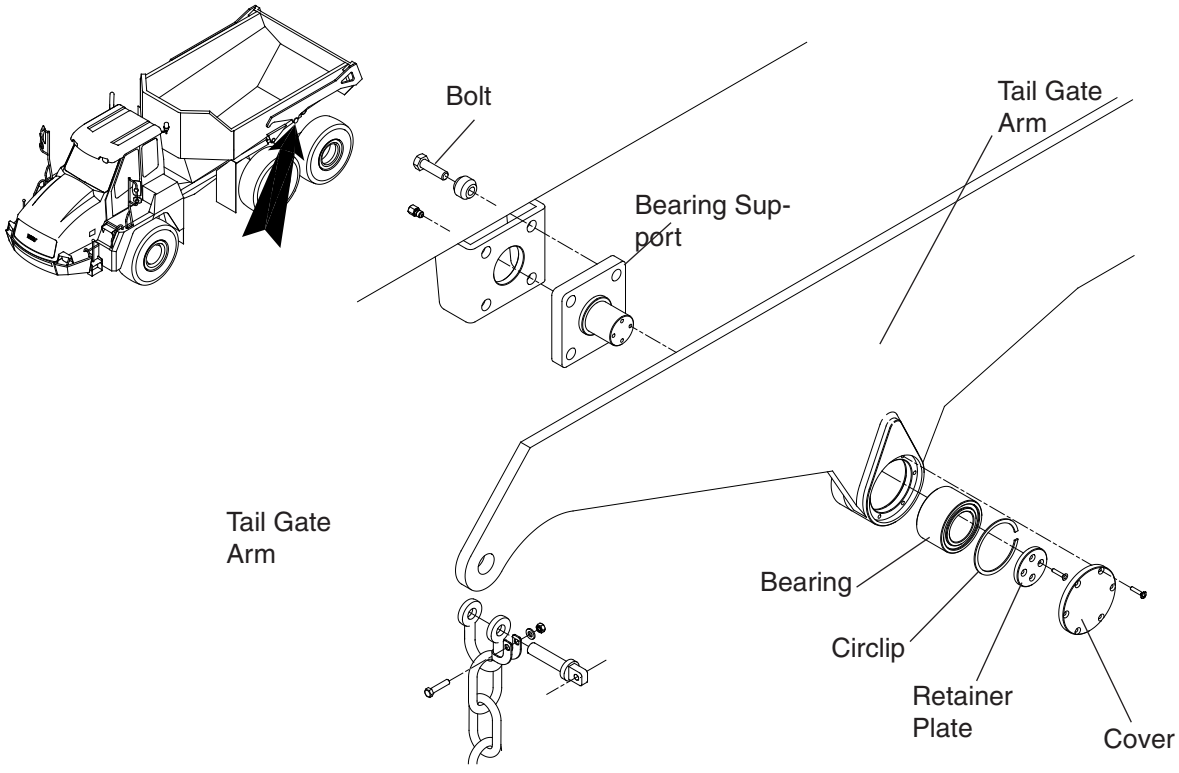


Fig 9.2 Tail Gate Bearing

Lift the tail gate and place on dumper body. Secure tail gate temporary with large clamps.
Lift each arm in position and secure arm bearing. to the bracket by tightening four bolts.
Attach the lubrication line if equipped.
Enter the bolts securing the arms to the tail gate, and use the number of shims required to obtain a satisfactory closing of the tail gate. Tighten the twelve bolts.

Check the chain links, replace if worn. Attach the chains to the tail gate arms.

Control
Start the dumper and tilt the body to check the operation of the tail gate. Re-adjust if necessary.

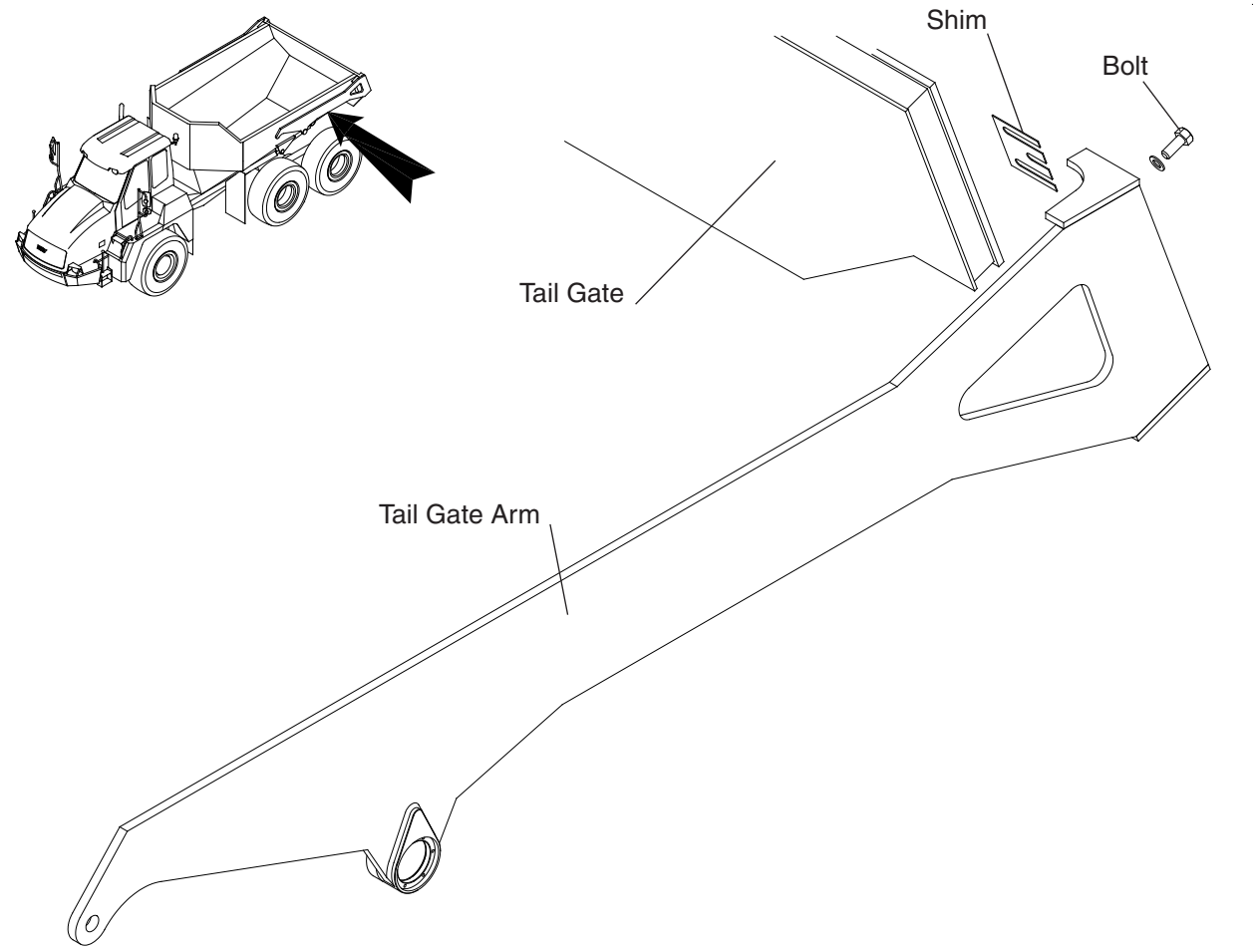


Fig 9.3 Tail Gate Arm Removal

9.2 Automatic Central Lubrication

The Central Lubrication System takes care of some of the daily maintenance, and greases a number of locations automatically as the dumper is running.

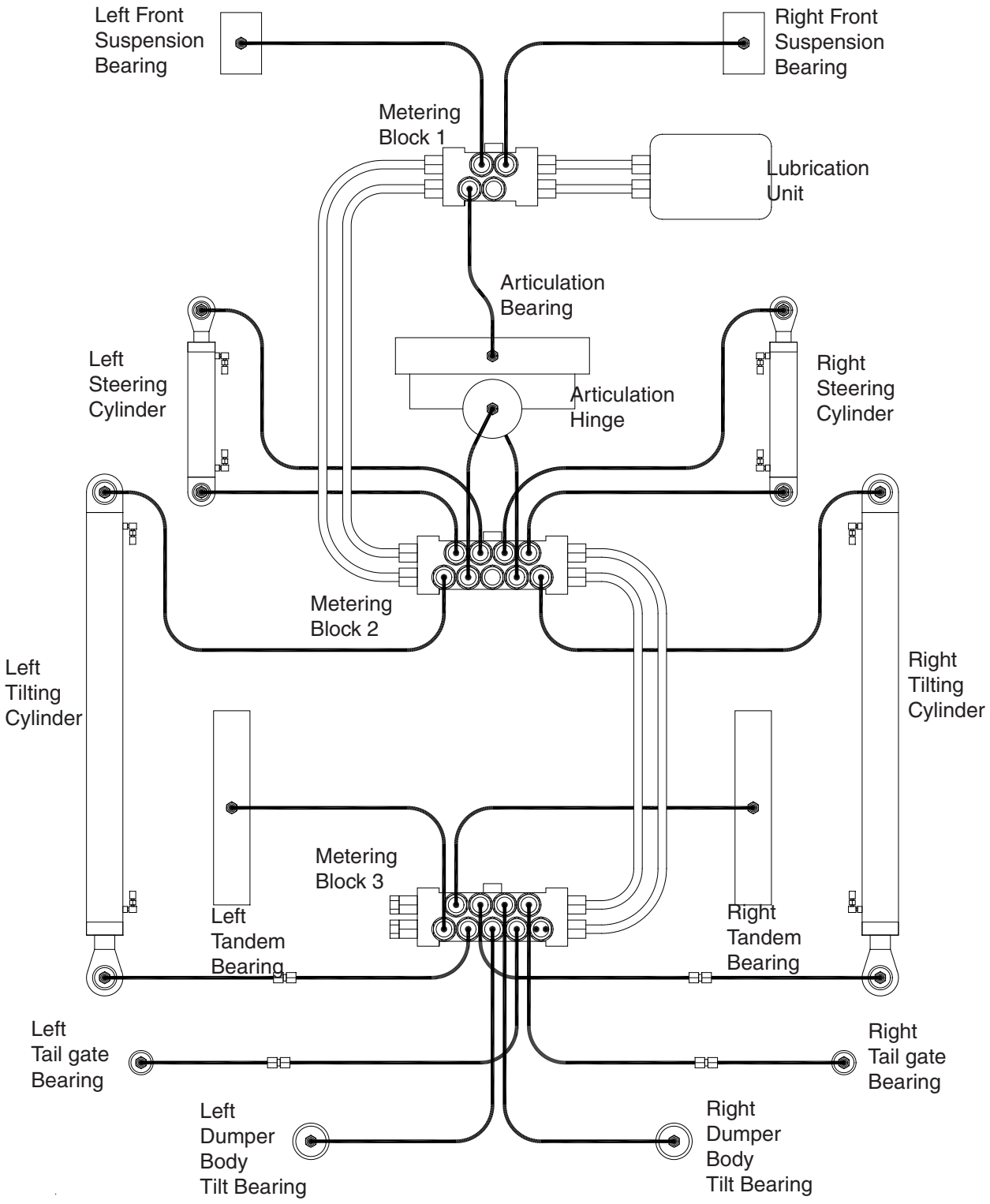


Fig 9.4 Central Lubrication System

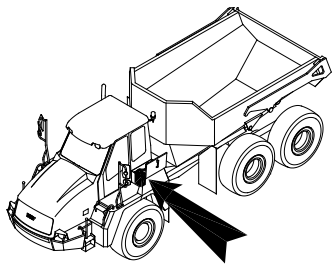
9.2.1 Lubrication Unit

The lubrication unit is located in the compartment on the left hand mud guard, just behind the cab door.
The unit is programmed to pump grease into the lubrication circuit at predetermined intervals, and in predetermined quantities.
The unit have a minimum level switch that monitors the reservoir grease level, and initiates a signal to the driver when level reaches a minimum.
The unit also have a relief valve that ensures that the system pressure never exceeds 250 bar.

Removal
Thoroughly clean the lubrication unit and the area around for accumulated dirt.
Make sure the battery main switch is turned off.
Remove the electrical connection by unscrewing the cable connector.
Disconnect the two grease lines.
Unscrew the four bolts securing the lubrication unit, and remove from dumper.

Installation
Position the lubrication unit and tighten the four securing bolts securing the unit. Fill the container with grease up to the indicated maximum level. (Ref. Operation and Maintenance Manual 7.8.1)
Connect the electrical cable.
Place a container to catch any spilt grease under the grease line connectors. Switch the battery main switch on, turn the starter key into position I, and push the test button located on the front of lubrication unit 3 to 5 seconds to perform a lubrication cycle in one of the lines. Repeat to lubricate the other line.
Turn starter key in off position.
Connect the two grease lines.

Control
Check that all parts are located as before removal.
Turn starter key in position I, and observe that the signal lamp flashes four times to indicate that the lubrication system is activated.
Press the test button and make another lubrication cycle to observe that the signal lamp flashes during the hole cycle indicating that the system is working.



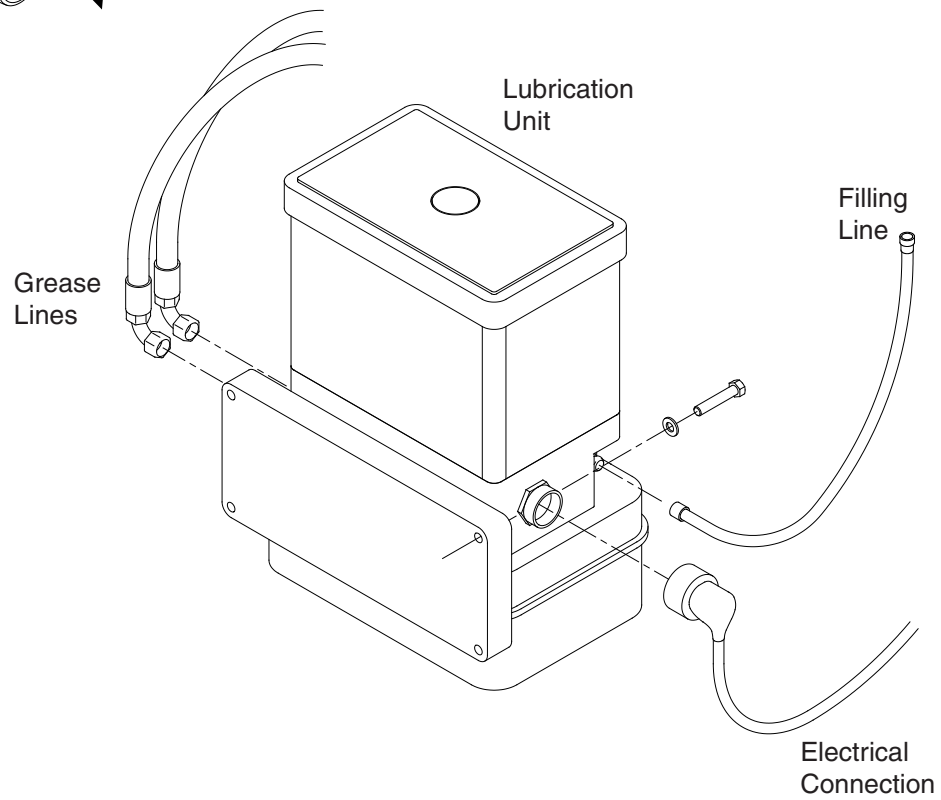


Fig 9.5 Lubrication Unit

9.2.2 Lubrication Lines

The lubrication lines distribute the media from the lubrication unit to the doser blocks and from the dosers to each lubrication point.

Removal
Thoroughly clean the actual line and the area around for any accumulated dirt.
Disconnect the electrical connection to the lubrication unit to make sure no one activates the system.
Remove all clamps and strips from actual line, and disconnect from system.

Installation
Connect the line to the connection nearest the lubrication unit, reconnect the electrical connector to the lubrication unit, and perform test cycles until grease is flowing from the free end of the line.
Connect free end, and secure line with clamps and strips as removed.

Control
Check that all parts are located as when removed.
Perform two single test cycles to check the function of the system, and to look for any leakage.

9.2.3 Metering Block

Metering Blocks consists of a body in which several metering units are connected. Each unit is connected to a lubrication point, and delivers exact the amount of grease needed for that point during each cycle.

Removal
Thoroughly clean the metering block and the area around for any accumulated dirt.
Disconnect the electrical connection to the lubrication unit to make sure no one activates the system.
Disconnect the lubrication line connected to the actual metering unit.
Unscrew the unit from the block.

Installation
If the doser is going to be replaced with a new unit, make sure the new doser is of the same type as the one removed.
Check that the number punched in is the same as the number on the one removed. The number is referring to the amount of grease delivered pr. cycle.
Check the condition of the O-rings, Re-new if necessary.
Screw the doser firmly into the metering block.
Reconnect the electrical connector to the lubrication unit, and perform test cycles until grease is flowing from the metering unit.
Connect the lubrication line.

Control
Check that all parts are located as when removed.
Perform two single test cycles to check the function of the system, and to look for any leakage.

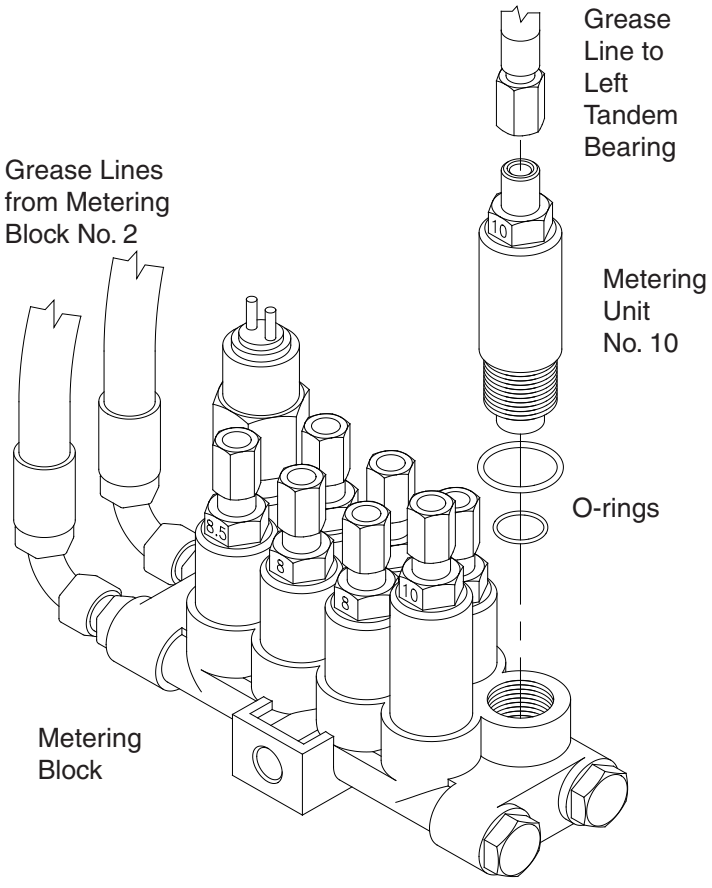


Fig 9.6 Metering Block (No. 3 shown)

9.3 Cab Hydraulic Tilting Unit

The hydraulic tilting unit makes tilting of cab safe and easy, by means of a manual hydraulic pump and cylinder.

Removal
Thoroughly clean the cab tilting unit and the area around for accumulated dirt.
Tilt the cab and place on safety stand. (Ref. Operation & Maintenance Manual 2.20)

Cylinder
Remove the nuts from the bolts securing the hydraulic cylinder. Use the manual pump to adjust the cylinder to a position where the bolts easily can be removed.
Unscrew the nuts securing the bolts.
Place a container below to catch any hydraulic oil spilt during removal.
Disconnect the two hydraulic hoses. Remove the bolts, and remove the cylinder.

Pump
Place a container below to catch any hydraulic oil spilt during removal. Disconnect the two hydraulic hoses.
Unscrew the two bolts securing the pump to the bracket and remove pump.
To remove the hydraulic hoses remove securing strips and clamps, and pull out.

Installation
Position the pump in the mounting bracket, and secure with two bolts.
Route and strap the hoses as when removed, and connect them to the pump.
Secure front end of cylinder to the front frame, and connect the hoses.
Fill pump with oil. (Ref. Operation & Maintenance Manual 6), and bleed the system.
Check that the movement of the cylinder is according to marking (Up/Down)
Adjust cylinder length to align with the cab bracket, install bolt and nut and tighten.

Control
Check that all parts are located as before removal.
Rise the cab to remove safety stand, and lower to normal position.
(Ref. Operation & Maintenance Manual 2.20)

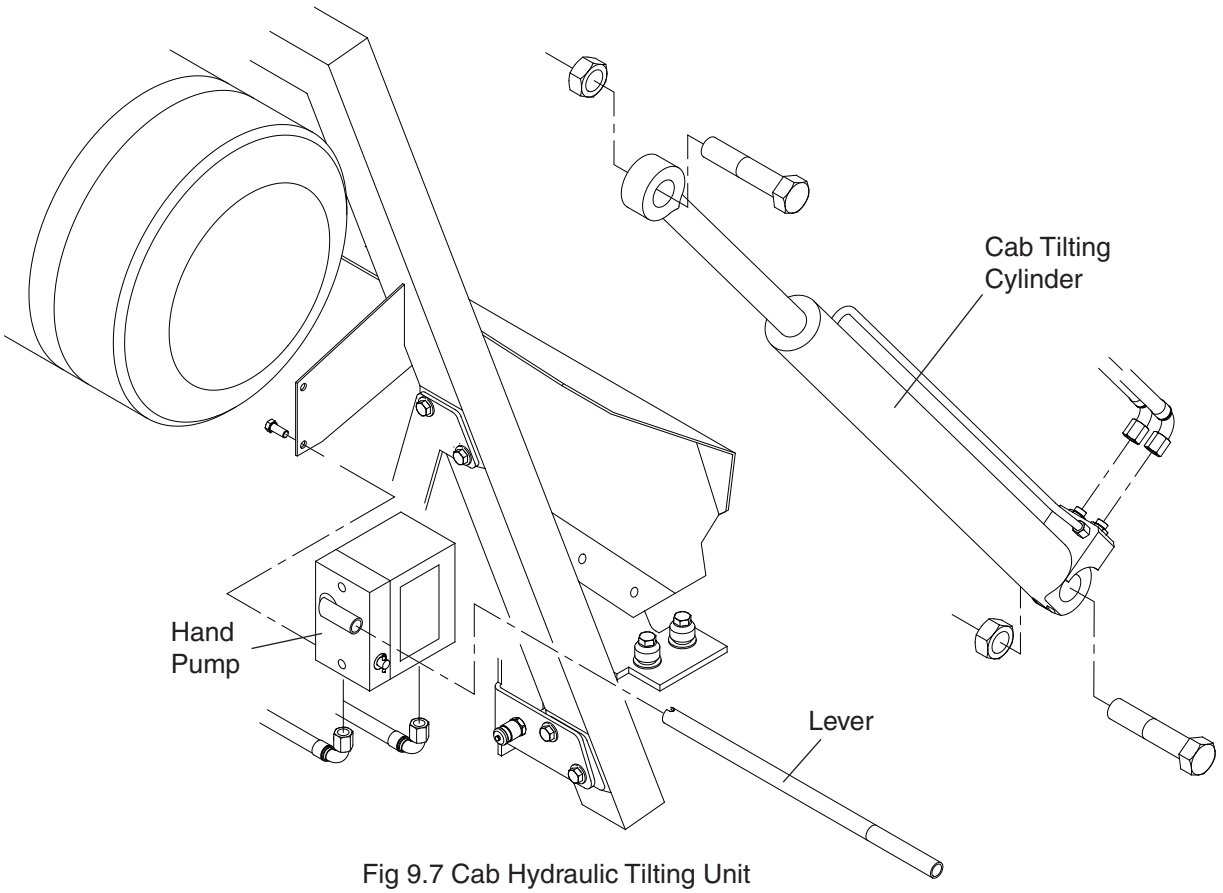


Fig 9.7 Cab Hydraulic Tilting Unit

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Quicklub®

VDC-Pumps 223 (without) and 233 (with Data Logger) Microprocessor, Control Unit and Membrane Keypad



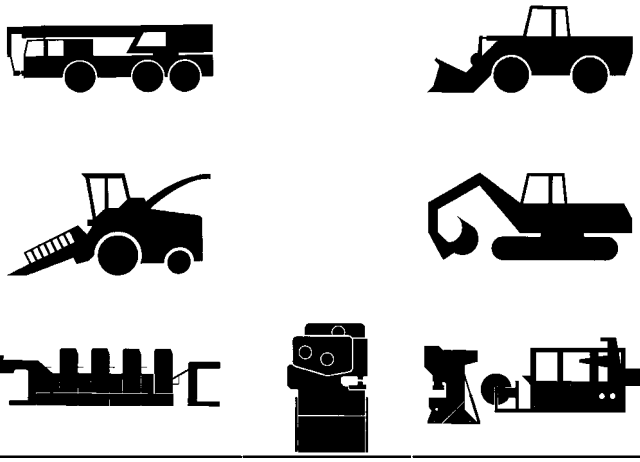
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Fields of Application for Quicklub Progressive Central Lubrication Pumps

Industry - Machines	Pump Type	
	**Pump:**	Quicklub 223, 233
	Reservoir:	2 l - 2XL[1)], 2XLBO[1)] 4 l - 4XLBO[1)] 8 l - 8XLBO[1)] [1)] Filling from the bottom 4l, 8l – with lockable reservoir lid (Option) **Low-level control for all reservoir sizes**
	Control:	Integrated control unit with metering device monitoring

See the respective model designation on the pump type plate e.g. P233-2XL-1K6-24-2A6.15-**MDF00**
or P223-2XL-1K6-24-2A6.15-**MF00**

Further information can be found in the following manuals:
Technical Description for „Diagnostic Software QuickData“ for pump 233 and QLS 331
Technical Description for progressive divider valves for grease and oil, model SSV, SSV M and SSV D
Installation Instructions
Parts Catalogue
Spare Parts Catalogue for pump 203

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Introduction

Explanation of Symbols Used

The following description standards are used in this manual:

Safety Instructions

Structure of safety instructions:

- Pictogram
- Signal word
- Danger text
  - Danger note
  - How to avoid danger

The following pictograms are used in this manual and are combined with the corresponding signal words:

 1013A94	 4273a00	 6001a02
- **ATTENTION** - **CAUTION** - **WARNING**	- **ATTENTION** - **CAUTION** - **WARNING**	- **NOTE** - **IMPORTANT**

The signal words give the seriousness of danger if the following text is not observed:

ATTENTION	refers to faults or damages on machines.
CAUTION	refers to bad damages and possible injuries.
WARNING	refers to possible dangerous injuries.
NOTE	refers to improvements in handling of systems.
IMPORTANT	refers to considerable disadvantages in handling of systems.

Example:


1013A94

ATTENTION!

When making use of other than the tested spare parts, serious damage may affect your device.

Therefore, for the operation of your device always use original spare parts made by Lincoln GmbH & Co. KG.

Furthermore, you will find the following text symbols in this manual:

- Listing of applicable statements
  - Subpoint of applicable statements

1. Determination of the number or sequence of contents

➲ Procedural instruction

User's Responsibility

To ensure the safe operation of the unit, the user is responsible for the following:

1. The pump / system shall be operated only for the intended use (see next chapter "Safety Instructions") and its design shall neither be modified nor transformed.
2. The pump / system shall be operated only if it is in a proper functioning condition and if it is operated in accordance with the maintenance requirements.
3. The operating personnel must be familiar with this Owner Manual and the safety instructions mentioned within and observe these carefully.

The correct installation and connection of tubes and hoses, if not specified by Lincoln GmbH & Co. KG, is the user's responsibility. Lincoln GmbH & Co. KG will gladly assist you with any questions pertaining to the installation.

Environmental Protection

Waste (e.g. used oil, detergents, lubricants) must be disposed of in accordance with relevant environmental regulations.

Service

The personnel responsible for the handling of the pump / system must be suitably qualified. If required, Lincoln GmbH & Co. KG offers you full service in the form of advice, on-site installation assistance, training, etc. We will be pleased to inform you about our possibilities to support you purposefully. In the event of inquiries pertaining to maintenance, repairs and spare parts, we require model specific data to enable us to clearly identify the components of your pump / system. Therefore, always indicate the part, model and series number of your pump / system.

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Safety Instructions

Appropriate Use

- Use the 223 and 233 pumps only for dispensing lubricants in centralized lubrication systems. The pump is designed for intermittent operation.

Misuse

Any use of the 223 and 233 pumps that is not expressly mentioned in this User Manual will be regarded as misuse.
If the 223 and 233 pumps are used or operated in a different manner other than specified, any claim for warranty or liability will be null and void.



6001a02

NOTE

If personal injury or material damage occurs as a result of inappropriate operation, e.g. if the safety instructions are ignored or resulting from an incorrect installation of the 223 and 233 pumps, no claims or legal actions may be taken against Lincoln GmbH & Co. KG.

Exclusion of Liability

The manufacturer of the pumps 223 and 233 will not accept any liability for damages:

- caused by a lack of lubricant due to an irregular refilling of the pump;
- caused by the use of contaminated lubricants;
- caused by the use of greases which are not or only conditionally pumpable in centralized lubrication systems (see page 45 and 46);
- caused by chemical or biological modifications of the lubricant used;
- caused by inadequate disposal of used or contaminated lubricants as well as of components that have been in touch with lubricant;
- caused by unauthorized modification of the system components;
- caused by the use of unapproved parts.

Disposal

Dispose of used or contaminated lubricants as well as of parts that were in touch with lubricant according to the legal regulations pertaining to environmental protection. Make sure to observe the safety data sheets of the lubricants used.

Regulations for Prevention of Accidents

- To prevent accidents, observe all city, state and federal safety regulation of the country in which the product will be used.

Avoid the operation with

- unapproved parts.
- insufficient or contaminated lubricants.

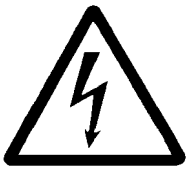
General Safety Instructions

- Lincoln Quicklub centralized lubrication systems
  - are designed state-of-the-art.
  - can be assembled for safe operation.
- Incorrect use may result in bearing damage caused by poor or over-lubrication.
- Unauthorized modifications or changes to an installed system are not admissible. Any modification must be subject to prior consultation with the manufacturer of the lubrication system.

Installation

- Any safety equipment already fitted to the vehicle or the machine:
  - should not be modified or made ineffective;
  - should only be removed for the purpose of fitting the system;
  - must be reinstalled after fitting the system.
- Keep Quicklub centralized lubrication systems away from sources of heat. Adhere to the operating temperature.
- Use only original Lincoln spare parts (see Parts Catalog) or parts approved by Lincoln.
- Adhere to:
  - the installation instructions of the vehicle or machine manufacturer as regards all drilling and welding procedures.
  - the specified minimum distances between the boreholes and the upper/lower rim of the frame or between two boreholes.

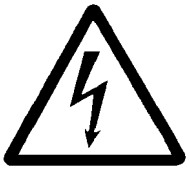
Operation, Maintenance and Repair



4273a00

CAUTION!

The centralized lubrication system may be installed by qualified personnel only. ***Before beginning with the installation or service work, disconnect the power supply!***



4273a00

ATTENTION!

Consider residual ripple of max. ±5 % to connect pumps with direct current version (in relation to the operating voltage acc. to DIN 41755).

- Suitably pack defective printed circuit boards and return to the factory (see page 33, paragraph „Printed Circuit Boards“).

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Safety Instructions, continuation

Operation, Maintenance and Repair, continuation


1013A94

ATTENTION!

Risk of bursting if the reservoir is overfilled! When filling the reservoir by means of pumps with a large delivery volume do not exceed the max. filling mark.

CAUTION!

It is not allowed to use the pump in potentially explosive fields.

- Repair should only be performed by authorized and instructed personnel who are familiar with the instructions.
- Lincoln Quicklub centralized lubrication systems
  - must be operated only with installed pressure relief valve.
  - must be refilled in regular intervals with clean lubricant recommended by the manufacturer without air entrapments.
  - operate automatically. However, a regular check (approx. every 2 days) should be made to ensure that lubricant is emerging from all lubrication points.

Pump Models



Fig. 1 Different models of pumps 223 (without) and 233 (with reading window)

Pumps 223 and 233 basically differ by the read-out function ((P223 without; P233 with). However, both pumps are available with all reservoir variants.

Reservoir sizes

- 2 l transparent plastic reservoir
- 4 l transparent plastic reservoir
- 8 l transparent plastic reservoir

Control unit models 223, 233

- Pumps 223, 233 can be used with integrated control panels with monitoring of the metering device; pumps 233 additionally with data logger for the data transmission to the Lincoln diagnostic software **QuickData.**

[1] **Refer to the designation on the pump type plate, e.g. P233 -2XLBO- 1 K6 - 24 - 2A6.15- MDF00 (see also chapter “Identification Code” page 7 and 8).**

For the following features of distinction please see the identification code on pages 7 and 8:

- motor voltage
- type of control unit (if any)
- remote control for triggering an additional lubrication cycle
- design and number of pump elements
- design and number of pressure relief valves
- filling type
- use of return line connections
- low-level control

Electrical connection

Pumps model 223, 233 may be equipped with a 10 m electric cable.

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Identification Code – DC Pump Models P223

Examples of model designations


6001a02

NOTE

Any pump combinations other than the following standard pumps can be composed and ordered in accordance with the valid model identification code.

P223 - 4 - X - L - 1 - K6 - 24 - 2A - 6. - 15 - MF00
P223 - 2 - X - L - BO 1 - K7 - 24 - 2A - 6. - 15 MF00
P223 - 8 - X - L - BO 1 - K6 - 12 - 2A - 6. - 15 - MF00
P223 - 4 - X - L - BO - 1 - K6 - 24 - 2A - 6. - 15 MF00

Basic pump model for grease
with 1-3 outlets and 12 VDC or 24 VDC motor

Reservoir design
2 = 2 l transparent plastic reservoir
4 = 4 l transparent plastic reservoir
8 = 8 l transparent plastic reservoir

X = Reservoir for grease

L = Low-level control

without designation = Standard reservoir (2 liters)
BO = Filling from top

Pump elements
1-3 = Number of the use elements

K 5 = Piston diameter = 5 mm
K 6 = Piston diameter = 6 mm
K 7 = Piston diameter = 7 mm
KR = Pump element, adjustable, Piston diameter = 7 mm

Connecting voltage
12 or **24** VDC motor

Number of electric connecting possibilities (on pump housing only)
2A = 2 connections:
- connection for power supply on the left, external illuminated pushbutton for additional lubrication and malfunction
- piston detector on the right

Type of connection [1)]
6 = Bayonet plug, 7/5-core, DIN 72585-1

[1)] other types of connection on request possible

Connection outside the pump
00 = without socket-outlet, without cable
15 = Bayonet socket with 10 m cable, 7/5-wire

Control p. c. b. s. 12V / 24 V
MF00 = with microprocessor control and membrane key pad

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Identification Code – DC Pump Models P233

Examples of model designations


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NOTE

Any pump combinations other than the following standard pumps can be composed and ordered in accordance with the valid model identification code.

P233 - 4 - X - L - 1 - K6 - 24 - 2A - 6. - 15 - MDF00
P233 - 2 - X - L - BO 1 - K7 - 24 - 2A - 6. - 15 MDF00
P233 - 8 - X - L - BO 1 - K6 - 12 - 2A - 6. - 15 - MDF00
P233 - 4 - X - L - BO - 1 - K6 - 24 - 2A - 6. - 15 MDF00

Basic pump model for grease
with 1-3 outlets and 12 VDC or 24 VDC motor

Reservoir design
2 = 2 l transparent plastic reservoir
4 = 4 l transparent plastic reservoir
8 = 8 l transparent plastic reservoir

X = Reservoir for grease

L = = Low-level control

without designation = Standard reservoir (2 liters)
BO = Filling from top

Pump elements
1-3 = Number of elements used

K 5 = Piston diameter = 5 mm
K 6 = Piston diameter = 6 mm
K 7 = Piston diameter = 7 mm
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Connecting voltage
12 or **24** VDC motor

Number of electric connecting possibilities (on pump housing only)
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- connection for power supply on the left, external illuminated pushbutton for additional lubrication and malfunction
- piston detector on the right

Type of connection [1)]
6 = Bayonet plug, 7/5-core, DIN 72585-1

[1)] other types of connection possible on request

Connection outside the pump
00 = without socket-outlet, without cable
15 = Bayonet socket with 10 m cable, 7/5-wire

Control p. c. b. s. 12V / 24 V
MDF00 = with microprocessor control, data logger and membrane keypad

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Description

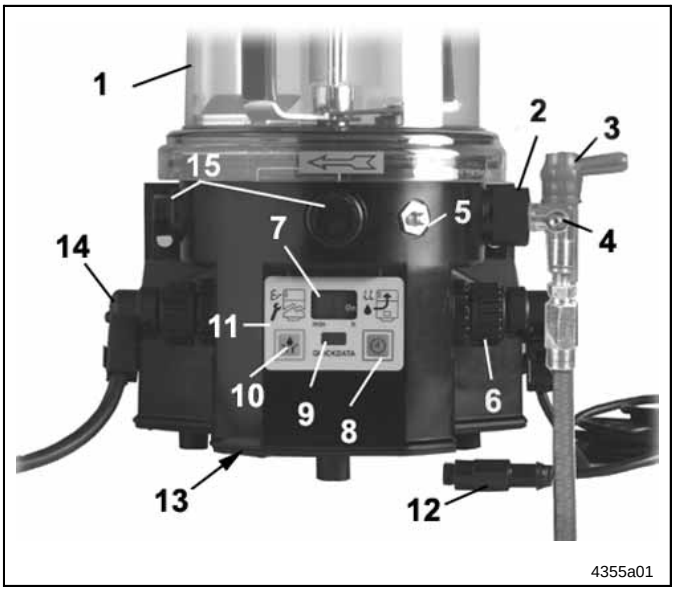


Fig. 2 Components of pump 223, 233

1 -	Reservoir	9 -	Reading window for Datalogger (only P233)
2 -	Pump element	10 -	Momentary-contact switch for additional lubrication
3 -	Pressure relief valve	11 -	Membrane key pad
4 -	Filling nipple, system emergency lubrication possible	12 -	Piston detector
5 -	Fillilng nipple, pump	13 -	Covering to the p.c.b.
6 -	Adaptor for piston detector	14 -	Adaptor for power supply
7 -	Display	15 -	Closure plug for the use of a pump element
8 -	Momentary-contact switch for indication or setting of pause time		

Quicklub centralized lubrication pumps

- Are compact multi-line pumps consisting of the following components:
  - Housing with integrated motor
  - Reservoir with stirring paddle and fixed paddle
  - P223: Control printed circuit board (p.c.b.)
    P233: Data logger (control p.c.b. with readable data memory)
  - Pump element
  - Accessories:
    - Pressure relief valve
    - Refilling unit
    - Electrical connection parts


6001a02

NOTE

Pressure relief valve are not part of the pump components and have to be ordered separately. Accessories for refilling of the reservoir (see parts catalogue).

- can drive up to 3 pump elements
- operate according to lubrication cycles (pause and operating times)
- can be equipped with a low-level control
- can supply up to 100 lubrication points depending on the line lengths
- are designed for the automatic lubrication of the connected lubrication points
- are designed for the delivery of greases up to NLGI 2 at temperatures from - 25° C to 70° C
- can be used at low temperatures down to - 40° C

During the operating time the pump dispenses lubricant to the connected lubrication points via one or several metering devices.

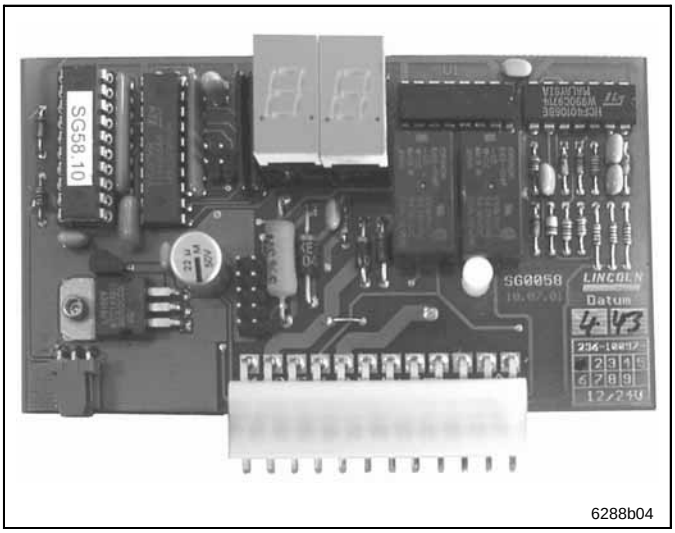


Fig. 3 Control p.c.b. MF00 (P223)

P223 without data logger

Control p.c.b. MF00

- The control unit is installed in the housing of the pump behind the membrane keypad (see pos. 11, fig. 2) as an integrated p.c.b. MF00.

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Description, continuation

P233 with data logger

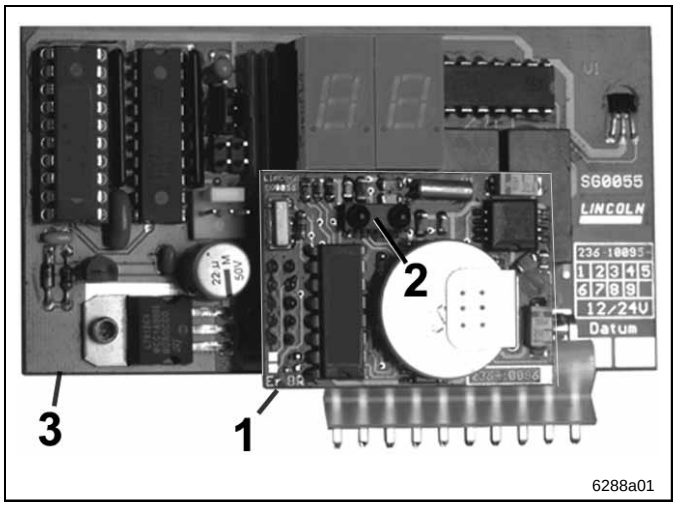


Fig. 4 Control p.c.b. MDF00 with built-on data logger

1 - Data logger
2 - IR interface
3 - Control p.c.b.

Control p.c.b. MDF00

- The control unit is installed in the housing of the pump behind the membrane keypad (see pos. 11, fig. 2, page 9) as an integrated p.c.b. MDF00.
- The data logger (fig. 4, pos. 1) is fixed onto the p.c.b.

Control and monitoring system QuickData®

- The control and monitoring system consists of:
  - control p.c.b. MDF00 (pos. 3, fig. 4)
  - built-on data logger module with IR interface (pos. 2, fig. 4)
  - membrane keypad with display (pos. 3, fig. 2)
  - IR interface module RS 232 (COM) for laptops, PDA and Palm
  - Lincoln diagnostic software QuickData®
  - monitored metering device model SSV with integrated piston detector (comp. fig. 22, page 17)

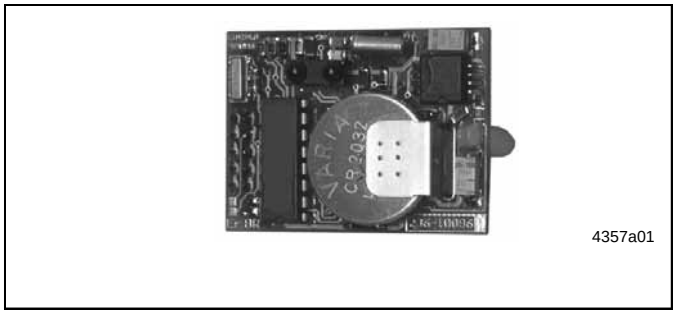


Fig. 5 Data logger module

Data logger module

- Pump 233 is equipped with a readable data memory (data logger) QuickData®.
- The data logger renders information regarding system settings, events such as low-level indications, malfunctions, operating times and lubrication cycles.
- By means of the Lincoln diagnostic software QuickData® the above-mentioned data can be read on a suitable laptop via an infrared interface (see User Manual “Diagnostic Software QuickData®).

Control Unit

Control p.c.b.

- The centralized lubrication system is monitored, i.e. events such as malfunctions of the centralized lubrication system, faults in the elapse of the operating time, low-level indications, pause time, residual pause times of the pump are displayed in the display window of the membrane keypad.
- Version P233 additionally transmits data into the data logger.

Data memory

The following events are memorized in the EEPROM of printed circuit boards MF00 (P223) or MDF00 (P233). However, they can be read and analyzed only out of pumps 233 via the Lincoln diagnostic software QuickData®:

- Malfunctions (start, end and duration) in the centralized lubrication system
- faults in the elapse of the operating time
- low-level indication (start, end and duration)
- number of connections and disconnections of the power supply
- automatically triggered lube cycles
- manually triggered lube cycles
- operating data
- customer related data

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Description, continuation

Control Unit, continuation

Operating states

Functions, processes, settings, faults or malfunctions of the pump are indicated on a membrane keypad as shown on the survey:


6001a02

NOTE

*The fault indication **„LL“** appears whenever the solenoid fixed to the stirring paddle has passed the proximity switch six times. Appearing **„LL“** on the display, the lubrication cycle is being completed fully. Afterwards, the control unit does not switch the pump on automatically any longer.*

Pump	Display
· Failure in the power supply	no indication
· Power supply ON	right segment illuminated
· Failure in the membrane key pad	**EP**
· Operating time elapses	Rotating segment
· Pump element does not dispense	**Er**
· Reservoir empty	**LL**
· Pause time	**PP**
· Residual pause time	**rP**
· Lubrication point or divider valve blocked	**Er**
· Leakage in the main line from the pump to the monitored divider valve	**Er**
· Air entrapments in the grease	**Er**
· Failure in one lube cycle (depending on the installation of the monitored divider valve)	**Er**

Mode of Operation

Pump elements with fixed lubrication output

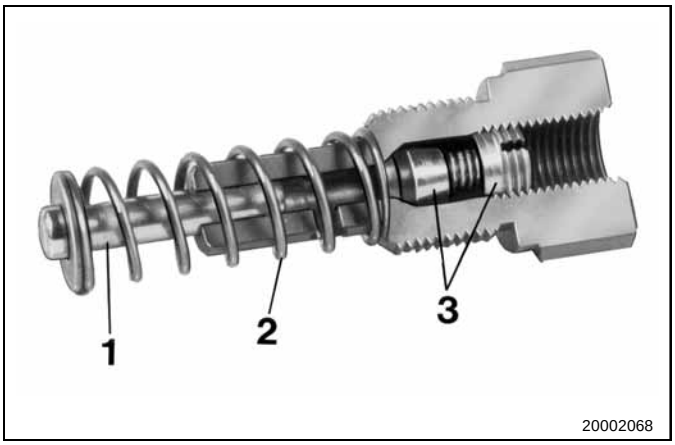


Fig. 6 Pump element, sectional drawing

1 - Piston
2 - Return spring
3 - Check valve

- The electric motor drives the eccentric (pos. 1, fig. 7-8, page 12).
- During the operating time:
  - piston (pos. 2) sucks in lubricant from the reservoir (refer to fig. 7).
  - piston 2 dispenses the lubricant to the connected lubrication points via the metering device (see fig. 8).
- The following designs are available:

  Piston diameter, K5 ..... 5 mm
  Lubricant output ..... approx. 2 cm³/min
  Piston diameter, K6 (Standard) ..... 6 mm
  Lubricant output ..... approx. 2,8 cm³/min
  Piston diameter, K7 ..... 7 mm
  Lubricant output ..... approx. 4 cm³/min
- Tightening torques ..... 25 Nm

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Mode of Operation, continuation

Pump elements with fixed lubrication output, continuation

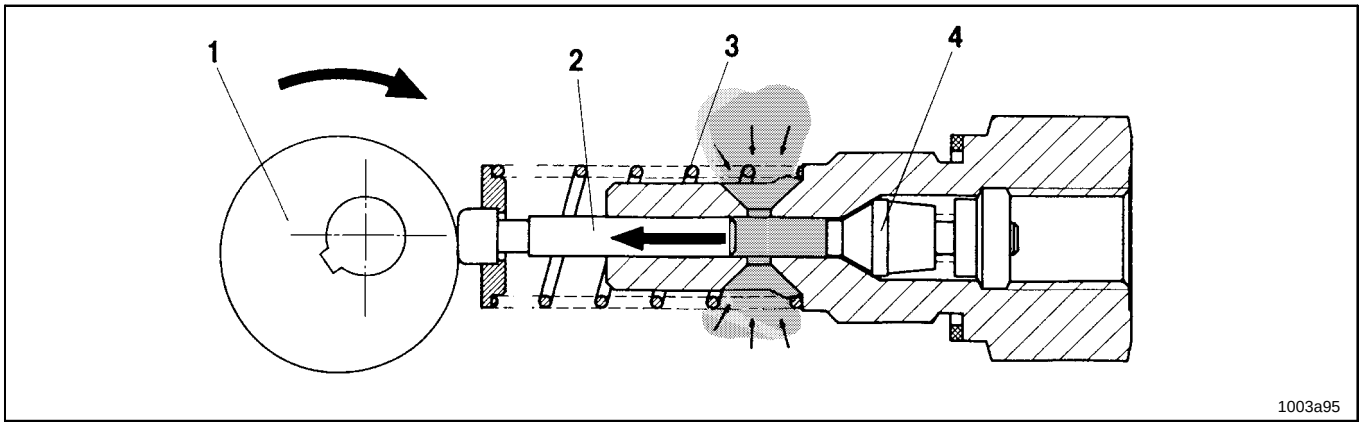


Fig. 7 The pump element sucks in lubricant

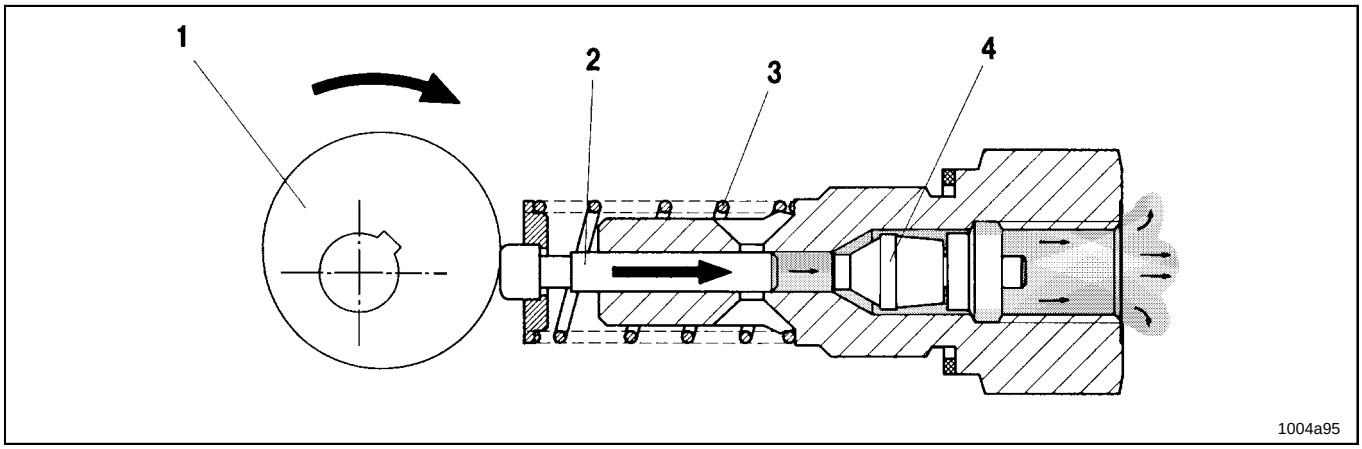


Fig. 8 The pump element dispenses lubricant

1 - Eccentric 2 - Piston 3 - Spring 4 - Check valve

Pump element B7 with bypass check valve

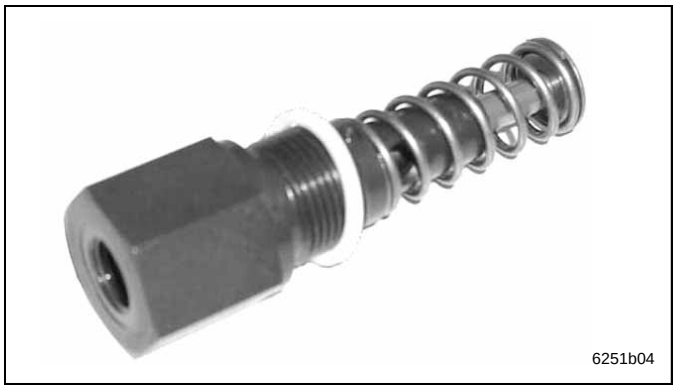


Fig. 9 Pump element B7

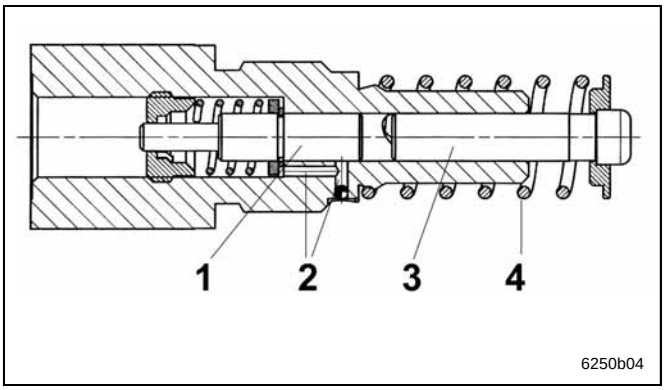


Fig. 10 Sectional diagram - pump element B7

- Pump element B7 suits especially applications in contaminated environments as the supplied lubricant is passing through a bypass bore (pos. 2) on the check valve (Pos. 1).
- The output is 2 cm³/min.

1 - Check valve
2 - Bypass
3 - Pump piston
4 - Return spring

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Mode of Operation, continuation

Pump elements with fixed lubrication output, continuation

Check valve

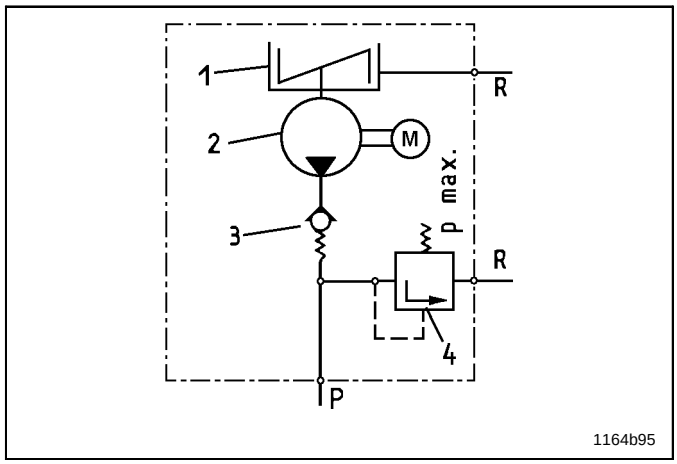


Fig. 11 Hydraulic diagram of the pump

1 - Reservoir with stirring paddle
2 - Pump
3 - Check valve, spring-loaded
4 - Pressure relief valve
R - Return line
p - Pressure line

- The check valve
  - closes the pressure line during suction stroke.
  - prevents the lubricant from flowing back to the housing or reservoir.

Arrangement of the pump elements

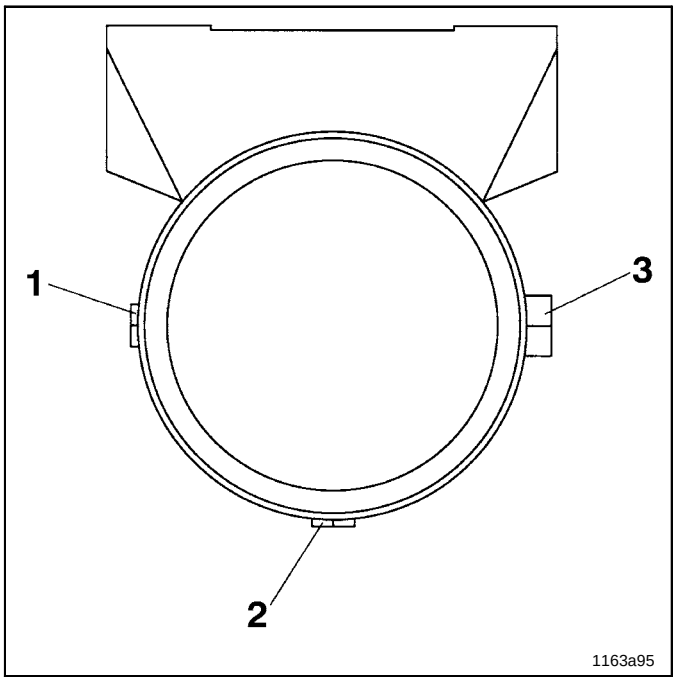


Fig. 12 Arrangement of the pump elements

- If several pump elements are to be installed, the installation arrangement shown in Fig. 12 must be adhered to.
- If there is only one pump element, it can be installed in any position. Standard position is no. 3.
- If there are two elements, install one in position 3 and the other in position 1.

Pump elements with adjustable lubricant output

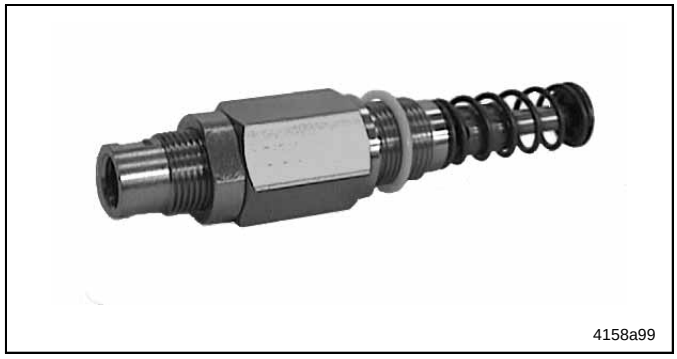


Fig. 13 Adjustable pump element

- The mode of operation (suction and supply phase) is the same as that of the pump elements with an invariable lubricant output.
- Lubricant outputs are adjustable from 0.04 to 0.18m^3/stroke, or 0.7 to 3cm^3/min.
- The pump elements are factory-set to the maximum lubricant output; the adjusting dimensions “S” should be 29 ± 0.1 mm (see fig. 14, page 14).

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Mode of Operation, continuation

Pump elements with adjustable lubricant output, continuation

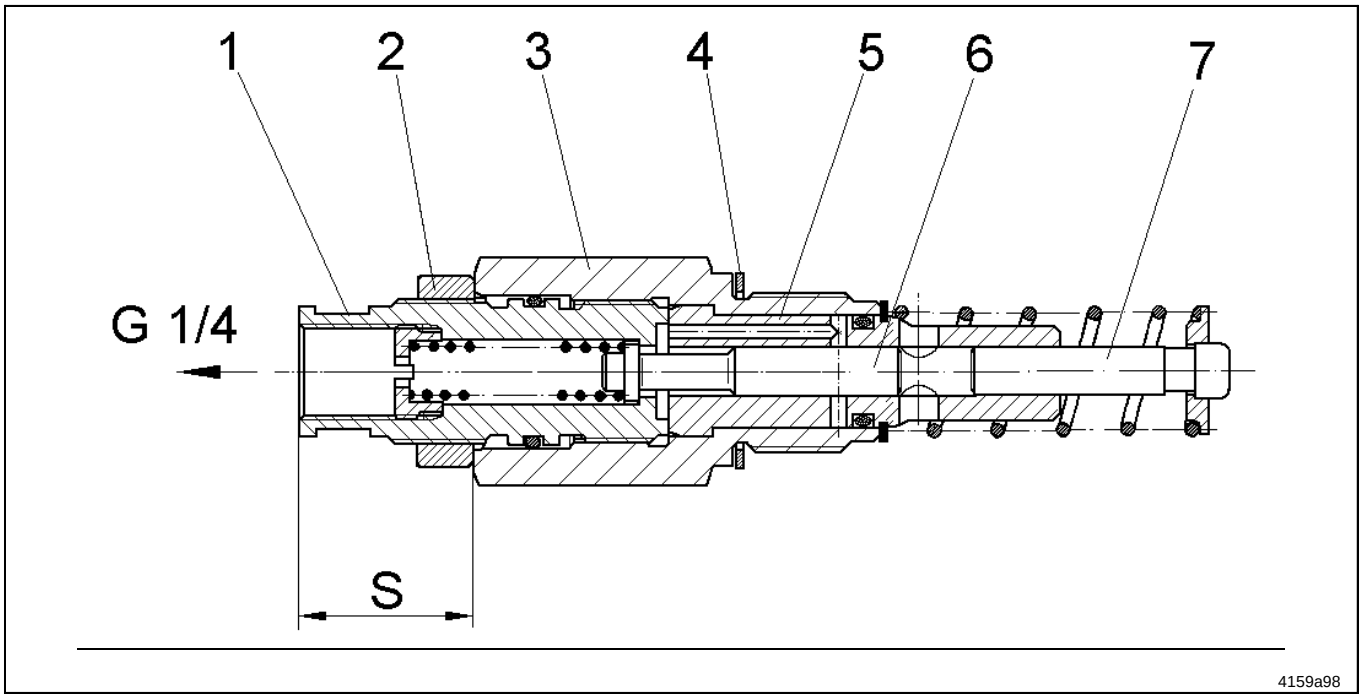


Fig. 14 Sectional view: adjustable element

1 -	adjusting spindle SW 16 (SW ~ with over flats)	3 -	pump element body	6 -	control piston
2 -	counternut SW 24	4 -	gasket	7 -	delivery piston
		5 -	pump cylinder	S -	setting dimension

Setting of adjustable pump elements

- ➲ Unscrew the coupling nut for fixing the pressure relief valve.
- ➲ Loosen counter nut (pos.2[1)]) while holding in position pump element body (pos.3) by means of a second wrench.
- ➲ Change the position of the adjusting spindle (pos.1) by means of a wrench, see supply diagram (fig. 13).
- ➲ The dimension “S” (fig. 14) for the desired lubricant output can be ascertained by using the supply diagram (fig. 15).

[1)] All indications of positions refer to fig. 14.

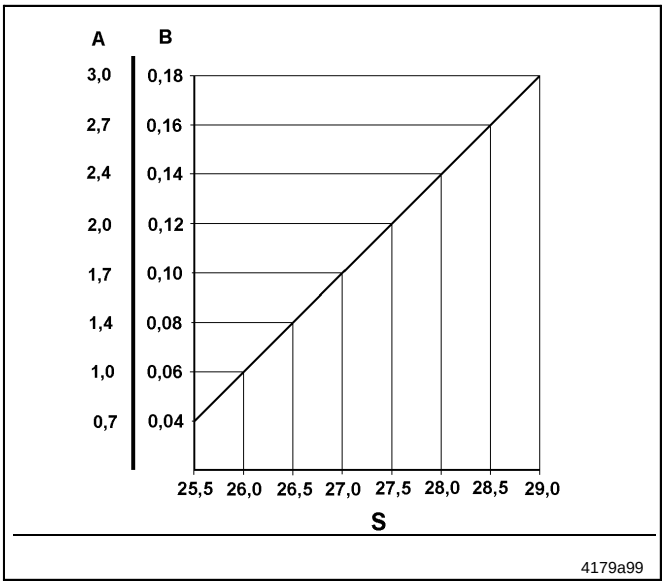


Fig. 15 Supply diagram

A - Lubricant output cm^3/min
B - Lubricant output cm^3/stroke
S - Setting dimension

Retrofit adjustment of min. lubricant output

- ➲ Before the pump element can be adjusted to a small lubricant output, the dimension “S” for max lubricant output must be ascertained, and the difference from the nominal value 29 must be transferred to any desired settings between 25.5 ... 28.5.
- ➲ Dimension “S” must be adjusted to the desired value in accordance with the delivery diagram (fig. 15).



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NOTE

At maximum setting “S“ is 29 ±0.1 mm.

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Mode of Operation, continuation

Setting of adjustable pump elements, continuation

Retrofit adjustment of max. lubricant output

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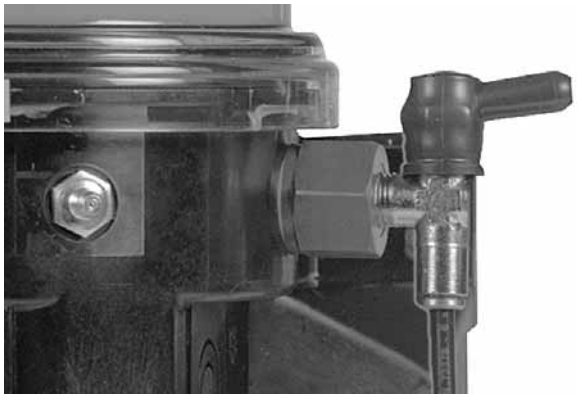
NOTE

In order to ensure that the lubricant output setting will be as exact as possible, first the actual dimensions "S" of the max. lubricant output must be ascertained as follows. The measured difference from the nominal value 29 must be considered for all other settings values (e.g. ± 0.1).

- Unscrew the adjusting spindle (pos.1[1)]) from the pump element body (pos.3) until "S" is approx. 30 mm.
- Screw counter nut (Pos.2) onto stop collar of the adjusting spindle (pos.1).
- Screw adjusting spindle (pos.1) with counter nut (pos.2) into pump element body (pos.3) until stop.

[1)] All indications of positions refer to fig. 14, page 14.

Pressure Relief Valve



10022618a

Fig. 16 Pressure relief valve

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IMPORTANT

Each pump element must be secured with a pressure-limiting valve.

The pressure relief valve is not contained in the scope of supply of the pumps 223, 233. Therefore it is to be ordered ***separately*** *(see Spare Parts Catalogue).*

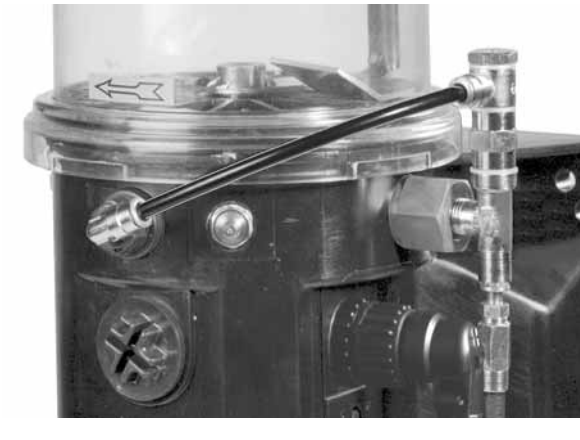
without grease return

- The pressure relief valve
  - limits the pressure build-up in the system.
  - opens, if the specific overpressure is reached.
  - is to be selected according to the requirements to the lubrication plant (see different opening pressures; 200, 270, 350 bar).
- If lubricant is leaking at the pressure relief valve, this indicates that the system is malfunctioning.
- Despite existing fault monitoring devices a regular visual and function control must be carried out on the lubrication system.

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NOTE

Between a malfunction (blockage) and the following fault indication (lubricant leakage; monitoring intermittent LED display) there may be a longer time delay.
The duration of the delay depends on the type and length of the lines, the type of lubricant, the ambient temperature and other influences.



6336b04

Fig. 17 Pressure relief valve with grease return

with grease return (optional)

- If the system is blocked, grease will leak from the pressure relief valve. This grease quantity is returned to the reservoir.

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Mode of Operation, continuation

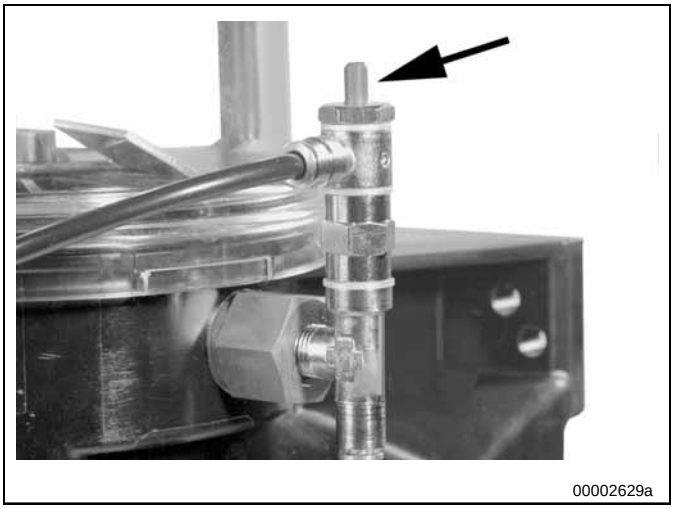


Fig. 18 Fault indication in the case of a blockage

Pressure relief valve with grease return (optional), continuation

Fault indication

- In the case of a blockage in the system, the grease pushes out the red pin at the pressure relief valve, thus indicating that there is a fault.

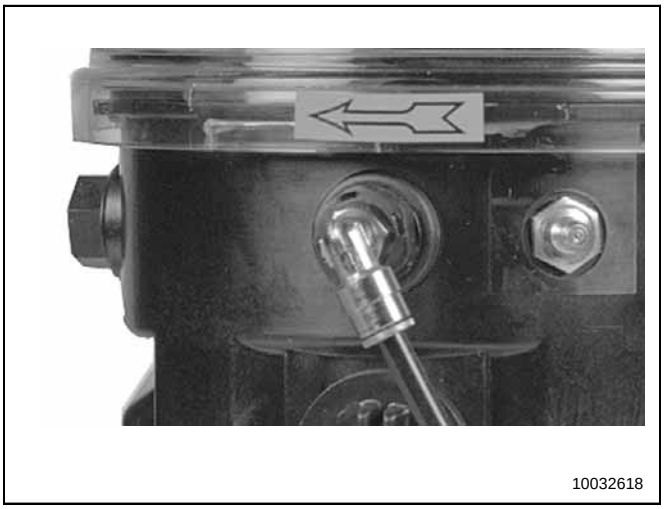


Fig. 19 Return line connection

Return Line Connection

- The lubricant quantities, which cannot be dispensed by the metering device, must be returned to the pump via the return line connection.

Control p.c.b. with or without data memory

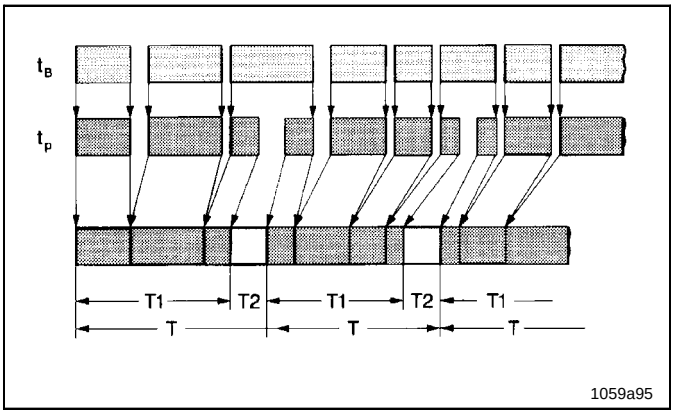


Fig. 20 Time sequence diagram

t_B - working hours
t_P - individual pause time
T - lubrication cycle
T1 - stored pause time
T2 - operating times

- The control p.c.b. controls the sequence of the pause and operating times of the 223 and 233 centralized lubrication pumps as a function of the vehicle or machine working hours t_B (see fig. 20).
- The sequence of the pause and operating times is activated when the machine contact or driving switch is switched on, i.e. the centralized lubrication pump is ready for operation.
- A lubrication cycle consists of one pause time and one operating time. Once the pause time has elapsed, the operating time starts to run. This lubrication cycle is repeated permanently after the machine or vehicle has been put into operation.
- During the operating time the pump element dispenses the lubricant to the lubrication points via progressive metering devices.

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Mode of Operation, continuation

Control p.c.b. with or without data memory, continuation

Pause time

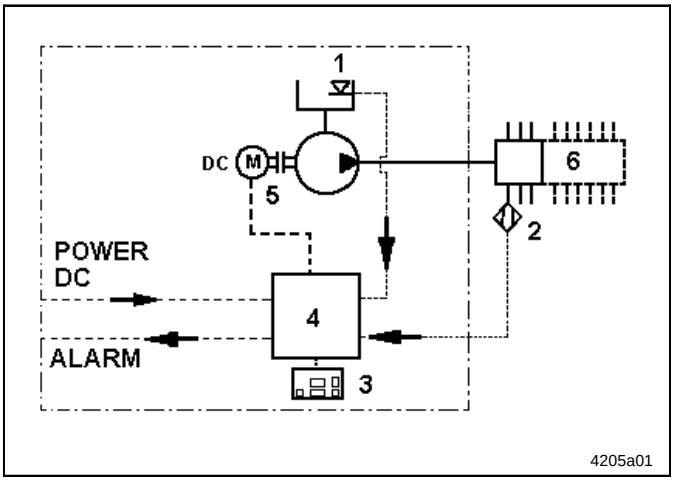


Fig. 21 Schema of the centralized lubrication pump

1 -	low-level control	4 -	control p.c.b.
2 -	piston detector	5 -	pump
3 -	membrane key pad	6 -	divider block model SSV N

Factory setting of the pause time ..... 6 hours

- The pause time
  - determines the frequency of the lubrication cycles within a working cycle.
  - is started and stopped with the power supply via the machine contact or the driving switch.
  - is adjustable
- When the machine contact ort he driving switch is switched off, the pause times which have already elapse are stored and added up by an electronic data memory (EEPROM) until the time which has been set on the membrane key pad is reached.
- After the machine contact or driving switch is switched on again, the control p.c.b. operates from the point where it had been interrupted.
- If the setting is modified within the pause time, the control p.c.b. takes over the new value automatically on completion of the programming procedure (see paragraph “Programming Mode”, page 26).
- The pause time setting may be different for each application. It must be adjusted in accordance with the respective lubrication cycle (see paragraph “Programming Mode”, page 26).

Operating time

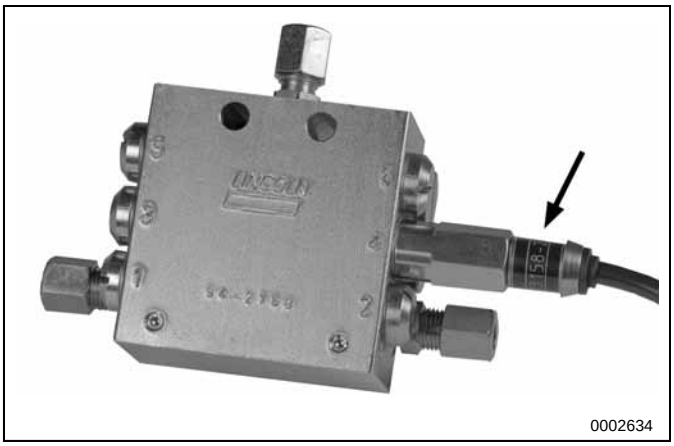


Fig. 22 Divider block SSV 6 with piston detector

- The operating time depends on the system’s lubricant requirement and on the location of the piston detector (either on the main metering device or on the secondary metering device).
- A piston detector (initiator) which has been installed on a metering device instead of a piston closure plug, monitors and brings he pump operating time to a close after all the pistons of this metering device have dispensed their lubricant quantity once.
- During the pump operating time a circulating segment appears in the display of the membrane keypad (see paragraph “Display of the membrane key pad, page 18).
- After an interruption of the operating time, e.g. by switching off the power supply, the operating time continues from the point where it had been interrupted.
- When the machine contact ort he driving switch is switched off, the pause times, which have already elapsed, are stored and added up by an electronic data memory (EEPROM) until the piston detector stops the operating time.

Monitoring time


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NOTE

Only one lubrication cycle can be monitored.

NOTE

Normally, the monitoring time ends at the same time as the operating time.

- A fixed monitoring time of a maximum of 30 minutes runs in parallel to the operating time.
- If there is no switching off signal from the piston detector (fig. 22) to the control p.c.b. within 30 minutes a fault signal will occur (see paragraph “Display of the membrane key pad”, page 18).
- An external signal lamp flashes continuously in case of a fault.

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Mode of Operation, continuation

Membrane keypad

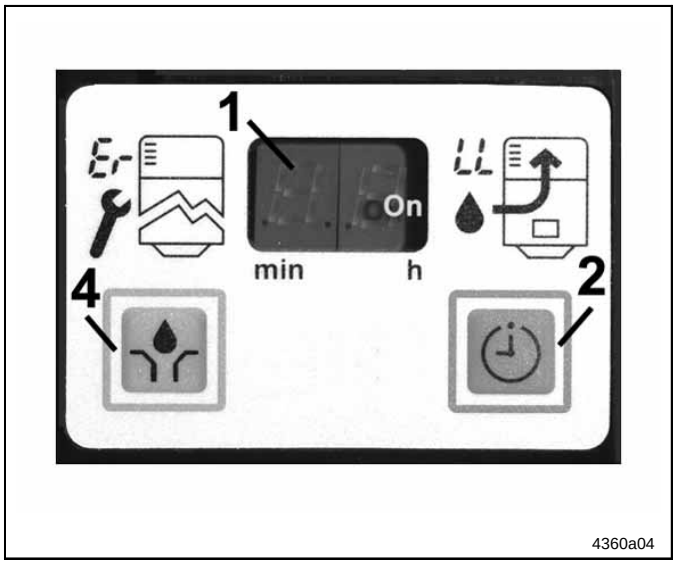


Fig. 23 P223 membrane keypad

1 - Display
2 - Key for acknowledgment of fault indications and setting of time (shift key)

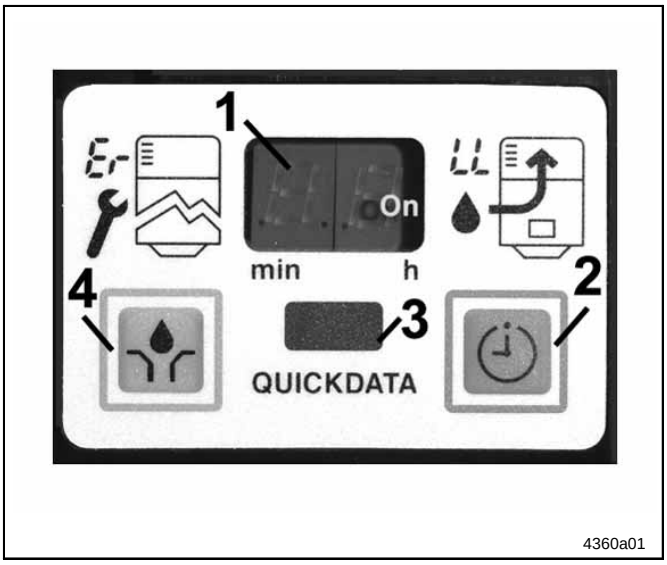


Fig. 24 P233 membrane keypad with display and reading window

3 - Reading window for "QuickData"
4 - Key for triggering an additional lubrication and for setting the time values (setting key)

Display of the membrane keypad



Fig. 25 Green segment, pause time, voltage applied

- As soon as voltage is applied (On), the lower right-hand segment in the display window flashes (pause time runs).
- If the power supply is interrupted during the pause time, after switching it on again, the pause time continues at the point of interruption.

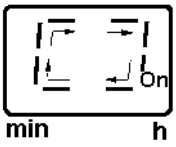


Fig. 26 Green circulating illuminated segment, operating time

- During the operating time of the pump, a circulating illuminated segment appears in the display window of the membrane keypad.
- If the power supply is interrupted during the operating time, after switching it on again, the operating time continues at the point of interruption.

Low-level control



Fig. 27 Announcement of a low-level indication

- **In the display mode**, a low-level is announced by an intermittent display of * L8 *, * L7 *, * L6 *, ... * L1 *.
- Finally the intermittent *** LL *** appears for a low-level indication that had not been confirmed (see fig. 28, page 19).

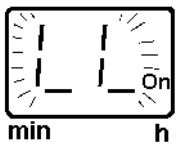
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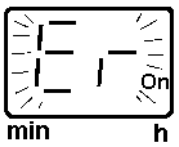
Mode of Operation, continuation

Display of the membrane keypad, continuation

Monitoring time / Malfunction



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Fig. 28 Display of an low-level indication or malfunction

- If there is no feedback from the piston detector (initiator) within **30 minutes** (monitoring time) from completion of the pause time or from triggering an additional lubrication, the jump switches off immediately. One of the fault signals *** Er *** (Error) or *** LL *** (Low-Level) is displayed as a flashing light in the display of the membrane keypad.



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IMPORTANT

*If a malfunction *** Er *** or low-level indication *** LL *** is present, the pump does not switch on automatically any longer.*

Operator keys of the membrane keypad

Operator keys of the membrane keypad in the display mode



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Fig. 29 Acknowledging receipt of a flashing low-level or fault indication

Acknowledging receipt of a low-level indication / malfunction

- By pressing the key (fig. 26, < 2 sec.) the flashing *** Er *** changes into a permanent light.
- Fault indications that have been confirmed but not been remedied yet will flash again after switching the power supply off and on again.

Operator keys of the membrane keypad in the operating mode



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Fig. 30 Operator key to trigger an additional lubrication cycle



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NOTE

External triggering of an additional lubrication cycle (see fig. 38, page 23).

Additional lubrication cycle

➲ An additional lubrication cycle is triggered via the button (fig. 30). Press the button **for 2 seconds**.

➲ It can be initiated at any time, provided that the power supply is applied.

- If a fault signal (malfunction) is present, it will be cancelled as soon as the system is operating properly, again.



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NOTE

*If a malfunction is present (flashing display *** ER ***), it can be acknowledged before triggering an additional lubrication cycle (see fig. 29). However, this is not compelling.*



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Fig. 31 Information regarding the set pause time and residual pause time

Display of information regarding the set pause time and residual pause time

➲ Press key > 2 seconds.

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Mode of Operation, continuation

Operator keys of the membrane keypad

Operator keys of the keypad in the programming mode



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Fig. 32 Settings in the programming mode

· **Reset of the pause time**

➲ Setting of the pause time by
- single key activation for one hour/ minute
- permanent activation for quick run

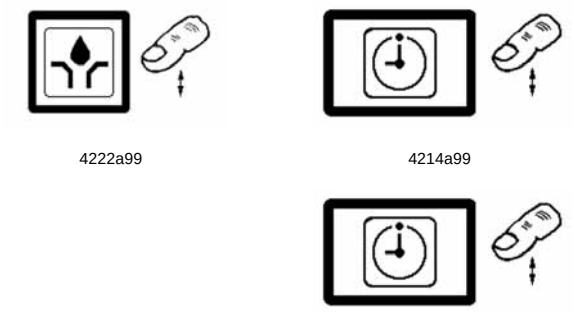
· **Settings of the monitoring relay**
How to set the metering device cycles:

· The monitoring relay signalizes a malfunction over an external lamp Lampe via the optional connection “X2“ (see connection diagrams).
In case of the standard setting “normally open contact (NO)“ a malfunction is signalized by a permanently lit lamp.
In case of the standard setting “normally closed contact (NC)” the malfunction is signalized by a lamp that stopped burning.

➲ For VDC version …… 1 to 5 cycles

· **Termination of the programming mode**

➲ Terminate the programming mode.



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Fig. 33 Changing to the different programming levels

1. **Changing to the different programming levels**

➲ Press key to change into the programming mode.

➲ Settings:
hours …… P1
minutes …… P2
metering device cycles…… P3
output potential-free contact …. P4

➲ Termination of programming

Monitoring relay

· The monitoring relay signalizes a malfunction (only in combination with optional connector “**X2”;** see electrical connection diagrams pages 39 ff).

· In the first case the relay picks up (normally open contact).

· In the second case the relay releases (normally closed contact, broken-wire interlock).

· The signal is available via a potential free contact.

· When the fault indication is confirmed, the relay releases. The flashing display changes into a permanent display.

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Mode of Operation, continuation

Reading of the data memory “QuickData“ (only P 233)

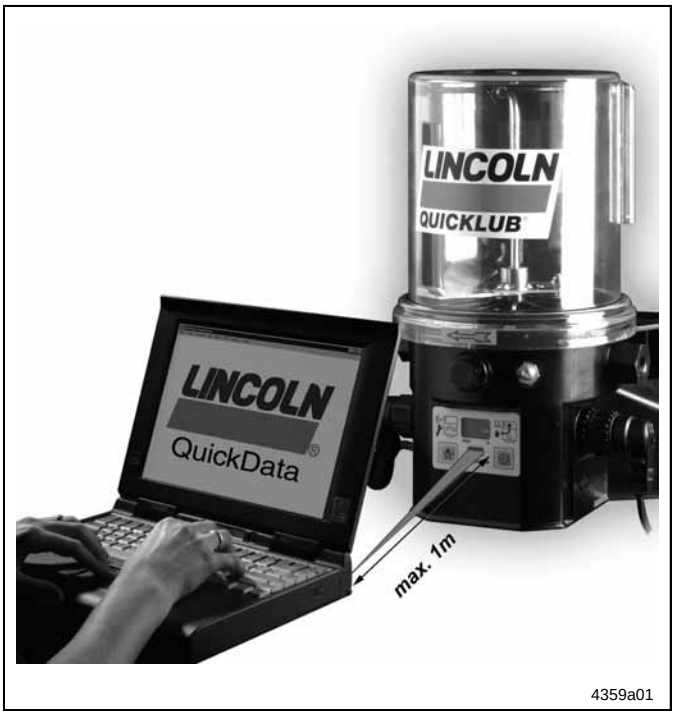


Fig. 34 Reading of the data memory

- ➲ Read data memory via a suitable laptop with integrated or, if not available, external infrared interface (see User Manual “Diagnostic Software QuickData“.
- ➲ To be able to read from the reading window, place the infrared interface of the laptop at a maximum distance of 1 m horizontally in front of it, and then read the data.

Hardware requirements

Operating system: ...MS Windows 95, 98, ME, NT, 2000

- *Computer: .....*IBM AT or compatible device,
- 486 DX or faster,
- 16 MB RAM hard disk with min. 1 MB free memory
- a free serial connection (COM-Port, ... 9-pole)
- mouse
- CD-ROM drive

External infrared interface

- Part n°. 236-10127-1
- Protocol : IrDA 1.2 19200/8/N Baud
- Plug-in for COM-Port (RS 232, 9-pole SubD-plug; socket)
- Reach approx. 1 m

Low-level control for grease

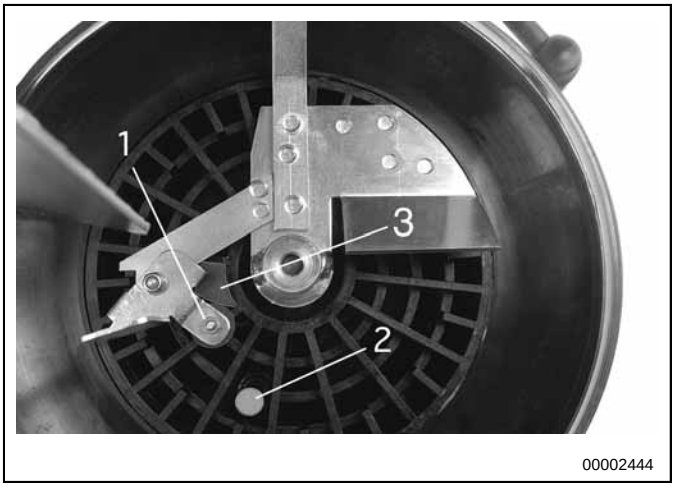


Fig. 35 Switching parts of the low-level control

1 - Guiding plate with round solenoid (at the stirring paddle)
2 - Electromagnetic switch
3 - Control cam


6001a02

NOTE

The above-mentioned switching parts must not be used with fluid grease. In this case, use a float magnetic switch; see below low-level control for oil.


6001a02

NOTE

The flashing signal starts only after the solenoid has activated the electromagnetic switch 6 times contact-free.

When the reservoir is filled

- The stirring paddle rotates clockwise during the operating time.
- Due to the rotating motion of the stirring paddle in the lubricant the pivoting guiding plate with the round solenoid, item 1[1)], is pressed backwards. The solenoid moves toward the center of rotation of the stirring paddle. The electromagnetic switch item 2[1)] cannot be activated.
- Control cam item 3[1)] guides the round solenoid with the pivoting guiding plate automatically outwards, in the direction of the reservoir wall. After the lubricant has left the control cam, it flows against the guiding plate, thus displacing the solenoid again onto the center of rotation of the stirring paddle.

[1)] All indications of positions refer to fig. 35.

Subject to modifications

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Mode of Operation, continuation

Low-level control for grease, continuation

When the reservoir is empty

6001a02

NOTE

The flashing signal starts only after the solenoid has activated the electromagnetic switch 6 times contact-free.

- During the rotating motion of the stirring paddle there is no backpressure from the lubricant. The guiding plate with the round solenoid no longer moves towards the center of rotation of the stirring paddle. After control cam (pos. 3) has been overtravelled, the solenoid remains in the outer position and overruns electromagnetic switch (pos. 2). The solenoid activates the electromagnetic switch contact-free, thus triggering a low-level signal. The operating time is terminated via the piston detector.
- The flashing frequency in the case of the control p.c.b. 236-13870-2 is:
  0.5 seconds ON and 0.5 seconds OFF
- The external relay drops out and the LED is extinguished once the operating time has expired. The pump stops operating and doesn't restart automatically any longer.

[1] All indications of positions refer to fig. 35 (page 21).

Magnetic switch

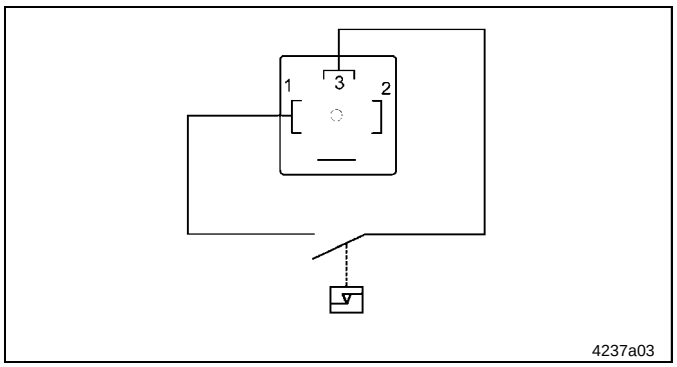


Fig. 36 Connection diagram, low-level control for grease

- The electromagnetic switch is activated contact-free and without wear by the magnetic field of the solenoid fitted to the stirring paddle.

6001a02

NOTE

The life of the magnetic circuit breaker strongly depends on the conditions under which it is loaded. Since the data relative to the maximum switching capacity refer to strictly resistive loads, which cannot always be guaranteed in practice, it is necessary to take the corresponding contact protection measures in the case of deviating loads.

Technical Data

Switching capacity ..... max. 60VA
Switching voltage ..... max. 230 V
Current switched ..... 3 A

Contact protection measures

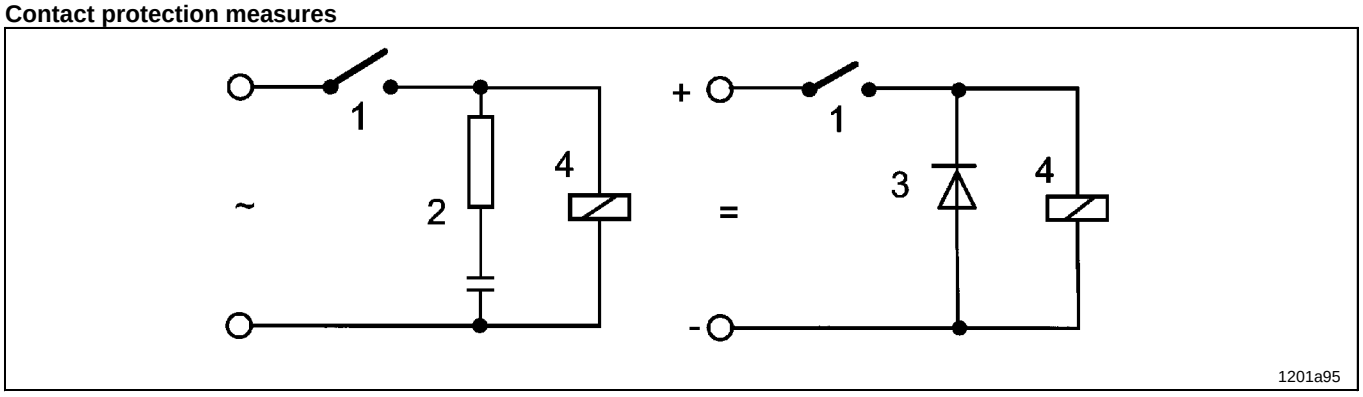


Fig. 37 Contact protection measures

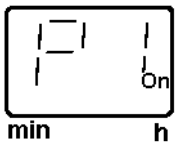
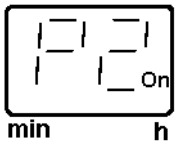
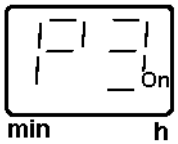
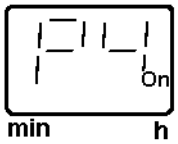
1 - Electromagnetic switch
2 - RC element
3 - Diode
4 - Load

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Setting and Operation

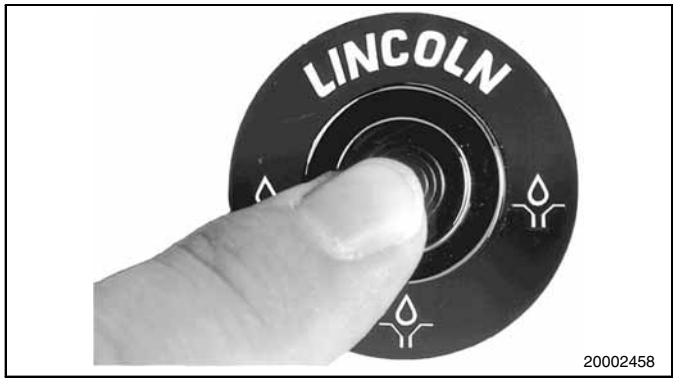
Factory Settings

Programming steps	Factory Setting	Description	Page
 4215a99	**0.0**	6 hours Pause time	26
 4217a99	**0.30**	0 minutes Pause time	26
 4218a99	**0.1**	Lubrication cycles: 1 cycle (metering device cycle)	27
 6252b04	**n.0**	Signal output of the fault relay: NO (normally open) Signalizing during the failure or low-level indi cation	27

Operator Keys

Key Function		Key Function	
 4222a99	**Key for modifying the parameters in the programming step**	 4214a99	**Key for switching to the next programming step**

External triggering of an additional lubrication cycle



Press key > 2 seconds.

Fig. 38 Key for triggering an additional lubrication cycle

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Setting and Operation, continuation

Three possible modes of operation and settings can be selected on the keypad.

- **Display mode**
- **Programming mode (page 26 ff)**
- **Operating mode (page 29 ff)**

Display Mode

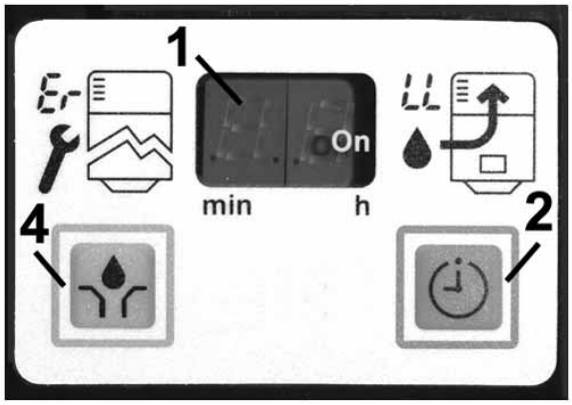


Fig. 39 P223 Membrane keypad

- **In the display mode** the user receives information on functions and malfunctions.
- As soon as voltage is applied to the pump, the keypad is automatically in "**display mode"**. The **right-hand segment** is illuminated on the display.
- Normally, the display is dark. Only functions (segment, rotating segment display) or malfunctions (* **Er ***, * **LL ***) are displayed.

1 - Display
2 - Operator key to acknowledge malfunctions and for time setting
4 - Operator key to trigger an additional lubrication cycle

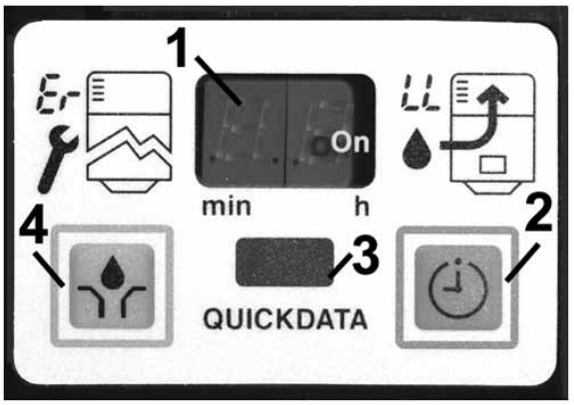


Fig. 40 P233 membrane key pad with reading window

Only P233:

- By means of the Lincoln diagnostic software QuickData the data memory of pump 233 can be transmitted to a notebook, PDA or Palm via the reading window (pos. 3).

1 - Display
2 - Operator key to acknowledge malfunctions and for time setting
3 - Reading window for data transmission out of the integrated data memory to diagnostic software QuickData
4 - Operator key to trigger an additional lubrication cycle

Subject to modifications

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Setting and Operation, continuation

Display Mode, continuation

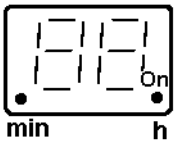
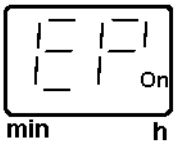
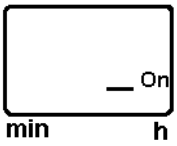
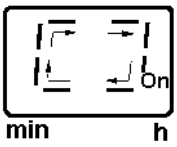
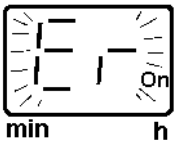
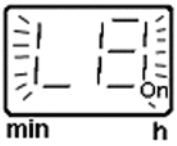
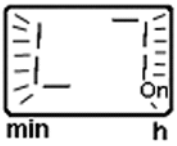
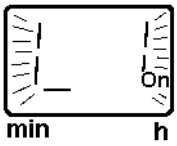
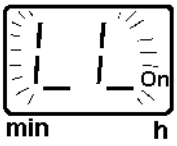
Display	Press
 4207a99	2 sec.
 4227a99	
 4208a04	
 4209a99	
 4210a99	
 6262b04  6263b04  6264b04	
 4210a99	
 4214a99	< 2 sec.

Fig. 41 Display mode

- A test display is made when the voltage is applied; all segments and decimal points are illuminated for 2 seconds.


6001a02

NOTE

*If ***EP*** is displayed after the display test, this indicates that the button or the keypad is defective.*

- The right-hand segment (On/h) indicates the available voltage supply during the pause time. As soon as another message is displayed, the segment turns off.
- The operating time is displayed as a rotating segment.
- * **Er *** is shown to indicate a malfunction
- **In the display mode**, a low level is announced by an intermittent display of *** L8 *, * L7 *, * L6 * … * L1 ***.
- Finally appears the intermittent display *** LL *** for a low-level indication that had not been confirmed.

<u>To acknowledge a malfunction</u>

- The flashing display is changed into a continuous light by pressing the button **(acknowledging).** To **acknowledge**, press the button only briefly (< 2 sec.).
- Messages that have been acknowledged but have not yet been remedied flash again after the pump is switched off and on again.

Subject to modifications

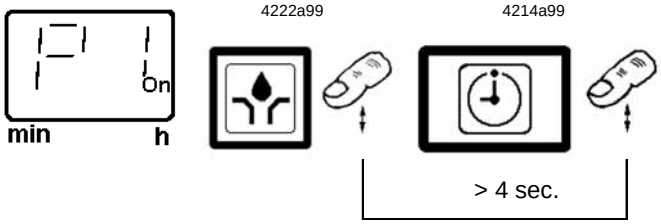
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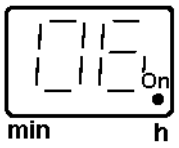
Setting and Operation, continuation

Programming Mode

Display **press**

4215a99





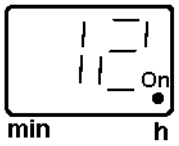
4281a00

Setting Pause Time P1 and P2

➲ To access to the programming mode, **press both buttons** at the same time **> 4 seconds**, so that “P1” appears in the display.

Programming options:	Pause time:
P1	0 - 59 hours
P2	0 - 59 minutes
Min. pause time DC	4 minutes
Max. pause time DC/AC	59 hours 59 minutes

P1: Setting hours
When releasing the two buttons, the currently set value appears (here the factory-set value: 6 hours).
The field “hour“ is indicated by a **decimal point** on the **right-hand side**.

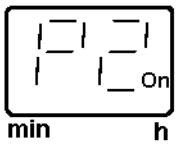


4220a99



4222a99

➲ Press button.
➲ Settings are made in one direction: 0, 1, 2, 3,....59 h
Button pressed once …..... increases by 1 hour
Button pressed continuously ..... quick sequence

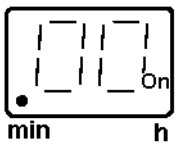


4217a99



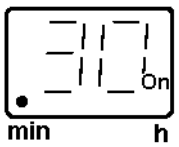
4214a99

P2: Setting minutes
➲ Press button, so that “P2“ appears in the display.



6270b04

When releasing the button, the currently set value appears (here the factory-set value: 0 minutes).
The field “minute“ is indicated by a **decimal point** on the **left-hand side**.



4220a99



4222a99

➲ Press button.
➲ Settings are made in one direction: 0, 1, 2, 3, 4, ... 59 min
Button pressed once …..... increases by 1 minute
Button pressed continuously ..... quick sequence



6001a02

NOTE

*The minimum pause time is 4 respectively 20 minutes. For settings < 4 respectively < 20 minutes (without input of hours) there automatically appears “**. 04**“ respectively “**. 20**“ in the display provided the programming sequence has been carried out completely.*

Fig. 42 Programming mode (continuation next page)

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Setting and Operation, continuation

Programming Mode, continuation

P3: Setting number of cycles

If lube points are divided via sub-divider valves (SSV 6) and a main divider valve (SSV 6, SSV 8), **never exceed a maximum of 18 (24) lube points**.

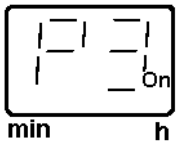
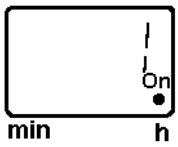
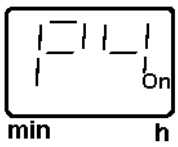
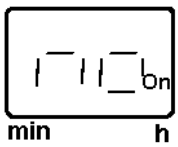
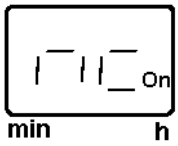
Display	Press
 4218a99	 4214a99
 4219a04	
 4219a99	 4222a99
 6252b04	 4214a99
 6254b04	
 6253b04	 4222a99

Fig. 42 Programming mode (continuation next page)


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IMPORTANT

Settings are only possible in connection with progressive divider block SSV 6 or SSV 8 KNQLS (connected as a main divider block) and a jumper attached to the p.c.b.

➲ Press button so that “P3“ appears in the display.

Max. cycle time VDC …… 1 to 5

When releasing the button, the currently set value appears (here the factory-set value: 1 cycle).

➲ Press button.
➲ Settings are made in one direction: 1, 2, 3, 4, 5

P4: Programming of the output signal on the monitoring relay for external fault indication (external fault contact)

➲ Press button so that “P4“ appears in the display.

When releasing the button, the currently set value appears in the display (here the factory-set value **NO**, **n**ormally **o**pen contact).

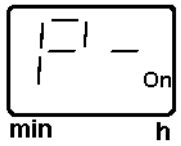
➲ Press button.
The external fault contact is modified by programming it as **NC** **n**ormally **c**losed contact.

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Setting and Operation, continuation

Programming Mode, continuation



4221a99



4214a99



4222a99



4208a99

Fig. 42 Programming mode

Completing the programming

➲ Press button. **„ P -“** is displayed.



6001a02

IMPORTANT

In order to avoid a wrong program, make sure to always carry out the programming order completely, i.e. setting of P1 (hours), P2 (minutes), P3 (number of cycles), P4 (potential-free contact) and P- (Programming end).

· Press this key (additional lubrication) to complete the programming and to save the entered parameters.



6001a02

NOTE

If the button “additional lubrication” is not pressed within 30 seconds, the changed parameters are not saved and the previous programming remains valid.

IMPORTANT

After completion of the programming, check the parameter settings in the operating mode once again (see pages 29 ff).

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Setting and Operation, continuation

Operating Mode

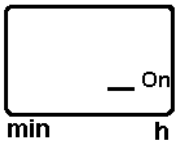
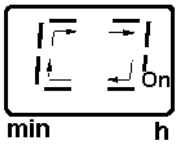
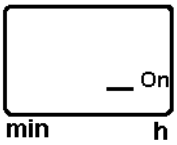
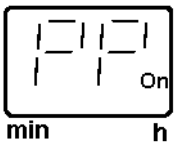
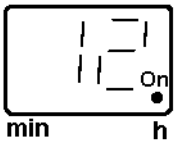
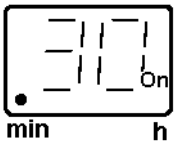
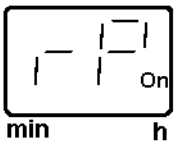
Display	Press
 4208a04	
 4209a99	 > 2 sec. 4222a99
 4208a04	
 4123a99	 4214a99
 4216a99	after two sec.
 4220a99	after two sec.
 4224a99	after two sec.

Fig. 43 Operating mode (continuation next page)


6001a02

IMPORTANT

The operating mode is accessible only during the pause time, and cannot be operated during the running time (pump operating time).

- Precondition: When the voltage supply is applied, the segment (On) is lit.

Operating option: Initiating an additional lube cycle

➲ Press the button (> 2 sec.). The elapsed pause time is reset. The operating time starts. A rotating segment is visible on the display during the whole operating time.

Operating option: Calling up of set parameters and data determined

➲ Press the button.

PP (set pause time)


6001a02

NOTE

*The following display sequence is shown **once** and is cancelled after 40 seconds. The change of display occurs every two seconds. Example:*

PP = 12h 30 min
rP = 5h 10 min

12 . (hours)

. 30 (minutes)

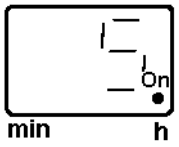
rP (remaining pause time)

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Setting and Operation, continuation

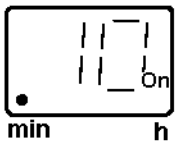
Operating Mode, continuation



4225a99

after two sec.

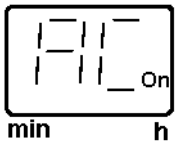
5 . (hours)



4226a99

after two sec.

. 10 (minutes)

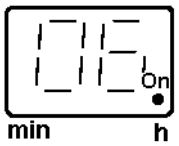


4277a00

after two sec.

AC number of the automatically triggered lube cycles, countable up to 9999 cycles.
Then counting starts from the beginning again.

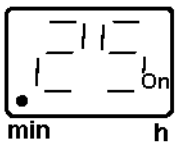
Example **0625** cycles:



4281a00

after two sec.

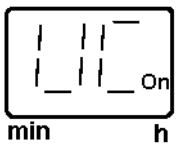
06. Display for thousands and hundreds
06 as 600



4280a00

after two sec.

.25 Display for tens and ones

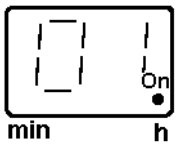


4278a00

after two sec.

UC Number of the manually triggered (by the user) additional lube cycles, countable up to 9999 cycles.
Then counting starts from the beginning again.

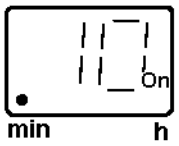
Example **0110** cycles:



4297a00

after two sec.

01. Display for thousands and hundreds
01 as 100



4226a99

after two sec.

.10 Display for tens and ones

Fig. 43 Operating mode (continuation next page)

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Setting and Operation, continuation

Operating Mode, continuation

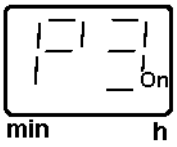
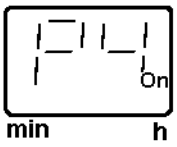
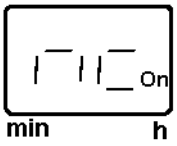
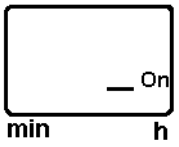
 4218a99	after two sec.	P3: Number of metering device cycles
 4219a99	after two sec.	Display of the metering device cycles
 6252b04	after two sec.	P4: Programming of the output signal
 6253b04	after two sec.	Display of the output signal “normally closed“ (NC) or “normally open“ (NO)
 4208a04	after approx. 40 sec.	Termination of the operating mode

Fig. 43 Operating mode

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Maintenance, Repair and Tests

Maintenance

- The maintenance is essentially limited to refilling the reservoir with clean lubricant in good time. However, check regularly whether the lubricant is really dispensed to all the lubrication points.
- Also check the main lines and lubricant feed lines for damage and replace them, if necessary.


6001a02

NOTE

Whenever work is done on the centralized lubrication system, particular attention should be paid to absolute cleanliness. Dirt in the system will cause malfunctions.

- For cleaning the system use benzine or petroleum. Do not use tri-, perchloroethylene or similar solvents.
  Also do not use polar organic solvents such as alcohol, methylacohol, acetone or similar.

Pump Filling



1011b93

Fig. 44 Fill pump reservoir

2 l, 4 l, 8 l - Reservoir

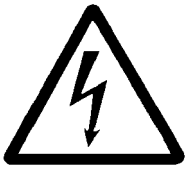
➲ Fill the reservoir up to the ”Max.” mark via the filling nipple, if any, or via the upper filling opening.

➲ It is possible to use greases up to penetration class NLGI grade 2.


6001a02

IMPORTANT

The grease or oil must be free from impurities and must not be liable to change its consistency in the course of time.


4273a00

CAUTION!

If the pump is filled via the upper filling opening, switch off the power supply before starting filling.


1013A94

CAUTION!

Risk of bursting if the reservoir is overfilled.

When filling the reservoir by means of pumps with a large delivery volume do not exceed the max. filling mark.


6001a02

NOTE

If the reservoir has been completely emptied, the pump may require until 10 minutes before it operates with its full output.

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Maintenance, Repair and Tests, continuation

Repair

Pump

- Use only original Lincoln spare parts for repair on the pumps.
- The pump should be returned to the factory for warranty work or major repairs.

Replace pump element

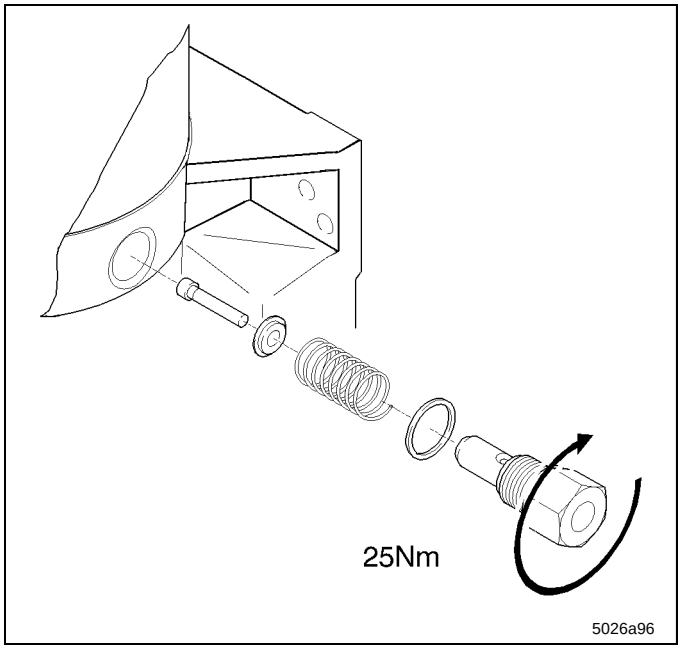


Fig. 45 Replace pump element

➲ Remove the pressure relief valve from the pump element.

➲ Unscrew the pump element.



6001a02

IMPORTANT

Take care that the piston, the pull-back spring and the washer are not left lying in the grease; otherwise the reservoir must be disassembled in order to remove these pieces.

IMPORTANT

Do not leave the piston, spring and washer in the housing because they may block the motor.

NOTE

Pump elements with adjustable lubricant output are to be set to the required output before installation.

➲ Install a new pump element with a new sealing ring.

Control p.c.b.

➲ Note down the jumper positions of the defective control p.c.b.

➲ Pack the defective control p.c.b. properly so that it will reach the factory without any further damages.

- A defective control p.c.b. will always be replaced by a control p.c.b. version MF00 (P223) or MDF00 (P233).

➲ Set the jumper configuration on the new control p.c.b. according to the one noted down from the old control p.c.b.

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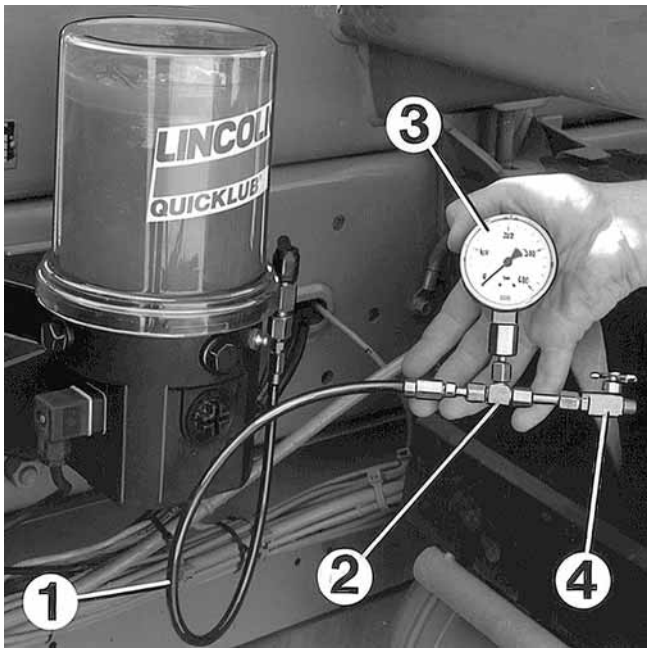
Maintenance, Repair and Tests, continuation

Tests

Operational Test / Triggering an Additional Lubrication Cycle

- To check the pump operation it is possible to perform an additional test (see paragraph ”Additional lubrication cycle“, page 19).

Check the Pressure Relief Valve



1005a93

Fig. 46 Check the pressure relief valve

1st option

➲ Connect the pressure gauge (0-600 bar; 0-8708 psi) to the pressure relief valve (see fig. 16, page 15).

➲ Trigger an additional lubrication cycle.

2nd option

➲ Connect the manual pump of the pressure and checking set 604-36879-1 to the pressure relief valve and check the opening pressure by means of the manual pump.

➲ The pressure relief valve should open at a pressure of 200, 270 or 350 bar depending on its design.



6001a02

IMPORTANT

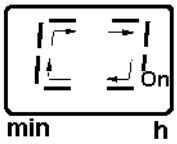
Do not connect the pressure gauge directly to the pump element. High pressure may exceed the above-mentioned range, causing the motor to stall. The motor is designed in such way that it can stall for about 30 minutes without being damaged.

1 - Hose line, min. length 1m
2 - T-piece
3 - Pressure gauge
4 - Relief cock

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Troubleshooting



4209a99

Fig. 47 Green circulating illuminated segment, operating time



6001a02

NOTE

The pump operation can be checked from the outside by observing whether the stirring paddle is rotating (e.g. by triggering an additional lubrication).
Additionally, during the operating time of the pump a circulating illuminated segment appears in the display window of the membrane keypad (see fig. 47).

Fault: The pump motor does not run, stirring paddle does not turn

Cause:	**Remedy:**
· Power supply interrupted, segment display for On/h is not lit	➲ Check the power supply (connection, lines) and fuses. ➲ If necessary rectify the fault and/or replace the fuses.
· Power supply from control p.c.b. to motor interrupted, electric motor defective	➲ Check the line leading from the fuses to the pump plug. ➲ Check the power supply to the motor. If necessary, replace the motor.
· Defective control printed circuit board	➲ Replace the control p.c.b.
· Defective operator key of the membrane key pad	➲ *** EP *** display is lit. Replace housing and membrane keypad.

Fault: Pump motor does not stop dispensing (30 minutes monitoring time)

Cause:	**Remedy:**
· Defective piston detector (initiator)	➲ Remove main line towards the monitored divider valve.
· Blockage in the system	➲ Unscrew the piston detector. ➲ Check the piston detector by introducing an iron pin into the borehole of the detector, maintain it there for more than 2 seconds and pull out again. If then the pump switches off, a blockage may exist. If the pump does not switch off, check cable connections towards the pump.
· Coble connections from the piston detector towards the pump interrupted.	➲ Check cable connections towards pump. ➲ If necessary, replace piston detector with connecting plug.
· Defective control p.c.b.	➲ Replace the control p.c.b.

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Troubleshooting, continuation

Fault: The pump does not deliver lubricant

Cause:	Remedy:
· Reservoir empty. *** LL *** display on the membrane keypad is flashing.	➲ Fill up the reservoir with clean grease. Let the pump run (trigger additional lubrication cycle, see fig. 30, page19) until lubricant shows at all lube points.
· Pump does not deliver lubricant and *** Er *** display on the membrane keypad is flashing.	
	 6001a02 **NOTE** *Depending on the ambient temperature and/or sort of lubricant it may take 10 minutes of operation before the pump elements reach their full lubricant output. Therefore, trigger several additional lube cycles.*
· Air bubbles in the lubricant	➲ Trigger an additional lubrication cycle (see fig. 30, page 19). Loosen the outlet fitting or the main line on the pressure relief valve. The lubricant must penetrate without air bubbles.
	 6001a02 **NOTE** *When push-in type fittings are used, the high-pressure hose, which is under pressure, cannot be easily disconnected from the pressure relief valve. For this purpose, loosen the pressure relief valve or, if exists, the filling nipple on the pressure relief valve in order to relieve the high-pressure hose.*
· Unsuitable lubricant has been used	➲ Renew the lubricant (see the lubricant list page 45 and 46).
· Suction hole of the pump element clogged	➲ Remove pump element. Check suction hole for foreign particles. If there are any, remove them.
· Pump piston worn	➲ Replace pump element.
· Check valve in the pump element defective or clogged	➲ Replace pump element.

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Technical Data

PUMP

Admissible operating temperature ..... -40° C to 70° C [1)]
Number of outlets ..... 1,2 or 3
Reservoir capacity ..... 2 l, 4 l, 8 l
Refilling .....via hydraulic lubrication fitting or from top
Lubricant ..... greases up to NLGI grade 2
Class of protection ..... IP6K 9K acc. to DIN 40050 T9
.....U_L type 4X only for indoor use, 12 and 13



6001a02

***1)* NOTE**

The pump is designed for the above mentioned temperature range. However, most times the lubricants are pumpable up to –25°C only. For lower temperatures use low-temperature lubricants.

Pump element with fixed lubricant output

Piston diameter, K5, B7 .....5 mm
- Lubricant output ..... approx. 2 cm³/min
Piston diameter, (Standard) K6.....6 mm
- Lubricant output ..... approx. 2.8 cm³/min
Piston diameter, K7, S7 .....7 mm
- Lubricant output ..... approx. 4 cm³/min
Max. operating pressure . ..... 350 bar
Connection thread ..... G ¼“
- suitable for tube dia ..... 6 mm

Pump element with adjustable lubricant output

KR ..... 0.04 to 0.18 cm³/stroke
..... 0.7 to 3 cm³/min
Connection thread ..... G ¼“
- suitable for tube dia ..... 6 mm
- suitable for tube dia ..... 8 mm



6001a02

IMPORTANT

The lubricant outputs listed refer to grease of NLGI grade 2 measured at 20°C, backpressure 100 bar, and nominal voltage 12/24 V. Any differing pressures or temperatures result in different lubricant outputs. Any system design must be based on the above values.

PRESSURE RELIEF VALVE

SVTE-350-G 1/4A-D6 624-28894-1
SVTE-350-G 1/4A-D8 624-28774-1

TORSION TORQUES

Install pump ..... 18 Nm
Electric motor on housing ..... 12 Nm
Pump element in housing ..... 25 Nm
Closure plug in housing ..... 12 Nm
Return line connector in housing ..... 10 - 12 Nm

WEIGHTS

The weights below include the following ‘‘**individual weights**”:
- Pump kit with **one** pump element, safety valve, grease filling (0.75 kg, 1.5 kg)
- Packing (cardboard box)
- Attaching parts
- Operating Instructions

2 l reservoir, standard design (0.75 kg)

- Pump 233, version 2A6.15 ..... approx. 7.6 kg

4 l reservoir, standard design (1.5 kg)

- Pump 223, 233, version 2A6.15 ..... approx. 10.4 kg

8 l reservoir, standard design (1.5 kg)

-Pump 223, 233, version 2A6.15 ..... approx. 10.6 kg

In the case of pump versions deviating from those mentioned, add the weights of the following components to the mentioned weights:
- per pump element ..... +0.2 kg
- per pressure relief valve ..... +0.1 kg
- Connection cable with piston detector ..... +0.1 kg
- Reservoir version ”Filling from top” (only 2 l) [3)] ..... +0.15 kg
- 2 l flat-type reservoir..... +0.5 kg



6001a02

***3)* NOTE**

The 4l and 8l reservoirs have the standard design ”filling from top”.

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Technical Data, continuation

Electrical Data

PUMP

Input

Rated voltage ..... 12 VDC, -20% / +30%
Max. operating current ..... 2.0 A
Rated voltage ..... 24 VDC, -20% / +30%
Max. operating current ..... 1.0 A
Class of protection ..... IP6K 9K acc. to DIN 40050 T9

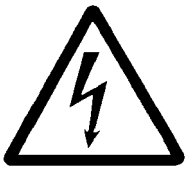

6001a02

NOTE

The protection IP6K9K is guaranteed when the socket (X1:, X2:) is tightened on housing cover with flat packing.

Reverse polarity protection ..... The operating voltage .....inlets are protected against reverse polarity

Residual ripple in relation to the operating voltage
..... ± 5% acc. to DIN 41755


4273a00

CAUTION!

Consider residual ripple of max. ±5 % to connect pumps with direct current version (in relation to the operating voltage acc. to DIN 41755).


6001a02

NOTE

If the internal fuse must be replaced, only use the original fuse type.


6001a02

IMPORTANT

Pump 223, 233 is suitable for interval operation only, not for permanent operation!

Output

Output voltage, internal ..... 24 VDC ±1%

EMC

In addition to the EMV directive, the **DC systems** also comply with the following guidelines and standards:
- the vehicle guideline 95/245/EC
- EN 40839 T1, 3 and 4

The printed circuit board is protected against condensate by a protective paint coating.

Emitted interference acc. to ..... EN 55011 / 03.91
..... and EN 50081-1 / 01
Interference immunity acc. to ..... prEN 50085-2 / 1994

Motor

DC gear motor (interference-suppressed)
- Operating voltage 24VDC
- Max. current input 24V ..... 3 A
- Speed ..... approx. 17 U/min

Relay for Malfunction DC

Malfunction / low-level control:
- Switching voltage ..... max. 48 VAC/ VDC
- Switching current ..... max. (resistive) 2 A
- Switching capacity ..... max. 100 VA/80 W


6001a02

NOTE

All data depends on operating voltage, ambient temperature and max. operating pressure.

CONTROL PRINTED CIRCUIT BOARD

Rated voltage ..... 24 VDC
Operating voltage ..... 9 to 30 V
Residual ripple in relation
- with the operating voltage..... ±5% acc. to DIN 41755
Output motor ..... transistor 7A / short-circuit proof
Reverse voltage protection ... The operating voltage inputs
..... are protected against polarity reversal
Temperature range ..... -25 °C to 70 °C
- Output fault / readiness for service
.....transistor 3A / short-circuit proof

Class of protection:
Printed circuit board installed in housing ..... IP 6 K 9 K

TIME SETTING

Range of pause time ..... increment 1 minute
- VDC ..... 4 minutes to 60 hours
Factory setting:
Pause time..... 6 hours/cycle
Number of lubrication cycles:
- VDC ..... 1 to 5 cycles
Timer memory ..... indefinite over EEPROM

Operation with bayonet plug


4273a00

CAUTION!

If the protective-conductor terminal is not connected or interrupted, dangerous touch voltages may occur on the equipment!

Protective measures to be applied for the appropriate operation with quarter-turn type plugs:
"Functional extra-low voltage with safe isolation" /
"Protective Extra-Low Voltage" (PELV)
Standards: EN60204 Part1:1992 / IEC 204-1:1992, modified
DIN VDE 0100 Part 410 / IEC 364-4-41:1992

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Technical Data, continuation

Electrical connection VDC

Observe the safety instructions (page 6) and the technical data (pages 37 and 38)!

- ➲ Make sure of the connection and the type of construction of your P223, 233.
- ➲ Connect the electrical wires according to the following electrical connecting diagrams.



6001a02

NOTE

For connection of the low-level control observe the respective connection diagrams and contact protective measures (see fig. 37, page 22).

Pump 223 with control p.c.b. MF00

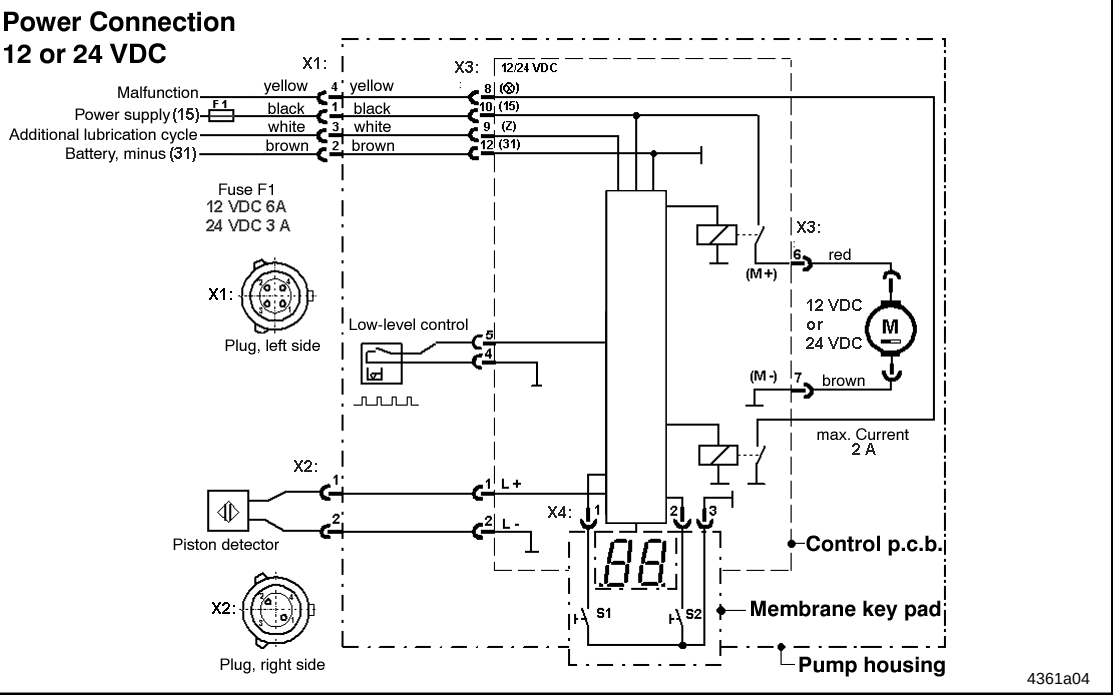


Fig. 48 Connection diagram DC, pump 223

Pump 233 with control p.c.b MDF00

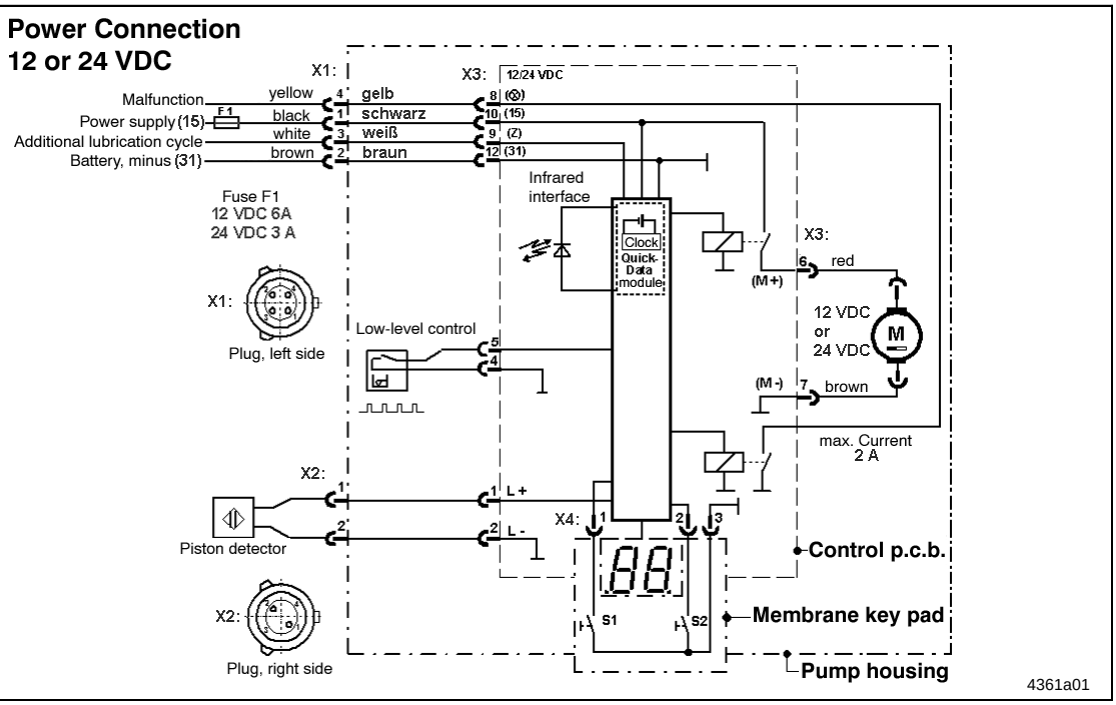


Fig. 49 Connection diagram DC, pump 233

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Technical Data, continuation

Dimensions - 2 l reservoir

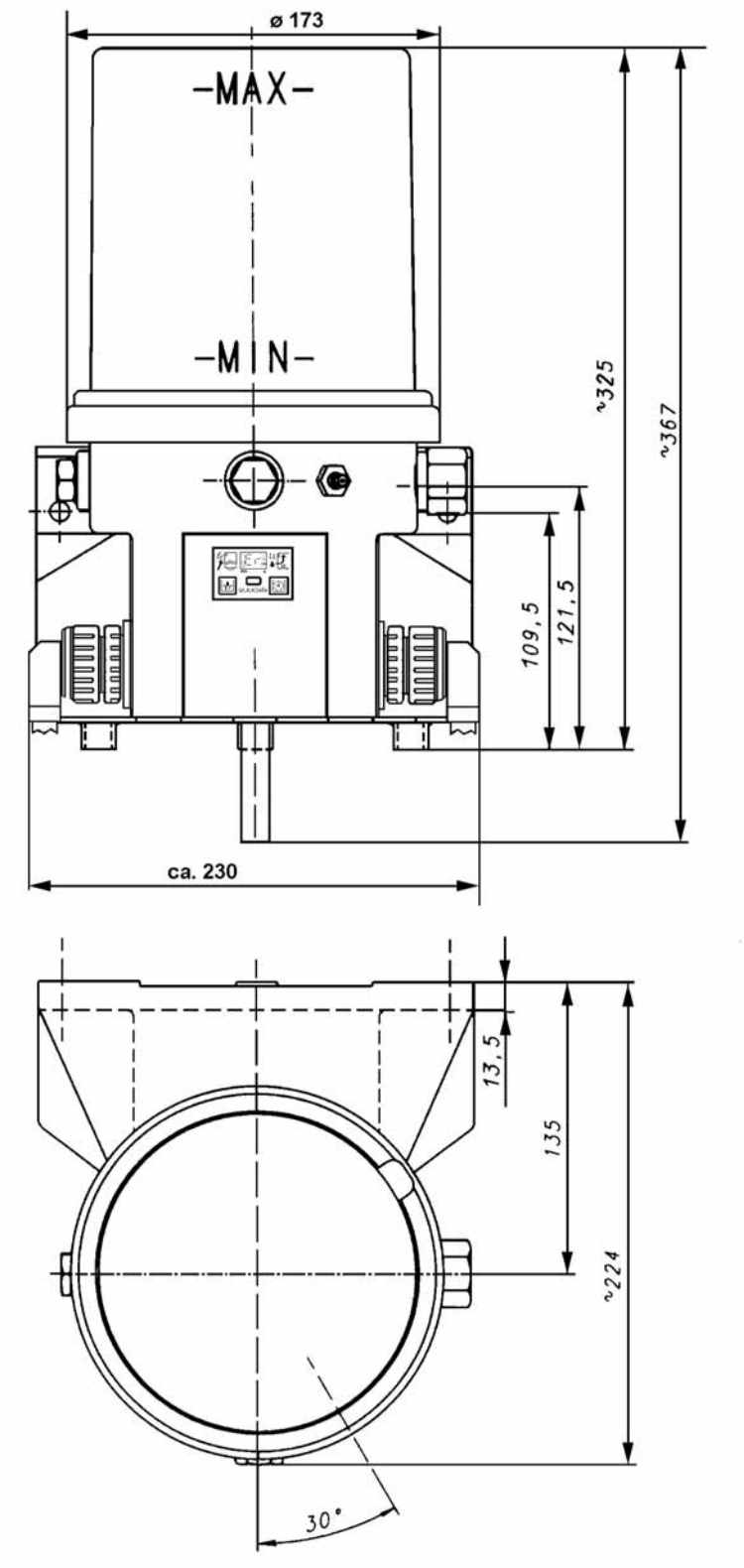


Fig. 50 Dimensions - 2 l reservoir

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Technical Data, continuation

Dimensions - 2 l reservoir with filling from the top

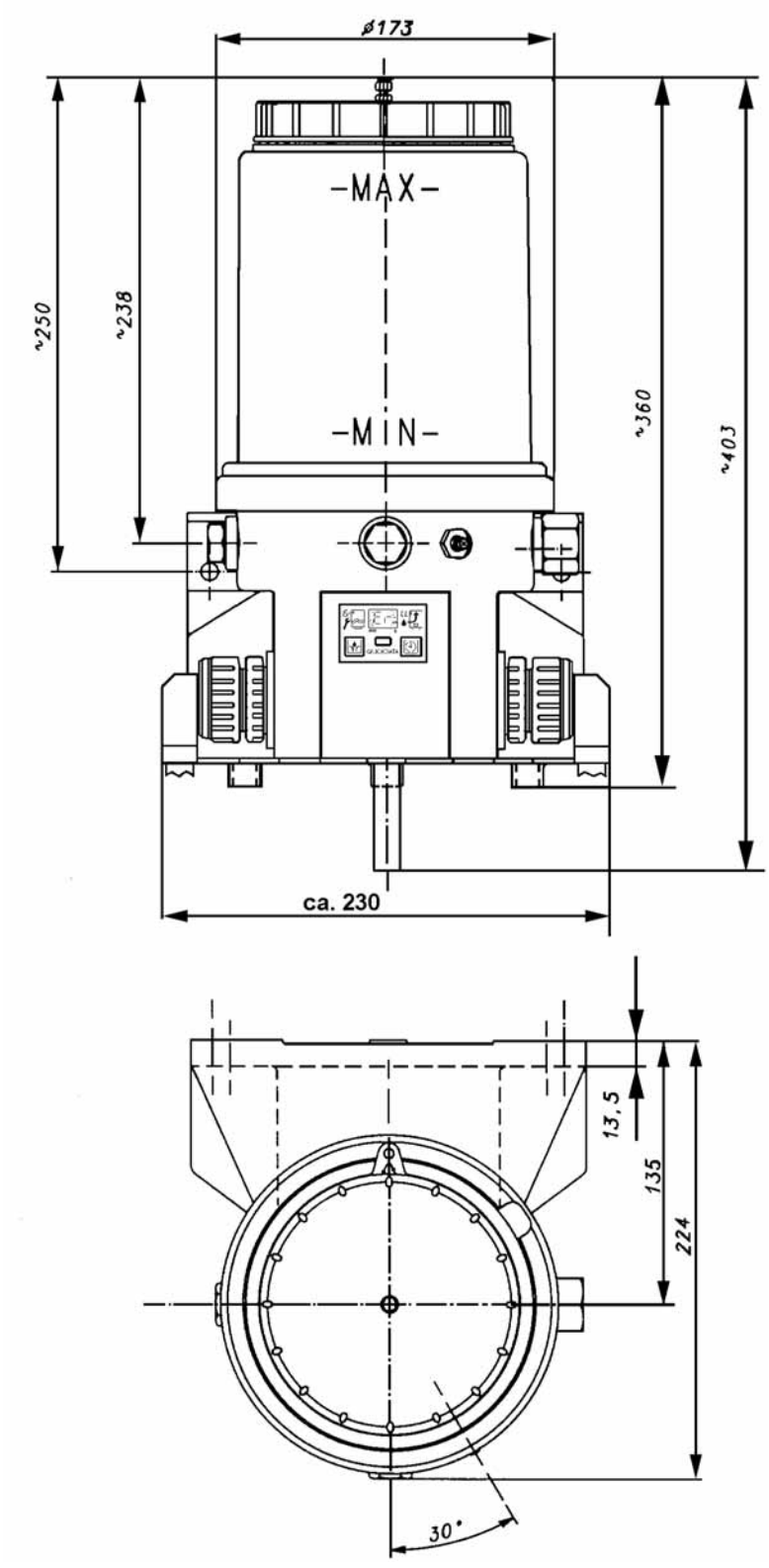


Fig. 51 Dimensions - 2 l reservoir with filling from the top

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Technical Data, continuation

Dimensions - 2 l flat-type reservoir

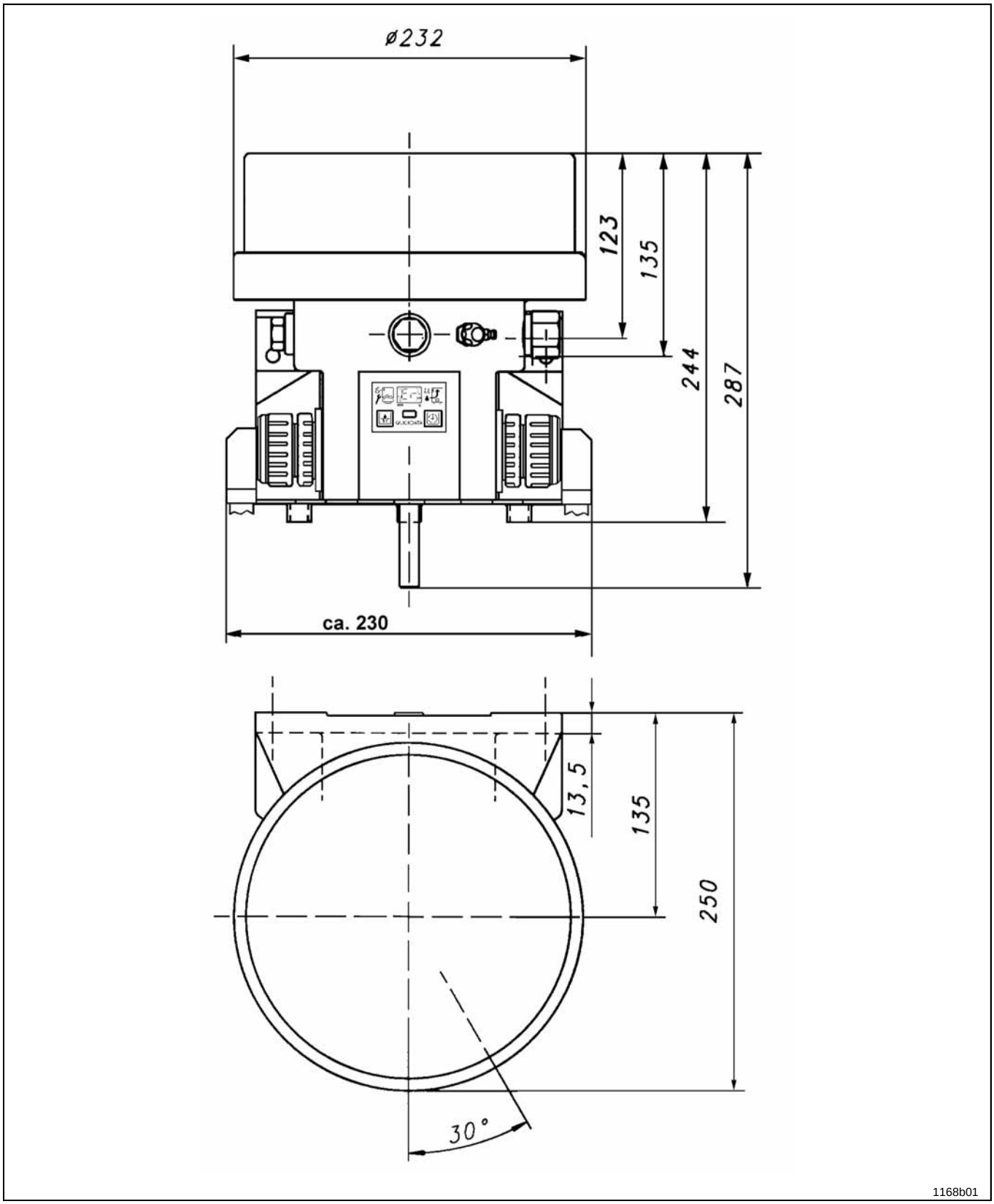


Fig. 52 Dimensions - 2 l flat-type reservoir

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Technical Data, continuation

Dimensions - 4 l reservoir

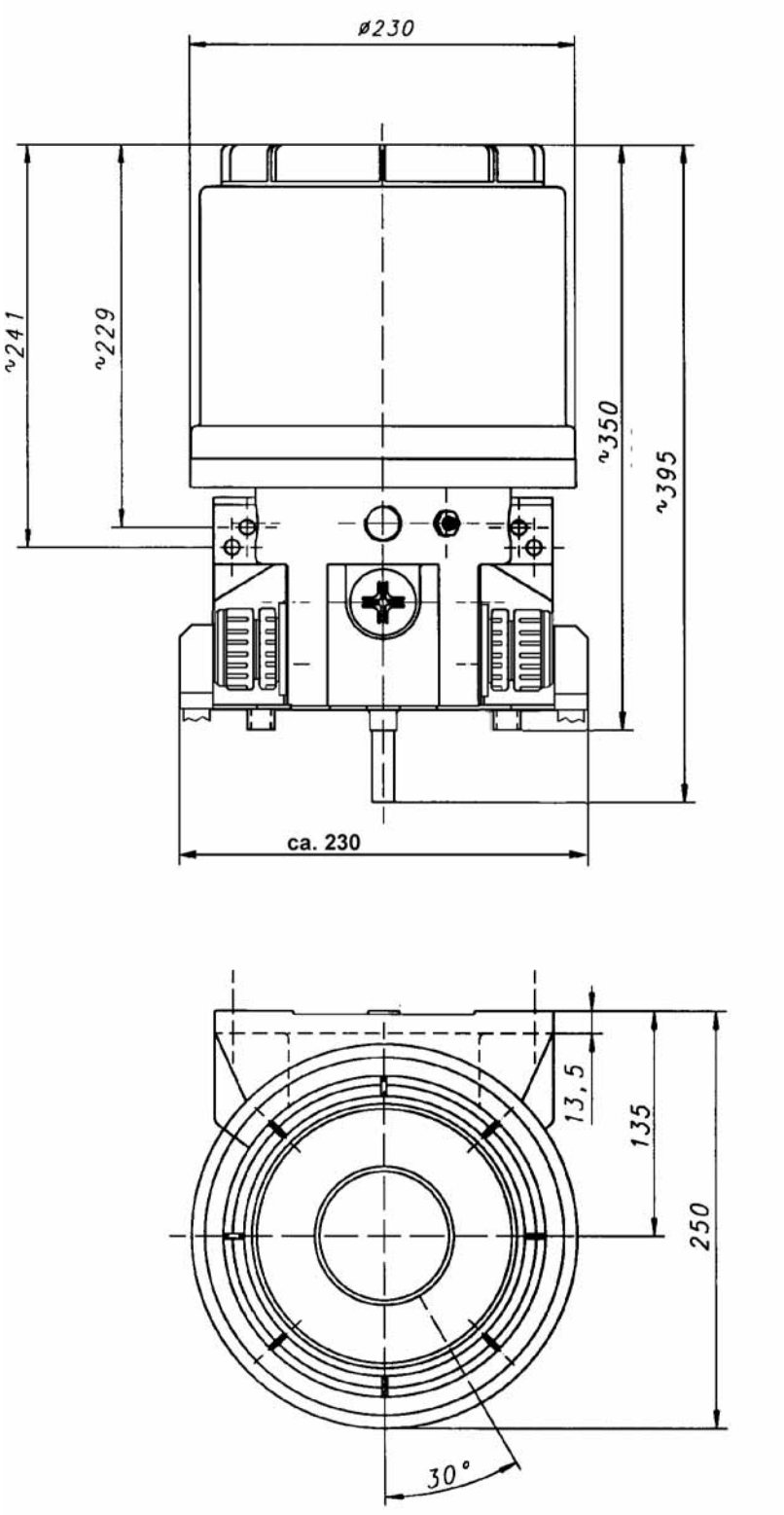


Fig. 53 Dimensions - 4 l reservoir

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Technical Data, continuation

Dimensions - 8 l reservoir

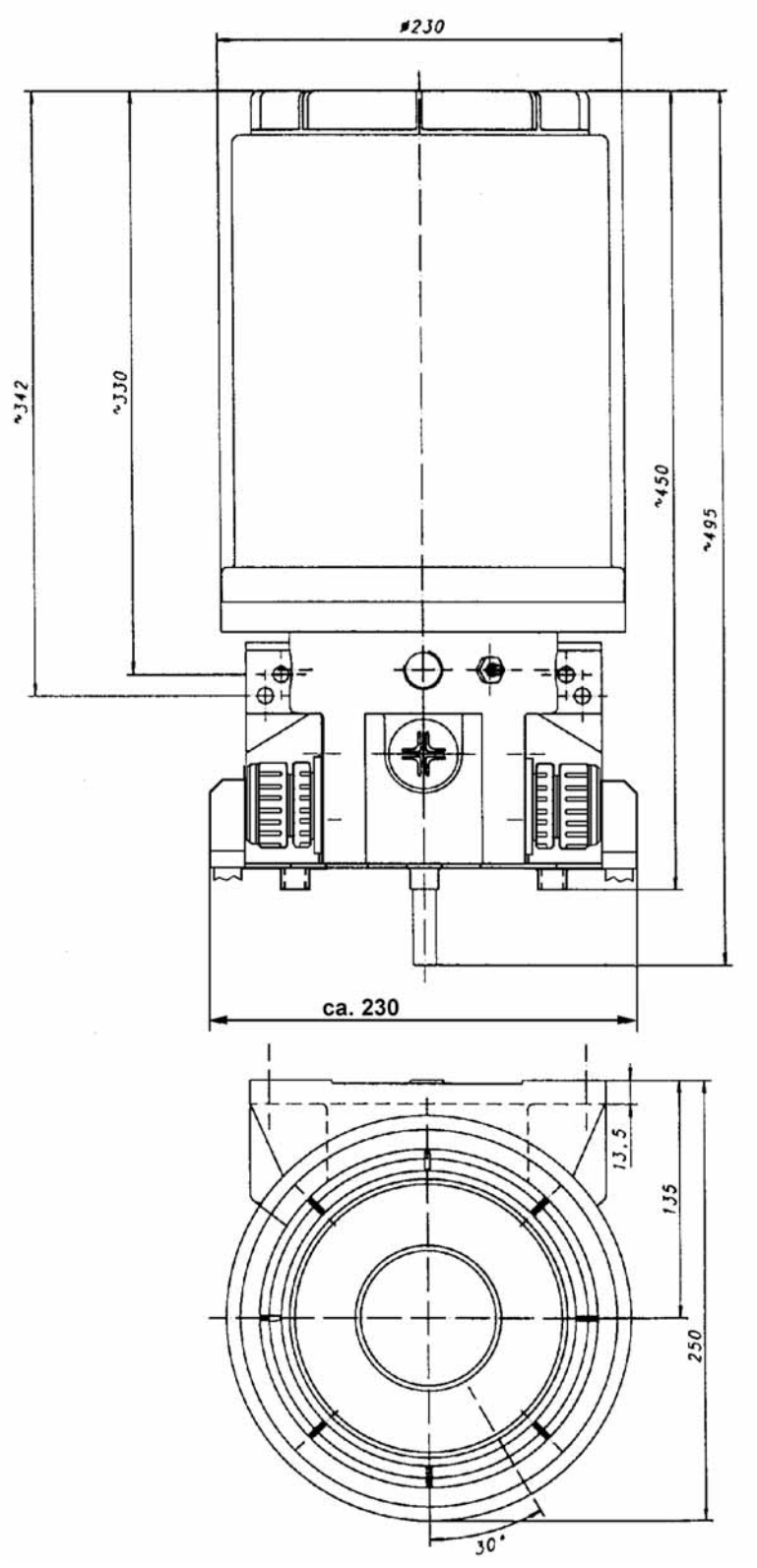


Fig. 54 Dimensions - 8 l reservoir

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Technical Data, continuation

Attaching boreholes of the 2 l, 4 l and 8 l pump

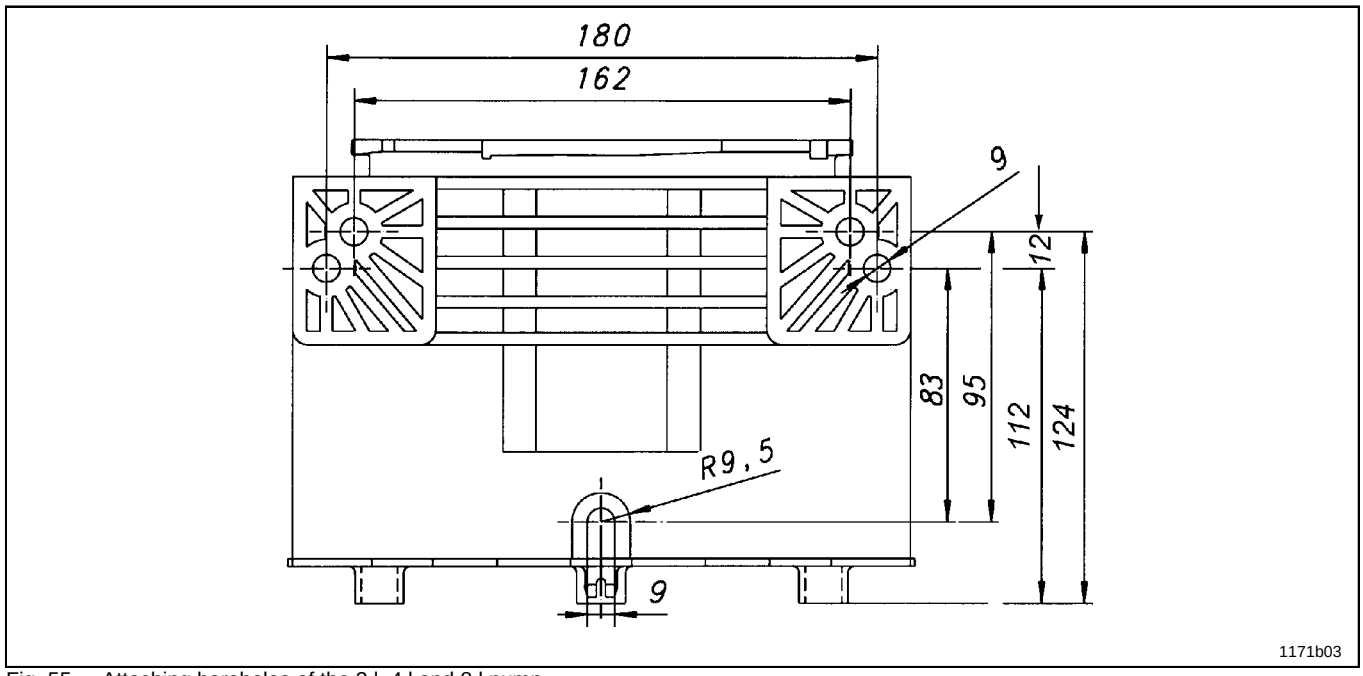


Fig. 55 Attaching boreholes of the 2 l, 4 l and 8 l pump

6001a02

NOTE

Tighten pump models with 2 l-flat-type, 4 l and 8 l reservoir with three fastening screws (see point R 9,5).

Lubricants

6001a02

IMPORTANT

Absolute cleanness is essential when handling lubricants. Impurities will remain suspended in the lubricant and cannot settle. This will result in damage to the lubrication system and thus to the bearing.

The Quicklub pump can dispense commercial greases up to NLGI grade 2 or mineral oils of at least 40 mm/s (cST) at 40 °C.

The **proven lubricants** (see following tables) have been tested by us with regard to their transportability and bleeding behavior. We can recommend them for an application up to the indicated **minimum delivery temperature** in Quicklub lubrication systems by Lincoln& Co. KG. During the tests these lubricants did not cause any damage due to incompatibility with the material used by us. The composition of the lubricants, their behavior during the transport and their compatibility with other material are not known to us.

The lubricants we recommend on the basis of the manufacturer's data sheet (see following tables) can be used in our lubrication systems up to the indicated **minimum delivery temperature**.

Lubricant recipes may change. In case of doubt, send your request for more information to the manufacturer of the centralized lubrication system. This refers in particular to lubricants with more than 3% graphite that are transportable in lubrication systems only conditionally.
The lubricants released by us have not been tested with regard to their long-term behavior.

6001a02

IMPORTANT

The manufacturer of the centralized lubrication system can accept no liability for:

- *damages due to the use of greases that are not or only conditionally transportable in centralized lubrication systems.*
- *damages on parts of the centralized lubrication system caused by chemical or biological changes of the lubricant used.*
- *damages due to the incompatibility with other materials.*

The liability is limited to transportable lubricants in centralized lubrication systems.

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Lubricants, continuation

Quicklub List of Lubricants



6001a02

IMPORTANT

Use lubricants with solid matter additives only after having consulted the manufacturer of the system!

Proven lubricants:

Manufacturer	Designation	Base soap	Min. delivery temperature
AUTOL	Top 2000	Ca-complex	-10 °C
AUTOL	Top 2000 W	Ca-complex	-20 °C
BP	C1 Multipurpose grease	Ca	-20 °C
BOSCH-REXROTH	Dynalub 510	Li	-15 °C
BOSCH-REXROTH	Dynalub 520	Li	-20 °C
ELKALUB	GLS 135/N2	Li	-15 °C
FUCHS-LUBRITECH	Stabil Eco EP2	Li/Ca	-25 °C
FUCHS	Renocal FN 745	Ca-12-OH-stearat	-25 °C
FUCHS	Renocal FN3	Ca	-20 °C
FUCHS	Renolit LZR 2 H	Li	-20 °C
FUCHS	Renolit HLT 2	Li	-25 °C
MOBIL	Mobilith SHC 100	Li-complex	-25 °C
MOLYKOTE	TTF 52	inorganic thickener	-30 °C
OPTIMOL	Longtime PD 2	Li-12-OH-stearat	-20 °C
OPTIMOL	OLIT CLS	Li/Ca	-15 °C
SHELL	Retinax EPL 2	Li-12-OH-stearat	-10 °C
WESTFALEN	Gresalit ZSA 2	Li-12-OH-stearat	-15 °C

Lubricant recommendations based on the manufacturer's data sheet:

Manufacturer	Designation	Base soap	Min. delivery temperature
AGIP	F1 Grease 24	Ca	-15 °C
ARAL	Multipurpose grease ZS 1/2	Li/Ca	-20 °C
BP	Energrease LC 2	Li-complex	-15 to -10 °C
BP	Energrease MP-MG 2	Ca-complex	-5 °C
CASTROL / TRIBOL	Molub Alloy 6780	Li-12-OH-stearat	-30 to -25 °C
CASTROL	CLS - Grease	Li/Ca	-25 °C
DEA	Glissando 20	Li-12-OH-stearat	-15 to -10 °C
ESSO	Ronex Extra Duty 2	Li-complex	5 °C
ESSO	Ronex MP2	Li-complex	-5 °C
ESSO	Beacon EP2	Li	-5 °C
ESSO	Cazar K2	Ca	-15 °C
FIAT LUBRIFICANTI	Comar 2	Li	-25 °C
FINA	CERAN LT	Ca-complex	-20 °C
FINA	CERAN WR2	Ca-complex	-10 °C
KLÜBER	Centoplex 1 DL	Li/Ca	-20 °C
KLÜBER	Isoflex NBU 15	Ba	-25 °C
MOBIL	Mobilgrease XHP 221	Li-complex	-10 °C
MOBIL	Mobilgrease XHP 461	Li-complex	-10 °C
MOBIL	Mobilgrease XHP 222	Li-complex	-5 °C
MOBIL	Mobilith SHC 220	Li-complex	-20 °C
SHELL	Alvania EP(LF) 1	Li-12-OH-stearat	-15°C +/- 5°C
SHELL	Alvania EP(LF) 2	Li-12-OH-stearat	-10°C +/- 5°C
SHELL	Alvania RL2	Li-12-OH-stearat	-15°C +/- 5°C
SHELL	Retinax CS	Li	-20 °C
SHELL	Retinax LX 2	Li	-5°C +/- 5°C
SHELL	Retinax HDX 2	Li/Ca	-10°C +/- 5°C
TEXACO	Premium RB	Li	-20 °C
ZELLER & GMELIN	DIVINOL Lithogrease G 421	Li-complex	-15 °C

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Lubricants, continuation

Quicklub List of Lubricants, continuation



6001a02

IMPORTANT

Use lubricants with solid matter additives only after having consulted the manufacturer of the system!

Biodegradable lubricants

Proven lubricants:

Manufacturer	Designation	Base soap	min. delivery temperature
ARAL	Aralub BAB EP 2	Li/Ca	-25 °C
BP	Biogrease EP 2	Li/Ca	-25 °C
FUCHS-LUBRITECH	Stabyl ECO EP 2	Li/Ca	-25 °C

Lubricant recommendations based on the manufacturer's data sheet:

Manufacturer	Designation	Base soap	min. delivery temperature
AUTOL	Top Bio 2000	Ca	-25 °C
AVIA	Biogrease 1	Li	up to 0 °C
DEA	Dolon E 2	Li	-15 °C
FUCHS	Plantogel 2 S	Li/Ca	-15 °C
KLÜBER	Klüberbio M72-82	Polycarbamide	-20 °C

Lubricants for the food & beverage industry

Lubricant recommendations based on the manufacturer's data sheet:

Manufacturer	Designation	Base soap	min. delivery temperature
ARAL EURAL	Grease EPF 2	Al-complex	-5°C
BREMER & LEGUIL	RIVOLTA F.L.G 4 – 2	Al-complex	-20 °C
ELKALUB	GLS 364	organic thickener	-10 °C
ELKALUB	GLS 367/N2	inorganic thickener	-5°C
ELKALUB	GLS 380/N1	Al-complex	-10 °C
ELKALUB	GLS 380/N2	Al-complex	-5°C
FUCHS	RENOLIT G 7 FG 1	Bentonite	-5°C
FUCHS-LUBRITECH	GLEITMO 585 M (KTW-drinking water release)	Li	-10 °C
INTERFLON	FIN FOOD GREASE EP	Al-complex	-5°C
KLUEBER	PARALIQ GA 343	Al-complex	-10 °C
KLUEBER	KLUEBERSYNTH UH1 14-151	Al-complex	-20 °C
MOBIL	MOBILGREASE FM 462	Al-complex	-15 °C
Nordischer Maschinenbau BAADER	Special grease GLS 380/N3	Al-complex	-5°C
OKS	470	Li-12-OH-stearat	-15 °C
OPTIMOL	OBEEN UF 1	Al-complex	-15 °C
OPTIMOL	OBEEN UF 2	Al-complex	-10 °C
RHENUS NORPLEX	AFD 2	Al-complex	-5°C
RHENUS NORPLEX	AFP 2	Al-complex	-5°C
RHENUS NORPLEX	AFS 2	Al-complex	-25 °C
RHENUS NORPLEX	AFW 2	Al-complex	-5°C
SHELL	CASSIDA Grease EPS 1	Al-complex	-15 °C
SHELL	CASSIDA Grease EPS 2	Al-complex	-10 °C
TOTAL	LUBRIPLATE FGL 2	Al-complex	-5°C
TRIBOL MOLUB-ALLOY	FoodProof 823-2 FM	Al-complex	-15 °C
TRIBOL MOLUB-ALLOY	9830 high-temperature grease	PTFE	0°C

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Declaration by the Manufacturer

D	GB	F	I
Herstellererklärung im Sinne der EG-Richtlinie Maschinen 98/37/EG, Anhang II B	**Declaration by the manufacturer as defined by machinery directive 98/37/EEC Annex II B**	**Déclaration du fabricant conformément à la directive 98/37/CEE, annexe II B**	**Dichiarazione del costruttore ai sensi della direttiva 98/37/CEE in materia di macchinari, Appendice II B**
Hiermit erklären wir, dass die Bauart von	*Herewith we declare that the supplied model of*	*Par la présente, nous déclarons que le produit ci-dessous*	*Si dichiara che il prodotto da noi fornito*

Product: *Pump 223 and 233*

in der von uns gelieferten Ausführung zum Einbau in eine Maschine bestimmt ist und dass ihre Inbetriebnahme solange untersagt ist, bis festgestellt wurde, dass die Maschine, die in das o.g. Produkt eingebaut werden soll, den Bestimmungen der oben genannten Richtlinie – einschließlich deren zum Zeitpunkt der Erklärung geltenden Änderungen – entspricht.	*is intended to be incorporated into machinery covered by this directive and must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the provisions of the above mentioned directive – including all modifications of this directive valid at the time of the declaration.*	*dans l'exécution dans laquelle nous le livrons, est destiné à être installé sur une machine, et que sa mise en service est interdite tant qu'il n'aura pas été constaté que la machine sur laquelle il sera installé est conforme aux dispositions de la directive ci-dessus, y compris les modifications qui y auront été apportées et qui seront valides à la date de la déclaration.*	*è destinato all' installazione su di un macchinario e che la sua messa in funzione non sarà autorizzata fino a quando non sarà stata accertata la conformità del macchinario, sul quale esso dovrà essere installato, in relazione alle disposizioni della direttiva 98/37/CEE – comprese tutte la rettifiche di questa direttiva al momento della dichiarazione.*
Angewendete harmonisierte Normen, insbesondere	*Applied harmonized standards in particular*	*Normes harmonisées, notamment*	*Norme armonizzate applicate in particolare*

Standards: EN 292-1; EN 292-2; EN 563; EN 8099

01.03.2004 Z. Paluncic

(Datum / Unterschrift)	*(date / signature)*	*(date / signature)*	*(data/firma)*

GR	E	P	NL	DK
Δηλωση του κατασκευασ του συμφ. με τις προδιαγρ αφες: 98/37/ΕΟΚ, παρ. ΙΙ Β	**Declaración del fabricante conforme con la Directiva CE sobre máquinas 98/37/CEE, Anexo II B**	**Declaração do Fabricante segundo directiva CE 98/37/CEE, Anexo II B**	**Verklaring van de fabrikant inzake de richtlijn betreffende machines, (98/37/EEG, bijlage II B)**	**Fabrikantens erklaring i henold til EF-lovgivning om maskiner 98/37/EØF bilag II b**
Δια του παροντος σας γνω–στοποιουμε, οτι το προιον	*Por la presente, declaramos que el modelo suministrado*	*Em anexo declaramos que o modelo fornecido*	*hiermede verklaren wij, dat de*	*Hermed erklares, at*

Product: *Pump 223 and 233*

προοριζεται για τοποθετηση εντος μηχανηματος, και οτι δεν επιτρεπεται να τεθει σε λειτουργια μεχρις οτου διαπιστωθει, οτι το μηχανημα εντος του οποιου προκειται να τοποθετηθει ανταποκρινετ αι στις προαναφερομενες ισχυουσες προ – διαγραφες (συμπεριλαμβανο–μενων των αλλαγων που ισχυ –ουν και που εγιναν στο χρον ι–κο αυτο διαστημα).	*es destinado a ser incorporado en una máquina y que su puesta en servicio está prohibida antes de que la máquina en la que vaya a ser incorporado haya sido declarada conforme a las disposiciones de la Directiva en su redacción 98/37/CEE – incluso las modificaciones de la misma vigentes a la hora de la declarción.*	*deverá ser incorporado na maquinaria coberta por esta directiva e não poderá ser colocado em serviço até a maquinaria na qual é para ser incorporado for declarada em conformidade com as provisões da directiva acima mencionada / incluindo todas as modificações desta directiva válida desde a emissão desta declaração.*	*ertoe bestemd is, ingebouwd te worden in een machine en dat een inwerkstelling verboden is, voordat vastgesteld is, dat de machine, waarin deze machine wordt ingebouwd, in overeenstemming met de bepalingen van de richtlijn 98/37/EEG – ingesloten de tot dit tijdstip geldende veranderingen van deze richtlijn - verklaard is.*	*er bestemt til inkorpoering i en maskine og at igangsætningen forbydes indtil der er konstateret, at maskinen, som skal inkorporeres i denne maskine, er bragt i overensstemmelse med alle relevante bestemmelser, samt ændringer gældende på deklarationstidspunktet.*
Προσθετα προς εφαρμογην χρησιμοποιηθησες εναρμον ισμενες προδιαγραφες	Normas armonizadas utilizadas, particularmente	Normas harmonizadas utilizadas, em particular	Gebruikte geharmoniseerde normen,namelijk	Harmoniserede standarder, der blev anvendt,i særdeleshed

Standards: EN 292-1; EN 292-2; EN 563; EN 8099

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